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Correlates of depressive symptoms in rural elderly Chinese

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SUMMARY

Objective—Late life depression has been studied in many populations around the world. However, findings on risk factors for late life depression have remained inconsistent.

Methods—A cross-sectional survey of 1737 rural Chinese age 65 and over from two provinces in China was conducted assessing cognitive functions using various cognitive instruments and collecting information on demographic characteristics and medical history. Depressive symptoms were assessed using the Geriatric Depression Scale (GDS). Analysis of covariance and logistic regression models were used to identify factors associated with the continuous GDS score, mild or severe depression.

Results—In this cohort, 26.5% (95% CI: 24.4–28.6%) met the criteria for mild depression and 4.3% (95% CI: 3.4–5.4%) for severely depression. Living alone, history of heart attack, head injury, and fracture were associated with higher depressive symptoms. Alcohol consumption and higher cognitive function were associated with lower depressive symptoms. Living alone, not attended

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CONFLICT OF INTEREST DECLARATION
The authors report no conflicts of interest.

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school, history of head injury, fracture, and low cognitive function were associated with increased probability of mild depression. Living alone, history of stroke or heart attack, and low cognitive function were associated with severe depression.

Conclusions—Depression, particularly mild depression, is common in rural elderly Chinese. Among a number of factors identified in this cohort as being significantly associated with depressive symptoms, living alone and lower cognitive function were the most consistent factors associated with depressive symptoms, mild and severe depression. History of stroke, heart attack, and fracture were also risk factors for depressive symptoms.

Keywords

depressive symptoms; Geriatric Depression Scale; Elderly Chinese

INTRODUCTION

Depression represents a major international public health problem associated with adverse health outcomes (Cole and Bellavance, 1997) and all-cause mortality (Kouzis *et al*., 1995) in both developed and developing countries. There is less information on late life depression internationally but certainly it is recognized as common and as a major public health problem at least in the United States (Steffens *et al*., 2006) across ethnic groups (Blazer, 2003), in Europe (Copeland *et al*., 2004) and in other countries. (Papadopoulos *et al*., 2005; Chen *et al*., 2007) Low estimates of depression in the Chinese population have been reported. (Zhang *et al*., 1998; Demyttenaere *et al*., 2004) However, little is known on late life depression in the rural elderly Chinese population which accounts for three quarters of the country's elderly population. (Shen, 1995)

Many risk factors including older age, female gender, low education, and cognitive impairment have been examined previously and remained inconsistent across studies (Cole and Dendukuri, 2003; Vink *et al*., 2008). In this paper we examine the association of the depressive symptoms with a number of demographic characteristics, health conditions, *Apolipoprotein E* (*APOE*) status, and cognitive function.

METHODS

Study population

Two thousand Chinese age 65 years or older were recruited from four counties in China during December 2003–May 2005. Two counties were from Sichuan province in southwestern China and the other two from Shandong province in eastern China. Details on site selection process was described previously. (Gao *et al*., 2007) Interviews were conducted with study participants to assess their cognitive function and to collect information on demographic and medical conditions. A second evaluation of this cohort was conducted two and half years after the initial evaluation. In addition to cognitive instruments used at the first interview, the Geriatric Depression Scale (GDS) was administered to all participants during the second evaluation. The results reported here are based on data collected at the second interview.

The study was approved by Indiana University Institutional Review Board and the Institute for Environmental Health and Related Safety, Chinese Center for Disease Control and Prevention.

Geriatric depression scale (GDS)

The GDS is a 30-item scale developed specifically for use in elderly populations. (Yesavage *et al*., 1982) It has been used extensively in the United States (Kurlowicz *et al*., 2005) as well as in other countries. (Ganguli and Hendrie, 2005) GDS scores between 11 and 20 are generally

considered to represent significant mild depression and scores of 21 or higher are considered severe depression. (Baiyewu *et al*., 2007) In a previous study of Chinese age 60 or older, the GDS was validated in a psychiatric outpatient sample. (Chan, 1996) Internal consistency reliability was 0.89 (α), and the test–retest reliability was 0.85. Criterion-related validity was good at 0.95 when compared to psychiatrist diagnosis, and concurrent validity was 0.96 when compared with the Center for Epidemiologic Studies Depression Scale (CES-D). (Radloff, 1977)

We obtained two versions of Chinese translation of the GDS, one by Dr Hingchu B. Lee of the Chinese University of Hong Kong (Journal of Gerontologist), and another by Sandy Chen Stokes from San Jose University. Both translations were reviewed and modified by investigators first and with all interviewers to select the appropriate translation that was understandable and unambiguous to participants in the cohort in a face-to-face interview. Although the GDS is generally self administered, because of low literacy rates in our cohort, the GDS was administered by trained interviewers.

