An Evaluation of Transition in Functional States among the Elderly in Beijing, China

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Abstract

Objectives: The goal of the present study was to describe the changes in activities of daily living (ADL) of community-dwelling Beijing elderly people (n=3,257), observed for 8 years, and to identify the demographic characteristic that predict the functional change.

Methods: Two sets of interview data (1992 and 2000) were used to evaluate changes among the elderly in reports of limitation in ADL management.

Results: The prevalence of disability increased over 8 years both in IADL and BADL disability. The patterns of ADLs change were bi-directional. A large proportion (74.7%) of the elderly were found to remain active in their functional states, 20.4% of the elderly declined, 3.4% of the elderly remained disabled, and 1.5% showed improvement in functional states. The transition rates from non-disability and disability states to various functional states showed different characteristic, a high disability rate accompanied a high mortality rate. The demographic factors that affected the level of disability among different kinds of population manifested similar trends.

Conclusion: Age was the most significant predictor for functional limitations. In addition, demographic variables played an important role in estimating functional outcomes. It is recommended that the demarcation factor for the evaluation of ADLs should be 75 years of age.

Key words: functional states, transition, activities of daily living, elderly, cohort study

Introduction

Evidence of secular changes in disability has been sought as an indication of the effects of disease prevention, health promotion and health care activities (1–3). The life period of 55 years and older is particularly appealing for examination of such secular changes, because age-related chronic diseases and disability appear during this period (4). This evaluation is also significant for planning the provision of care for the elderly population.

At any given time, the proportion of disability among the elderly is determined by the past rates of incidence of disability, past rates of restoration in functioning and the history of death rates of the disabled and non-disabled persons in the population (5). However, most previous studies about disability were conducted in the West and only a few were from the East (6–8), and many findings on age-related changes in functional states stem from cross-sectional studies making it impossible to distinguish

age and cohort effects. This is the first cohort study (1992–2000), complete in many aspects, which was conducted in Beijing, China.

In this study, the effect of aging on functional limitations was estimated in a random sample of elderly people aged 55 years and older who were followed up for 8 years. Disability change trends were also analyzed among different functional states during this period. Furthermore, we investigated the roles of demographic variables in stability, improvement, or decline in functional limitations among the elderly. Four questions have been addressed: (a) change in the trends between 1992 and 2000 in the prevalence of disability; (b) likelihood of the elderly becoming disabled; (c) likelihood of recovery from disability; and (d) likelihood of death while disabled.

As the number of elderly Chinese grows at an unprecedented rate, there is concern over the increase in the disabled population. The purpose of this study was two-fold: I) to describe the change in the patterns of physical activity among the elderly using a variety of definitions; II) to determine demographic correlates of physical activity in this population.

Subjects and Methods

Study population

The Beijing Longitudinal Study of Aging (BLSA) (9) is a

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longitudinal investigation of lifestyle, chronic diseases, health in the elderly and health care utilization between 1992 and 2000 for persons 55 years of age and older, conducted by the Beijing Geriatric Clinical and Research Center and funded by the United National Population Fund and by the United National Development Program Fund. The sample was ascertained through a stratified randomized sampling method to cover different residential conditions in Beijing (urban, rural and mountainous). The sampling and data collection procedures were described in detail elsewhere (10). Briefly, in the autumn of 1992, a random sample ($n=3,257$, urban 65.6%, rural 21.1%, mountainous 13.3%) of all community-dwelling persons were recruited (the response rate was 91.2%). Subsequently, in the autumn of 1994, 1997, and 2000, all survivors of this cohort were reexamined. The elderly were supplied with a questionnaire, containing questions on disability, which was filled out at home and checked by two trained medical students. Illiterate people completed their questionnaire with assistance from the interviewers.

The BLSA sample was stratified in term of gender and age, from 55 to 75 years (in five-year cohorts) and greater than 80 years old, forming six age groups of approximately equal size. The distribution of educational categories of the final sample was found to be consistent with that of older populations in Beijing obtained from the Fourth National Census Data of China.

