

# A three-year follow-up study of age-related dementia in an urban area of Beijing

Li G, Shen YC, Chen CH, Zhau YW, Li SR, Lu M. A three-year follow-up study of age-related dementia in an urban area of Beijing. *Acta Psychiatr Scand* 1991; 83: 99–104.

G. Li, Y. C. Shen, C. H. Chen,  
Y. W. Zhau, S. R. Li, M. Lu

Institute of Mental Health, Beijing Medical  
University, Beijing, People's Republic of China

A 3-year follow-up study of 1090 people aged 60 years or over in an urban area of Beijing, China, was conducted to determine the incidence of dementia and its characteristics of distribution. This cohort had been studied first in a cross-sectional survey of dementia in 1986. The follow-up examination employed the same interviewers, psychiatrists, instruments (Mini-Mental State Examination and the Crichton Royal Behavior Rating Scale) and diagnostic criteria for dementia (modified DSM-III) in 1989. The respondent rate in this study was 75.7%. The average annual incidence rate of moderate and severe dementia for  $\geq 60$  years was 0.3% (95% confidence interval 0.08–0.52%). As expected, the rate increased sharply with aging. No sex difference was found. The prevalence rate of moderate and severe dementia was 1.10% among those aged  $\geq 65$  years, similar to that (1.82%) in the first survey. Our results showed that the multi-infarct dementia was somewhat more common than primary degenerative dementia (ratio 3:2), both among incident cases and current prevalent ones. The average duration of dementia in the community was 8.0 years (SD 3.4). The risk for death in demented patients was 3 times higher than in the whole cohort (standardized mortality ratio = 2.95), and no specific cause of death was observed. In addition, our study showed that elderly people with less education, a history of consistent unemployment, limited physical activity and stroke history had a higher risk for developing dementia.

Key words: dementia; longitudinal study; risk factor; morbidity; mortality

Ge Li, Psychiatry Service 116A, Bronx Veterans Administration, 130 W. Kingsbridge Rd., New York, NY 10468, USA

Accepted for publication August 17, 1990

Population-based epidemiological information on dementia is of utmost importance for clinicians, health care resource planners and those interested in developing research strategies to discover etiology and mechanism. To date, most epidemiological investigations on dementia have been prevalence studies (1–5). Studies of incidence have been few; most have been conducted in the Scandinavian countries (6–8) and the United States (9–11). This is the first report of the incidence rate of dementia in China. A cohort aged 60 years and over (12) was followed up after 3 years to obtain the incidence of dementia and its characteristics of distribution in an urban area of Beijing.

## Material and methods

### Cohort

This follow-up study was based on a cross-sectional survey of dementia conducted 3 years ago (12). The initial survey was done during December 1985 to March 1986 in the West District, an urban area of Beijing. A total of 1090 people aged 60 years and over were interviewed. Three years later, the same interviewers and psychiatrists used the same instru-

ments and diagnostic criteria to follow up the same cohort.

Of 1090 subjects, 739 (67.8%) survived and were interviewed again, 86 (7.9%) died and an additional 256 (24.3%) were lost to follow-up during this period. For each deceased subject, an informant was interviewed. Thus, the overall respondent rate was 75.7%. The main reason for the loss of subjects in the follow-up were a permanent or temporary move out of the catchment area after the initial investigation (69.8% of the lost subjects) and prolonged travel of vacation away from the area (25.7%). The refusal rate among nonrespondents was only 0.4%. There were no significant differences in age or sex between the respondents and the nonrespondents.

### Procedures

The assessment procedures for the follow-up investigation was the identical 2-stage survey employed in the first cross-sectional study. In the first stage, subjects were screened individually with the Mini-Mental State Examination (MMSE) (13) and the Crichton Royal Behavior Rating Scale (CRBRS) (14). Following these evaluations, psychiatrists gave

suspected demented subjects careful clinical examinations and diagnostic evaluation. An additional assessment in the follow-up survey was the collection of information from informants using the CRBRS regarding deceased subjects' mental states before their death.