Cognitive assessment

Cognitive assessment was conducted in face-to-face interviews using the Community Screening Instrument for Dementia (CSID), CERAD 10-word list learning and recall,(Morris *et al*., 1989) IU Story Recall, Animal Fluency test (Isaacs and Akhtar, 1972), and IU Token test. The CSID was developed as a screening tool for dementia in populations with various cultural backgrounds and literacy levels. Details of the instrument have been published elsewhere. (Hall *et al*., 1996) The CSID has demonstrated good 2 week test–retest reliability and inter-rater reliability as well as good validity in detecting dementia in various populations. (Hall *et al*., 1996; Hall *et al*., 2000) CSID scores range from 0 to 30. The CERAD Word List Learning test is one of the measures from the CERAD neuropsychological assessment battery which was designed to assess cognitive skills in the elderly. It consists of a 10-item, three trial word list in which free recall is taken after each learning trial and after a brief delay (approximately 5 min). The Word List Learning score is the total number of words recalled across the 3 learning trials (range 0–30). The Word List Recall score is the number of words recalled at delay (range 0–10). The IU Story Recall task was created by the research team to be suitable to the Chinese culture and the rural population. The examiner reads the story out loud to the subject who attempts to recall it verbatim immediately and again after a brief delay. The story has 14 units of information that are gist scored (range 0–14). The story was tested in 1500 elderly Chinese in a previous pilot study and was found to be acceptable to the villagers and produced a normally distributed range of scores. (Emsley *et al*., 2000) The Animal Fluency test is a measure of executive function in which a subject names as many animals as possible in 60 s. The IU Token Test is a brief measure of language comprehension and working memory. (Yamamoto *et al*., 2003) A sheet of paper has an array of circles and squares which vary in size (small and large) and color (red, black, yellow, and green). The examiner reads aloud a series of 12 commands that ask the subject to point to or touch the figures in various combinations and orders. Commands that are correctly executed on the first exposure receive 2 points. If an error occurs, the command is repeated and the subject receives 1 point for correct response or no points for another failure. Score is number correct across all 12 commands (range 0–24). The validity of the CSID, CERAD word list learning and recall, and the Animal Fluency test have been previously established in Chinese population and elsewhere. (Prince *et al*., 2003) A composite cognitive z-score was created by using the average of standardized scores of the six cognitive tests. (Wilson *et al*., 2004a; Stampfer *et al*., 2005)

Apolipoprotein E (APOE) genotype

Blood spots on filter paper were collected from all study participants. *APOE* genotype was determined by eluting DNA from a dried blood spot (Yang *et al*., 1996) followed by *HhaI* digestion of amplified products. (Hixson and Vernier, 1990)

Other information

Other information collected in the second evaluation included age, gender, whether the participant attended school and years of schooling, marital status, household composition, alcohol consumption and smoking history, history of cancer, Parkinson's disease, diabetes, hypertension, stroke, heart attack, head injury, and bone fracture by self-report. Participants' height, weight, and blood pressure (2 times) were also measured during the interview. BMI was derived from height and weight measurements. The average of the two blood pressure measures were used in our analyses.

Statistical analysis

Internal consistency of the GDS was estimated using Cronbach's α. Mean GDS scores were compared by participants' characteristics using analysis of variance (ANOVA) or *t*-tests. Analyses of Covariance (ANCOVA) models were used to select significant variables associated with continuous GDS scores. Participants with GDS scores between 11 and 20 were considered mild depression and those scoring of 21 or higher were considered severe depression. Frequencies of participants with mild or severe depression were compared to those not in the classification using χ^2-tests. Logistic regression models were used to identify factors significantly associated with mild or severe depression.

