

Projected number of people with Parkinson disease in the most populous nations, 2005 through 2030

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Abstract—Based on published prevalence studies, we used two different methodologies to project the number of individuals with Parkinson disease (PD) in Western Europe’s 5 most and the world’s 10 most populous nations. The number of individuals with PD over age 50 in these countries was between 4.1 and 4.6 million in 2005 and will double to between 8.7 and 9.3 million by 2030.

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As worldwide life expectancy has increased, the burden of chronic disease has grown¹ and will likely continue to grow, especially in developing Eastern nations.^{2,3} Understanding and predicting the burden of disease are critical to guide health, social, and economic policy.¹ We therefore sought to project the number of individuals with Parkinson disease (PD) in Western Europe’s and the world’s most populous nations.

Methods. *Country selection.* From the U.S. Census Bureau’s International Data Base, we identified Western Europe’s 5 most

populous nations (Germany, France, the United Kingdom, Italy, and Spain) and the world’s 10 most populous nations (China, India, United States, Indonesia, Brazil, Pakistan, Bangladesh, Russia, Nigeria, and Japan) in 2005.⁴

Prevalence studies. Disease prevalence projections often are estimated using statistics for incidence and survival.⁵ Because incidence and survival data for PD are not available for much of the world,⁶ we instead used prevalence data. For the countries listed, we determined age-specific prevalence of PD from published studies. We used a MEDLINE search from 1966 to February 2006 of “PD,” “prevalence,” and the country’s name to identify studies published in English^{7-10,E1-E13} (see E-references on the *Neurology* Web site at www.neurology.org). We supplemented this analysis by examining studies^{E14-E32} from the reference sections of retrieved articles and selected reviews on PD prevalence.^{6,E33,E34}

Where multiple studies for a given country existed, we gave highest priority to those that used a “door-to-door” screening methodology, had the greatest number of individuals sampled, included physical examinations as part of their initial screen, and provided age-specific prevalence rates. Door-to-door surveys are generally the most accurate method for determining prevalence.⁶

For countries without studies (Indonesia, Brazil, Pakistan, Bangladesh, and Russia), we used prevalence studies from neighboring countries. For Indonesia, we used prevalence estimates from Singapore.¹⁰ For Brazil, we used estimates from neighboring Latin American countries.^{E35-E38} For Pakistan and Bangladesh, we used India,^{E14} and for Russia, we used Estonia.^{E39}

PD projections. To project the number of individuals over age 50 (only 4% of U.S. incident PD cases occur before age 50)^{E40} from 2005 to 2030, we used two different methodologies. In the first method, we calculated the number of individuals with PD as the product of the country’s age-specific prevalence and the country’s population structure from 2005 to 2030 as determined from the International Data Base’s population pyramids.^{E41} When the age ranges of the prevalence studies and the population pyramids did not coincide, we applied the age-specific prevalence across age cohorts or used the lower estimate when two estimates were provided for one age group.

In the second method, we identified 14 door-to-door studies (conducted around the world) with age-specific prevalence.^{8,E3,E8,E10,E11,E13,E14,E18,E20-E23,E35,E36,E38} From these 14 studies, we then selected the study that resulted in the median number of individuals with PD in 2005 (because there was an even number of studies, we used the average of the middle two). We used that study’s prevalence to project the number of individuals with PD in 2030.

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Table Age-specific prevalence estimates of Parkinson disease by country

Country	Ref. for base case	Prevalence by age strata /100,000							2005 estimate (millions)	2030 projection (millions)
		50–54	55–59	60–64	65–69	70–74	75–79	>80		
China	E13	NA	320	320	1,130	1,130	2,740*	2,740*	1.99	4.94
India	E14	128	128	260	260	260	260	260	0.32	0.69
U.S.A.	E18	128	128	128	550	550	958	958	0.34	0.61
Indonesia†	10	50	50	280	280	510	510	1,250	0.09	0.25
Brazil‡	E36	371	371	443	443	443	443	443	0.16	0.34
Pakistan§	E14	128	128	260	260	260	260	260	0.04	0.08
Bangladesh§	E14	128	128	260	260	260	260	260	0.03	0.08
Russia	E39	127	127	493	493	1,232	1,232	1,109	0.21	0.34
Nigeria	E32	58	58	58	58	58	58	58	0.01	0.01
Japan	E2	20	64	97	196	322	525	341	0.10	0.13
Germany	E20	NA	NA	NA	0	700	1,800	700	0.11	0.15
France	E19	NA	NA	NA	500	400	1,800	2,200**	0.12	0.19
U.K.	E24	76	111	159	343	664	859	1,044	0.09	0.13
Italy	E10	116	116	621	621	1,978	1,978	3,055	0.24	0.33
Spain	E21	0	0	630	630	1,300	1,300	10,400††	0.26	0.40
Total									4.10	8.67

* Prevalence for ages 80 to 84 is 1,760/100,000 and for ages >85 prevalence is 4,030.