#### Instruments and diagnostic criteria

The Chinese version of the MMSE was pretested on a clinical sample of 137 subjects before it was used in the population (12). The results indicated that an MMSE score of 17 or less was appropriate for defining those with suspected dementia, with a sensitivity of 1.00 and a specificity of 0.89 (15). In the initial survey, the MMSE score was strongly related to the subject's education level (12, 15). Thus 2 cut-off points in the MMSE to screen for dementia were adapted according to whether the subjects was illiterate or not ( $\leq 17$  for the illiterates and  $\leq 19$  for literate).

The CRBRS was used to screen the subjects who could not communicate verbally. Based on results of the pretest and the initial survey, a score of 2 or more of a possible total of 19 in the mental activity section indicated suspected dementia (12, 14). For the deceased subjects, the CRBRS was also employed to estimate cognitive impairment before their death by interviews with informants.

As in our initial survey (12), the diagnostic criteria and classification for dementia used in the current study was modified from DSM-III criteria (12, 16). A diagnosis of moderate or severe dementia was defined as a loss of intellectual ability that is sufficient to interfere with social and occupational functioning and activities of daily life. The impairment must have required help from others on a day-to-day basis either part or all of the time. Mild dementia was diagnosed in subjects who met all criteria for dementia except the more restrictive criterion for moderate or severe dementia above regarding day-to-day help. Possible dementia was assigned to those who met all the criteria but with a course that was less than 4 months.

#### Reliability

All the interviewers were trained to use the instruments before the first cross-sectional survey. Agreement on the MMSE score was excellent (intraclass correlation coefficient = 0.998), as was the diagnosis of dementia (kappa = 0.72–1.00). Before the second follow-up survey, the same interviewers went through additional training in the use of all the instruments.

#### Statistics

Incidents rate means the number of new disease cases in a population divided by the sum of the time period of observation for all individuals in the population.

Relative ratio (RR) is a ratio of incidence rate of disease in an exposed and non-exposed population to a factor. It is used to indicate the strength of an association of disease with exposure to a factor of interest.

We used the Mantel-Haenszel estimation of RR and test for stratified data (17).

Standardized mortality ratio (SMR) is a ratio of an observed number of deaths to an expected number. This statistical indicator was used to compare the mortality of demented patients with that of the general population.

#### Results

##### Description of the cohort

Of the 825 respondents, 392 (47.5%) were males and 433 (52.5%) were females. Most of them (61.2%) were below age 70 years in 1986. There was no significant difference in the age structure between sexes (Table 1).

Among these 825, 86 died during the 3 years, an average annual death rate of 3.7%.

##### Incidence

Seven moderately or severely demented patients and 6 mild or possible demented cases developed during the 3-year interval between surveys. The average annual incidence rate of moderate or severe dementia was 0.3% among those  $\geq 60$  years (95% confidence interval (CI) 0.08–0.52%). When the 6 mild or possible cases were included, the corresponding rate was 0.56% (95% CI 0.26–0.86%) (Table 2).

Of the 7 new moderately or severely demented cases, 3 were diagnosed as multi-infarct dementia (MID), 2 as primary degenerative dementia (PDD), 1 caused by alcohol, and an additional 1 was due to unknown cause. The ratio of MID to PDD was 3 : 2 (Table 3).

The incidence of dementia increased rapidly with aging (Table 2). The rate of moderate or severe dementia was 0.36% for males and 0.25% for females (NS). When the mild or possible cases were included, the corresponding rates were 0.44% for males and 0.66% for females (NS).

##### Prevalence

Of the 739 subjects aged 63 years of over living at the time of the follow-up survey, 7 cases were identified

Table 1. Distribution of respondents by age and sex

Age in 1986 (years)	Male			Female			Total	
	Surviving	Dead	Total (%)	Surviving	Dead	Total (%)	Surviving (%)	Dead (%)
60–69	222	17	239 (61.0)	257	9	266 (61.4)	479 (64.8)	26 (30.2)
70–79	107	21	128 (32.6)	120	16	136 (31.4)	227 (30.7)	37 (43.0)
≥ 80	14	11	25 (6.3)	19	12	31 (7.2)	33 (4.5)	23 (26.8)
Total	343	49	392 (100)	396	37	433 (100)	739 (100)	86 (100)

as moderate or severe dementia and 5 as mild or possible dementia. The prevalence rate of moderate or severe dementia was 0.95% (95% CI 0.25–1.65%) for those aged 63 years or over and 1.10% (95% CI 0.29–1.91%) for those aged 65 years or over. When the mild and possible cases were included, the rates were 1.62% for ≥63 years and 1.89% for ≥65 years.

