BJPsych The British Journal of Psychiatry (2014)
204, 436–440. doi: 10.1192/bjp.bp.113.134734

Socioeconomic status and survival among older adults with dementia and depression

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Background
People from lower socioeconomic groups have a higher risk of mortality. The impact of low socioeconomic status on survival among older adults with dementia and depression remains unclear.

Aims
To investigate the association between socioeconomic status and mortality in people with dementia and late-life depression in China.

Method
Using Geriatric Mental Status – Automated Geriatric Examination for Computer Assisted Taxonomy (GMS-AGECAT) we interviewed 2978 people aged ⩾60 years in Anhui, China. We characterised baseline socioeconomic status and risk factors and diagnosed 223 people with dementia and 128 with depression. All-cause mortality was followed up over 5.6 years.

Results
Individuals with dementia living in rural areas had a three times greater risk of mortality (multivariate adjusted hazard ratio (HR) = 2.96, 95% CI 1.45–6.04) than those in urban areas, and for those with depression the HR was 4.15 (95% CI 1.59–10.83). There were similar mortality rates when comparing people with dementia with low *v.* high levels of education, occupation and income, but individuals with depression with low *v.* high levels had non-significant increases in mortality of 11%, 50% and 55% respectively

Conclusions
Older adults with dementia and depression living in rural China had a significantly higher risk of mortality than urban counterparts. Interventions should be implemented in rural areas to tackle survival inequality in dementia and depression.

Declaration of interest
None.

Dementia and depression are highly prevalent in people over the age of 60 years.[1] Globally, around 50 million people are living with dementia[2] and 50 million older adults are estimated to have depression.[3] There is evidence that dementia and depression in older adults significantly reduced survival.[4,5] Previous studies also showed that people with low socioeconomic status (SES) have an increased risk of mortality.[6–8] However, it is unclear whether or not SES plays a role in dementia and depression survival in older adults. A study of people with dementia in Israel observed no association between education or occupation and 6-year survival rate.[9] No significant associations were found between family income and length of time between dementia onset and death in America and Canada.[10,11] But a data analysis from the Cognitive Function and Ageing Studies (CFAS) in England and Wales[12] has revealed that high occupational complexity was associated with a 1.4-fold increase in mortality in participants with dementia. The uncertainties relating to the association between SES and survival rates in dementia and late-life depression may reflect different SES variables; measured by educational level, occupation class, income and other comprehensive indexes, and lack of data from low- and middle-incomes countries (LMICs). Current knowledge about the impact of SES on survival among older adults with dementia and depression is predominantly derived from studies undertaken in high-income countries, with conflicting findings.[9,10–12] Consequently, generalisation to LMICs is likely to be fraught with problems. There are few studies examining the association of SES with survival in older adults with dementia in LMICs, where the majority of dementia occurs.[13] Studying LMICs' older populations may offer internationally applicable insights into the effects of SES on survival in dementia and depression and help reduce health inequality. China is the biggest country among LIMCs in terms of population and areas, and has the largest number of people with dementia in the world.[14] Since the economic reform of the 1980s, China has had a rapid growth in income, and along with its economic development, it has experienced increasing differentials in SES. For example, in rural areas, the average annual income (US$ 140–340) is two to five times lower than that in urban areas (US$ 412–652).[15] In this paper we examine the impact of low SES, indicated by levels of education, occupation and income, and living in a rural area on survival among older adults with dementia and depression in a community-based cohort study in China.[16,17]

Method

Study population and data collection

The study population is as reported in the Anhui cohort study in China.[16,17] The methods of the baseline investigation in the Anhui cohort study have been fully described.[16–18] Briefly, we randomly selected 1810 older people aged ⩾65 years who had lived for at least 5 years in Yiming subdistrict of Hefei city in 2001, and 1709 aged ⩾60 years from all 16 villages in Tangdian District of Yingshang County in 2003. A total of 3336 individuals participated in the study of which 1736 were urban participants, with a response rate of 94.8%. Permission for interview and informed consent were obtained from each participant. In about 5% of the interviews, informed consent was impossible to elicit, and for these the nearest relative or carer were approached to provide assent to participation. Refusals were respected. The participants were interviewed at home by a trained survey team from the School of Health Administration, Anhui Medical University. The main interview materials were a general health and risk factors questionnaire, and the Geriatric Mental Status (GMS) – a comprehensive semi-structured mental state interview that has been widely used in older populations worldwide.[19] The general health and risk factor record, which was derived partly

