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Research Articles

Prevalence of Parkinson's Disease in Cantalejo, Spain: A Door-to-Door Survey

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Abstract: We assessed the prevalence of Parkinson's disease in Cantalejo, Spain. In 1994, we screened 1,579 persons (age ≥ 40 years) using a high-sensitivity method. Cases fulfilling established clinical criteria were followed for a minimum of 3 years. Prevalences were compared with those from other door-to-door surveys. We detected 27 individuals with parkinsonism, 20 of whom had Parkinson's disease. The prevalence of Parkinson's disease increased with age and, when age-adjusted to European standards, was 9.01 per 1,000 (age 40 years and over; 10.78 in men and 5.23 in women). Of the 11 men, three were in Hoehn & Yahr grades III–IV, but six of the nine women were more severely affected. Overall, we found 18 newly diagnosed cases of parkinsonism, 13 of which were Parkinson's disease, and the majority of which were in men aged 80 years or older with a mean duration of illness of 5 years. Our prevalence figures are the highest reported, apparently because of the inclusion of several very elderly men. Parkinson's disease in Cantalejo is less severe in men than in women, particularly in those newly diagnosed. Despite the low numbers, the high prevalence and sex-related pattern are unexplained but they probably relate to the high sensitivity of the screening method. © 2002 Movement Disorder Society

Key words: door-to-door surveys; epidemiology; Parkinson's disease; prevalence

Door-to-door surveys are the most appropriate way of accurately assessing the prevalence of Parkinson's disease (PD), and the detection rate of previously undiagnosed cases can be high. In a review of such studies in Europe,[1] the proportion of newly diagnosed PD was 24% but in those studies conducted in Spain,[1,2] it was even higher: 26% in Girona[1] and 52% in Pamplona,[1] and for parkinsonism in general, 68% in Vejer de la Frontera, Cádiz.[2] Door-to-door studies are generally performed in two phases: the first, aimed at identifying all possible cases using specific screening methods, followed by a second phase to ascertain the diagnosis through examination of all positively screened individuals by specialists. However, assessments of the prevalence of PD have been obtained by door-to-door surveys conducted worldwide in a rather heterogeneous manner, with differences as to screening methods, application of procedures, diagnostic criteria, and clinical expertise. Accordingly, the determinants of prevalence estimates by door-to-door surveys are multiple and limit their comparability. The use of different diagnostic criteria induced variations of up to 32% in prevalence of PD.[3,4] Furthermore, door-to-door surveys are costly, which limits study size, and comparisons of PD prevalence in small, carefully screened populations can be inconclusive due to scant data. The logistic difficulties increase when such studies are conducted in larger populations.

The diagnosis of PD is clinical, as no specific diagnostic test exists, and it is accepted that up to 24% of diagnoses are wrong, even in expert hands.[5] Additional difficulties arise when diagnosing PD after screening, because the proportion of individuals with mild parkinsonian symptoms can be high, and the need to evaluate

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progression of symptoms may require longer follow-up, including assessment of response to levodopa.

Taking these factors into account, we selected Cantalejo, a small Castilian town in the Segovia province of Spain, to perform a door-to-door survey aimed at assessing the prevalence of PD. We used a screening method specifically designed to identify parkinsonism with high sensitivity and reviewed the diagnosis after a 3-year follow-up.[6] Validation of the method in a community sample of individuals with different types of parkinsonism, and the implications of the screening procedure in prevalence measurements and features of the natural history of PD are reported elsewhere.[7]

METHODS

Study Population and Medical Services

Cantalejo (Fig. 1) is a medium-sized town in the province of Segovia, in the autonomous region of Castilla y León, one of the less densely populated regions in the European Union. According to the 1991 census, Cantalejo had 3,503 inhabitants, representative of a semirural Castilian population; it lies 45 km north-east of Segovia and 150 km north of Madrid. After emigration peaked in the 1960s, the population, settled in a central urban nucleus, has remained somewhat static and aged, and is predominantly engaged in services and commerce, with farming as a sideline. There is universal health coverage provided by the National Health Service at a local Health Centre attended by five general practitioners, neurological expertise being available at Segovia General Hospital. Chronic care, including that of demented patients, and terminal care, are generally provided at home, with reliance upon the family and only rarely on institution-based support. Since 1991, there has been a local, 30-bed nursing and old people's home.