Of the 7 cases of moderate or severe dementia, 3 were MID, 2 PDD, 1 was caused by carbon monoxide poisoning and another case was associated with the excessive alcohol use (Table 3).

As in the previous study (12), the prevalence rate increased sharply with age. Of these 7 cases, 6 were female and only one was male.

Course and outcome

Of 14 moderately or severely demented patients in the 1986 investigation, 8 cases had died and 5 survived to the second investigation 3 years later, and an additional case was lost to follow-up. The average annual death rate was 29.6%, which was higher than that of the current cohort (3.7%). The SMR for moderate or severe dementia was 2.95.

The duration of dementia among the dead cases, from onset of dementia to death, ranged from 4 to 12 years (mean 8.0, SD = 3.4). The average duration of the illness among the surviving cases was 10.8 years (SD = 4.5, range 5–17). Causes of death were non-specific; 3 patients died of senility, 2 of infectious disease, 1 PDD caused by cerebral hemorrhage, 1 cancer and 1 unknown cause.

Of the 5 mild of possible cases considered in the initial investigation, 3 developed to moderate or

severe dementia before their death, 1 was lost to follow-up and 1 case who had had a stroke with cognitive impairment showed some improvement in his cognition at the follow-up (the MMSE improved to 22 from 16).

Risk factors

The risk of dementia among illiterate subjects was 3.2 times higher than that of literate subjects. After age adjustment, RR (2.4) was still higher (*P* < 0.10) (Table 4). A higher risk for dementia was also observed in subjects who were never employed (RR = 3.3, *P* < 0.05; after age adjustment, RR = 2.4, *P* < 0.10). But the risk to widows and widowers for dementia was not significantly increased (Table 4).

Subjects with physical mobility problems and with a history of stroke had a higher risk of dementia: RR was 8.7 for persons who were limited to indoor activities and 4.1 for those with a history of a stroke (Table 4). Self-evaluation of physical health tended to be lower among the subjects who developed dementia.

Discussion

Incidence

The average annual incidence rate of moderate or severe dementia was 0.30% among people aged ≥ 60 years. The incidence of dementia for those 70 to 79 years old (0.41%) was similar to other reports: Sluss reported an incidence of senile dementia of

Table 2. Incidence of dementia by age

Age group (years)	Moderate + severe			Mild + moderate + severe		
	New case	Sum of risk years	Incidence (%)	New case	Sum of risk years	Incidence (%)
60–69	1	1467.0	0.07	5	1462.5	0.34
70–79	3	729.0	0.41	4	727.5	0.55
≥ 80	3	120.0	2.50	4	118.5	3.38
Total	7	2316.0	0.30	13	2308.5	0.56

Table 3. Types of dementia

Type	Incidence		Prevalence	
	Moderate or severe	Mild or possible	Moderate or severe	Mild or possible
MID	3	3	3	2
PDD	2	1	2	2
Mixed (PDD/MID)	1	0	0	0
Other	1	2	2	1
Total	7	6	7	5

MID = multi-infarct dementia; PDD = primary degenerative dementia.

Table 4. Relationship of dementia with some psychosocial and physical factors

Factor	Risk years	New cases	RR	$\chi^2$	RR <sub>MH</sub>	$\chi^2$
Education						
Illiterate	771.0	8	3.18	4.60	2.47	2.84
Literate	1533.0	5		( <i>P</i> < 0.05)		( <i>P</i> < 0.10)
Employment						
Never employed	747.0	8	3.33	5.03	2.37	2.90
Employed	1557.0	5		( <i>P</i> < 0.05)		( <i>P</i> < 0.10)
Marital status						
Widowed	598.0	5	1.78	1.06	—	
Not widowed	1706.0	8		NS		
Physical mobility						
Indoor activity	112.5	4	8.66	18.76	4.89	7.70
Not limited	2191.5	9		( <i>P</i> < 0.05)		( <i>P</i> < 0.05)
Stroke history						
Yes	226.5	4	4.08	6.43	5.75	12.04
No	2077.5	9		( <i>P</i> < 0.05)		( <i>P</i> < 0.05)
Self-evaluation of health						
Poor	454.5	5	2.88	3.58	2.84	3.84
Fair or good	1833.5	7		( <i>P</i> < 0.10)		( <i>P</i> = 0.05)