RESULTS

The GDS was administered to 1737 participants. Mean age was 74.3 years (SD =5.2), with 53.1% women, 61.0% never attended school. Mean BMI was 22.3 (SD =3.8). The GDS had high internal consistency (Cronbach's α =0.88) in this cohort. The quartile points (25, 50, and 75% percentiles) for the GDS score in the cohort were 4, 7, and 12, respectively.

Continuous depressive symptoms

To identify factors associated with depressive symptoms, we used three separate outcomes: the continuous GDS score, mild depression defined as GDS score between 11 and 20, and severe depression as GDS score greater than 20. A continuous GDS outcome allows us to identify factors that may relate to depressive symptoms in a dose-dependent fashion, or that exerts an association below the threshold for mild or severe depression.

In Table 1, we present mean GDS scores by participants' characteristics examining univariate associations. Age, gender, schooling, marital status, living condition, BMI, alcohol, smoking, history of stroke, heart attack, head injury, and fracture were associated with continuous GDS scores univariately ($p < 0.05$). In Table 2, we present results of ANCOVA models including significant factors associated with GDS scores. Living alone, history of heart attack, head injury, and fracture were associated with higher GDS scores, while drinking alcohol and higher composite cognitive scores were associated with lower GDS scores.

Mild or severe depression

Out of the 1737 individuals with GDS scores, 460 (26.5%, 95% CI: 24.4–28.6%) met the criteria for mild depression and 75 (4.3%, 95% CI: 3.4–5.4%) were severely depressed. In Table 3, we present participants' characteristics by mild depression or severe depression. Univariately, older age, female gender, never attended school, marital status, living

arrangement, BMI, not smoking, history of head injury, history of fracture, and lower cognitive scores were associated with greater probability of mild depression. Marital status, living arrangement, history of stroke, heart attack, head injury, and lower cognitive scores were associated with greater probability of severe depression. In Table 4, we present results from the logistic model including all significant factors associated with mild depression. Living alone, have not attended school, history of head injury, history of fracture, and lower cognitive score were associated greater probability of mild depression. In Table 5, results from the logistic regression model with severe depression as the outcome were presented. Living alone, history of stroke, heart attack, and lower cognitive scores were associated with increased probability of severe depression.

DISCUSSION

In this rural elderly cohort, using three different outcomes of depressive symptoms, we identified a number of risk factors for depressive symptoms. The model using continuous GDS was used to identify factors that may relate to depressive symptoms in a dose-dependent fashion or an association not related to the threshold for mild or severe depression. Two consistent correlates emerged from all three models. Living alone and low cognitive function were risk factors for higher GDS scores, and for increased probabilities of mild or severe depression. In the literature, while some studies found living alone a risk factor for depression, other studies reported no association. (Baiyewu *et al*., 2007; Pan *et al*., 2008; Chen *et al*., 1999) A previous study conducted in the 1980s reported relatively low percentage of living alone in the elderly Chinese (3.7%). (Chen *et al*., 1987) In this cohort; however, much higher proportions of participants were reported to be living alone (17.9% overall), especially in those with severe depression (30.7%). We suspect that in these rural areas with limited health care options or lack of social support, living alone may bring additional hardship to elderly participants' daily routine.

Cognitive impairment has been linked to increased risk of depression. (Steffens *et al*., 2006) Many studies suggest that depressive syndromes are early manifestation of dementia disorder (Ganguli *et al*., 2006), or that depression represents an independent risk factor for cognitive decline. (Wilson *et al*., 2004b) In our cohort, cognitive function was the most consistent factor identified in this cohort, being associated with depressive symptoms, mild depression, and severe depression. However, since our analyses were cross-sectional in nature, we are not able to comment on the direction of this observed association. Future longitudinal evaluation of this cohort may offer means to examine the direction of the association.

Our finding of increased risk for severe depression with history of stroke or heart attack is consistent with previous results. (Vink *et al*., 2008) Depression after stroke has long been recognized as a common condition with many negative effects in the poststroke period. In addition, history of head injury was shown to be associated with higher depressive symptoms and mild depression, but not with severe depression. Some previous studies have reported the association between the number of chronic medical conditions and depressive symptoms. (Vink *et al*., 2008) In this cohort, we did not find other conditions associated with depressive symptoms beyond stroke and heart attack.

