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A Brief Metacognition Questionnaire for the Elderly: Comparison with Cognitive Performance and Informant Ratings:

The Cache County Study

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Abstract

Objective—To examine the utility of a brief, metacognition questionnaire by examining its association with objective cognitive testing and informant ratings. We hypothesized that the association between self-ratings of change and both outcomes would be greater among individuals without dementia than among those with dementia.

Methods—Participants were 535 persons without dementia and 152 with dementia from the Cache County Memory Study who had completed a metacognition questionnaire, two administrations of the Modified Mini-Mental State Exam (3MS) and who had data on the Informant Questionnaire of Cognitive Decline in the Elderly (IQCODE). Cronbach's alpha was calculated as a measure of internal consistency of the metacognition questionnaire. Multiple regression was used to examine the relationship between metacognition and 3MS change. Logistic regression was used to examine the relationship between metacognition and IQCODE ratings (no change vs. worse).

Results—Cronbach's alpha was 0.75. Among individuals without dementia, metacognition significantly predicted 3MS change ($p=.027$) and IQCODE ratings ($OR=4.0$, 95% $CI= 1.2 - 13.8$, $p=.029$), suggesting consistency among measures. For those with dementia, there was a weak, inverse relationship between 3MS change and metacognition ($r = -0.16$, $p=.056$). IQCODE ratings were not significantly associated with metacognition ($p=.729$). Degree of dementia severity did not modify the relationship between metacognition and either outcome ($p>.05$).

Conclusions—We demonstrated adequate internal consistency and evidence for validity of a brief metacognition questionnaire. The questionnaire may provide a useful adjunct to memory and functional assessments for assessing anosognosia in elderly populations.

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The authors declare no conflicts of interest.

Key Points:

- Brief metacognition questionnaire demonstrated acceptable rates of validity as compared with two external criteria
- Results indicate worse metacognitive abilities among those with dementia and mild cognitive difficulties when compared with actual cognitive change or informant report

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Keywords

metacognition; anosognosia; insight; dementia; elderly

Introduction

Many elderly individuals experience a decline in cognitive ability, such as loss of memory, ability to concentrate, or ability to learn new information (Weaver et al., 2006; Anstey & Low, 2004). Despite declining performance in these areas, however, some individuals may be unaware of such changes. Unawareness of cognitive deficit has been described as loss of awareness, loss of insight, or anosognosia by researchers in the field, and has recently received considerable attention in the aging literature. Studies have shown that among individuals with dementia, diminished insight of cognitive deficit is associated with lack of compliance with pharmacological treatments (Burke & Morgenlander, 1999; MacLaughlin et al., 2005), increased caregiver distress (Clare, 2005), and presence of psychiatric disturbances (Kashiwa et al., 2005; Mizrahi et al., 2006). Diminished insight may also reduce the effectiveness of cognitive rehabilitation or psychotherapy (Koltai, Welsh-Bohmer & Schmechel, 2001; Clare et al., 2004; Burns et al., 2005; Chodoff, 2006). In Alzheimer's disease (AD), anosognosia has been associated with hypometabolism in the superior frontal sulcus, the parietal cortex (Salmon et al., 2006, Salmon et al., 2005), and the orbitofrontal prefrontal cortex (Salmon et al., 2006).

Anosognosia has not been well-studied in Mild Cognitive Impairment (MCI). Historically, subjective memory complaints have been included as part of the diagnostic criteria for MCI. However, studies have shown that subjective memory complaints are not reliable in MCI populations (Meguro, 2007). Several studies have reported less severe anosognosia in MCI than AD, although the findings are inconsistent (Clemente et al., 2008, Kalbe et al., 2005).