https://doi.org/10.1192/bjp.bp.113.134734 Published online by Cambridge University Press

from the MRC-ALPHA study[20] and the Scottish MONICA surveys,[21] contained (a) sociodemographic information, including levels of education, main occupational class and annual income, (b) social support and relationships, (c) psychosocial aspects, (d) doctor-diagnosed cardiovascular diseases, medications and self-assessed physical health, (e) adverse life events occurring in the past 2 years, and (f) hobbies and activities of daily living (ADL).[22] According to standard procedures,[21] we measured systolic and diastolic blood pressure, weight and waist circumferences for all participants.

We employed a computer program-assisted diagnosis, the Automated Geriatric Examination for Computer Assisted Taxonomy (AGECAT), to analyse the information from the GMS to identify the principal mental disorders in the study participants.[19] The methods of diagnosing dementia and depression have been described in previous publications.[16,17,23] In brief, AGECAT analyses of the GMS data brings symptom components together into groups that typify the major symptom areas of each diagnostic syndrome (organic disorder, depression, mania, schizophrenia and paranoia, obsessional, phobic, hypochondriacal and general anxiety). Individual participants are allocated to levels of confidence of diagnosis (0–5) on each of the eight diagnostic syndromes. The various syndrome levels are then compared with one another to derive a final differential diagnosis and a level of confidence of diagnosis from 0 to 5. A level of $\geqslant 3$, in most circumstances, designates a 'case level', which corresponds to a level of severity that warrants clinical intervention. Levels 1 and 2 are designated as 'subcases', whereas level 0 (no confidence level on any syndrome) is classified as 'well'.[22] The GMS-AGECAT dementia and depression 'case' diagnoses have been compared with psychiatrists' diagnoses and DSM-III criteria and applied with good levels of agreement in a variety of settings,[24] including in Chinese older populations.[16,17,25,26] Subcases describe those having cognitive impairment and depressive symptoms not severe enough to qualify as a case.[22,23]

The cohort was followed up until March 2009. Apart from identifying the vital status of the cohort members,[27] we completed two waves of re-interviewing the surviving participants in the follow-up.[28,29] We visited the local residential areas to obtain information about participants' survival status through resident committees, family members, neighbours and friends. In the urban cohort, we also reviewed electronic registration databases from the Centre for Disease Control and Police Registration in Hefei city to identify mortality and causes of deaths. For those deceased, we used a standard verbal autopsy questionnaire to interview family members, relatives, neighbours or friends of the deceased to further explore causes of death. Ethical approval for the study was obtained from the Research Ethics Committee, Anhui Medical University, China, and the Research Ethics Committee, University College London, UK.

Socioeconomic status

In this study we measured SES in four different ways, including educational level, occupational class, income and rural *v.* urban living. The educational level for each participant was recorded at his/her actual school level, and those without any school attainment were defined as illiterate. Participants' occupational class were determined from their main job titles as an officer/teacher, businessman, manual worker, peasant, housewife and 'other'. All participants were required to provide the answers 'very satisfied', 'satisfied', 'average' or 'poor' to the question 'Are you satisfied with your income?' and the answers 'yes' or 'no' relating to having experienced a financial problem in the past 2 years.[17] An expert panel estimated annual income for each category of these answers, which was validated by actual annual personal and family incomes that we recorded at the wave 3 survey.[18] We defined all participants who lived in rural areas as having a low SES compared with their urban counterparts. Apart from low incomes, they had lower levels of education and occupation, and most of them had no medical insurance, unlike those in urban China who had medical coverage provided by the government or their employers.[15] The primary care system in rural areas was mainly carried out through clinics staffed by less intensively trained medical personnel. We categorised those illiterate, or with a main occupation being recorded as a 'manual labourer or peasant', and a family income that was 'average or poor' as having a low SES.