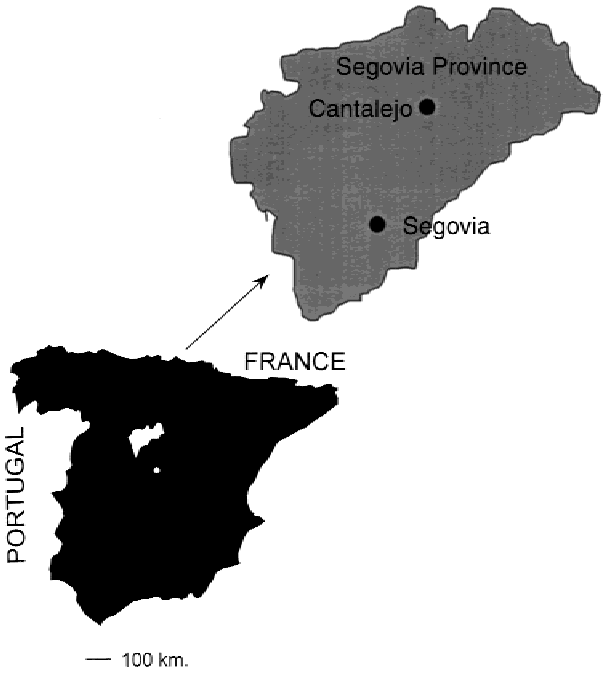

FIG. 1. The study site.

The municipality provided us with the official 1991 census of residents, containing addresses used for definition of household units of 1,653 individuals aged 40 years and over. We updated the census data and set up a register with individual records for each de facto resident aged 40 years or more. De facto residents we defined as people who had lived in Cantalejo for 9 months or more during the year of our study (1994), regardless of whether they figured in the official census, and this accounted for 196 inclusions. Individuals who had not lived permanently for at least 9 months during that year, despite being included in the official census—270 in all—were excluded. The age and sex of the study population is shown in Table 1. The prevalence date were established as of 31 December 1994.

Background and Study Design

To facilitate participation, we contacted the local general practitioners who collaborated in case-finding. Cooperation was encouraged by the local authorities through public announcements, local radio, and newsletters. The objectives were set out at a well-attended public meeting, held in the Town Hall 2 weeks before our initiating the study. All studies, screening tests, and clinical follow-up were performed free for participating individuals. A single complete enumeration approach based on each eligible subject was adopted for data collection and identification of affected individuals. The study was completed in two phases.

TABLE 1. *Number of individuals in the age- and sex-matched structure of the study subjects and safety sample at Cantalejo*

	Study subjects		Safety sample	
Age (yr)	M	F	M	F
40–44	38	59	3	12
45–49	70	87	5	14
50–54	104	95	15	11
55–59	77	110	8	8
60–64	124	124	17	15
65–69	116	115	15	11
70–74	97	101	11	11
75–79	52	68	4	7
80–84	21	73	1	14
85–89	18	18	4	4
90+	4	8	1	3
Total	721	858	84	110

Phase 1: Screening Method and Safety Sample.

A previously reported, a validated screening method with nine items[6] was distributed door-to-door and collected by hand by a local expert field-worker 6 weeks before the prevalence date. The questionnaire was accompanied by a personally addressed letter, explaining the purpose of the study. A search was made by the field worker for each individual eligible for inclusion in the updated census. When individuals were unable to answer on their own, a next-of-kin relative was taken as surrogate. A detailed description and validation of the application procedure is presented elsewhere.[7] The screening phase was completed before the prevalence date.

Phase 2: Diagnostic Ascertainment.

We selected a deliberately low cut-off point, to increase sensitivity. All individuals giving one or more positive answers to any item were examined neurologically in Phase 2. To minimise any possible loss of individuals with parkinsonism through failure to screen, a systematic sample, the "safety sample" (Table 1), was selected for examination by the specialists, comprising 100 individuals with negative, "don't know," or "uncertain" answers to any screening question and 94 individuals not screened in Phase 1 for different reasons (not located, initially not collaborating or people for whom no screening results had been collected). The senior neurologist at the Segovia General Hospital Movement Disorders Clinic, assisted by two trained neurologists, was in charge of supervising all examinations and establishing the final diagnoses. All persons screening positive, and the safety sample, were examined by at least two of the three neurologists. The systematic neurological examination took 10 to 15 minutes using the Webster scale protocol and was conducted and recorded at the Health Centre, private home, or nursing home.

Individuals diagnosed on clinical grounds as suffering from parkinsonism were referred to the Neurological Unit at the Segovia General Hospital, where the diagnosis was confirmed by a further examination, treated accordingly in the context of the appropriate clinical criteria, and followed-up for at least 3 years after the prevalence date, or until death. Cases in which identifiable causes of parkinsonism were not found or in which no atypical features enabling identification of Parkinson-plus syndromes were observed were classified as PD. All diagnoses were deemed provisional, until a definite diagnosis of PD could be made clinically (including response to levodopa) at the end of the follow-up period.

