

The prevalence of Parkinson's disease continues to rise after 80 years of age: a cross-sectional study of Chinese veterans

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Abstract. – OBJECTIVE: The purpose of this study was to examine whether the prevalence of Parkinson's disease (PD) continues to rise after 80 years of age.

METHODS: This is a two-stage, multi-center, cross-sectional study using a stratified cluster sampling approach was employed. Subjects included veterans at ≥ 60 years of age living in veterans' communities for at least one month in 18 major cities across China. In the first step, possible PD was screened using a PD screening scale. Demographic and relevant information were collected. In the second step, PD diagnosis was established using the United Kingdom Parkinson's Disease Society Brain Bank (UKPDSBB) diagnostic criteria.

RESULTS: The study was conducted during the period from December 2009 to December 2012. The study included 277 veterans' communities. Among the approached 11,593 subjects, 9676 subjects, (9096 men, 580 women) responded. The response rate was 83.46%. The age was ≥ 80 years in 6722 (69.47%) subjects. A diagnosis of PD was established in 228 subjects (2.36%) in the entire sample. The rate of PD was 2.65% in those with an age of ≥ 80 years. The rate of PD increased with increasing age (0%, 1.84%, 2.60% and 3.68% in the subjects at < 70 , 70-79, 80-89 and ≥ 90 years of age, respectively; $\chi^2 = 10.891$, $p = 0.001$ in chi-square test). The rate of PD was higher in men (2.44%) than in women (1.46%) on the surface. However, no significant difference was detected ($p = 0.241$).

CONCLUSIONS: The prevalence of PD continues to increase beyond the age of 80 years. The prevalence of PD in Chinese veterans is not lower than that in other countries and regions.

Key Words:

Parkinson's disease, Prevalence, Regional variation, Chinese veterans, oldest old.

Introduction

It was estimated that the prevalence of Parkinson's disease (PD) was 70.7-98/100,000 for people aged ≥ 50 years in mainland China in 1980s, based on the large-scale, multi-center epidemiological surveys¹⁻³, which was lower than that in developed countries (164.2-3400/100,000)⁴⁻⁹ and Japan and Korea in Asia (94.7-1470/100,000)¹⁰⁻¹¹, and even lower than that in Chinese population in Hong Kong, Taiwan and Singapore (330-3400/100,000)¹²⁻¹⁷. In 1990s, a regional survey showed that the prevalence of PD was 1100/100,000 in population aged ≥ 55 years in Beijing, mainland China, which was similar to that in aforementioned countries and regions¹⁸. However, there is a lack of data from a nation-wide survey to validate this conclusion.

Ethnic and gender differences in the prevalence of PD have been reported, with high prevalence in Caucasian subjects and men and low prevalence in black people and subjects of Asian ethnicity¹⁹. In addition, regional difference is observed in the PD prevalence, and a significantly higher prevalence of PD is detected in the Midwest and northeastern regions than in other regions of USA¹⁹. It is estimated that the prevalence of PD is 70.7-1200/100,000 in the elderly population in mainland China^{1-3,18,20-22,28}, with a large variation seen. However, the findings obtained from various regions are not comparable due to the lack of nation-wide epidemiology survey with unified diagnostic standard and unified scheme during the unified period, resulting in the difficulty in evaluating the regional difference in the PD prevalence.

A significant rise in the prevalence of PD has been observed with increasing age^{1-18,20-22}. However, whether the PD prevalence continues to increase beyond the age of 80 years remains controversial^{1,3,5-7,10,15-17,21,22}. In addition, a decline in the prevalence of PD is reported in the oldest old subjects^{1,3,10}. The few previous studies covering

the oldest old subjects had small sample sizes or low constituent ratios^{1,3,5-7,10,15-17,21,22}, thereby, leading to the difficulty in describing the changing tendency of PD prevalence with age in the oldest old subjects.

Based on the elderly veterans' health care system in China, the veterans were recruited in 18 cities from the eastern, central and western regions of China, and men and the oldest old subjects are predominant in these veterans. In this nation-wide cross-sectional study, the prevalence of PD was investigated in 18 cities of the mainland China using the unified diagnostic standard and unified scheme during the unified period, to estimate the prevalence of PD in China and its regional difference, and investigate the prevalence of PD in the oldest old subjects and men.