Measurements

BADLs and IADLs—Functional states was measured in terms of self-reported disability in routine daily activities. The questionnaire consisted of 12 items adapted from the questionnaire used in a study carried out by the World Health Organization (10) which was grouped along two dimensions: (a) basic activities of daily living (BADL) and (b) instrumental activities of daily living (IADL). Disability in BADLs was defined as being unable, because of health, to perform by oneself at least one of six BADL activities (feeding, grooming, dressing, getting in and out off bed, bathing, moving about inside one's home). IADL disability was an inability to perform at least one of the six activities (cooking, managing money, taking a bus, shopping, walking 300 meters, walking up and down stairs). For subsequent analyses, the hierarchy of disability was evaluated in two steps. First, the prevalence of BADL and IADL disability between 1992 and 2000 was examined separately. The BADL and IADL subscales were a combined version of a summary ADL measure which was labeled as ADL since then, because the BADL and IADL items had a high inter-item correlation and secondly the subscales possessed a hierarchical structure where IADLs were more complex activities than BADLs and hence tended to be lost before BADLs. The internal reliability for the combined scale was very high ($\alpha=0.94$).

In ADLs, the transitions between disability and non-disability between 1992 and 2000 were examined. Considering that there was high mortality and many elderly were missing during this period, the transition was discussed in the following 4 groups: a)

disability, b) non-disability, c) deceased, and d) missing.

Demographic characteristics.—From the information obtained in 1992, the following variables were selected for their possible relation to functional stability: age, gender, marital states, educational and residential states. Marital states was treated as a dichotomous variable: (a) currently married and (b) unmarried. The unmarried group included separated, widowed, divorced, and those that remained unmarried, a dichotomy was used of the relatively small numbers in all these categories (except widowed). Educational attainment was divided into three categories: illiterate, primary, and secondary and above.

Statistical methods

Changes in the prevalence of disability were assessed with χ^2 tests for independence. The average increasing rate of disability was estimated with ordinary least squares. Multivariate logistic models were used to adjust the effect of some demographic factors for potential confounding variables. All analyses were used in the Statistical Package for the Social Sciences (SPSS, version 10.0).

Transitions in t-ADLs from both non-disability and disability states to any other states were analyzed according to the present physical conditions of the elderly namely non-disability, disability, deceased, missing.

Evaluating and comparing the risk levels of the demographic characteristics for disability were conducted among 4 different types of the study population. The population was grouped as: I) elderly of the original cohort; II) survivors in 2000; III) elderly who were deceased by 2000; IV) elderly who were missing by 2000.

Results

Of the 3,257 elderly as the baseline, 1,578 (48.4%) completed all surveys, 1,156 (35.5%) were deceased and 523 (16.1%) elderly were missing by 2000 (Table 1). In general, the population deteriorated in functional states over 8 years of follow up. The percentage of non-disability decreased from 83.3% (1992) to 75.8% (2000). The percentage of IADL disability increased from 12.3% (1992) to 17.7% (2000), and BADL disability increased from 3.9% (1992) to 7.1% (2000) (Table 2).

The change trends of BADL and IADL disability within the same age groups between 1992 and 2000 are shown in Figure 1 & 2. There was no significant difference in disability within the same age groups during this period ($P>0.05$).

The influence of age is noteworthy as the levels of disability varied significantly across the compositional groups. Among each age group, the average decreasing rate of non-disability, compared with 1992, was 0.9% per year in the 55–64 age group, 1.9% per year in the 65–74 age group, and 2.9% per year in the ≥ 75 years of age after 8 years follow up. The average increasing rates of IADL disability for the above age groups was 0.6%, 1.4%, and 1.9% per year and BADL disability was 0.3%, 0.6%, and 1.1% per year,

Table 1 Participants in each follow—up survey of beijing elderly

	1992		1994		1997		2000
Number of survivors of original cohort	3,257		2,703		2,002		1,578
Number of deceased between two interviews		384		400		294	
Number of missing (refused or moved from Interview area)		170		301		130	
Elderly who participated in all surveys	1,578		1,578		1,578		1,578

Table 2 Distribution of ADL function among beijing elderly aged 55 years and older in 1992 and 2000 (as % of population)