Prevalence Measurement and Comparisons

We used a protocol for symptoms and signs, capable of classifying patients clinically diagnosed as having parkinsonism, to apply a selected set of diagnostic criteria: (1) progression of symptoms in the past with at least two of the four cardinal features—tremor, rigidity, bradykinesia or altered postural reflexes—was used for calculation of the prevalence of parkinsonism; and (2) PD prevalence was calculated using another eight reported sets.[3] The prevalence of PD in Cantalejo was assessed taking age-specific PD prevalences, described by door-to-door investigations undertaken worldwide,[8–19] including a recent pooled survey of a European cohort in which two aged Spanish populations were studied,[1] then comparing these with the prevalence found in Cantalejo. Comparisons were run using stratified analysis and exact tests to calculate Mantel-Haenszel estimators of prevalence ratios (PRMH) and their 95% confidence intervals (CI).

Parkinson's disease natural history

We looked at five features of the natural history of the disease for the purposes of description and comparison. Ages at the date of prevalence and at the onset of symptoms and were described for groups aged 50 to 59 years, 60 to 69 years, 70 to 79 years, and 80 to 89 years and for the study population overall, as mean and median values. Man/woman ratio was obtained, both crude and as the PRMH and their 95% CI. Disease severity was described according to the Hoehn & Yahr (H&Y) index.

RESULTS

Population attrition across the study is shown in Figure 2. Of the 1,579 eligible individuals, 352 were not screened due to death, refusal to participate, or proved unreachable during the survey period, although 94 were eventually examined in Phase 2. Legible responses to the questionnaire were obtained from 1,227 (78%) of the $\geq$40-year-old eligible population. A large proportion of the screened population, 528 individuals (33%), provided clearly positive answers to one or more questions and entered Phase 2.

The 528 positively screened individuals, plus the 194 in the safety sample, in all 722 individuals, 46% of the study population, underwent neurological examination in Phase 2. Two women in the safety sample, previously diagnosed as PD and treated at Segovia General Hospital, had not screened in Phase 1 as both believed they should not reply to the questionnaire. We detected 28 individuals with parkinsonism in Phase 2, of whom 21 were initially diagnosed clinically as having PD; 14 were newly diagnosed during the study, 13 with PD. Throughout the 3-year follow-up (Table 2), all the newly diagnosed patients improved with levodopa (L-dopa), although their symptoms eventually worsened, except for

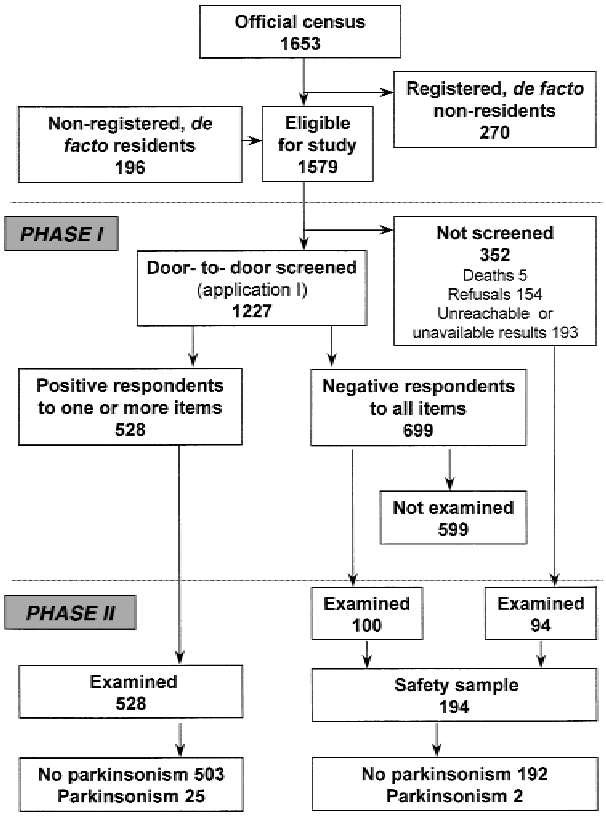

FIG. 2. Study population attrition.

one who remained clinically unchanged, proved unresponsive to L-dopa, and was eventually considered a case of essential tremor. One woman, diagnosed as having PD during the study, deteriorated rapidly, with profound dementia, and died. Necropsy confirmed that she had been suffering from Lewy-body disease. The symptoms and signs of three patients classified as drug-induced parkinsonism in Phase 2 resolved completely after withdrawal of the medication (cinnarizine). The remaining three patients had an akinetic-rigid parkinsonian syndrome unresponsive to L-dopa.