Methods

Study Design

This study is a part of the construction of the clinical research platform for chronic non-communicable diseases in Chinese elderly veterans²³, and the current study only described the methods to investigate the prevalence of PD. A two-stage, multi-center, cross-sectional stratified cluster sampling approach was employed, and the veterans at age of ≥ 60 years living in veterans' communities continuously for 1 month were enrolled. This study was approved by the Ethics Committee of General Hospital of the People's Liberation Army, and written informed consent was obtained from the veterans enrolled in the current study or their guardians. Qualified medical staff from the department of neurology and geriatrics through the unified training served as investigators.

At the first stage, the early symptoms of PD were screened using a PD screening scale²⁴, and the demographic characteristics including age, gender, education level, history of smoking and alcohol consumption, and personal hobbies, previous history of chronic diseases including hypertension, diabetes mellitus, coronary heart disease and cerebrovascular disease, history of drug use, and family history were collected. Those with PD screening scale scores of > 1 were enrolled in the second stage, when the clinical diagnosis of PD was made by qualified senior physicians in the department of neurology. The history of PD-related diseases was collected, and systematical physical examinations were performed.

In addition, the patients with suspected Parkinsonism underwent brain computed tomography (CT) or magnetic resonance imaging (MRI), and received routine blood test, liver and kidney function tests, thyroid function test and detection of blood glucose. The clinical diagnosis of PD or other Parkinsonism was, finally, made by an expert panel consisted of the heads of the participating institutions, based on the disease history, physical examinations and auxiliary examinations, and the diagnosis of PD was performed according to the United Kingdom Parkinson's Disease Society Brain Bank (UKPDSBB) diagnostic criteria²⁵.

Statistical Analysis

All data were double entered into the software EpiData version 3.1 (The EpiData Association, Odense, Denmark) and checked for consistency. The prevalence, age-specific prevalence and region-specific prevalence of PD were calculated. Differences of proportions were tested for statistical significance with Pearson chi-square test, Fisher's exact probability test and the chi-square test for trends. All statistical analyses were performed using the statistical software SPSS version 18.0 (SPSS Inc., Chicago, IL, USA) $p < 0.05$ was considered statistically significant.

Results

The study was conducted during the period from December 2009 through December 2012, involving 18 cities of Beijing, Shanghai, Guangzhou, Tianjin, Qingdao, Dalian, Fuzhou, Shijiazhuang, Yantai, Baoding, Wuhan, Xi'an, Chengdu, Harbin, Lanzhou, Taiyuan, Hohhot and Guiyang. Totally 11593 subjects at ages of ≥ 60 years sampled from 277 sanatoria for retired cadres in the 18 cities were enrolled in this study, and 9676 subjects responded, with a response rate of 83.46%. The subjects responding to the study involved 6722 (69.47%) cases aged ≥ 80 years, 9096 (94.01%) men and 9269 (95.79%) Han ethnic populations.

At the first stage, 411 subjects (4.25%) were screened positive for PD using the PD screening scale, while 228 subjects with clinical diagnosis of PD were made at the second stage (Figure 1), indicating that the prevalence of PD was 2.36% in Chinese veterans aged ≥ 60 years. The clinically diagnosed patients involved 72 cases (0.74%) with clinically possible PD and 156 cases (1.61%) with clinically probable PD. In addition, the prevalence of clinically diagnosed essential tremor, Secondary Parkinson syndrome and Parkinson plus syndrome was 1.26% (122 cases), 0.50% (48 cases) and 0.13% (13 cases), respectively.