There are few standardized approaches to assessing insight in the elderly (Clare, 2005), particularly for use in epidemiological studies. The existing approaches can be classified into one of the following methods: (1) clinician-rating methods that measure level of awareness by a trained clinician, (2) questionnaire-based methods of self or informant-report, (3) performance-based methods relying on standardized cognitive testing, and (4) multi-dimensional methods, which combine two or more approaches (Clare, 2005). Creating comparison scores between individual and caregiver reports of decline against objective testing is the most common (Salmon et al., 2005). Each approach, however, has a variety of strengths and weaknesses. For example, questionnaire-based approaches reflect the biases of the individual completing the questionnaire, and performance-based methods that involve cognitive testing may not generalize to real-life situations (Clare, 2005). These limitations may be overcome by using a combined approach that maximizes the strengths and minimizes the weaknesses inherent within each approach. However, the effort and time involved in combined approaches may limit their use. Clare (2005) suggests that it may not be necessary to measure all aspects of metacognition for a clinically useful assessment. Therefore, shorter, more concise questionnaires may be just as useful as longer, more complex questionnaires in assessing anosognosia in dementia.

In the present study, we examined the internal consistency and validity of a brief metacognition questionnaire that, when used in conjunction with other measures, may form part of an assessment of anosognosia. We compared the questionnaire with two external criteria: change in objective cognitive testing and informant ratings of cognitive and functional change over a 3-year period in a population-based sample of elderly individuals. Members of the population have been followed as part of an ongoing, epidemiological study

of MCI and dementia in Cache County, Utah. The metacognition questionnaire was completed by individuals with known dementia status. Because anosognosia is often a feature of dementia, we predicted lower associations between metacognitive ratings and the external measures among persons with dementia in contrast to those without dementia. In additional analyses, we examined the same relationships among those with mild cognitive difficulties without dementia.

Methods

This project utilized data from the Cache County Study on Memory in Aging (CCMS), a longitudinal study of memory and aging of the elderly population of Cache County, Utah (Breitner et al., 1999). Four triennial “waves” of dementia ascertainment were completed between 1995 – 2006. The subjects in these analyses were those determined to be dementia-free at Wave 1 and who participated in Wave 2, three years later. This protocol is described in detail elsewhere (Breitner et al., 1999; Miech et al., 2002). Briefly, in Wave 1, elderly residents of Cache County, Utah, aged 65 years and older as of January 1st 1995 (N=5,677; Breitner et al., 1999) were invited to undergo a multi-stage dementia screening and assessment protocol with 5,092 (90%) participating. The cognitive screening consisted of a revised version of the Modified Mini-Mental State Exam (3MS; Teng & Chui, 1987, Tschanz et al., 2002). Individuals with sensory and education adjusted screening scores below 87 out of 100, or who were selected as a member of a designated sub-sample to complete all stages of screening and assessment, were studied further using the Dementia Questionnaire (DQ; Silverman et al., 1986). The designated sub-sample was sampled according to an iterative process to match at a 2:1 ratio, each identified case of AD with a control according to age, gender, and APOE genotype. Each DQ, which assesses symptoms commonly associated with dementia, was rated by a neuropsychologist in consultation with a senior geropsychiatrist and neuropsychologist. Individuals who were rated with dementia or significant cognitive impairment were then invited to undergo a comprehensive clinical assessment. At the clinical assessment, a neuropsychological technician administered a battery of neuropsychological tests to the subject (Tschanz et al., 2000), and a research nurse conducted a neurological exam and interviewed a knowledgeable informant (generally, a close relative) regarding the subject's clinical, medical, and family history. If the informant indicated very limited contact with the subject or had difficulty responding to interview items, other informants were sought. The results of the evaluation were then reviewed by a geropsychiatrist and neuropsychologist who followed DSM-III-R criteria for dementia to assign preliminary diagnoses of dementia, other cognitive disorders, or no impairment. Subjects diagnosed with dementia were then classified into severity stages of dementia using the Clinical Dementia Rating Scale (CDR; Hughes et al., 1982; Morris et al., 1993). The CDR assesses a patient's cognitive and functional performance in the areas of: memory, orientation, judgment & problem solving, community affairs, home & hobbies, and personal care (Morris, 1993). CDR rating was based upon the subject's performance on neuropsychological testing and his/her history of clinical symptoms as provided by the informant. A rating of the overall health of the subject was also assigned using the General Medical Health Rating Form (GMHR; Lyketsos et al., 1999). The rating was based on review of the nurse evaluation, medical history, and medication use. GMHR scores were assigned according to the following categories: “excellent” (4), “good” (3), “fair” (2), or “poor” (1). Persons diagnosed with dementia, or its prodrome, were invited to undergo a physician exam, MRI scan and laboratory tests.