Characteristics	Non-disability		IADL Disability		BADL Disability	
	1992	2000	1992	2000	1992	2000
Age group, y						
55–64	96.5	89.0**	2.8	7.6**	0.7	3.4**
65–74	89.4	73.6	7.8	18.7	2.7	7.6
75–	66.2	42.4	25.8	40.7	8.0	16.9
Gender						
Male	87.1	77.4	9.5	15.9**	3.3	6.5
Female	80.6	74.3	15.0	18.0	4.4	7.7
Marital States						
Married	89.7	82.4**	7.9	12.3**	2.3	5.3**
Unmarried	72.5	64.2	20.7	25.4	6.8	10.3
Region of residence						
Urban	87.7	82.0**	8.9	11.1**	3.4	6.9**
Rural	74.1	63.4	20.7	30.5	5.2	6.0
Mountainous	80.0	62.1	16.1	28.2	3.9	9.7
Education						
Illiterate	76.6	64.5**	18.1	26.4**	5.3	9.1**
Primary school	88.7	82.0	8.3	12.1	3.1	5.9
Secondary and above	94.6	87.9	4.0	6.9	1.4	5.2
Total	83.3	75.8	12.3	17.0	3.9	7.1
(n)	2,729	1,199	402	268	126	112

** Compared among each stratified group between 1992–2000, $P < 0.01$

Fig. 1 Percentage of IADL disability compared with the same age groups between 1992 and 2000. ($P > 0.05$) **Fig. 2** Percentage of BADL disability compared with the same age groups between 1992 and 2000. ($P > 0.05$)

respectively. All these changes were marked especially in the age group of ≥ 75 years. The variation was 3-fold or greater compared with the 55–64 age group.

Although male had a higher rate of non-disability and lower rates of IADL or BADL disability than female, their rate of change between 1992 and 2000 was faster compared with females in non-disability or IADL disability. The average decreasing rate of non-disability was 1.2% per year for males and 0.8% per year for females. The average increasing rate of IADL disability was 0.8% per year for males and 0.4% per year for females.

A similar disability variation was also observed in other compositional groups with the highest prevalence of IADL or BADL disability among the unmarried, the illiterate, and those who did not live in urban areas. This trend remained the same until 2000.

All activities of IADL and BADL were impaired with advanced age. After 75 years and older, the impairment increased significantly. Of them, the highest prevalence of BADL impairment was bathing (8.2% in 1992, 8.6% in 2000), followed by walking (3.3% in 1992, 3.8% in 2000) and transferring (2.7% in 1992, 3.9% in

2000) and the lowest was feeding (1.8% in 1992, 2.4% in 2000). For IADL impairment, the highest prevalence was taking a bus (27.5% in 1992, 19.6% in 2000) and the lowest was managing money (13.5% in 1992, 11.1% in 2000).

The rates of transition within different functional states (non-disability, disability, deceased, and missing) are shown in Table 3. It was seen that the transitions in the disabled and the non-disabled states to any other states in the cohort period had different characteristics.

From the non-disability to any other states, the distributions in the proportion of transitions were significantly different within each subgroup although they were not highly concentrated at some functional states. As the rate of transition from “non-disability to non-disability” sharply decreased, it increased the “non-disability to deceased” and “non-disability to missing” with advancing age. Consideration of marital states, the rate of transition from “non-disability to non-disability” among unmarried was 29% less than married. Nevertheless, unmarried elderly people had a higher rate of transition (22% > married) from non-disability to deceased. Within gender, region, and educational groups, females, suburban

Table 3 Transition rates among different functional states (1992 through 2000)

