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Screening Parkinson's Disease: A Validated Questionnaire of High Specificity and Sensitivity

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Summary: A questionnaire designed to screen Parkinson's disease (PD) in literate populations has been developed. It consists of nine questions, self-administered at medical facilities or by mail, and a scale of weights for ascribing scores to specific questions when the answer is positive. The questions were chosen to be symptom specific for PD and the weights were determined from answers provided by 37 PD patients in a neurological outpatient clinic. The questionnaire sensitivity was tested on a different PD population from the same outpatient clinic—50 individuals—and the specificity on a group of 100 ophthalmological patients. The sensitivity was 100% and the specificity was 100%. Three individuals who screened positive among the 100 ophthalmological patients were assessed and given a new diagnosis of PD. This questionnaire therefore constitutes an instrument that should prove valuable as the first stage of a door-to-door survey. It has high sensitivity and specificity. **Key Words:** Parkinson's disease—Screening—Questionnaire—Sensitivity—Specificity.

Genetic and environmental factors are both implicated in the etiology of PD (1,2). However, we have only limited knowledge about age-specific incidence and prevalence in defined populations, yet this information is crucial for identification of etiological determinants (3). Several factors distort the value of epidemiological data that are currently available. Surveys based on registered diagnoses are incomplete (4,5). Studies have been undertaken on door-to-door surveys, but many involve small numbers, often limited to certain age groups, conducted in urban populations (5). Door-to-door surveys by clinicians solve the problem of accurate case ascertainment (4,6), but the implementation of such studies in rural or geographically isolated regions is difficult. New research methods are needed, particularly in circumstances where the distribution of several variables reported to be associated with PD present a rural–urban gradient (7). To summarize, there is a need to develop a sensitive, specific, and economic door-to-door technique to study PD.

Mutch et al. have formulated a simple questionnaire for use in primary care facilities (8). Because sensitivity of grouped items for screening PD is higher for questions than for tasks (4), it should be possible to create mail questionnaires capable of performing efficiently in literate populations. We present here the results of a study designed to develop and validate a screening, self-administered questionnaire for early detection of PD in specific settings.

METHODS

The Questionnaire

The questionnaire is taken from Tanner et al. (9); it consists of nine questions, self-administered by

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A

SCREENING QUESTIONNAIRE

We are trying to evaluate the usefulness of this questionnaire. We would like you to help us by answering the following questions. If you do not wish to answer these questions, your care will not be affected in any way. All information will be confidential. THANK YOU.

Please answer the following questions by circling the correct response:

1.- Do you have trouble arising from a chair?
YES NO UNCERTAIN
2.- Is your hand writing smaller than it once was?
YES NO UNCERTAIN
3.- Do people tell you that your voice is softer than it once was?
YES NO UNCERTAIN
4.- Is your balance, when walking, poor?
YES NO UNCERTAIN
5.- Do your feet suddenly seem to freeze in door-ways?
YES NO UNCERTAIN
6.- Does your face seem less expressive than it used to?
YES NO UNCERTAIN
7.- Do your arms and legs shake?
YES NO UNCERTAIN
8.- Do you have trouble buttoning buttons?
YES NO UNCERTAIN
9.- Do you shuffle your feet and take tiny steps when you walk?
YES NO UNCERTAIN

TO BE COMPLETED BY PHYSICIAN

Name:_____
Age:_____
Neurologic Diagnosis (if known):_____

B

Cuestionario de Prospección

Estamos intentando evaluar la utilidad de este cuestionario. Quisieramos que nos ayudara contestando a las siguientes preguntas. Si no quiere contestarlas, ello no supone bajo ningún concepto un detrimento para su salud. Toda la información es confidencial. MUCHAS GRACIAS.