Statistical analysis

All analyses were performed using the SPSS statistical package (Windows version 16.0). We examined distributions of baseline risk factors among participants with dementia and depression using ANOVA test for continuous variables and a χ^2 test for category variables. We employed multivariate adjusted Cox regression models to examine the survival of people with dementia and depression (cases and subcases groups). To strengthen comparability of rural and urban data, we censored the urban cohort follow-up to 1 December 2006, which gave a 5-year follow-up period similar to that in the rural cohort.[27] We calculated follow-up time of the cohort members from the baseline interview to the end of follow-up or date of death. We tested for an interaction between SES and dementia and depression using a 2-sided *P*-value and calculated a ratio of two hazard ratios (RHRs and its 95% confidence interval) for mortality in participants with low SES compared with high SES.[30]

Results

Of 3336 participants, 2978 (89.3%) were followed up over 5 years (minimum follow-up time of 1 month; maximum 5.6 years). Online Table DS1 shows baseline characteristics of the participants. The average age was 71.8 years (s.d. = 6.9), 51.9% were women and 50.8% were illiterate. A total of 7.5% of participants had baseline dementia and 4.3% had depression. Compared with the non-cases of dementia and depression group, patients with these disorders (including the subcases group) were more likely to be older, female, non-smokers throughout life, not alcohol drinkers, live in rural areas, have low levels of education, occupation and income, and likely to be divorced/never married or widowed and have a history of stroke. There were no significant differences in body mass index, hypertension, diabetes and heart disease among those with dementia or depression and other participants (Table DS1).

During the 5.6 years follow-up period, 565 participants died. Table 1 shows number, percentage and relative risk of all-cause death among participants with and without dementia and depression. The hazard ratio (HR) for mortality among the dementia cases or subcases groups in comparison with the non-cases group was 2.77 (95% CI 2.19–3.51) and 1.22 (0.92–1.60). Among the depression cases or subcases groups the HR was 2.07 (1.49–2.89) and 1.81 (0.97–3.02) respectively. After adjustment for age and gender, these figures did not substantially change (Table 1). With further adjustment for socioeconomic variables, the HRs for mortality among the cases with dementia and depression groups and the respective subcases groups were reduced (Table 1). In the multivariate adjustment analysis, including social support and cardiovascular risk factors, increased risk of mortality in the cases with dementia and depression groups remained significant

https://doi.org/10.1192/bjp.bp.113.134734 Published online by Cambridge University Press

Table 1 Number of deaths and hazard ratios (HR) among participants with and without dementia and depression in the Anhui cohort study

Dementia and depression status group	Deaths/participants *n* (%)	HR (95% CI)		
		Age and gender adjusted analysis	SES adjusted analysis[a]	Fully adjusted analysis[b]
Non-cases of dementia and depression	355/2216 (16.0)	1.00	1.00	1.00
Dementia				
Cases	85/223 (38.1)	2.69 (2.11–3.42)	2.30 (1.79–2.97)	2.07 (1.62–2.66)
Subcases	58/307 (18.9)	1.15 (0.87–1.52)	1.11 (0.84–1.48)	1.06 (0.80–1.41)
Depression				
Cases	39/128 (30.5)	2.29 (1.64–3.20)	1.87 (1.32–2.64)	1.50 (1.06–2.13)
Subcases	28/104 (26.9)	1.78 (1.21–2.61)	1.53 (1.04–2.26)	1.45 (0.98–2.46)

SES, socioeconomic status.
a. Adjusted for age, gender, urban–rural location, educational level, occupation and family income.
b. Adjusted for age, gender, rural–urban, educational level, occupation and family income, body mass index, smoking, alcohol, marital status, frequencies of children/relatives visiting, hypertension (defined as having blood pressure measured ⩾140/90 mmHg or taking antihypertensive drugs), diabetes, heart disease and stroke.

(adjusted HR being 2.07, 95% CI 1.62–2.66 and 1.50, 95% CI 1.06–2.13 respectively), but not for the subcases groups (Table 1).

Table 2 shows mortality related to dementia or depression cases in rural *v.* urban location. We found a significant interaction between the rural–urban variable and dementia or depression. In the multivariate adjusted analysis the significance of this interaction was maintained. In the non-cases of dementia and depression group, living in rural *v.* urban areas doubled the risk of mortality ($P = 0.002$), whereas for participants with dementia the RHR for rural *v.* urban location was 2.96 (95% CI 1.45–6.04), $P = 0.003$, and for depression the corresponding figure was 4.15 (95% CI 1.59–10.83), $P = 0.004$.