† Based on prevalence estimate for Singapore.

‡ Based on prevalence estimate for Bolivia.

§ Based on prevalence estimate for India.

¶ Based on prevalence estimate for Estonia.

|| Prevalence for ages 80 to 84 is 700/100,000 and for ages 85 to 89 prevalence is 900.

** Prevalence for ages 80 to 89 is 2,200/100,000 and for ages >90 prevalence is 6,100.

†† Prevalence for ages 80 to 89 is 10,400/100,000 and for ages >90 prevalence is 18,750.

NA = not available.

Results. From MEDLINE, 62 articles were identified, and 17 were original PD prevalence studies,^{7-10;E1-E13} of which 6 used a door-to-door method. Based on the age-specific prevalence for Western Europe's and the world's most populous countries (the first method), the number of individuals over age 50 with PD is expected to more than double from 4.1 million in 2005 to 8.7 million in 2030 (table). With use of the median prevalence from the door-to-door studies (the second method), the number of individuals with PD is expected to grow from 4.6 million in 2005 to 9.3 million in 2030. As shown in figure 1, the burden of PD will grow substantially and become increasingly concentrated outside the Western world. For example, China's proportion of individuals with PD in the selected countries will rise from 48% in 2005 to 57% in 2030. By contrast, the proportion that resides in the United States and the most populous European nations will decrease from 29 to 21%. Figure 2 displays the projected growth in the most populous nations from 2005 to 2030.

Discussion. Using two different approaches, we estimate that the number of individuals over age 50 with PD in 2005 was between 4.1 and 4.6 million and project that the number will more than double by 2030 to between 8.7 and 9.3 million. The burden of

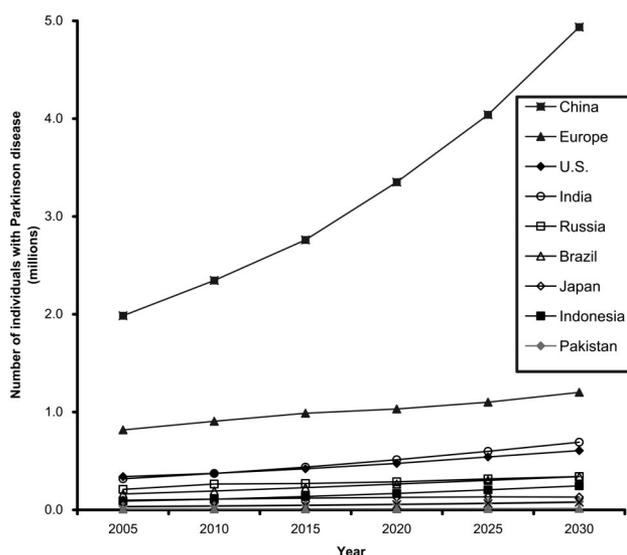


Figure 1. Projected number of individuals over age 50 with Parkinson disease by country, 2005 through 2030. The values for Europe are for the five most populous nations in Western Europe (Germany, France, the United Kingdom, Italy, and Spain).

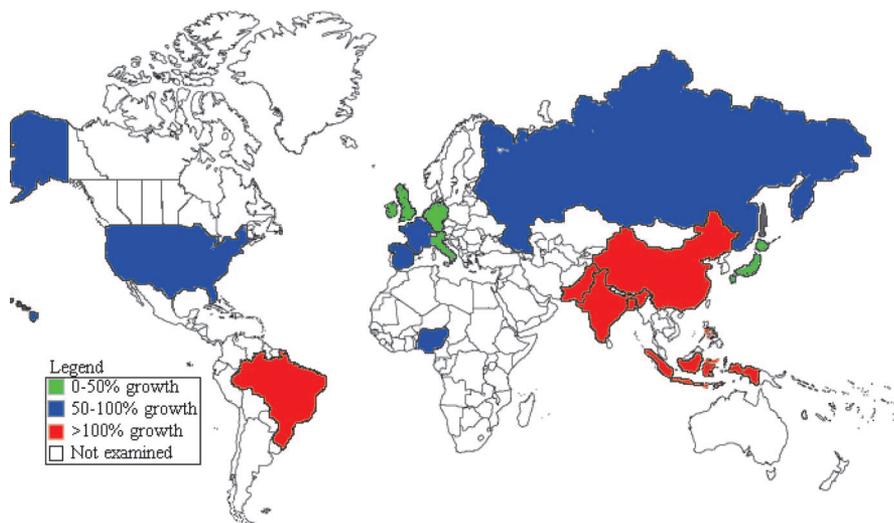


Figure 2. Projected growth rates in number of individuals over 50 with Parkinson disease in the most populous nations in Western Europe and the world from 2005 to 2030.