Alzheimer type of 0.58% among 70- to 74-year-old men (9) and Kokmen showed an incidence of dementia of 0.60–0.64% among the same age group in the United States (10). But the rate observed was lower than those presented by Hagnell (6), Nilsson (7) and Magnússon (8) from Europe, in which the rate varied from 1.2% to 5.2% in the same age group. These great differences are likely to be partly due to differences in age structure in the samples and differences in method, especially the selection of instruments to detect dementia and the use of criteria to diagnose dementia.

Based on Magnússon's study (8), the incidence rate of dementia among the age group 74–80 years increased dramatically with aging: from 1.01% at age 74 to 2.99% at age 80 in the females. Thus, the rate triples in 6 years. Among the 70- to 79-year-old age group, the proportion of those aged 75–79 years in our cohort (31.9%) was obviously less than that in the Nilsson's sample (45.6%) (7). Thus, the difference age structure of the samples may explain in part the variance in incidence.

Differences in the method of data collection as well as diagnostic criteria used also influence the incidence and need to be considered in comparing various studies. In Europe, the interviews were usually performed by experienced psychiatrists (6, 7) and diagnoses of dementia were based on Roth's criteria (18). But in the studies in the United States and the current study, non-psychiatrists were employed to screen the demented patients with standardized instruments, then psychiatrists diagnosed dementia with DSM-III criteria (9–11). These variations in methods might contribute to variations in results across studies and highlight the need for a cross-cultural study in which methods and

procedures are standardized. In the absence of such studies, it is difficult to delineate real differences in rates between different regions.

Distribution and types of dementia

*Sex.* In the current study, no significant difference was found between males and females in the incidence rate of dementia among subjects ≥ 60 years. Katzman & Kokmen (10, 11) found a higher incidence rate of dementia in females than males. The Lundby study (6) indicated a tendency in which the incidence rate of senile dementia is higher in females, but the rate of MID alone was higher in males. Other studies have not found a difference between the sexes (7, 8).

*Age.* As expected, the incidence of dementia increased dramatically with aging. But our sample does not provide sufficient information to determine whether the rate increases further, remains the same, or decreases after 90 years of age.

*Type.* Jorm et al. (19) reviewed the epidemiological studies from all over the world and noted that Alzheimer's disease appears to be more common in Western countries than Eastern countries, such as China and Japan. The results in this study provide additional evidence for this finding. Unlike most studies from Europe (7) and the United States (10, 11), the ratio of MID to PDD cases in the present study was 3 : 2 in both incident and prevalent cases. The reason remains to be clarified. One possible explanation for this discrepancy may be regional differences in the risk of cerebral vascular disease, because its mortality in Japan and Hong Kong is significantly higher than that observed in Europe and the United States (20). Even within China, the ratios of MID to PDD may vary among different regions. For example, in contrast to this study, a recent study carried out in Shanghai (21), in southern China, showed a significantly higher prevalence rate of Alzheimer's disease than that of MID among subjects aged ≥ 65 years. The different ratios observed in the Shanghai study and the current one are consistent with a report that the incidence rate of cerebral vascular disease was lower in southern China (22).

Natural course

Among 14 moderately or severely demented patients, 8 cases died during the 3-year follow-up, and an additional case was lost. The average duration of dementia in these deceased cases was 8.0 years (SD 3.4), which falls within the range of 6.5 to 10.5 as reported by Mölsä et al. in Finland (23). The average annual death rate of the demented patients was 29.6%, and the mortality risk in the demented cases was almost 3 times as high as in the whole cohort.

No specific cause of death among the demented patients was observed in this study, though some authors, such as Magnússon (8) and Peck et al. (24), have reported that respiratory infection is the most common cause of death in the demented patients.