Several previous studies have reported depression or higher depressive symptoms were associated with low bone density and increased risk of fracture (Robbins *et al*., 2001; Mussolino, 2005; Mezuk *et al*., 2008) and some has speculated that the association may be bi-directional, meaning it is possible for those with fracture to show an increased level of depressive symptoms (Mezuk *et al*., 2008). In our cohort, we found that history of fracture was associated with higher depressive symptoms and mild depression, perhaps reflecting the impact of restricted mobility and hardships due to the occurrence of fracture.

Several demographic factors such as age, gender, or educational levels had been reported to be associated with depressive symptoms in some studies, but they were not associated with depressive symptoms in this cohort. Age has been reported as a risk factor in a number of studies (Valvanne *et al*., 1996; Bergdahl *et al*., 2005) In other studies, it was shown that higher rates of depression in the older age groups were explained by other factors, such as a higher proportion of women, comorbid conditions, or cognitive impairment. (Blazer, 2003) In our cohort, after controlling for cognitive function and other covariates, age was not associated with GDS scores, mild or severe depression. In some studies, women were reported to have higher rates of depression than men, but many other studies reported no difference in depressive symptoms between men and women. (Vink *et al*., 2008) In our cohort, gender was not a significant variable for the depressive symptoms, mild depression or severe depression. Lower level of education has also been indicated as a risk factor for depression. (Jang *et al*., 2002; Minicuci *et al*., 2002) In our cohort, not attended school was a risk factor for mild depression, but not severe depression, after adjusting for other covariates.

Some studies have shown that alcoholism was associated with major depression. (Vink *et al*., 2008) The association between moderate alcohol consumption and depression is not yet clear, however. There was some evidence of a J-shaped relationship for major depression, that is, greater depression among abstainers compared with moderate drinkers. (Graham *et al*., 2007) Our result showed that ever consuming alcohol is associated with lower GDS score, but not with mild or severe depression. It seems to suggest that although there was a difference in the numbers of depressive symptoms between the ever drinkers and abstainers, the difference did not reach the threshold for mild or severe depression. More detailed information on quantifying alcohol consumption may be required to fully interpret the association between alcohol drinking and depression in this cohort.

The *APOE* gene is involved in lipoprotein metabolism and is a risk factor for Alzheimer's disease and cardiovascular disorders. The association between APOE and depression has not been consistent. Only one of four studies in a recent review of risk factors and depression reported a significant association between APOE and depressive symptoms and depression, while the other three studies found no significant association. (Vink *et al*., 2008) In our cohort, APOE was not related to depressive symptoms, mild or severe depression after adjusting for other covariates.

Our results indicate that depression, particularly mild depression, is common in the rural elderly Chinese. It is difficult to compare these rates defined using the GDS with those from other studies which use different assessments from Europe and the United States. (Blazer, 2003) The mild depression rate in our cohort (26.5%) is higher than the rates of depression (12%) reported from an elderly Greek population, (Papadopoulos *et al*., 2005) and somewhat higher than the rate in an elderly Yoruba population (19.8%, Baiyewu *et al*., 2007) both using the GDS. The rate of severe depression in our cohort (4.3%) is slightly higher than estimated severe depression from an African-American cohort (2.2%) and from a Nigerian cohort (1.6%) again both using the GDS. (Baiyewu *et al*., 2007). The finding that mild depression is much more common than severe depression is consistent with the findings of most other studies. (Papadopoulos *et al*., 2005; Chen *et al*., 2007)

Rates of depression from previous studies in Chinese populations varied a great deal. A large survey conducted in seven regions of China in 1993 reported 1.1% for major depressive disorder. (Zhang *et al*., 1998) The World Mental Health Survey reported that the rate of mood disorder was 1.7% in Shanghai and 2.5% in Beijing. (Demyttenaere *et al*., 2004) These studies, however, included young adults as well as elderly persons. A study using the CES-D reported depression rates of 4.1% for Shanghai and 14.9% for Beijing, in residents aged 50–70, a slightly younger population than our cohort. (Pan *et al*., 2008) A meta-analysis of 10 cross-sectional

Chinese studies reported pooled depression prevalence of 3.86% (95%CI 3.37–4.42%), and the prevalence of depressive mood was 14.81% (14.20–15.64%). (Chen *et al*., 1999) The same review also concluded that the risk of depression in rural communities (5.07%, 3.61–7.13%) was higher than in urban ones (2.61%, 2.22–3.08%) and the same trends were observed for depressive mood. (Chen *et al*., 1999) In addition, two studies conducted by the same group of investigators using the same instruments found higher rate of depression in the rural older Chinese (6.0%) than in an urban population (2.2%). (Chen *et al*., 1997; Chen *et al*., 2005) The explanation for the reported higher depression rate in the rural Chinese is not clear, however. The authors suspected poverty being a contributing factor for the rate difference.

