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Cognitive Change and Its Predictive Value among Elderly People in Beijing

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(Abstract) The purpose of this study was to observe the longitudinal change of cognitive function of elderly people. Over 180 community-dwelling elderly people were tested with MMSE at baseline and followed up five years later. About 42.9% of 1,225 people who had cognitive impairment at baseline survey were found to be dead in follow-up survey, and the death rate was much higher than that of cognitive intact person, which was 19.45%. Among 1,335 cases who finished MMSE test twice the mean score of MMSE at follow-up was 23.35, which was lower than original mean score (23.77). The rate of people identified as abnormal by education adjusted cutoff point also increased from 8.24% to 17.8%. Viewed individually 51.9% of

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them remained stable in MMSE score, 24.5% decreased and 23.6% increased after five years. Old people aged 70 or above, less educated, and people who scored around or lower than cutoff point were more likely to decline. Conclusion: The performance of MMSE has certain predictive value to the outcome of elderly people, and cognitive decline in community lived people is quite slow.

[Key words: Chinese Elderly, Cognitive Impairment, Longitudinal Study, MMSE, Population-based survey]

Cognitive function is comprehensive aspects of mental function, such as sensation, perception, memory, speech, abstract thinking and so on. Dysfunction in cognition is the impairment of these functions which manifest as the decline of the individual's perception of the outside world. The research on the change of cognitive function, its progress and its character is of significance in the understanding of early diagnosis, natural history, progress and intervention of dementia. It is also of theoretical significance in the understanding of mechanism and progress of brain aging (Li et al., 1989; Zhang, 1990). The purpose of this program is to investigate the current level of cognitive function in general population in Beijing, to trace the cognitive decline longitudinally, and to identify characters associated with the functional deterioration.

Method

A cohort of community lived elderly persons was ascertained through a randomized sampling method to cover different residential condition in Beijing: One representing an urban area, one a suburban area and the last one a mountain area (Xiang & Liu, 1995). The sample was stratified in term of sex and age, from 55 to 80 years and over (in 5 year cohorts), forming six age groups

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of approximately equal size.

The total sample interviewed at the first stage was 3,257, of whom 2,047 received cognitive test. Five years later same procedure was conducted for the follow-up study and 1,811 cases were traced, another 236 cases were missing because of moving away from interviewed area, out of home during the time of field work, or refusing, the rate of following being 88.47%. Among the traced 1,811 cases, 409 cases were found died, 65 cases failed to administer the second cognitive test. Therefore, the sample included for longitudinal analysis in this paper sized 1,337.

The elderly people were first visited at their home in 1992 by trained interviewers for cognitive testing and questionnaire, while the most interest of the paper is focused on the change of cognition. The cognitive function was assessed with the Mini-Mental State Examination (MMSE), which had been revised to suit the Chinese culture and condition. The adopted version is named as MMSE Modified in China (MMSE-MC). Educational adjusted criteria were used to detect impairment of cognitive function since the pilot survey indicated an obvious educational influence on test achievement (Meng & Meng, 1991). Five years later similar procedure was repeated in 1997 on same sample to follow the outcome of the subjects, and retest their functional change.

Results

Result from baseline survey

The result from baseline survey showed that among 2,047 cases who finished MMSE testing, 249 cases were abnormal according to the educational-based cutoff standards, given a overall cognitive impairment rate of about 11.77%. Weighted by the age

constitution of Beijing elderly people, the age-standardized rate is 10.65%. Subjects were classified into four grades of cognitive function based on the cutoff points and standard deviation (*SD*) as interval. That is, intact group (1 *SD* or more higher than cutoff point), borderline group (lower than 1 *SD* above cutoff), mild abnormal (1 *SD* below cutoff point), and moderate abnormal (1 *SD* and more lower than cutoff) (see <Table 1>).

<Table 1> Cognitive Function By Age, Sex, Education
And Residential Area In Baseline Survey

	Total	Normal				Abnormal			
		Intact		Borderline		Mild		Moderate	
		Case	No.	%	No.	%	No.	%	No.
Total		2047	1526	74.5	280	13.7	160	7.8	81
Age **	55-	330	288	87.3	30	9.1	10	3.0	2
	60-	381	311	81.6	46	12.1	17	4.5	7
	65-	372	300	80.6	43	11.6	21	5.6	8
	70-	363	275	75.8	45	12.4	34	9.4	9
	75-	326	225	69.0	50	15.3	34	10.4	17
	80-	275	127	46.2	66	24.0	44	16.0	38
Sex**	M	1007	816	81.0	122	12.1	49	4.9	20
	F	1040	710	68.3	158	10.7	111	10.7	61
Area**	Urban	1229	986	80.2	140	11.4	69	5.6	34
	Suburban	524	352	67.2	95	18.1	55	10.5	22
	Mount	294	188	63.9	45	15.3	36	12.2	25
Edu.**	Illiterate	1068	691	64.7	181	16.9	125	11.7	71
	Primary	607	511	84.2	66	10.9	23	3.8	7
	Second	235	202	86.0	20	8.5	10	4.3	3
	Tertiary	137	122	89.1	13	9.5	2	1.5	0

** $p < .01$ when compared between different stratum

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Cognitive abnormality increased with age advancing. The impairment rate ranged from 3.6% at age group of 55-59 to 29.8% at age group of 80 and over. There is an obvious difference between gender, residential area, and educational attainment for cognitive dysfunction. The impairment rate was higher in women, in farmers, or in persons with low educational level when compared with that in men, in urban residents, or in subjects with longer schooling years, respectively (see <Table 1>).