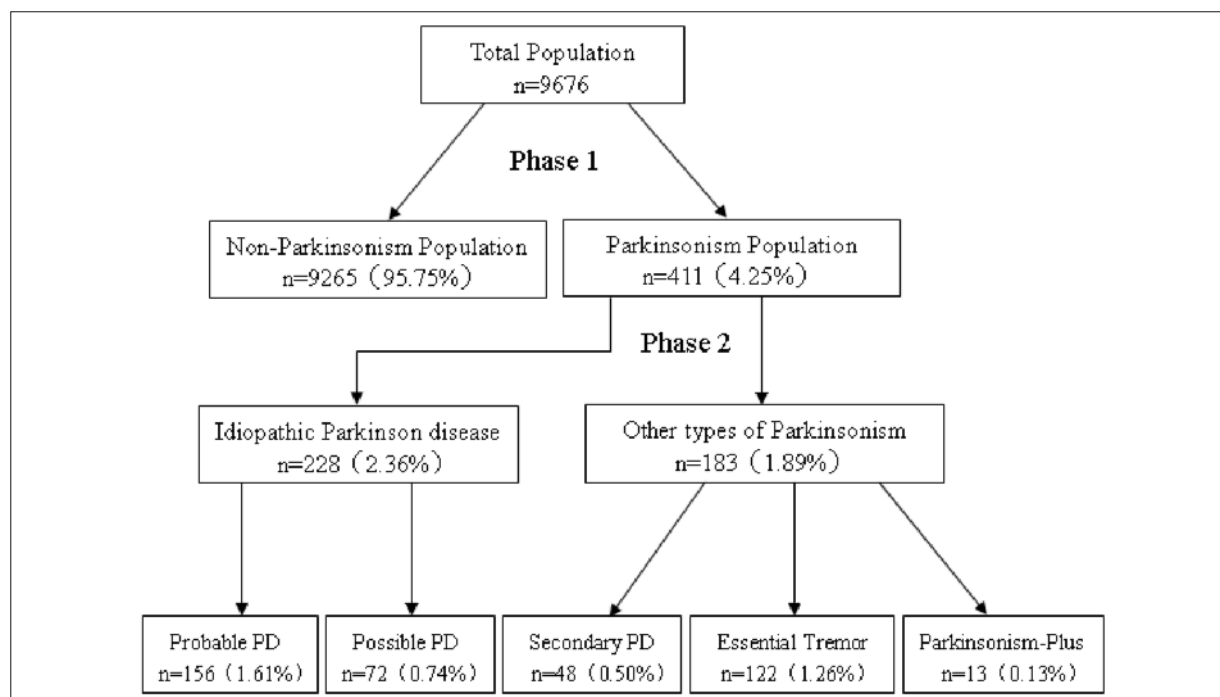


Figure 1. Flow of study with a screening questionnaire (Phase 1) and a neurologic examination (Phase 2).

The prevalence of PD was 0, 1.84%, 2.60% and 3.68% in the subjects aged < 70, 70-79, 80-89 and ≥ 90 years, respectively, which appeared a significantly gradual increase tendency the age, revealed by the chi-square test for trends ($\chi^2 = 10.891, p = 0.001$). A high prevalence was found in men (2.44%) than in women (1.46%) on the surface. However, no significant difference was detected ($p = 0.241$; Table I).

Discussion

The Prevalence of PD in Chinese Veterans is Comparable to that in Other Countries and Regions

A nation-wide survey conducted in 29 provinces and 6 cities of China revealed a significantly lower prevalence of PD than in other countries and regions^{1,2}. The studies since 1990s indicated that the burden of PD in China was comparable to that in other countries and regions (Table II, Figure 2)^{18,20-22,26-29}; however, these studies were carried out in local regions and there is lack of findings from nation-wide survey to validate the above conclusion. The present study covered 18 cities in 14 provinces from 3 economical regions including eastern, central and western regions of China, and 6 administrative regions including north, east, northeast, central south, southwest, and northwest of China, and it is the first nation-wide, multi-center, large scale clinical epidemiological survey of the prevalence of PD in elderly subjects after the survey of PD prevalence in 29 provinces of China. The survey showed that the prevalence of PD was 2.36% in Chinese veterans aged ≥ 60 years, and was 1.84%, 2.60% and 3.68% in the subjects aged 70-79, 80-89 and ≥ 90 years, respectively. It is suggested that the overall prevalence in Chinese veterans and the age-specific prevalence of PD in