Table 3 summarises combined data on the individuals diagnosed as PD. Mean age at onset and prevalence date were 73 and 80 years, giving a duration of disease of 7 years, with slightly earlier onset and longer duration (9 years) in women. Of the patients with PD, 55% were in low (I or II) grades. However, 8 of the 11 men were in H&Y I or II, whereas six of the nine women were H&Y III or IV at the prevalence date. Considerable differences were seen between cases known before and those diagnosed during the study. The latter were predominantly men with mild dysfunction and, despite similar age at the prevalence date, their mean age at onset and mean disease duration differed: 69 and 11 years, respectively, for those diagnosed before the study; and 75 and 5 years for those diagnosed de novo. The difference in average disease duration in men and women diagnosed during the study was approximately 1 year. Individuals aged 80 years and over accounted for 9 of the 13 newly diagnosed; three (two women, one man) had mild to severe disability (H&Y III or IV).

The age- and sex-specific, crude and age-adjusted prevalence of parkinsonism and PD; the age-specific and age-truncated mean age at onset; and disease duration for PD are listed in Table 4. The prevalence of parkinsonism per 1,000 at age 40 years or more over, was crude 19.42 (95%CI, 10.60–32.62) in men and 15.15 (8.06–25.90) in women and, when adjusted for age, 13.13 in men and 7.36 in women. For both parkinsonism and PD, prevalence increased with age, generally proving higher in men in the different age groups. The prevalence of PD at age 40 years or more, in both sexes, men and women were crude 12.67 (95%CI, 7.74–19.51) overall, 15.26 (7.61–27.31) in men, and 10.49 (4.80–19.93) in women, and age-adjusted 9.01, 10.78, and 5.23 per 1,000, respectively, thus being 106% higher in men than in women. Mean age at onset increased from 55 years in the 60 to 69 year age-group to 81 at the 90 years and older. The average age-specific mean age at onset of PD was 71 years and the mean age 73 years. Disease duration, mean 7 years, increased with age and was heavily influenced by the presence of an outlier in the 60 to 69 year age-group.

Table 5 and Figure 3 take PD prevalence recorded in other door-to-door surveys and compare them with that in Cantalejo. Table 5 shows the crude and age-adjusted prevalences, and the statistical testing of heterogeneity of the prevalence ratios. The prevalence of PD in Cantalejo was the highest overall, and similar only to those reported in Italy (in eight centres), where individuals over the age of 84 years were not studied. Our age-adjusted PD prevalence was 1.4 to 5.2 times higher than similar measurements in the same age-groups in other surveys. We found statistically significant differences in the Mantel-Haenszel estimator of prevalence ratios, in comparison with those for six Chinese towns, for Kinmen, Gironde, and Pamplona. Heterogeneity of age-specific prevalence ratios was not statistically significant, but low *P* values (0.07–0.09) were obtained in comparisons with Copiah County and large-accrual surveys in Sicilian municipalities and Junín, Argentina. Figure 3 shows age-specific PD prevalences in eight door-to-door surveys, two of which, from Girona and Pamplona, were conducted in Spain among individuals aged 70 to 89 years, and those we found in Cantalejo. Although the prevalence figures in Cantalejo at 60 to 69 and 70 to 79 years

TABLE 2. *Characteristics of individuals with parkinsonism in Cantalejo*

Patient No.	Diagnosis		Sex	Age (yr)		Disease duration (yr)	H&Y (grade)	Webster Scale score	FINWU score
	After follow-up	Prior to survey		At prevalence date	At disease onset				
1	PD	PD	M	76	72	4	III	13	44
2	PD	PD	M	88	67	21	IV	19	23
3	PD	PD	F	65	45	20	III	10	40
4	PD	PD	F	84	80	4	III	11	45
5	PD	PD	F	92	79	13	IV	22	34
6	PD	PD	F	65	63	2	II	4	46
7	PD	PD	F	88	76	12	III	13	35
8	PD	Not diagnosed	M	87	84	3	II	8	44
9	PD	Not diagnosed	M	61	56	5	I	8	47
10	PD	Not diagnosed	M	81	76	5	III	12	34
11	PD	Not diagnosed	M	76	75	1	I	7	46
12	PD	Not diagnosed	M	81	76	5	II	1	43
13	PD	Not diagnosed	M	92	82	10	II	10	40
14	PD	Not diagnosed	M	80	75	5	I	8	45
15	PD	Not diagnosed	M	81	79	2	II	10	46
16	PD	Not diagnosed	M	74	72	2	II	9	46
17	PD	Not diagnosed	F	75	74	1	I	7	45
18	PD	Not diagnosed	F	82	78	4	IV	20	37
19	PD	Not diagnosed	F	86	70	16	III	14	38
20	PD	Not diagnosed	F	81	80	1	I	8	46
21	Akinetic-rigid syndrome	Akinetic-rigid syndrome	M	71	68	3	IV	16	36
22	Lewy body disease	PD	F	81	75	6	V	31	3
23	Drug-induced parkinsonism	Not diagnosed	M	74	70	4	II	6	49
25	Drug-induced parkinsonism	Not diagnosed	F	83	73	10	IV	19	36
26	Drug-induced parkinsonism	Not diagnosed	F	73	67	6	I	4	47
24	Akinetic-rigid syndrome	Not diagnosed	M	79	77	2	V	28	27
27	Akinetic-rigid syndrome	Not diagnosed	F	80	78	2	V	27	15