Outcome of the subjects

The 1,811 cases were traced five years later. Among them, 409 subjects deceased. The cumulative death rate was 22.58%. A linear relation between different level of cognitive function and the prognosis is revealed from detailed analysis. The cumulative mortality rates in intact group were 17.3%, while 33.5% of cases in borderline group died, which is similar with the mortality in mild impaired group. The moderate to severe cognitive impaired group has the highest mortality rate (refer to the first 3 columns in <Table 2>).

The difference on mortality between cognitive function level was not due to confounding by organic diseases. 22.6% of chronic diseases sufferers died, similarly 22.5% of non-sufferers died (see <Table 2>). However, age itself has additional effect on mortality. More people in advanced old group died than their younger counterpart regardless of their cognitive grades. While within the two age segments of the young-old and the old-old, there still exists the trend that more people with poor function would die (see <Table 3>). On the other hand, the association between poor cognition and death within 5 years was seemed not due to the effect of terminal drop which was coined by Kleemeier (1962),

<Table 2> Cognitive Function, Morbidity and Mortality

	Cases	Cumulative Death ^a		Free of diseases ^b		With Diseases ^c	
		N	%	No.	% of Death	No.	% of Death
Intact	1350	234	17.3	443	15.1	907	18.4
Borderline	242	81	33.5	96	36.5	146	31.5
Mild Abn.	144	52	36.1	60	38.3	84	34.5
Mod. Abn.	75	42	56.0	33	51.5	25	59.5
Total	1811	409	22.6	632	22.5	1179	22.6

a Compare among different cognitive groups

($\chi^2 = 289.91$, $p < .01$)

b Compare within subgroup of free of any diseases

($\chi^2 = 125.44$, $p < .01$)

c Compare within subgroup of with diseases

($\chi^2 = 185.42$, $p < .01$)

<Table 3> Cognitive Function, Age and Mortality

	Cases	< 75 yrs ^a		>= 75 yrs ^b	
		N	% of Death	N	% of Death
Intact	1350	812	8.9	538	30.1**
Borderline	242	102	21.6	140	42.1**
Mild Abn.	144	45	11.1	99	47.5**
Mod. Abn.	75	14	28.6	61	62.3**
Total	1811	973	10.6	838	36.5**

a Test among young old group ($\chi^2 = 138.39$, $p < .01$)

b Test among old old groups ($\chi^2 = 117.86$, $p < .01$)

** Test between different cognitive function group, $p < .01$

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because we failed to verify a statistical significance in correlate coefficients between MMSE achievement on baseline and distance between test and death in the died group (see <Table 3>).

From the above result it could be concluded that cognitive impaired subjects had higher mortality regardless their age and physical health. Therefore it is reasonable to suppose the cognitive impairment may be a sign of terminal drop (White & Cunningham, 1988). The correlative analysis showed MMSE achievement was significant associated with chronologic age, the age of death, while the correlate coefficient between MMSE achievement and distance from test and death is not significant among died cases (see <Table 4>). The result gives a weak support to the hypothesis that the cognitive impairment is general deterioration before death.

Result of MMSE retest

1337 of 1402 survived people finished repeated test of MMSE. The mean score of MMSE at follow-up was 23.36, 0.41 lower than original mean score which was 23.77. The rate of people identified

<Table 4> Correlation Efficient Between MMSE Achievement
and Death

	Age	Age at death	Distance b/t test & death (year)
Total cohort	-0.348**	-0.284**	0.269**
Survived cases	-0.258**	--	--
Died cases	-0.321**	-0.304**	0.087
MMSE normal	-0.191	-0.169	0.089
MMSE abnormal	-0.155**	-0.158**	-0.023

** $p < .01$

as abnormal by education adjusted cutoff point also increased to 17.8%. When viewed individually 24.5% decreased more than 2 points, 23.6% obtained 3 or more points higher than their original score, and 51.9% of them remained stable in MMSE score (change 0-2 points) (see <Table 5>).