#### Factors related to dementia

Unlike prevalence or incidence rates, the identification of risk factors within samples may be easier to compare across independent studies, even assuming differences in method. Nevertheless, no risk factors for dementia other than age have been consistently confirmed.

The prevalence study of dementia in the same sample 3 years ago indicated that poorer education is related to the prevalence of dementia (12), although methodological bias was possible. The results of this study provide further evidence that poor education might be a risk factor ( $RR = 3.2$ ) for dementia, though the  $RR$  did not reach statistical significance ( $P < 0.10$ ) after the age-adjustment. Magnússon's observations in Iceland (8) agree with our finding: both prevalence and incidence rates of dementia were greater among those in the lower social classes, depending on education and occupation. Other researches have also reported that cognitive impairment was more common among poorly educated vs well-educated people (2, 25). This factor might reflect their early adverse experience, such as a tendency towards a higher risk for malnutrition or greater environmental stressors in poor people. Therefore, it may be an important clue for further etiological studies of dementia.

However, since most psychological tests used to detect dementia and diagnostic criteria of dementia are highly sensitive to education (15, 26), it is difficult to exclude the methodological effect on the estimation of an association of dementia with education. We adapted different cut-off points in the MMSE to detect dementia in illiterate and literate people. We also modified the judgement of severity in the DSM-III criteria for dementia, so that it did not depend entirely on the impairment in social and occupational functioning, but also on the activities of daily life. In this way, the possibility of methodological bias was controlled to some degree in our study.

The relationship we observed in the cross-sectional study 3 years earlier between cognitive impairment and physical mobility (12) was supported in this longitudinal study. Elderly people with poor mobility tended to be at higher risk for dementia. This association has also been observed in other investigations (25, 27). The role of physical functioning in development of dementia is not clear and needs to be studied further.

A history of stroke was another risk factor for dementia found in this study and indicated that preventing cerebral vascular disease can be important for efforts to decrease the incidence of dementia in China.

In conclusion, the current study provides the first population-based epidemiological information on the incidence of dementia in China. Although comparison across studies may be problematic, the incidence rate for dementia observed in this population appeared to be similar to the rates in the United States but lower than those observed in the European studies. In contrast to most Western countries and a recent prevalence study conducted in southern China, however, we found the proportion of MID to be higher than that of PDD. Although several risk factors observed in this study have been previously identified, such as poor education, a history of consistent unemployment and limited physical activity, additional follow-up evaluations with the same cohort will further elucidate the role of the factors and permit additional examination other factors, such as family history of dementia and head injury. Finally, continued longitudinal follow-up of this cohort of elderly people may provide information on the risks for dementia in the ninth decade of life.

#### Acknowledgements

This project was supported in part by the World Health Organization Regional Office for the Western Pacific. We wish to thank the staff of the Mental Health Center in the West District of Beijing for conducting the interviews, and Jeremy M. Solveman Ph.D. and Winston W. Shen M.D., who helped to review the manuscript.

#### References

1. MÖLSÄ PK, MARTILLA RJ, RINNE UK. Epidemiology of dementia in a Finnish population. *Acta Neurol Scand* 1982; 65: 541–552.
2. KRAMER M, GERMAN PS, ANTHONY JC, VON KORFF M, SKINNER EA. A pattern of mental disorders among the elderly residents of eastern Baltimore. *J Am Geriatr Soc* 1985; 33: 236–245.
3. BOLLERUP TR. Prevalence of mental illness among 70-year-olds domiciled in nine Copenhagen suburbs: the Glostrup survey. *Acta Psychiatr Scand* 1975; 51: 327–339.
4. SCHOENBERG BS, ANDERSON DW, HAERER AF. Severe dementia: prevalence and clinical feature in a biracial US population. *Arch Neurol* 1985; 42: 740–743.
5. SHIBAYAMA H, KASAHARA Y, KOBAYASHI H et al. Prevalence of dementia in a Japanese elderly population. *Acta Psychiatr Scand* 1986; 74: 144–151.
6. HAGNELL O, LANKE J, RORSMAN B, ÖJESJÖ L. Does the incidence of age psychosis decrease? A prospective, longitudinal study of a complete population investigated during the 25-year period 1947–1972: the Lundby study. *Neuropsychobiology* 1981; 7: 201–211.
7. NILSSON LV. Incidence of severe dementia in an urban sample followed from 70 to 79 years of age. *Acta Psychiatr Scand* 1984; 70: 478–486.