Por favor conteste a las siguientes preguntas, haciendo un circulo en la respuesta adecuada:

1.- ¿Tiene Ud. problemas para levantarse de una silla?
Sí No No sabe
2.- ¿Ha notado sí su escritura se ha hecho más pequeña que antes?
Sí No No sabe
3.- ¿Le han comentado sobre sí el volumen de su voz es menos potente que antes?
Sí No No sabe
4.- ¿Ha notado que su equilibrio está alterado?
Sí No No sabe
5.- ¿Ha notado que los pies se le quedan pegados al suelo al cruzar el umbral de las puertas?
Sí No No sabe
6.- ¿Le parece que su cara es ahora menos expresiva?
Sí No No sabe
7.- ¿Le tiemblan los brazos y piernas?
Sí No No sabe
8.- ¿Tiene dificultad para abrocharse los botones?
Sí No No sabe
9.- ¿Arrastra los pies y da pasitos cortos al andar?
Sí No No sabe

PARA SER CUMPLIMENTADO POR EL MEDICO

Nombre:_____
Edad:_____
Diagnóstico neurológico (Sí es conocido):_____
Fecha de la encuesta:_____

FIG. 1. A: English version of the screening questionnaire. B: Spanish version of the screening questionnaire.

the general population (Fig. 1A). We adapted this, giving particular attention to wording (a) for local idiomatic expressions in Spanish and (b) for graphic structure; the size of letters was 3 mm because elderly individuals with diminished visual function might have particular difficulty with standard print size. The Spanish version of the questionnaire is shown in Fig. 1B.

A major problem in screening PD is the frequency of false-positive results, often deriving from individuals with tremor of other causes, in particular essential tremor. We therefore weighted the questions in favor of other parkinsonian deficits, in an attempt to improve specificity.

The Patients

Segovia is a Spanish province with 151,494 inhabitants located close to Madrid in the center of the Iberian Peninsula. The General Hospital is the only existing one in the province and is located in the capital, Segovia City, which has 54,754 inhabitants. The Neurological Outpatient Clinic is the central and only referral facility available for neurological patients. Ninety-eight percent of the population in the province is covered by the public health care system. Some characteristics of the population are provided in Table 1.

The questionnaire was administered to 128 patients attending the Movement Disorders Polyclinic at the Neurological Department of the General Hospital, Segovia. The diagnoses fell into three groups: idiopathic parkinsonism (PD), 37; essential tremor (ET), 32; and other diagnoses after excluding other parkinsonisms, 59. All of these patients received the questionnaire before consultation with a neurologist (J.D.) and they were asked to complete the form while waiting to be seen. The neurologist did not have any information from their clinical records. The diagnoses of new patients were determined before analysis of the answers to the questionnaire. All patients diagnosed as PD fulfilled the

TABLE 1. *Characteristics of the population of Segovia*

	Males	Females	Total
City	26,377	28,377	54,754
Rest of province	49,149	47,591	96,740
Total	75,526	75,968	151,494

TABLE 2. *Proportion of individuals from different diagnostic groups giving a positive answer to questions*

Question No. (Fig. 1)	PD patients		Essential tremor		Other diagnoses		Ratios of percentages		
	No. cases	%	No. cases	%	No. cases	%	PD/ET	PD/OD	Mean value
1	22	59.0	6	17.1	24	40.6	3.45	1.45	2.45
2	24	64.8	11	31.4	11	19.4	2.06	3.34	2.70
3	29	78.3	5	14.2	15	25.4	5.51	3.08	4.29
4	31	83.7	15	42.8	33	55.9	1.95	1.49	1.72
5	19	51.3	7	20.0	6	10.1	2.56	5.07	3.81
6	22	59.0	11	31.4	15	25.4	1.87	2.32	2.09
7	33	89.1	32	91.4	29	49.1	0.97	1.81	1.39
8	27	72.9	11	31.4	12	20.3	2.32	3.59	2.95
9	27	72.9	6	17.1	15	25.4	4.26	2.87	3.56
	36	100	32	100	59	100			

PD, idiopathic Parkinson's disease; ET, essential tremor; OD, other diagnoses excluding other parkinsonisms.

criteria of Marttila and Rinne (10). The PD patients had a mean age of 66.3 years, range 30–89 years; the male/female ratio was 21/16 and 52% were assigned a stage of III or IV on the Hoehn and Yahr (H–Y) scale. The sensitivity and specificity of the instrument, when used in this population, were evaluated. Different procedures were tested for weighting specific questions, to optimize sensitivity for PD.