Diagnoses of dementia were assigned after review of all available information at consensus conferences consisting of experienced clinicians in geropsychiatry, neurology, and neuropsychology. Standard research protocol was followed, for example; criteria for AD was consistent with the National Institute of Neurological and Communicative Disorders

and Alzheimer's Disease and Related Disorders Association (McKhann et al., 1984). Individuals were classified with a mild cognitive syndrome (MCS) if there was evidence of cognitive or functional difficulties insufficient to meet criteria for dementia. Examples included prodromal AD and cognitive impairment as a result of a medical condition such as mild traumatic brain injury or stroke (Tschanz et al., 2006). Study procedures were identical in both waves, with the exception of a slight modification of screening cut-off scores in Wave 2 (Miech et al., 2002). Furthermore, at the Wave 2 clinical assessment, subjects also completed a brief, 7-item metacognition questionnaire (see below) and the informant completed the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE, Jorm, 2004), to obtain structured information on the participant's cognitive and functional abilities. Information from the 3MS, IQCODE, and metacognition questionnaire was not considered in determining the cognitive/dementia status of participants. All study procedures were approved by Institutional Review Boards (IRB) from both Utah State and Duke Universities.

Study Participants

To be included in the present analyses, subjects must have met the following criteria: 1) no dementia diagnosed at Wave 1, 2) participated in the Wave 2 clinical assessment, and 3) completed the metacognition questionnaire. The final sample consisted of 687 individuals. Figure 1 displays a summary of the two waves of dementia screening and the final sample. Individuals excluded due to incomplete questionnaire data were older ($p < 0.05$) and had fewer years of education ($p < 0.05$). However, there were no differences in overall health rating ($p > 0.05$) or on change in 3MS score ($p > 0.05$).

Instruments

Metacognition Ratings—Participants completed a brief, 7-item questionnaire that was adapted from other published instruments assessing cognitive and functional status (Jorm, 2004, Gilewski et al., 1990). Three of the questions were designed to assess *functional* changes within the past three years and four questions were designed to assess *cognitive* changes occurring within the same time interval. Participants rated change in their ability on each item according to the following scale: “a bit improved”=1, “much improved”=2, “no change”=3, “a bit worse”=4, and “much worse”=5. A mean rating was calculated to represent an overall score. A copy of the questionnaire can be found in Appendix I.

Informant Ratings of Cognitive and Functional Change—Knowledgeable informants were asked to rate change in the participant's functional and cognitive abilities relative to three years ago using the IQCODE. The IQCODE is an informant-based questionnaire that serves as a widely-used screening instrument for dementia, and has excellent psychometric properties (Jorm, 2004). The IQCODE consists of questions regarding an individual's present cognitive and functional abilities compared to 10 years ago. In the CCMS, a modification was made to ask about change over the 3-year interval between Waves 1 and 2. We maintained the Likert scale rating of the IQCODE: “a bit improved”=1, “much improved”=2, “no change”=3, “a bit worse”=4, and “much worse”=5. A mean rating was calculated to represent an overall score. IQCODE scores were then reclassified into three categories: “No change” (IQCODE mean scores of 2.5–3.49); “Improved” (IQCODE mean scores below 2.50); and “Worse” (IQCODE mean scores of 3.50–5.00). The informants for two subjects rated their cognitive ability as improved; thus, these individuals were combined with the “No Change” group. IQCODE questionnaires were used if 20 of the 26 items were complete.

Change in Cognitive Test Performance—To examine change in cognitive test performance, we utilized the 3MS that participants completed in both Waves 1 and 2. The

3MS is a modified version of the Mini-Mental State Exam (MMSE; Teng & Chui, 1987) that assesses orientation, immediate, delayed, and recognition memory, remote and working memory, verbal fluency, confrontation naming, receptive language, abstract reasoning and constructional praxis. The 3MS has adequate internal consistency ($r=.91$), interrater reliability ($r=.98$), and correlates strongly with the original MMSE ($r=.95$; Bassuk & Murphy, 2003). Slight modifications were made to the 3MS for use in the Cache County Study (Tschanz et al., 2002). Three-year 3MS change scores were calculated as the Wave 2 score subtracted from the Wave 1 score.