Our study has a number of strengths. Many potential correlates were measured, including demographic, medical conditions, APOE genotype, and measures of BMI and blood pressures. The study also conducted an extensive cognitive assessment, enabling the analyses to adjust for concurrent cognitive function of the study participants.

There are also a number of limitations in this study. Most important, the analyses reported here are based on cross-sectional association, thus cannot suggest any directional causation on significant associations. Future continued evaluation of this cohort will offer the opportunity to examine these correlates in prospective relationships. Secondly, we relied on the GDS to assess depressive symptoms rather than clinical diagnosis of specific depressive disorders, an approach adopted by many large epidemiological studies. (Wilson *et al*., 2004b; Ganguli *et al*., 2006) It has been suggested that rates of depression are generally higher in studies using cut off points derived from questionnaires than in studies using clinically defined studies using standard diagnostic criteria (Cole and Dendukuri, 2003) which may partly explain the higher depression rates in this cohort. Further limitations include the use of self-report which may include recall bias and the exclusion of potentially important risk factors for depression such as disability or a detailed measure of social support.

In summary, we found that depression, particularly mild depression, is common in the rural elderly Chinese. We identified a number of factors associated with depressive symptoms including history of stroke, heart attack, or fracture with living alone and lower cognitive function being the most consistent factors associated with depressive symptoms, mild and severe depression.

KEYPOINTS

- Depression, particularly mild depression, is common in rural elderly Chinese.
- Living alone and lower cognitive function were the most consistent factors associated with depressive symptoms.
- History of stroke, heart attack and fracture were also risk factors for depressive symptoms.

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Table 1

Mean GDS scores by participants' characteristics collected at baseline. *p*-values were derived using analysis of variance (ANOVA) or *t*-tests

Baseline variables	*N*	Mean	SD	*p*-value
Age group				
65–74	1002	7.7	5.8	<0.0001
75–84	652	9.0	5.9	
85+	83	9.4	5.5	
Gender				
Male	815	7.5	5.8	<0.0001
Female	922	8.9	5.9	
Ever attended school				
Yes	676	7.1	5.7	<0.0001
No	1061	9.0	5.8	
Marital status				
Married	1016	7.6	5.7	<0.0001*
Widowed	704	9.1	5.9	
Other	17	11.5	8.2	
Living arrangement[a]				
With spouse	828	7.4	5.7	<0.0001
With children	585	8.8	5.6	
Living alone	311	9.6	6.5	
Body mass index tertiles				
<20.45	578	8.8	5.5	0.0025
[20.45, 23.24)	577	8.4	6.0	
>=23.24	582	7.6	5.6	
Ever drink alcohol				
Yes	687	7.6	5.7	<0.0001
No	1040	8.7	5.9	
Ever smoked				
Yes	701	7.7	5.8	0.0003
No	1036	8.7	5.9	
History of Cancer				
Yes	33	8.8	6.5	0.56
No	1704	8.3	5.9	
History of Parkinson's				
Yes	36	8.7	6.0	0.68
No	1701	8.3	5.9	
History of diabetes				
Yes	75	8.7	6.6	0.54
No	1662	8.2	5.8	
Hypertension[b]				

Baseline variables	*N*	Mean	SD	*p*-value
Yes	1029	8.4	5.8	0.41
No	708	8.1	5.9	
History of stroke[a]				
Yes	45	10.2	7.0	0.0245
No	1690	8.2	5.8	
History of heart attack				
Yes	52	12.0	6.4	<0.0001
No	1685	8.1	5.8	
History of head injury				
Yes	66	11.4	6.4	<0.0001
No	1671	8.1	5.8	
History of fracture				
Yes	30	12.5	6.0	<0.0001
No	1707	8.2	5.8	
APOE e4 carriers				
Yes	291	8.5	5.7	0.44
No	1446	8.2	5.9	
Quartile groups defined by composite cognitive score				<0.0001
Q4 (75–100%)	434	5.5	4.8	
Q3 (50–75%)	434	7.7	5.7	
Q2 (25–0%)	435	9.1	5.7	
Q1 (0–25%)	434	10.7	5.9	

[*] Comparing those married to widowed, excluding those in the ‘other’ group.