Data analysis for the other SES variables of low education, occupation and income suggest no such interaction effect (online Table DS2). For these SES variables, among patients with dementia similar HRs of around 2.5 were found when compared with high-SES participants without dementia and depression, and there was no increase in the HRs in those with low SES compared with high SES. In patients with depression with a low level of education, occupation and income a significantly increased HR of around 1.8 was found (Table DS2). Compared with patients with depression with high levels of education, occupation and income, the RHRs in those with respective low levels of SES were 1.11 (95% CI 0.48–2.55), 1.50 (95% CI 0.53–4.23) and 1.55 (95% CI 0.55–4.41).

Discussion

In this community-based cohort study in China we observed that dementia and late-life depression were significantly associated with increased mortality. After adjustment for socioeconomic and other confounding variables, the associations between these disorders and mortality were attenuated, but remained significant. Individuals with dementia (cases) had a doubled risk of mortality and for depression there was a 50% increase. Regardless of levels of education, occupation and income, the impact of dementia and depression on survival were consistent. However, patients living in rural areas had a further, higher risk of mortality.

Strengths and weaknesses of the study

To the best of our knowledge, the current study is the first to investigate the impact of SES on survival in dementia and late-life depression in LMICs, in which most of the population have undergone substantial socioeconomic transitions and the risks of dementia and depression increase. China is the world's most populous nation, and is acknowledged as having the greatest number of people with dementia[13] and depression in the world.[31] The study population has experienced an extensive change in SES and healthcare over the past 30 years, reflecting the emergent prosperity of China and illustrating the relevance of population-based socioeconomic factors in influencing survival rates. These findings illustrate the importance of SES in terms of understanding survival in individuals with dementia and depression. A second strength is the use of a standardised face-to-face interview (GMS-AGECAT) and diagnostic system in diagnosing dementia and depression at baseline. This enables the findings to be compared with populations in the West.[24,32,33]

Our study has some limitations. We selected people in rural areas aged ⩾60 years, which was different from urban participants. This is because at the time of the study, the age of ⩾60 years in rural China was usually taken to define older people. Analysis of data, having excluded patients aged between 60 and 64, did not demonstrate age-specific differences. Aproximately 10% of participants in the cohort were lost to follow-up, which may introduce direction bias. However, there were no significant

Table 2 Numbers, mortality rate and hazard ratios in participants with low and high socioeconomic status (SES) defined by urban *v.* rural location in the Anhui cohort study, China

Dementia and depression status group	Deaths/participants, *n*	Mortality rate, %	Hazard ratio[a] (95% CI)
Non-cases of dementia and depression			
High SES	218/1463	14.9	1.00
Low SES	223/1164	19.2	2.11 (1.33–3.34)
Dementia			
High SES	18/49	36.7	1.57 (0.95–2.60)
Low SES	67/174	38.5	4.64 (2.79–7.71)
Depression			
High SES	7/37	18.9	0.87 (0.40–1.87)
Low SES	32/91	35.2	3.61 (2.04–6.39)

a. Adjusted for age (continuous variable), gender, rural *v.* urban location, educational level, occupation and family income, marital status, frequencies of children/relatives visiting, body mass index group, smoking, alcohol, hypertension (defined as having blood pressure measured ⩾140/90 mmHg or taking antihypertensive drugs), diabetes, heart disease and stroke.

https://doi.org/10.1192/bjp.bp.113.134734 Published online by Cambridge University Press

differences in the baseline characteristics of participants followed up and those lost to follow-up, except for more women, non-lifetime smokers and widows being less likely to be followed up (online Table DS3). Female gender was related to lifetime non-smoking and widowed status at baseline. As adjustments were made for gender, marital status and smoking history in the analysis, we do not consider that the directional bias is significant in terms of the impact of SES on survival in dementia and late-life depression.

At baseline, we employed the GMS-AGECAT algorithm to diagnose dementia and depression. Although the GMS-AGECAT dementia diagnosis has been validated in older Chinese populations,[25,26] it may misidentify cases of mild cognitive impairment as dementia, particularly in illiterate adults. This would make our findings biased towards the null hypothesis. Within the analysis for dementia cases, it may attenuate the association of educational level with mortality, showing no differences in the impact of low level of education on survival in dementia. This requires further investigation. However, the finding of people with dementia living in rural areas having a higher risk of mortality compared with their urban counterparts seems not to be affected by the educational levels associated with a GMS-AGECAT dementia diagnosis. Our data of significantly reduced survival in people with dementia living in rural China are robust.