disability [†]	From non-disability				From			
	to non-disability	to disability [†]	to deceased	to missing	to non-disability	to disability [†]	to deceased	to missing
Age group, y								
55–64	61.8	6.8	12.2	19.2	0.5	0.7	51.6	47.2
65–74	39.6	12.6	26.2	21.6	0.8	1.6	61.5	36.1
75–	8.5	9.8	52.7	29.0	0.8	2.6	79.5	17.1
Sex								
Male	36.4	9.4	31.6	22.6	0.5	1.0	78.0	20.5
Female	35.8	10.2	24.6	29.4	0.9	2.3	70.3	26.5
Marital States								
Married	46.1	10.1	21.5	22.3	0.7	1.1	67.6	30.3
Unmarried	17.1	9.2	43.8	29.9	0.8	2.7	77.3	19.2
Region								
Urban	41.0	7.8	24.1	27.1	0.3	1.0	71.5	27.2
Suburban	26.1	12.8	37.7	23.4	1.3	2.9	77.0	18.8
Mountainous	27.9	15.2	36.3	20.6	1.6	2.8	71.3	24.3
Education								
Illiterate	25.3	12.1	35.6	27.0	1.1	2.3	74.1	22.5
Primary school	44.9	8.7	24.7	21.7	0.5	1.0	72.0	26.5
Secondary and above	50.3	5.9	18.1	25.7	0.0	0.8	68.4	30.8

[†] disability means t-ADL disability

Table 4 Age-adjusted relative risks (RRs) for developing prevalence of disability in actives of daily living (t-ADL), by demographic characteristics

	All elderly (n=3257) in 1992		Survivors (n=1578) in 2000		Deceased (n=1156) by 2000		Missing (n=523) by 2000	
	RR	(95% CI)	RR	(95% CI)	RR	(95% CI)	RR	(95% CI)
Age group, y								
55–64	1.00		1.00		1.00		1.00	
65–74	3.21	(2.17, 4.77)	2.88	(2.09, 3.96)	2.09	(1.17, 3.75)	3.61	(1.23, 10.58)
75–	12.87	(8.74, 18.94)	11.60	(7.76, 17.33)	5.71	(3.25, 10.03)	12.36	(4.13, 36.95)
Gender								
Male	1.00		1.00		1.00		1.00	
Female	1.51	(1.19, 1.93)	0.90	(0.66, 1.23)	1.78	(1.31, 2.44)	2.29	(1.12, 4.72)
Marital states								
Married	1.00		1.00		1.00		1.00	
Unmarried	1.22	(0.97, 1.54)	1.14	(0.85, 1.52)	0.99	(0.75, 1.33)	0.73	(0.38, 1.41)
Education								
Secondary and above	1.00		1.00		1.00		1.00	
Primary school	1.56	(1.04, 2.34)	1.09	(0.72, 1.65)	1.45	(0.86, 2.44)	2.75	(0.93, 8.15)
Illiterate	1.67	(1.11, 2.51)	1.85	(1.19, 2.86)	1.36	(0.80, 2.29)	2.03	(0.69, 6.01)
Region of residence								
Urban	1.00		1.00		1.00		1.00	
Suburban	2.46	(1.90, 3.17)	2.50	(1.76, 3.55)	1.82	(1.32, 2.49)	3.06	(1.22, 7.67)
Mountainous	1.87	(1.37, 2.56)	3.15	(2.14, 4.64)	1.33	(0.90, 1.97)	1.71	(0.61, 4.81)

elderly and the illiterate had the lowest rates of transition of remaining active in their respective subgroups, but had the highest transition rate from “non-disability to disability” states.

The relative changes in the rates of transition from the disability states to various states were even greater. The highest proportion, in all categories, was in the transition “from disability to deceased”. The likelihood of recovery from disability or remaining inactive was very low.

All demographic characteristics (except marital states) were significantly associated with the risk for disability in the four groups of the study population (Table 4). The extent of this effect showed the same trend at the outset. Of all four groups, influencing factors were sequenced in the following order: age, region, education, gender, and marital states, and it remained the same after 8

years. In addition, it was also found that the elderly who had completed all surveys, despite their increasing age, had a lower risk than the 1992 populace in most of the demographic characteristics.

Discussion

The prevalence of disability was found to increase with advancing age. Compared with other studies in the West, the findings of the present study were different. From the 1970s through the early 1980s, many studies such as Colvez and Blanchet (11), Kramen (12), and Verbrugge (13) showed increased disability, but most of these studies did not observe this increase among those aged 75 and older. Later Ycas (14) suggested that the general

increase in elderly disability in the 1970s may have been replaced by stability during the 1980s. In the 1990s, more studies (15–19) showed substantial improvements in disability and functioning, and large declines in the prevalence of functional limitations, especially for very elderly people. The present study revealed a high correlation between the risk of disability and increasing age, especially in those elderly who were 75 years and older, and compared with Western countries, age-related changes were significantly different in functional states among Beijing elderly. Furthermore, the present study revealed similar results with previous Japanese studies (7), where greater age had a strong association with the deterioration in ADL function.