Analyses

Cronbach's coefficient alpha was calculated on the metacognition questionnaire to provide an estimate of internal consistency. To examine the association between metacognition ratings and change in cognition, multiple regression analyses were conducted where 3MS change scores were regressed onto metacognition questionnaire scores. Separate models were run for individuals with dementia and for those without dementia. We also examined the associations between metacognition and each of the outcomes among those with MCS. Multivariable logistic regression analyses were used in which metacognition scores were used to predict IQCODE rating (no change-improved vs. worse abilities). Covariates tested in both logistic and multiple regression models included participant age, level of education, gender, and overall health (GMHR). Within the dementia subgroup, the association between dementia severity and 3MS change and IQCODE ratings was also examined, along with the interaction between CDR dementia severity ratings and metacognition scores.

Results

The mean (SD) interval between Waves 1 and 2 screening was 3.25 (0.23) years. Through Wave 2 dementia screening and assessment procedures, 152 (22.1%) individuals with dementia and 535 (77.9%) without dementia met criteria for inclusion in the present analysis. Among those without dementia, 217 were classified with mild cognitive difficulties. Approximately 99% of the sample was Caucasian. As displayed in Table 1, individuals with dementia did not differ in educational attainment ($T = -1.07$, $p=.285$, $df=684$) compared to those without dementia, but were significantly older ($T=4.976$, $p<0.01$, $df = 273$), in poorer health ($T = -4.047$, $p<.001$, $df=228$), and had lower baseline 3MS scores ($T = -11.28$, $p<.001$, $df = 186$) and greater 3MS declines over the three-year interval ($T=13.5$, $p<.001$, $df = 168$). There were significantly more females in the dementia group than in the no-dementia group ($\chi^2 (1, N = 687, 5.01, p = .025)$). The internal consistency of the questionnaire fell within the moderate range (Cronbach's $\alpha=0.75$).

IQCODE's were available on 71% (490) of the sample. There were 116 informants who refused and 81 who completed an insufficient number of items. There were no significant differences in age ($T=1.006$, $df = 685$, $p=.315$) or education ($T=.658$, $df=685$, $p=.511$) between subjects with complete versus missing IQCODE scores. However, the participants with complete IQCODEs had higher baseline 3MS scores and exhibited less decline on the 3MS between Waves 1 and 2 than those lacking the IQCODE ($T= -3.493$, $df=678$, $p=.001$ and $T=3.547$, $df=277.93$, $p <.001$). Table 2 summarizes the data presented above.

Relationship between Metacognition Ratings and 3MS Change

In the no-dementia subgroup, bivariate correlation coefficients revealed a weak, although significant, positive relationship between metacognition ratings and 3MS change scores ($r=.117$, $p<.01$), indicating correspondence between worsening metacognitive ratings and cognition scores. This relationship remained when testing the effects of covariates including

age, gender, education and overall health. Lower educational attainment and poorer health also predicted greater 3MS decline ($p < 0.01$).

By contrast, in the dementia subgroup, there was a weak *inverse* relationship between the self-ratings of cognitive change and 3MS decline ($r = -.164$, $p = 0.056$), suggesting that within this subgroup, cognitive decline was associated with ratings of “no change”/“improved” cognitive abilities. Age, gender, education and overall health did not significantly predict 3MS change in this group. In addition, CDR score or its interaction with metacognition scores was not significantly associated with 3MS change ($p = 0.45$ and 0.97 , respectively). Table 3 displays the results of multiple regression analyses for both participant groups. Among those with MCS, metacognition scores were not significantly related to 3MS change scores ($r = .04$, $p = 0.57$).

Relationship between Metacognition Ratings and Informant Ratings

Among individuals without dementia, worse metacognition scores were significantly associated with informant ratings of worsening abilities ($OR = 4.0$, $CI(95) = 1.2, 13.8$, $p = .029$). Older participant age was associated with worse ratings on the IQCODE ($p < .05$) but education ($p = .09$) and general health rating ($p = .27$) were not. By contrast, among individuals with dementia, there was no association between metacognitive ratings and informant ratings ($OR = 1.21$, $CI(95) = 0.4, 3.5$, $p = 0.729$). None of the covariates of age, education, or gender were associated with informant ratings. Again, neither CDR scores nor its interaction with metacognition scores significantly predicted IQCODE ratings ($p = 0.39$ and 0.51 , respectively). The results of the final analyses are presented in Table 4. Among the MCS, metacognition was also not significantly related to informant ratings ($OR = 2.203$, $CI(95) = .7, 7.0$, $p = 0.18$).