H&Y, Hoehn and Yahr; PD, Parkinson's disease; FINWU, Northwestern University Disability Scale.

were similar to those elsewhere, the prevalence at 80 to 89 years was considerably higher than in other surveys.

DISCUSSION

We report on a door-to-door PD survey in which extraordinary emphasis was laid on achieving high standards in case-finding and diagnostic ascertainment. We found that the prevalence of PD in Cantalejo was high and that there were remarkable differences in prevalence, dysfunction, and disease duration between men and women. We also found that most cases of PD (9 of 11 men) had not been previously diagnosed. Considerable differences between our study and previous door-to-door surveys emerge, with regard to both prevalence and the natural history of PD. However, differences in methodology deserve comment.

The high prevalence of PD in Cantalejo is a phenomenon mainly restricted to men aged 80 years or more, but only 3, one diagnosed de novo, of 13 had severe dysfunction (H&Y III or IV). Scrutinising the characteristics of PD prevalence at ages 80 and over in other door-to-door studies,[1,8–19] we found that (1) a similar predominance of PD in elderly men was seen solely in Junín[19]; (2) the reported proportions of previously undiagnosed individuals were all lower, i.e., 6 of 16 (27%) in Sicilian municipalities,[11] 3 of 6 (50%) in Copiah County,[10] (and DW Anderson, personal communication), 12 of 51 (24%) in Junín[19]; and (3) the proportion of individuals aged 80 years or more with severe dysfunction was not reported. Taken together, these observations suggest that less than severe PD in elderly men might constitute a nonubiquitous subgroup present in Cantalejo or that a ubiquitous group was detected here owing to highly sensitive screening, selected diagnostic criteria, longer sex-, place-, and age-differential survival, or even differences in collaboration.

De Rijk and colleagues[3] verified empirically that methodological differences able to explain variations in overall prevalence of PD as assessed by door-to-door surveys could be traced to diagnostic criteria and individual responses to screening questions versus response delegated to one family member. Refusal or unavailability raised uncertainty with regard to prevalence results for elderly women. However, the impact of criteria frequently varied between surveys. Differences in application procedure, i.e., one family respondent versus individual response, might explain disparities with Copiah County, other than those attributable to refusals. The proportion of nonresponders in other studies, i.e., 0%,[8]

TABLE 3. *Natural history of PD and characteristics of prevalent PD categorised by diagnostic status before and after the survey*

Variable	When diagnosed		
	At prevalence date	Prior to prevalence date	During study
All cases			
Individuals	20	7	13
Age at prevalence date (yr): mean, median, and range	80, 81, 61–92	80, 84, 65–92	80, 81, 61–92
Age at clinical onset (yr): mean, median, and range	73, 76, 45–84	69, 72, 45–80	75, 76, 56–84
Disease duration (yr): mean, median, and range	7, 5, 1–21	11, 12, 2–21	5, 4, 1–16
Number in H & Y grades I, II, III, IV, V	5/6/6/3/0	0/1/4/2/0	5/5/2/1/0
M/F	11/9	2/5	9/4
M/F prevalences	(11/721)/(9/858)		
Prevalence ratio (Mantel-Haenszel) (95% CI)	2.12 (0.92–4.90)		
Crude ratio (95% CI)*	1.42 (0.59–3.51)		
Age ≥80 years			
Individuals	13	4	9
Age at prevalence date (yr): mean, median, and range	85, 84, 80–92	88, 88, 84–92	83, 81, 80–92
Age at clinical onset (yr): mean, median, and range	77, 78, 67–84	76, 78, 67–80	78, 78, 70–84
Disease duration (yr): mean, median, and range	8, 5, 1–21	13, 13, 4–21	6, 5, 1–16
Number in H & Y grades I, II, II, IV, V	2/4/4/3/0	0/0/2/2/0	2/4/2/1/0
M/F	7/6	1/3	6/3
M/F prevalences	(7/43)/(6/99)		
Prevalence ratio (95% CI*)	2.69 (0.96–7.52)		

PD, Parkinson's disease; H & Y, Hoehn and Yahr; CI, confidence interval.
*Taylor series 95% CI; Fisher exact 2-tailed *P* value 0.063.