Some studies (18–21) during the 1990s focused on changes in ADL functioning, and reported that ADL functioning, unlike many other physical systems, does not follow a consistent pattern of decline. This was in agreement with the present results. The patterns of ADL changes were bi-directional, i.e., in both the direction of improvement and decline. In general, a large proportion (74.7%) of the Beijing elderly were found to remain active in their functional states. A total of 20.4% of the elderly showed a decline in their functional states, 3.4% of the elderly remained disabled and 1.5% showed improvement in functional states during over 8 years of follow up. It was also found that elderly people, irrespective of age, could improve in functional states. Although this was a smaller population, it is important to note the improvement in the functional states.

Other studies in Japan such as these of Ishizaki (7, 8), Kai (9) showed the deterioration of ADLs had a strong relation with the demographic characteristics and these factors were not isolated. The present study concurs with these results. For example, residential states did have a strong association with stability in ADL functioning, rural elderly had a higher disability rate, and significantly higher mortality rate in both non-disability and disability states. Mountainous elderly residents, although their disability rate was lower than rural elderly at the baseline, had the fastest rate of change (it decreased by about 18% in non-disability, and increased by 12.1% in IADL disability and 5.8% in BADL disability) between 1992 and 2000. However, other studies (6) revealed that the proportions of illiterate, unmarried, lower income, and inadequate medical care were significantly higher in rural or mountainous elderly residents than urban elderly. Hence these risks were found to be on the rise.

Figure 1 & 2 shows that, in addition to the influence of age, the increased disability between 1992 and 2000 was mainly because of the increased BADL disability. The explanations of these findings need to be evaluated in the light of what might affect BADL ability but not IADL ability. Verbrugge and Jette (21) cogently clarified the role that health and environment potentially play in various types of disabilities. Compared with IADL ability, BADL ability represents a more basic ability and is less likely to be affected by factors extrinsic to the individual. For the population of this study, chronic diseases, especially stroke, were the main reasons for the increase of BADL disability (9). On the other hand,

IADL ability was different. In addition to health, IADL disability can be affected by physical environment, cultural background, some intelligence and psychological requirements, in addition to other factors that are not related to the extrinsic health states of a population.

When interpreting age-related changes in the health of the elderly, the effects of death and non-response should be considered, because functional states is predictive of mortality (20, 22–23). The elderly (except of those with a very high age) who did not survive until the end of the follow-up period were less healthy at baseline than those who participated in all surveys. The elderly who dropped out of the study because of non-response also constituted a less healthy group. In this study the mortality was 73.3% in the disabled states, which was significantly higher than that in the non-disability states (28.2%) ($P < 0.001$), which suggests it means most disabled elderly cannot survive until 2000. Furthermore, more than 80% of this mortality in the disabled states died in the first 5 years. In addition, the elderly who completed all surveys had a lower risk for disability than the total populace in most of the demographic subgroups. It was evident that these elderly had a better quality of the life than others. It was also seen that the rate of non-response was not very low, because of the displacement of many elderly from the interview site following for city planning requirements. Hence, significant characteristics among this group were not shown compared with other groups.

This study was limited by the use of the definition of disability, because while the receipt of assistance is commonly used as an indicator of old age disability, it is suggested that this is not a good method. One of the major problems with these definitions is that the receipt of assistance is highly related to living arrangements. Those who live with others are more likely to get assistance. In fact, most Chinese elderly live with a big family especially when they are very old. So, when we employed the definition of use-of-assistance, we presumably estimated the disability rate higher than in real life situations.

In short, prevention and reduction of chronic disease and identification of some demographic factors as high risk factors for disability and the influence of the level of different effects are vital for targeting interventions aimed at maintaining independence and to increase the quality of life among the elderly.

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