Significance of our findings

In the current study, age and gender-adjusted HRs for mortality as a result of dementia or depression are similar to those found in industrialised nations.[4,5] Adjustment for all socioeconomic variables reduced the HR for dementia from 2.69 to 2.30 and for depression from 2.29 to 1.87, suggesting that SES may play a potential role in influencing survival rates in older adults with dementia and depression in China. After further adjustment for social support and cardiovascular risk factors, the HRs remained significant, showing that dementia and depression were associated with a 100% and a 50% increased risk of mortality. These are lower than those found in high-income countries.[4,5] Partially the high levels of social support in older adults in China[17] may mitigate the impact of dementia and depression on mortality, as there is evidence that increased social support reduces the association between depression and mortality.[34] Social support may thus act as a buffer against mortality in older adults with these mental disorders and provide a source of intervention.

Many studies in high-income countries show no significant associations between low SES and dementia mortality.[9–12] In this study from China, we found that people with dementia living in rural areas had a higher risk of mortality than those with dementia living in urban areas, although there were no differences in mortality between people with dementia with low levels of education, occupation and income. Differentiating between rural and urban living environments was considered an important socioeconomic factor in determining SES, as people living in rural areas have low levels of education, occupational class and income[17] and rural–urban status is related to an ability to obtain or understand health-related information in general.[15–17] Rural residents have little medical insurance, unlike those in urban China who have medical coverage provided by the government or their employers.[15] People in rural China lack medical facilities and healthcare compared with their urban counterparts. The primary care system in rural areas is mainly carried out at clinics staffed by less intensively trained medical personnel.[15] These factors serve to increase health inequalities for rural people.

Our data also showed similar patterns of SES effects in people with depression. This suggests that there may be an inequitable distribution of mental healthcare between rural and urban China, which needs to be urgently tackled. To our knowledge, there is a dearth of literature in the world that has directly investigated the association of SES with mortality in late-life depression. In the absence of other evidence, our findings imply that in rural China greater attention should be paid to the care and treatment of dementia and late-life depression.

In this study, we also observed a slightly increased risk of mortality among the subcases of dementia and depression groups. Subcases may represent early stages of syndromes that are not severe enough to qualify as a case. For example, dementia subcases may fall into the category of mild cognitive impairment, suggested as a boundary area between normal ageing and dementia.[35] Small increases in mortality in mild cognitive impairment have been seen in Western populations (for example an adjusted HR of 1.24, 95% CI 1.04–1.48[36]). Similarly, our data showed a non-significant increase (about 10%) in mortality in relation to dementia subcases. Our study did demonstrate a significant increase in mortality in subcases of depression, even after adjustment for SES. The finding is similar to that of the Longitudinal Aging Study Amsterdam (showing an 80% increased risk of mortality in men with mild depression).[37] Multivariate adjustment including social support produced a borderline significant increase in mortality, suggesting that social support reduced the effect of depression on mortality. Although more large-scale cohort studies are needed to determine whether or not these subcases have direct associations with mortality in older adults, our findings suggest that early intervention and healthcare provision may be of some importance.

Implications

In conclusion, among older adults in China we found that people with dementia or late-life depression had a significantly increased risk of mortality. People with these conditions living in rural areas – a comprehensive index of low SES and an indicator of poor healthcare access – had higher mortality than urban counterparts, suggesting that overall poverty has an adverse impact on the survival of older adults with dementia and depression. These findings should act as a warning to governments and healthcare professionals to reduce mental health inequalities. Innovative primary and secondary care strategies targeting people in rural areas are required, along with effective measures to promote the uptake of effective dementia and depression interventions. These may include relatively simple strategies such as social support, in lower socioeconomic groups. Investments in rural medical care and insurance and the introduction of new mental healthcare systems from high-income countries, with evidence-based dementia and depression services for older adults, should be considered to help to reduce mortality for individuals with both early and established cases of dementia and late-life depression.

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First received 3 Jul 2013, final revision 30 Oct 2013, accepted 6 Nov 2013

Funding

The study was supported by research grants from the BUPA Foundation, UK (45/NOV/06, and TBF-M09-05) and Anhui Province Natural Science Fund, China. The sponsors of the

https://doi.org/10.1192/bjp.bp.113.134734 Published online by Cambridge University Press

study had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. The opinions expressed in this report are not necessarily those of the funders.

Acknowledgements

The authors thank the participants and all who carried out the survey. Drs Ying Ma, Yong Guo, Lei Li, Feng Li and Ke Zhang helped with the follow-up of the cohort.

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