The sensitivity of the refined instrument was verified with a new group of 50 PD patients. This group had a mean age of 66.5 years, range 30–89 years. The male/female ratio was 23/17 and 50% were at H–Y stage III or IV. A telephone call (where possible) and a new mailing questionnaire were employed to make contact with the patients whose responses were not received 1 month after the first mailing date. A further period of 2 weeks was allowed for a subsequent response.

The specificity of the instrument was ascertained in a population of 100 unselected patients attending the ophthalmology outpatient clinic at the same hospital. The questionnaire was given in the waiting room. All 100 ophthalmological patients were offered a short interview and examination at the neurological department by a neurologist who was not aware of the results of the screening test. The neurologist employed the North Western Disability scale and the Webster scale for identification of symptoms and signs of parkinsonism. All patients who accepted the questionnaire agreed to undergo the neurological interview and examination.

RESULTS

The results for the three diagnostic groups used for development of the screening instrument are presented in Table 2. The smoothed curves for distribution of scores by patients with PD and others (pooled ET and other diagnoses) intersected at a score of 4.4, which corresponded to a sensitivity of 92% and specificity of 95% (Fig. 2). These values

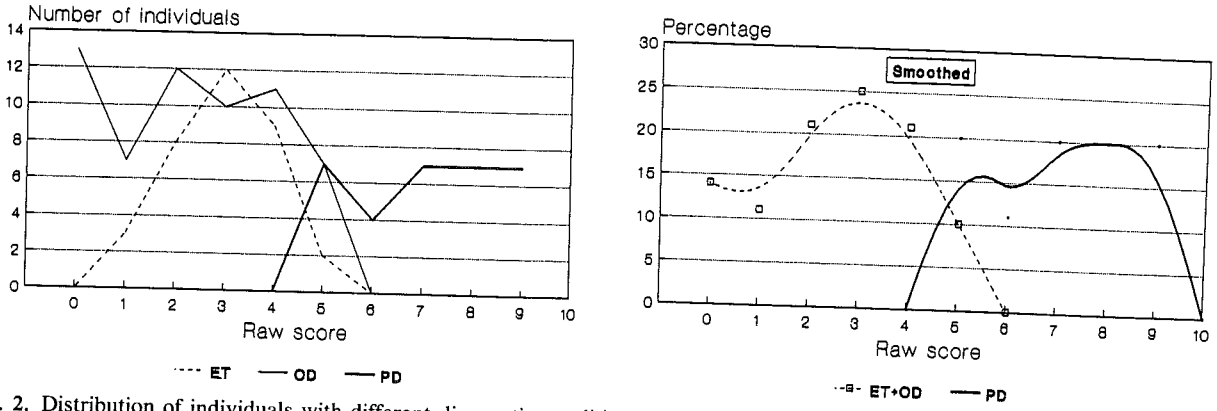

FIG. 2. Distribution of individuals with different diagnostic conditions by results of screening test. ET, essential tremor; OD, other diagnoses excluding other parkinsonisms; PD, idiopathic Parkinson's disease.

TABLE 3. *Weighting procedure for specific questions*

Basis for assignment of weights		Weights used for each question	
Percentage PD patients answered positive	Proposed weighting scores	Question no. (Fig. 1)	Ascribed score
<10	1	1	6
10–20	2	2	7
20–30	3	3	8
30–40	4	4	9
40–50	5	5	6
50–60	6	6	6
60–70	7	7	9
70–80	8	8	8
>80	9	9	8

PD, idiopathic Parkinson's disease.

were considered to be inappropriate for efficient PD screening and so certain questions that seemed to discriminate PD better than others were selected for a weighting procedure.