Discussion

In the population of Cache County, Utah, we demonstrated adequate internal consistency and evidence for validity of a 7-item metacognition questionnaire. As predicted, self-reported change in cognitive and functional abilities was significantly associated with cognitive performance and informant ratings among individuals without dementia, but not among those with dementia. In the latter, there was an inverse relationship between declining 3MS scores and self-perception of cognitive and functional ability. There was no association between 3MS or informant ratings and self-reported change in cognitive and functional ability among those with mild cognitive difficulties.

Our findings suggesting some degree of anosognosia in individuals with dementia or mild cognitive difficulties are consistent with prior work conducted by Kalbe and colleagues (2005). Several models have been proposed explaining how insight may decline in individuals suffering from dementia. Perhaps the most recognized is that proposed by Agnew and Morris (1998). They propose that information regarding memory performance first enters into semantic and episodic memory, passes to the conscious awareness system (CAS) which is a hypothesized function of the parietal lobes. With input from the central executive system, this information is compared with previously stored information regarding one's own memory abilities, in relation to past performance and the abilities of others. This comparison is then transferred to a personal knowledge base (PKB). In a properly working system, new input of memory failure into the CAS is compared with the PKB. Any discrepancy between the CAS and PKB results in updates to the PKB via inputs from episodic and semantic memory (Agnew & Morris). However, in dementia, the neural structures responsible for these functions deteriorate and no longer support the CAS. Comparisons between the CAS and PKB become dysfunctional, creating symptoms of anosognosia in dementia (Agnew & Morris).

Few studies have examined methods to assess anosognosia in elderly individuals. One study compared neuropsychologist ratings and questionnaires completed by participants and informants (Vogel, et al., 2004), and another calculated a discrepancy between participant and informant reports on a complaint interview (Kalbe et al., 2005). While both methods have demonstrated validity, the procedures involved may limit their use in epidemiologic or clinic settings where patients may not be accompanied by an informant. The advantages of the metacognition questionnaire used in the present study are its brevity and flexibility of use with either informant ratings or objective cognitive testing.

Among the other findings in our study, were that poorer health and less education significantly predicted greater 3MS decline in those without dementia. This is consistent with other work (e.g., Gunther et al., 2007). Unexpectedly, overall health was not associated with informant ratings of cognitive or functional change. One may speculate that informants may have “adjusted” their ratings by factoring out the effects of poor health when responding to the IQCODE items.

Several study limitations warrant discussion. A limited number of questions comprised the metacognition questionnaire, thus restricting the assessment of metacognition to a small number of domains. Additionally, there was little cognitive or functional change endorsed on the questionnaire, possibly due to limited change experienced over a relatively limited three-year study interval. Lastly, the present results were obtained in the relatively culturally homogenous population of elderly persons in Cache County, and may not generalize to populations with diverse ethnic or cultural representation.

The strengths of the study include the use of two forms of external criteria, objective measures of cognitive testing and informant reports, with which we compared metacognition scores. This is an advantage over previous studies that employed only a single external criterion (Clare et al., 2005). Using both cognitive performance and informant ratings provided rich information that targeted both cognitive and functional change. Conducting the study in a community-based sample with known cognitive status was also a strength, permitting an examination of the metacognition questionnaire in contrasting groups that differed in the degree to which members exhibited insight of cognitive change. Finally, the longitudinal follow-up permitted us to examine the perception of *change* in cognition, an important feature of cognitive syndromes in late-life that may predict subsequent dementia.

In summary, we report on the validity of a brief metacognition questionnaire in a population-based sample of elderly individuals. The questionnaire demonstrated moderate internal consistency and significant associations with two external criteria of cognitive and functional change among non-demented elderly individuals. This questionnaire may provide a useful adjunct to memory and functional assessments for assessing anosognosia in elderly populations.