Cognitive decline was associated with such demographic feature as age, gender, and residential area. Accordance with the trend of elevated impairment rate in older group which is revealed

<Table 5> Change on MMSE in Retest

	Cases	% of Abn.		Change in 1997		
		1992	1997	Dec.	Stable	Imp.
Total	1337	8.2	17.8	24.5	51.9	23.6
Age*						
55-59	280	3.6	8.6	17.1	53.6	29.3
60-64	310	7.1	14.8	21.9	53.2	24.8
65-69	267	6.7	13.1	18.0	59.6	22.5
70-74	232	9.9	19.0	29.3	49.6	21.1
75-79	167	12.6	33.0	37.7	43.1	19.2
80+	81	19.8	42.0	40.7	40.7	18.5
Sex*						
Male	632	4.2	12.0	21.5	55.5	22.9
Female	705	11.6	22.8	27.2	48.7	24.1
Area*						
Urvan	798	5.7	7.5	14.5	55.6	29.8
Suburban	338	10.1	36.1	45.0	43.5	11.4
Mountain	201	15.4	27.8	29.9	51.2	18.9
Education*						
Illiterate	654	13.4	28.4	34.3	45.4	20.3
Primary school	432	3.3	9.5	18.8	53.9	27.3
Secondary & above	251	2.4	4.4	9.2	65.3	25.5

* Compared among each stratified group, $p < .001$

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in baseline survey, more subjects in advanced age groups decline further. Old women exhibit a higher rate of mental functional decline compared with old men. Education is reversely related with cognitive decline, for more illiterates and people with primary school level degraded than persons with higher educational level. In summary the epidemiological character of cognitive deteriorating cohort are advanced age, female gender, low educational attainment, and rural farmers, especially persons aged 75 years and above had a quite big decline in the cognitive function.

Discussion

It is of significance to trace cognitive function longitudinally among old population dwelling in communities. First, cognitive dysfunction is an essential symptom of dementia in its early stage. Individuals with cognitive impairment are not necessarily demented, while more people in the group would develop dementia than cognitive intact persons (Flicker, Ferris, & Reisberg, 1991). Second, mortality rate in cognitive impaired persons is higher than that in elderly people in general (Kelman et al, 1994; Liu et al., 1990). Similarly, the percentage of the dependent who need help in their daily living is also higher in the cognitive impaired cohort (Melzer, Ely, & Brayne, 1997). Since the quality of life among dependent people is considerable decreased, and the demand on medical treatment and care from the dependent is tremendous, cognitive impairment in old people addresses an important issue in terms of medical practice, public health and care for elderly people.

It is reported in the paper the five-years' observation of cognitive change among a representative elderly sample living in Beijing. The result from our survey indicates that there is a negative association between cognitive function at baseline and

death rate. More people with poorer MMSE score five years before, even in the range of borderline score, tend to be found died. The age and the difference of chronic morbidity can not explain this kind of tendency. It is revealed that cognitive level indicated through MMSE test is of predictive value for the outcome of elderly people, especially for those young-old people, and those without definite organic diseases who is quite healthy clinically.

Some researcher hypothesized that the died people may exhibit a comprehensive decline in their cognitive function about five years before their death, which is termed as terminal drop (White & Cunningham, 1988). Our investigation has carried a five years observation which is just the length of terminal drop may function. But unfortunately we failed to show the popularity of terminal drop from our survey. It is inferred that terminal drop may be an specific phenomenon for certain group of aged people, not an general law.

It is revealed from our cross-sectional study that the older the poorer of cognitive performance, furthermore it is proved by follow-up investigation. For it is demonstrated that within the young-old people who aged younger than 75 years, the cognitive decline is minor, Less persons in the young old group manifested cognitive decline, and the extent is small. While growing to 75 years or older the decline tend to be more obvious and steep. It is reasonable to conclude that cognitive performance is basically stable before age of 75, but more men really can have obvious decline after 75 years old. Consequently the older population could be divided into two groups of the young-old and old-old with the age of 75 as cut point in term of feature of functional decline. Along with deterioration in their physical function, their mental function are likely to degenerate in the advanced age stage

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although most of them are not cognitively impaired serious enough to meet diagnosis criteria of dementia.

It has been well documented the negative association between cognitive function indicated by MMSE score and such demographic variables as age and education through studies in western countries (Fitcher et al., 1995; Luboshitzky et al., 1996; Magaziner et al., 1987). Current survey duplicates the findings in Chinese elderly people. Meantime it is coincide with report of research in another Chinese sample in Shanghai, China (Zhang, Li, & Wang, 1994), where 3.4 points of decrease in MMSE was revealed during 4 years follow-up on a group of elderly people aged 75 years. All these results suggest that mental functional deterioration indicated by cognitive decline among old people is universal without much racial difference.

Another interesting point is that a big difference between rural and urban area is revealed from our observation. Rural farmers exhibit greater extent of decline in MMSE performance even after control of educational disparity among areas. In addition to noticeable disparity in educational attainment between rural and urban residents, such characteristics as socioeconomic status, living arrangement, and social involvement are quite different. Therefore may we infer that variables other than demographic characters are more important predisposing factors associated with cognitive intact.

In conclusion, the status of cognitive function in community lived elderly is stable, and its decline is quite slow, especially among those who are younger than the age of 75. There is different feature between young-old and old-old in their cognitive decrease as well as its predisposing factors. Cognitive impairment and critical cognitive level are important index for outcome and further cognitive deterioration. Brief cognitive test like MMSE is

useful in the assessment of cognitive impairment in community people.

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