Chinese veterans aged ≥ 70 years are significantly greater than in Chinese descents from mainland China, Hong Kong and Macao special administrative areas and Singapore¹²⁻¹⁷, and in China neighboring Asian countries Japan and South Korea^{10,11}; in addition, the prevalence resulting from the current study was comparable to that in developed⁵⁻⁹ and developing countries^{30,31}, and was similar to that of American veterans (Table II, Figure 2)³². The survey of the PD prevalence in American veterans was carried out based on the clinically diagnosed PD cases registered in the veterans administration health care system³²; while the clinical diagnosis of PD in the current study was made based on two-stage face-to-face visits combined with clinical and auxiliary examinations. Therefore, the findings are more reliable than that in American veterans. Although the study subjects had special identity and had a high proportion of the oldest old populations, the nation-wide survey with a unified scheme further validated the conclusions from the surveys in Beijing, Shanghai, Xi'an and Xinjiang, China^{18,20-22,26-28}. Taking all these findings together, it is considered that the Chinese elderly are not low-risk population of PD, and the burden of PD is comparable to that in developed countries. Based on these data, it was estimated that there were 1.72-1.99 million people with PD in China in 2005, while the number would increase to 4.95 million in 2030, and the burden of PD would consist of approximately half of the global burden^{20,33}. As a major contributor to motor disability, the disease burden caused by PD in Chinese elderly should be paid much attention.

A Gradual Increase Tendency in the Prevalence of PD in the Oldest Old Population

The prevalence of PD is found to significantly increase with the age^{5-7,14-16,21,22}; however, a de-

Table I. Age and sex-specific prevalence.

Age	Men			Women			Total		
	Population	PD case	Prevalence %	Population	PD case	Prevalence %	Population	PD case	Prevalence %
< 70	106	0	0	15	0	0	121	0	0
70-79	2345	44	1.88	213	3	1.41	2558	47	1.84
80-89	6242	164	2.63	176	3	1.71	6418	167	2.60
≥ 90	293	11	3.75	6	0	0	299	11	3.68
Total	8986	219	2.44	410	6	1.46	9396	225	2.39

Missing case: 280.

Table II. The comparison of PD prevalence with other studies in China and in other countries and regions.

Survey location	Time of survey	Number of population	Crude prevalence (/10 ⁵)
Present Study	2009-2011	9676	2360 (≥ 60 years)
Mainland of China			
Six cities, China	1983	63195	198 (≥ 50 years)
Hongkou, Shanghai, China	1980	751563	111.4 (≥ 50 years)
29 provinces, China	1986	3869162	70.7 (≥ 50 years)
Xi'an, China	1997-1998	4850	783.5 (≥ 55 years)
Shanghai, China	1997	15910	990 (≥ 55 years)
Beijing, China	1996-1997	5743	1100 (≥ 55 years)
Three cities, China	1997-1998	29454	1070 (≥ 55 years)
Linxian, Henan, China	1999-2000	16448	522 (≥ 50 years)
Kashgar, Xinjiang, China	2008-2009	6145	928 (≥ 55 years)
Yili, Xinjiang, China	2012	5113	1200 (≥ 35 years)
Other regions of Chinese living			
Hongkong	1989	561	3400 (≥ 60 years)
Hongkong	2000	415	480 (≥ 55 years)
Kinmen, Taiwan	1993-1994	3915	587 (≥ 50 years)
Ilan, Taiwan	1993-1995	10058	368 (≥ 40 years)
Keelung, Taiwan	1999-2005	11332	706 (≥ 40 years)
Singapore (Chinese)	2001-2003	8906	330 (≥ 50 years)
Asia			
Hokkaido, Japan	1992-1994	80417	94.7 (≥ 40 years)
Korea	1999-2001	4218	1470 (≥ 60 years)
Other developing countries			
Bambui, Brazil	1997-2001	1186	3300 (≥ 64 years)
Kolkata, India	2003-2007	100802	351.2 (≥ 60 years)
Developed countries			
Gironde, France	1988-1989	3149	1400 (≥ 65 years)
Rotterdam, Netherlands	1990-1993	6969	1400 (≥ 55 years)
Scottish, United Kingdom	1983-1984	151616	164.2 (≥ 40 years)
Five cities in four countries of Europe	1988-1992	14636	1600 (≥ 65 years)
Sydney, Australia	2002-2003	501	3400 (≥ 55 years)
New York, America	1988-1990	179941	489.4 (≥ 60 years)
Veterans of America	1997-1999	887775	1640 (≥ 18 years)

cline tendency is reported in the prevalence of PD in the elderly subjects aged over 80 years (Table III, Figure 2)^{1,3,10,29}. As shown in Table III,