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Appendix I: Metacognition Questionnaire

Now I'd like you to remember what your memory was like 3 years ago and compare that to what it is like now. I'll give you some example situations and I want you to tell me whether you've gotten much better, a bit better, have not had much change, have gotten a bit worse or much worse in that situation. (SHOW CARD WITH RESPONSES)

Compared with 3 years ago, how are you at:		MUCH BETTER	A BIT BETTER	NOT MUCH CHANGE	A BIT WORSE	MUCH WORSE	RF	DK
1.	Remembering recent events, appointments, or recalling where you put objects?	1	2	3	4	5	7	8
2.	Remembering the names and faces of friends and relatives?	1	2	3	4	5	7	8
3.	Keeping your train of thought or finding the right words in a conversation?	1	2	3	4	5	7	8
4.	Finding your way around familiar places?	1	2	3	4	5	7	8
5.	Operating gadgets, appliances, or machinery around the house?	1	2	3	4	5	7	8
6.	Keeping up with household chores, hobbies, and other interests?	1	2	3	4	5	7	8
7.	In general how is your memory now compared to the way it was 3 years ago?	1	2	3	4	5	7	8

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Figure 1.
Flow Chart of Eligible Participants

Table 1

Sample characteristics: No- dementia and dementia subgroups

Sample Characteristics	No-Dementia		Dementia		Standardized Mean Differences
	Number (%)	Mean/SD	Number (%)	Mean/SD	
Male	241 (45%)		53 (35 %)*		
Female	294 (55%)		99 (65 %)*		
Years of education	534	13.3 (3.0)	152	13.0 (3.0)	.1
Age at diagnosis	535	80.9 (7.1)	152	83.8 (6.2)**	.44
3MS change score	530	1.6 (6.2)	137	12.9 (9.2)***	1.47
Wave 1 3MS score	534	90.6 (5.4)	146	83.0 (7.7)***	1.18
GMHR score	535	3.0 (0.6)	152	2.8 (0.6)***	.33

* p<0.05,

** p < 0.01,

*** p < 0.001

Table 2

Participants with complete IQCODE versus missing IQCODE

Sample Characteristics	Completed IQCODE		Missing IQCODE		Standardized Mean Differences
	Number (%)	Mean/SD	Number (%)	Mean/SD	
Male	209 (43 %)		85 (43 %)		
Female	281 (57 %)		115 (58 %)		
No-dementia	407 (83.1%)		58 (58.0%)		
Dementia	83 (16.9%)		42 (42.0%)		
Years of education	490	13.19 (3.0)	199	13.38 (3.0)	.06
Age at clinical asmt	490	81.41 (7.1)	200	81.91 (7.0)	.07
3MS score	484	89.51 (6.5)	196	87.54 (7.2)**	.29
3MS Change	477	3.15 (7.5)	190	5.91 (9.9)**	.32
GMHR score	490	3.03 (0.6)	197	2.84 (0.5)	.35

p < 0.01

Table 3
Multiple Regression Models: Metacognition and 3MS delta scores

Model for no-dementia subgroup	Unstandardized Coefficients		Standardized Coefficients		T	Sig.
	B	Std. Error	Beta			
(Constant)	4.60	3.31			1.389	0.17
Metacognition score	1.84	0.80	0.10		2.32	0.02
Subject education	-0.32	0.09	-0.16		-3.65	<0.01
GMHR score	-1.56	0.45	-0.15		-3.50	<0.01
Model for dementia subgroup	Unstandardized Coefficients		Standardized Coefficients		T	Sig.
	B	Std. Error	Beta			
(Constant)	25.22	6.43			13.92	<0.01
Metacognition score	-3.64	1.89	-0.16		-1.93	0.06

R = .275, R² = .076, Adjusted R² = .069, Standard error of the estimate = 7.982

Table 4
Results of logistic regression models: Metacognition and IQCODE group membership in subjects without dementia*

	B	S.E.	Wald	Df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
							Lower	Upper
Constant	-9.954	4.179	5.672	1	0.017	0.000		
Metacognition score	1.386	0.634	4.789	1	0.029	4.000	1.156	13.846
Subject age	0.079	0.035	5.168	1	0.023	1.083	1.011	1.159

* Results for the dementia group are not shown as none of the variables in the model were significant predictors of the outcome variable