We therefore calculated the proportion of PD patients screening positive for each question. The highest proportions of positive screening answers were found for questions 3, 7, 8, and 9 in Fig. 1. These nine questions were ranked and given weights of decreasing value from 9 to 0 as indicated in Table 4, disregarding their PD-specific discriminating power.

Acceptance by PD Diagnosed Population

The cumulative response proportion for the first and second mailing to the 50 PD patients was 80 and 88%. Ten of 50 PD patients never answered the first questionnaire or their answers were lost. Four of these 10 patients were located by telephone. The remaining six nonresponders were not located and death could not be excluded. The proportion of PD responders, listed in Table 4, changed across H–Y degree of dysfunction, sex, and age. Patients with a higher degree of dysfunction responded less than patients with lower levels. As indicated in Table 4, the proportion of positive responders for each question also varied. This ranking order-pattern may differ from that seen in Table 2 for PD patients used for elaboration of the questionnaire.

Sensitivity

All of the responding PD patients (40 of 40) attained a score of 42 or more.

Specificity

The presence of clinical parkinsonism was ruled out in 97 of 100 ophthalmological patients. At the consultation, three individuals were "newly" diag-

TABLE 4. *Response to mail questionnaire of 50 PD diagnosed patients*

All patients			Specific groups			
Question (Fig. 1)	Proportion giving positive answer		Hoehn and Yahr group	Gender	No.	Responders
	No. cases	%				
1	24/40	60.0	I	—	2	2
2	27/40	67.5	II	—	10	9
3	28/40	70.0	III	—	24	20
4	33/40	82.5	IV	—	14	9
5	27/40	67.5	V	—	0	0
6	23/40	57.5				
7	36/40	90.0		Males	29	23
8	32/40	80.0		Females	21	17
9	38/40	95.0				

PD, idiopathic Parkinson's disease.

TABLE 5. *Characteristics of the ophthalmological patients who were newly diagnosed with Parkinson's disease*

Patient	A = 44 points	B = 47 points	C = 54 points
Age	70	59	84
Sex	F	F	M
Hoehn–Yahr	II	II	II
Webster	5 points	6 points	8 points
Question			
1	Yes	Yes	Yes
2	No	Yes	No
3	No	Yes	Yes
4	Yes	Yes	Yes
5	Yes	No	Yes
6	Yes	No	No
7	Yes	Yes	Yes
8	No	No	Yes
9	Yes	Yes	Yes

nosed as having PD; they scored high on the Webster and North Western scales. The results of the neurological evaluation and the screening procedures of these three ophthalmological patients are presented in Table 5. They all responded to L-Dopa. Subsequently, 100% specificity and sensitivity was achieved with the cutoff point of 42 on the weighted assessment.

The sensitivity and specificity of the weighted questionnaire were higher than the corresponding values for the unweighted instrument (Fig. 3 and Table 6).

DISCUSSION

The results of this study suggest that a self-administered questionnaire is an appropriate instrument with which to identify PD in a literate population. Such a questionnaire should be capable of reducing a considerable proportion of the lay interviewers' work in a door-to-door survey, particularly in rural regions.

The questionnaire has high sensitivity and specificity. Both features are of major importance in exploring prevalence. Low sensitivity would result in values below the correct rates, whereas low specificity would generate false positives.

The validity of screening instruments is determined by the similarity of the test populations to the populations to be screened. The ophthalmological patients may, for various reasons, screen positive in a higher proportion than the general population of similar age and sex. Restricted visual acuity may reduce performance in test situations for motor function. Reported specificity of screening instruments for PD has varied from 78% in the study by Gutierrez et al. (11) to 92% in that by Mutch et al. (8), and 96% in that by Meneghini et al. (4). Our results, in an ophthalmological population, are therefore very encouraging (Table 7).