2.8%,[20,21] 3.7%,[22] 5.4%,[13] 8%,[23] 12.8%,[2] and 15%,[10] were all lower than our 16.3%, calculated after excluding unscreened subjects who had nevertheless been examined neurologically. Of the 142 individuals aged 80 years or older in our study population, the proportions undergoing screening in Phase 1 or neurological examination in the safety sample were 40 of 43 (93%) of men and 87 of 99 (88%) of women, reflecting a slightly lower degree of participation among elderly women. Stringent criteria for PD, as seen from empirical data and for which medium prevalences were found (two of four symptoms, and 1 year of observation[3]) were fulfilled by all indi-

TABLE 4. *Prevalence per 1000 of parkinsonisms and PD in Cantalejo and selected summary items of natural disease history*[a]

	Population		Parkinsonism				Parkinson's disease					
			Cases		Prevalence		Cases		Prevalence		Mean (yr)	
Age (yr)	M	F	M	F	M	F	M	F	M	F	Age at onset	Duration
40–49	108	146	—	—	—	—	—	—	—	—	—	—
50–59	181	205	—	—	—	—	—	—	—	—	—	—
60–69	240	239	1	2	4.17	8.37	1 (1)[b]	2 (2)[b]	4.17	8.37	55	9
70–79	149	169	6	2	40.27	11.83	3 (2)[c] (2)[b]	1 (0)[c] (1)[b]	20.13	5.92	73	2
80–89	39	91	6	8	153.85	87.91	6 (4)[a] (5)[b]	5	153.85	54.95	76	7
90+	4	8	1	1	250	125.00	1	1	250.00	125.00	81	12
Age ≥40 yr												
Crude	721	858	14	13	19.42	15.15	11	9	15.26	10.49	73	7
Age-adjusted					13.13	7.36			10.78	5.23	71[d]	7[d]
Age ≥60 yr	432	507	14	13	35.28	19.77	11	9	28.98	14.13	71[d]	7[d]

[a]Prevalences calculated using criteria sets 1, 2, 3, 5, 6, or 8.
[b]Counts differing when using criteria set 7. At least two cardinal signs of the following four: resting tremor, bradykinesia, rigidity, and impaired postural reflexes. One or more of the first three signs must display asymmetry (de Rijk et al., 1997).
[c]Counts differing when using criteria set 4. At least three cardinal signs of the following four: resting tremor, bradykinesia, rigidity, and impaired postural reflexes (de Rijk et al., 1997).
[d]Mean of age-specific mean values.
PD, Parkinson's disease.

TABLE 5. *Reported prevalences of PD from door-to-door surveys compared with Cantalejo*

Place, yr	Study population			Prevalence × 10^3		Prevalence ratio[a]				Heterogeneity	
						Crude		MH estimator			
	Age (yr)	n	Cases	Crude	Adjusted[b]	Point	95% CI	Point	95% CI	χ^2	*P*
Copiah County (USA), 1978	≥40	8,925	31	3.47	3.80	0.27	0.16–0.48	0.30	0.17–0.53	5.315	0.070
Six Chinese towns, 1983	≥50	14,141	28	1.98	2.93	0.13	0.07–0.23	0.20	0.11–0.36	0.283	0.595
Kinmen (China), 1993	≥50	3,915	23	5.87	6.06	0.39	0.21–0.71	0.40	0.22–0.73	3.711	0.156
Sicilian municipalities (Italy), 1987	50–99	6,782	63	9.28	10.58	0.61	0.37–1.01	0.71	0.43–1.19	7.162	0.067
Gironde (France) 1988–1989	≥65	4,502	46	10.21	8.88	0.37	0.22–0.63	0.32	0.19–0.53	4.363	0.498
Italy (eight centres), 1992–1994	65–84	4,502	113	25.10	20.23	1.24	0.70–2.19	0.99	0.56–1.73	3.093	0.378
Rotterdam (The Netherlands) 1990–1993	≥65	4,397	91	20.69	19.34	0.75	0.46–1.22	0.70	0.43–1.12	5.468	0.362
Girona (Spain) 1990–1991	70–94	1,435	41	28.57	27.78	0.77	0.44–1.34	0.76	0.43–1.33	5.414	0.247
Pamplona (Spain), 1991	70–94	1,127	29	25.73	18.30	0.69	0.38–1.25	0.46	0.26–0.81	3.676	0.452
Junin (Argentina), 1991	≥40	7,765	51	6.57	10.52	0.59	0.35–0.98	0.72	0.42–1.21	4.769	0.092
Cantalejo (Spain), 1994	≥40	1,579	20	12.67	—	—	—	—	—	—	—
	≥50	1,325	20	15.10	—	—	—	—	—	—	—
	≥65	651	19	27.50	—	—	—	—	—	—	—
	≥70	460	17	36.96	—	—	—	—	—	—	—