[a] Thirteen participants did not provide information on living arrangement, and two participants did not answer the question on history of stroke.

[b] Blood pressure measure ≥140/90 or self-reported history of hypertension.

Table 2

Results of analysis of covariance (ANCOVA) model with GDS score as the outcome variable

Variable	Parameter estimate	Standard error	*p*-value
Live alone	1.34	0.34	<.0001
Ever drink alcohol	−0.73	0.27	0.0061
History of heart attack	3.72	0.76	<.0001
History of head injury	2.25	0.69	0.0011
History of fracture	2.52	1.00	0.0118
Composite cognitive score	−2.55	0.17	<.0001

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Table 3

Participants' characteristics by depression status. Mild depression was defined as GDS score of 11–20 and severe depression was defined as GDS score greater than 21

Baseline variables	Mild depression[a] (11 ≤ GDS ≤ 20)			Severe depression (GDS ≥ 21)		
	Yes (*n* =460)	No (*n* =1202)	*p*-value	Yes (*n* =75)	No (*n* =1662)	*p*-value
Mean age (SD)	75.6(5.6)	73.8(5.0)	<0.0001	74.4(5.4)	74.3(5.2)	0.9135
Female, %	58.9	50.3	0.0017	61.3	52.7	0.1431
Ever attended school, %	27.4	43.9	<.0001	29.3	39.4	0.0818
Marital status, %			0.0021*			0.0273*
Married	52.2	61.4		50.7	58.8	
Widowed	46.7	37.9		45.3	30.3	
Other	1.1	0.8		4.0	0.8	
Living arrangement, %			<0.0001			0.0144
With spouse	39.6	51.7		41.3	48.3	
With children	39.4	32.2		28.0	34.2	
Living alone	21.1	16.1		30.7	17.5	
Mean BMI (SD)	21.9(3.6)	22.5(3.8)	0.0008	21.6(3.6)	22.4(3.8)	0.0896
Ever drink alcohol, %	37.6	41.7	0.1304	30.7	40.5	0.0927
Ever smoked, %	34.6	42.9	0.0019	34.7	40.6	0.3370
History of, %						
Cancer	1.5	1.9	0.6845	4.0	1.8	0.1679
Parkinson's	1.5	2.2	0.5553	4.0	2.0	0.2010
Diabetes	3.5	4.4	0.4919	8.0	4.2	0.1345
Hypertension[b]	60.2	58.9	0.6253	58.7	59.3	0.9177
Stroke	2.2	2.4	0.8580	8.0	2.4	0.0113
Heart attack	3.9	2.2	0.0591	10.7	2.7	0.0013
Head injury	6.7	2.3	<0.0001	9.3	3.6	0.0212
Fracture	3.5	1.1	0.0010	2.7	1.7	0.3746
APOE e4 carriers, %	16.7	16.7	0.9934	17.3	16.7	0.8906
Mean composite cognitive score	−0.3(0.7)	0.1(0.7)	<0.0001	−0.4(0.7)	0.0(0.8)	<0.0001

*Comparing those married to widowed, excluding those in the 'other' group.

[a] Those with severe depression (n =75) were excluded from the analysis on mild depression.

[b] Blood pressure measure ≥140/90 or self-reported history of hypertension.

Table 4

Factors associated with mild depression (defined as GDS score between 11 and 20) compared to no depression (GDS score <=10)

Variable	Odds ratio	95% Confidence interval	
Living alone	1.39	1.04	1.86
Attended school *versus* no school	0.73	0.57	0.94
History of head injury	2.76	1.59	4.81
History of fracture	2.51	1.10	5.72
Composite cognitive score	0.45	0.38	0.53

Table 5

Factors associated with severe depression (defined as GDS score ≥ 21) compared to those with GDS score <=20

Variable	Odds ratio	95% Confidence interval	
Live alone	2.17	1.29	3.64
History of stroke	3.02	1.18	7.76
History of heart attack	4.26	1.85	9.81
Composite cognitive score	0.51	0.37	0.69