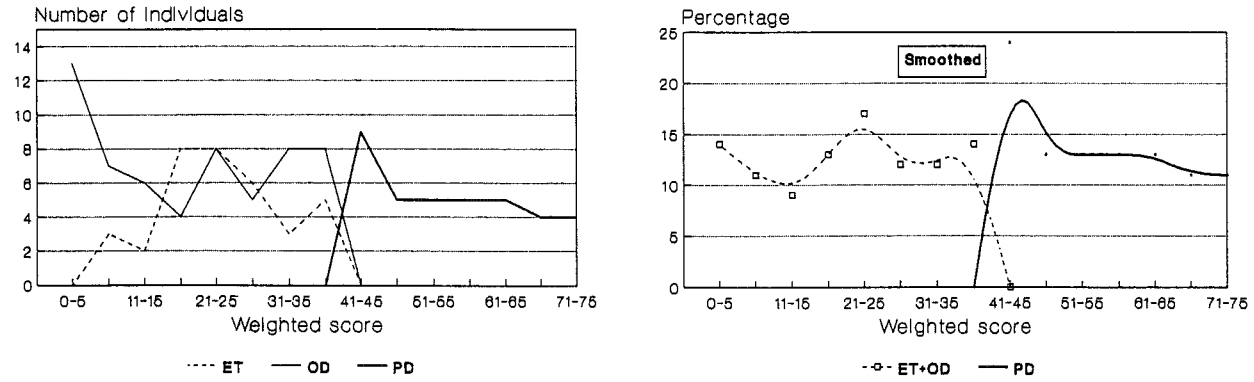

FIG. 3. Distribution of individuals with different diagnostic conditions by weighted scores. ET, essential tremor; OD, other diagnoses excluding other parkinsonisms; PD, idiopathic Parkinson's disease.

TABLE 6. *Variation of sensitivity and specificity as a result of weighting procedure*

Sensitivity (% screened—among PD)		Specificity (% screened—among ET or OD)	
Not weighted (cutoff 4.4 points)	Weighted (cutoff 42 points)	Not weighted (cutoff 4.4 points)	Weighted (cutoff 42 points)
92	100	95	100

PD, idiopathic Parkinson's disease; ET, essential tremor; OD, other diagnosis excluding other parkinsonisms.

Sensitivity is influenced by the selection of PD patients in the test population. The PD population of a hospital clinic may differ from the community-based group of individuals with PD in several respects—male sex, lower age, and a higher level of dysfunction have been claimed to be overrepresented in patients seen by specialists (12). When compared with an Aberdeen population (13), our set of PD patients presented (a) a higher 29/21 male/female ratio; (b) a lower proportion of mild H–Y stage I and II cases; and (c) absence of cases with clear signs of intellectual deterioration. Therefore, an artificially high sensitivity might be expected from our hospital-based material and from reports for other screening tests validated in a similar way (11,14,15).

Failure to respond may occur more frequently in subjects with PD—a possible confounding factor. In addition, the possible existence of false negatives—for example, among individuals with low dysfunction or cognitive impairment—constitutes a potential difficulty. Furthermore, we must admit that no screening procedure of this type can discriminate in the first instance between parkinsonism and PD. Our instrument should, therefore, only be used in conjunction with door-to-door interviews and examinations. These limitations are similar to those for other comparable questionnaires, such as the World Health Organization or SNES batteries (4,6).

The cost of door-to-door surveys for PD is determined by multiple factors. The geographical concentration of the population establishes travel expenses. Therefore, screening of PD in Europe has been limited, in general, to semirural populations of 6,000–12,000 or portions of urban populations (5). Other factors contributing to the cost are the number of false positives to be excluded by examination by a specialist, and the time needed to perform visits to minimize dropouts. Because the cost of mailing or passing the questionnaire to primary care facilities is lower than the visits and the proportion of false positives was nil among the ophthalmological patients, use of the mailed questionnaire or its administration at primary care facilities should also reduce expenses. Such strategies might improve cooperation with to door-to-door examiners in large cities (F. Bermejo, unpublished observations). Kurtzke has stressed limitations due to the low size of populations screened for PD (16). Screening of pure rural or geographically isolated populations has been proposed as a scientific priority in PD (17).