PD, Parkinson's disease; MH, Mantel–Haenszel; CI, confidence interval.
[a]Using age-stratified analysis.
[b]Standardised to population from Cantalejo.

viduals diagnosed as having PD in Cantalejo. It would seem that the inclusion of a minimum 1-year disease duration in the diagnostic criteria reduced the difference in prevalence by sex in Junín.[19] Hence, collaboration, application procedures, and diagnostic criteria would not seem to explain the high, sex-differentiated prevalence of PD among the elderly in Cantalejo.

The sensitivity of our method was tested at Segovia Hospital using a series, which should, however, be considered inappropriate owing to high disease severity. When the method was applied by telephone to different series in Rochester, MN,[4] it proved sensitive to already diagnosed PD on the basis of two positive answers, yet most of our cases were undiagnosed. Differences in sensitivity of specific screening methods were never tested on populations comparable to our community sample. That all the above-mentioned surveys were conducted using screening tests aimed at detecting various major types of neurological disorder, such as the WHO method, modified[23] or not,[8,10,13,17] and other methods,[2,9,12,14,16,18,19] or examination by neurologists[14] may not constitute sufficient grounds for attributing the high prevalence in Cantalejo to the method, despite the low statistical power of the comparisons. However, the specific H&Y scale-related sensitivity of our method would suggest that, to detect the age-, sex-, and H&Y-related patterns of high prevalence, high sensitivity screening is required for method and application alike.

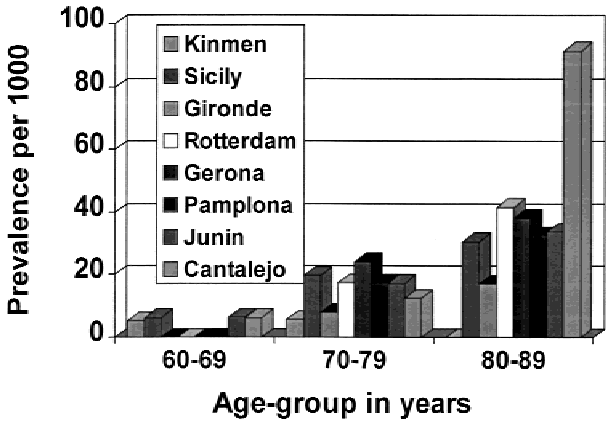

FIG. 3. Variation in age-specific prevalences of Parkinson's disease in door-to-door surveys worldwide.

Although higher survival in men than in women with PD is difficult to reconcile with the well-documented opposite pattern for the elderly population in general, it cannot be excluded as a cause of higher prevalence among men. In brief, we think that, rather than being due to measurement bias or differential survival, the prevalences reported here and corroborated only in Junín, might be due to a genuinely higher incidence or to selective migration of elderly women affected with PD. Given that the high prevalence is evident solely in elderly men, that this is unusual in other studies[24]; and that the contribution of high survival or migration cannot be evaluated, a speculative supplementary explanation is a birth cohort effect, consisting of a high incidence of PD among men born in 1903 to 1913, corresponding to those who took part in the Spanish Civil War (1936 to 1939) and/or to an occupational cohort exposed to agricultural chemicals.