8. MAGNÚSSON H. Mental health of octogenarians in Iceland: an epidemiological study. *Acta Psychiatr Scand* 1989; 79: (Suppl. 349): 59–66.
9. SLUSS TK, GRUENBERG EM, KRAMER M. The use of longitudinal studies in the investigation of risk factor for senile dementia – Alzheimer type. In: MORTIMER JA, SCHUMAN LR, ed. *The epidemiology of dementia*. New York: Oxford University Press, 1981: 132–154.
10. KOKMEN E, CHANDRA V, SHOENBERG BS. Trends in incidence of dementing illness in Rochester, Minnesota, in three quinquennial periods, 1960–1974. *Neurology* 1988; 83: 975–980.
11. KATZMAN R, ARONSON M, FULD P et al. Development of dementing illnesses in an 80-year-old volunteer cohort. *Ann Neurol* 1989; 25: 317–324.
12. LI G, SHEN YC, CHEN CH, ZHAO YW, LI SR, LU M. An epidemiological survey of age-related dementia in an urban area of Beijing. *Acta Psychiatr Scand* 1989; 79: 557–563.
13. FOLSTEIN MF, FOLSTEIN SE, MCHUGH PR. “Mini-mental state”: a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975; 12: 189–198.
14. WILKIN DW, MASHIAH J, JELLEY DJ. Changes in behavioural characteristics of elderly population of local authority homes and long-stay hospital wards, 1976–1977. *Br Med J* 1978; 147: 1274–1276.
15. LI G, SHEN YC, ZHAO YW et al. Preliminary application of MMSE in the aged of an urban population in Beijing. *Chin Ment Health J* 1988; 2 (1): 13–18.
16. American Psychiatr Association. *Diagnostic and statistical manual of mental disorders*. 3rd edn. Washington, DC: American Psychiatric Association, 1980.
17. ROTHMAN KL, ed. *Modern epidemiology*. Boston: Little, Brown & Company, 1986: 153–176.
18. ROTH M. The natural history of mental disorder in old age. *J Ment Sci* 1955; 101: 281–301.
19. JORM AF, KORTEN AE, HENDERSON AS. The prevalence of dementia: a quantitative investigation of the literature. *Acta Psychiatr Scand* 1987; 76: 465–479.
20. *World health statistics annual 1988*. Geneva: WHO, 1988: 104–407.
21. ZHANG M, KATZMAN R, SALMON D et al. The prevalence of dementia and Alzheimer’s disease in Shanghai, China: impact of age, gender, and education. *Ann Neurol* 1990; 27: 428–437.
22. CHEN DY. Epidemiological survey of stroke in a seven-hundred-thousand population of Beijing in 1984. *Neuroepidemiology Research Workshop*, Beijing, 1986. Unpublished.
23. MÖLSÄ PK, SAKO E, PALJARVI L, RINNE JO, RINNE UK. Nature course in dementia. *Acta Psychiatr Scand* 1988; 78 (suppl): 89.
24. PECK A, WOLLOCH L, RODSTEIN M. Mortality of the aged with chronic brain syndrome. II. In: KATZMAN R, TERRY RD, BICK KL, ed. *Alzheimer’s disease: senile dementia and related disorders*. Aging, Vol. 7. New York: Raven Press, 1978: 299–307.
25. YU ESH, LIU WT, LEVY P. Cognitive impairment among elderly adults in Shanghai, China. *J Gerontol* 1989; 44: 97–106.
26. HENDERSON AS. The risk factors for Alzheimer’s disease: a review and a hypothesis. *Acta Psychiatr Scand* 1988; 78: 257–275.
27. KAY DWK, BEAMISH P, ROTH M. Old age mental disorders in Newcastle upon Tyne. II. A study of possible social and medical cause. *Br J Psychiatry* 1964; 110: 668–682.