TABLE 7. *Structure and validity of different instruments used to screen idiopathic Parkinson's disease (PD)*

Test/first author	No. of disorders	No. of question	No. of tasks tested	%[a]		No. of[a]	
				SS	SP	True +	True −
WHO							
Gutierrez	6	15	7	93	78	NR	NR
Osuntokun	4	15	7	95	80	NR	NR
Bharucha	8	17	—	100	89	NR	NR
Tekle Haimanot	10	12	—	91	85	NR	NR
Mutch	1	6	—	90[b]	90[b]	35[b]	87[b]
SNES	5	11	7	100[b]	96[b]	21[b]	21[b]
Duarte	1	9	—	100[b]	100[b]	50[b]	100[b]

WHO, World Health Organization; SNES, Sicilian Neuro-Epidemiologic Study.
[a] For pooled, different neurological disorders if not specifically indicated.
[b] For PD.

The instrument described here may help to attain this priority.

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REFERENCES

1. Smith CAD, Cough AC, Leigh PN, et al. Debrisoquine hydroxylase gene polymorphism and susceptibility to Parkinson's disease. *Lancet* 1992;339:1375–1377.
2. Tanner CM, Chen B, Wang WZ. Environmental factors in the etiology of Parkinson's disease: a case-control study in China. *Neurology* 1989;39:660–664.
3. De Pedro-Cuesta J, Stawiaz L. Evaluation of how age modifies the risk for Parkinson's disease, based on stratified comparisons of descriptive data. *Acta Neurol Scand* 1991; 84:295–302.
4. Meneghini F, Rocca WA, Anderson DW, Grigoletto F, Morgante L, et al. Validating screening instruments for neuroepidemiologic surveys: experience in Sicily. *J Clin Epidemiol* 1992;45:319–331.
5. De Pedro-Cuesta J. Parkinson's disease occurrence in Europe. *Acta Neurol Scand* 1991;84:357–365.
6. Schoenberg BS, Anderson DW, Haerer AF. Prevalence of Parkinson's disease in the biracial population of Copiah County, Mississippi. *Neurology* 1985;35:841–845.
7. De Pedro-Cuesta J. Studies on the prevalence of paralysis agitans by tracer methodology. *Acta Neurol Scand* 1987;75 (suppl 112):6–106.
8. Mutch WJ, Smith WC, Scott RF. A screening and alerting questionnaire for parkinsonism. *Neuroepidemiology* 1991; 10:150–156.
9. Tanner CM, Gilley DW, Goetz CG. A brief screening questionnaire for parkinsonism [Abstract]. *Ann Neurology* 1990; 28:267–268.
10. Marttila RJ, Rinne UK. Epidemiology of Parkinson's disease in Finland. *Acta Neurol Scand* 1976;53:81–102.
11. Gutierrez MC, Schoenberg BS, Portera A. Prevalence of neurological diseases in Madrid, Spain. *Neuroepidemiology* 1989;8:43–47.
12. Kessler II. Epidemiologic studies of Parkinson's disease. III. A community-based survey. *Am J Epidemiol* 1972;96: 242–254.
13. Mutch WJ, Dyngwall-Forduce I, Downie AW, Paterson G, Roy SK. Parkinson's disease in a Scottish city. *Br Med J* 1986;292:534–536.
14. Kessler II. Epidemiologic studies of Parkinson's disease. II. A hospital-based survey. *Am J Epidemiol* 1972;95:308–318.
15. Hughes AJ, Daniel SE, Kilford L, Lees AJ. The accuracy of the clinical diagnosis of Parkinson's disease: a clinicopathological study of 100 cases. *J Neurol Neurosurg Psychiatry* 1992;55:181–184.
16. Kurtzke JF, Murphy FM. The changing patterns of death rates in parkinsonism. *Neurology* 1990;40:42–49.
17. De Pedro-Cuesta J. Risk factors of Parkinson's disease. In: Vuylsteek K, Hallen M, eds. *Epidemiology: fourth medical and health research programme*. Amsterdam: IOS Press, 1994:182–211.