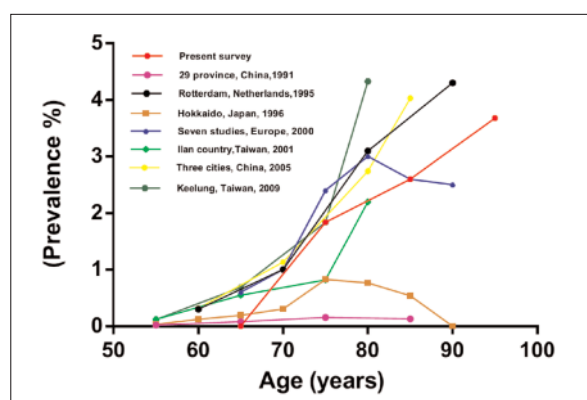


Figure 1. Comparison of age-specific prevalence of Parkinson's disease in community-based surveys in China and other countries.

the sample size of the oldest old populations was usually low, or the constituent ratio of the oldest old populations was usually low in previous studies, and < 10% constituent ratio of the oldest old subjects were found in most previous studies^{1,3,7,10,15-17,21,22}. In the current study, totally 6722 oldest old subjects were enrolled, with a constituent ratio of 69.47%, and the results showed a significant increase tendency in the prevalence of PD in the oldest old subjects, which was in agreement with the findings from the studies conducted in Linxian²¹ and Kashgar²² and Taiwan in China¹⁴⁻¹⁶ and in some European and American countries⁵⁻⁷. In addition, our findings showed that the prevalence of PD was 2.65% in Chinese elderly veterans aged ≥ 80 years, and the prevalence was more than two times in the veterans aged ≥ 90 years (3.68%) compared with the aged < 80 years (1.75%), which was similar to that (2-5%) reported in previous studies^{4,13,15,16,20,31}.

Table III. Comparison of the PD prevalence of the elderly population (≥ 80 years) among the relevant studies.

	Study population	Prevalence (/10 ⁵)	The tendency of prevalence (≥ 80 years/ ≤ 80 years)
Present study	6722 (69.47%)	2650	↑
Hongkou, Shanghai, China	6168 (0.82%)	145.91	↓
29 Provinces, China	36264 (0.94%)	132.4	↓
Shanghai, China	1710 (10.75%)	2398	↓
Linxian, Henan, China	344 (2.09%)	1744	↑
Kashgar, xinjiang, China	459 (7.47%)	1960.8	↑
Ilan, Taiwan	364 (3.62%)	2197.8	↑
Keelung, Taiwan	439 (3.87%)	4328	↑
Hokkaido, Japan	1674 (2.08)	358.4	↓ (≥ 85 years)
Singapore	932 (6.25%)	1250	↑
Sydney, Australia	77 (15.37%)	10390	↑
Gironde, France	959 (30.45%)	3858	↑
New York, America	5590 (3.11%)	1144.9	↑

It is widely accepted that there is gender difference in the prevalence of PD, and the prevalence is significantly higher in men than in women^{17,21}. The present study found a higher prevalence of PD in men than in women on the surface. However, no significant difference was detected. This finding was also reported in previous studies^{10,16,18,31}.

Limitations

The subjects enrolled in this study were Chinese elderly veterans experiencing the World War II and the Korean War; therefore, the demographic characteristics and the exposure to PD-related risk factors are different from the normal community residents. As compared to the eastern regions, much fewer subjects from the central regions of China were recruited, and sample size of women is small in relative to male subjects. Therefore, the limitations of the study should be noted if the study results are popularized.

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the Cadre Department from the Beijing Armed Police General Hospital and the PLA 252 Hospital; the Neurology Department and the Cadre Department from the PLA 253 and 264 Hospitals; and the third Internal Medical Department of the PLA 44 Hospital. The Health Bureau of the Ministry of Health of the General Logistics Department of the PLA and the medicines and health care regulatory agencies for veterans at all levels have organized and coordinated the survey, and medical staff from veterans' communities have also been involved in coordinating this study. The Clinical Department of Geriatrics and the Geriatric Neurology Department of the PLA General Hospital have provided great support for our work. Eisai China Incorporated has made a great effort in the platform training and academic activity. The study was supported by grants (No. 07BJZ04; 10BJZ19; 11BJZ09; 12BJZ46) from the Special Health Research Foundation of the Health Department of the PLA General Logistics Department.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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