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REFERENCES

1. de Rijk MC, Tzourio C, Breteler MM, et al. Prevalence of parkinsonism and Parkinson's disease in Europe: the EUROPARKINSON collaborative study. J Neurol Neurosurg Psychiatry 1997;62: 10–15.
2. Acosta-Varo J, de Pedro-Cuesta J. Prevalence survey of movement disorders, epilepsy, hypertension and smoking habit in Vejer de la Frontera, Southern Spain, I. Methodology. Parkinsonism Relat Disord 1996;2:195–203.
3. de Rijk MC, Rocca WA, Anderson DW, Melcon MO, Breteler MM, Maraganore DM. A population perspective on diagnostic criteria for Parkinson's disease. Neurology 1997;48:1277–1281.
4. Rocca WA, Maraganore DM, McDonnell SK, Schaid DJ. Validation of a telephone questionnaire for Parkinson's disease. J Clin Epidemiol 1998;51:517–523.
5. Hughes AJ, Ben-Shlomo Y, Daniel SE, Lees AJ. What features improved the accuracy of clinical diagnosis in Parkinson's disease. Neurology 1992;42:1142–1146.
6. Duarte J, Clavería LE, de Pedro-Cuesta J, Sempere AP, Coria F, Calne DB. Screening Parkinson's disease: a validated questionnaire of high specificity and sensitivity. Mov Disord 1995;11:643–649.
7. Sevillano MD, de Pedro-Cuesta J, Duarte J, Claveria LE. Validation of a method for population screening of parkinsonism. Mov Disord 2002;258–264.
8. Li SC, Schoenberg BS, Wang CC, Cheng XM, Rui DY, Bolis CL, Schoenberg DG. A prevalence survey of Parkinson's disease and other movement disorders in the People's Republic of China. Arch Neurol 1985;42:655–657.
9. Wang SJ, Fuh JL, Teng EL, et al. A door-to-door survey of Parkinson's Disease in a Chinese Population in Kinmen. Arch Neurol 1996;53:66–71.
10. Schoenberg BS, Anderson DW, Haerer AF. Prevalence of Parkinson's disease in the biracial population of Copiah County, Mississippi. Neurology 1985;35:841–845.
11. Morgante L, Rocca WA, Di Rosa AE, et al. Prevalence of Parkinson's disease and other types of parkinsonism: a door-to-door survey in three Sicilian municipalities. Neurology 1992;42:1901–1907.
12. de Rijk MC, Breteler MM, Graveland GA, Ott A, Grobbee DE, van der Meche FG, Hofman A. Prevalence of Parkinson's disease in the elderly: the Rotterdam Study. Neurology 1995;45:2143–2146.
13. Bharucha NE, Bharucha EP, Bharucha AE, Bhise AV, Schoenberg BS. Prevalence of Parkinson's disease in the Parsi community of Bombay, India. Arch Neurol 1988;45:1321–1323.
14. Tison F, Dartigues JF, Dubes L, Zuber M, Alperovith A, Henry P. Prevalence of Parkinson's disease in the elderly: a population study in Gironde, France. Acta Neurol Scand 1994;90:111–115.
15. Acosta J, Calderón E, Obeso JA. Prevalence of Parkinson's disease and essential tremor in a village of South Spain. Neurology 1989;(Suppl. 1):181.
16. López-Pousa S. Prevalencia de la enfermedad de Parkinson. Neurología 1993;8:328.
17. Gutiérrez del Olmo C, Schoenberg BS, Portera-Sánchez A. Prevalence of neurological diseases in Madrid, Spain. Neuroepidemiology 1989;8:43–47.
18. Manubens JM, Martínez-Lage JM, Lacruz F, et al. Prevalencia de la enfermedad de Parkinson y otros tipos de parkinsonismo en el anciano. Datos del estudio Pamplona. Neurología 1993;8:399.
19. Melcon MO, Anderson DW, Vergara RH, Rocca WA. Prevalence of Parkinson's disease in Junín, Buenos Aires province, Argentina. Mov Disord 1977;12:197–205.
20. Anderson DW, Rocca WA, de Rijk MC, Grigoletto F, Melcon MO, Breteler MM, Maraganore DM. Case ascertainment uncertainties in prevalence surveys of Parkinson's disease. Mov Disord 1998; 13:626–632.
21. Anderson DW, Schoenberg BS, Haerer AF. Racial differentials in the prevalence of major neurological disorders. Background and methods of the Copiah Study. Neuroepidemiology 1982;1:17–30.
22. Anderson DW, Melcon MO, Vergara RH. Methods for a prevalence survey of neurological disorders in Junín, Buenos Aires, Argentina. Neuroepidemiology 1995;14:110–122.
23. Meneghini F, Rocca WA, Grigoletto F, Morgante L, Reggio A, Savettieri G, Di Perri R, Anderson DW. Door-to-door prevalence survey of neurological diseases in Sicilian population. Background and methods. Neuroepidemiology 1991;10:70– 85.
24. Sevillano MD, Cuadrado JI, de Pedro-Cuesta J. Enfermedad de Parkinson en España: evidencias de infradiagnóstico y puntos de partida para su reducción. Rev Neurol 1999;29:881–883.