PD will also shift from more industrialized Western nations to developing Eastern nations.

Ideally, projecting disease prevalence is based on the disease incidence and duration. However, limited data on both PD incidence and disease duration for most of the world precluded this analysis.⁶ Instead, we used prevalence data in two methods. The first method relied on country-specific estimates for PD prevalence. This approach accounts for regional differences in prevalence. For example, Nigeria and India appear to have a lower PD prevalence than other countries. The disadvantage of this method is the variation introduced into the results by the methodologic differences of the studies. A systematic review of “high-quality” European studies found a more than two-fold difference in PD prevalence, which may have resulted from environmental factors, genetic factors, or methodologic differences.^{E33} The first method is also limited by the use of statistics from neighboring countries for countries without published PD prevalence studies. Although we cannot be sure that PD frequency in neighboring countries will be similar, this is a reasonable approach when no other data are available. To address the limitations of the first method, we used a second method that relied on the median prevalence estimate of 14 door-to-door studies to project the PD burden. Despite the differences, the two methods generated similar estimates for the number of individuals with PD.

The absence of incidence and prevalence studies on which to make projections and the methodologic differences of published studies are not unique to PD or to this study. In developing forecasts for the burden of Alzheimer disease, researchers have relied on experts’ consensus, guided by a systematic review of studies, to estimate the prevalence of Alzheimer disease for all regions of the world.³ Here, we limited our scope of investigation to 15 countries and relied on published studies for our projections.

Our estimates are likely conservative. Door-to-

door studies are not available for all countries. Other methodologies such as screening health service records often underestimate prevalence⁶ as many individuals, especially those from economically disadvantaged backgrounds, are missed. In addition, we assumed prevalence estimates would remain constant. However, with improving economic conditions and health care in developing countries, survival of individuals with PD is likely to improve, which will increase its prevalence.

The number of individuals with PD will grow substantially over the next 25 years. Many of these individuals currently are unaware of their diagnosis and have not received appropriate treatment. In at least one study (in Bolivia), none of the individuals diagnosed with PD had even received a neurologic evaluation prior to the study.^{E36} Identifying these individuals and delivering cost-effective medical care will be an enormous public health challenge.

References

1. Sen K, Bonita R. Global health status: two steps forward, one step back. *Lancet* 2000;356:577–582.
2. He J, Gu D, Wu X, et al. Major causes of death among men and women in China. *N Engl J Med* 2005;353:1124–1134.
3. Ferri CP, Prince M, Brayne C, et al. Global prevalence of dementia: a Delphi consensus study. *Lancet* 2005;366:2112–2117.
4. IDB—Rank Countries by Population. Washington, D.C.: U.S. Census Bureau. Available at: <http://www.census.gov/ipc/www/idbrank.html>; accessed December 5, 2005.
5. Brookmeyer R, Gray S. Methods for projecting the incidence and prevalence of chronic diseases in ageing populations: application to Alzheimer’s disease. *Stat Med* 2000;19:1481–1493.
6. Marras C, Tanner CM. Epidemiology of Parkinson’s disease. In: Watts RL, Koller WC, eds. *Movement disorders: neurological principles and practice*. 2nd ed. New York: McGraw-Hill, 2004:177–196.
7. Hobson P, Gallacher J, Meara J. Cross-sectional survey of Parkinson’s disease and parkinsonism in a rural area of the United Kingdom. *Mov Disord* 2005;20:995–998.
8. Zhang L, Nie ZY, Liu Y, et al. The prevalence of PD in a nutritionally deficient rural population in China. *Acta Neurol Scand* 2005;112:29–35.
9. Totaro R, Marini C, Pistoia F, Sacco S, Russo T, Carolei A. Prevalence of Parkinson’s disease in the L’Aquila district, central Italy. *Acta Neurol Scand* 2005;112:24–28.
10. Tan LC, Venketasubramanian N, Hong CY, et al. Prevalence of Parkinson disease in Singapore: Chinese vs Malays vs Indians. *Neurology* 2004;62:1999–2004.

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