Movement Disorders
CLINICAL PRACTICE
RESEARCH ARTICLE

Validation of the Parkinson's Disease-Cognitive Rating Scale Applying the Movement Disorder Society Task Force Criteria for Dementia Associated with Parkinson's Disease

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Abstract: **Background:** The authors studied the measurement properties of the Parkinson's Disease-Cognitive Rating Scale (PD-CRS) compared with Movement Disorders Society Task Force (MDS-TF) criteria for the diagnosis of dementia in patients with Parkinson's disease.

Methods: The sample consisted of 223 patients who were diagnosed in accordance with the United Kingdom Parkinson's Disease Society Brain Bank who were assessed with both the MDS-TF and the PD-CRS criteria (in addition to other instruments) without the assessors' knowledge of previous results. Internal consistency was studied (homogeneity of the items and Guttmann's λ values were obtained) in addition to convergent, divergent, and discriminative validity. The receiver operating characteristic curve was obtained, and the cutoff point at which the PD-CRS had the greatest efficiency was analyzed.

Results: The internal consistency was shown to be adequate, with a λ value of 0.821. A floor effect was observed in 4 of the items (Sustained Attention, Working Memory, Immediate Verbal Memory, and Alternating Verbal Fluency), and 1 item showed a ceiling effect (Clock Copying). The scale adequately discriminated patients with and without dementia (Kruskal-Wallis; $P \leq 0.000$). The area under the curve was 0.899. With a cutoff score of 62 (from a possible score of 134), the scale achieved 94% sensitivity and 99% specificity.

Conclusions: The PD-CRS has adequate measurement properties and is a valid tool for studying the presence of dementia in patients with Parkinson's disease.

Parkinson's disease (PD) is a degenerative disorder of the central nervous system that causes motor and nonmotor symptomatology; the latter includes cognitive deterioration and dementia in up to 40% of cases. Both PD and associated dementia are independent predictors of an elevated risk of mortality in older adults.[1,2]

The Parkinson's Disease Cognitive Rating Scale (PD-CRS)[3] is a scale used to evaluate cognitive deterioration in patients with PD. Its original validation study demonstrated a sensitivity and specificity of 94% and good internal consistency (Cronbach's $\alpha = 0.85$). It has been externally validated by investigators other than its authors, demonstrating adequate measurement properties[4,5]; and, recently,[6] it was stated that the PD-CRS is 1 of the tools designed for evaluating cognitive disorder in patients with PD.

The Movement Disorders Society Task Force (MDS-TF), has established diagnostic criteria for dementia in PD[7] and has developed a method for using this tool.[8] The objective of this

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study was to evaluate the measurement properties of the PD-CRS compared with the dementia criteria of the MDS-TF.

Patients and Methods

Patients

A representative sample of 223 consecutive, ambulatory patients were chosen who were diagnosed with PD in accordance with the United Kingdom Parkinson's Disease Society Brain Bank criteria.[9] All patients were regularly followed at the Abnormal Movement Unit of the Neurology Service at the Carlos Andrade Marin Hospital in Quito, Ecuador.

The number of patients who refused to participate was not registered, but it was a very small amount. In a previous study using the MDS-TF criteria, the prevalence of dementia in Parkinson's patients[10] was 36.5%. The present study was carried out over 18 months. Exclusion criteria included patients with any serious, acute, concomitant illness; amputated extremity; or sensory deficiencies (significant visual or auditory impairment).

Ethical Aspects

This study was approved by the Head of Teaching and Research at the Carlos Andrade Marin Hospital. All participants provided written informed consent.

Evaluations

Relevant demographic and clinical data were obtained for all participating patients and included age, sex, years of illness, years on levodopa (L-dopa), and years of education.

All patients were evaluated using the following measures: (1) the Short Parkinson's Evaluation Scale (SPES)/Scales for Outcomes in Parkinson's Disease (SCOPA) (SPES-Scopa),[11] (2) categorization according to Hoehn & Yahr (H&Y) stage,[12] (3) the Schwab & England (S&E) measure of daily life activities,[13] and (4) the Clinical Impression of Severity Index for Parkinson's Disease (CISI-PD).[14] In addition, all patients were evaluated first using the MDS-TF criteria,[3,4] which include the Mini-Mental Status Examination (MMSE), by 1 of the researchers.[15]

Later, another researcher evaluated the patient in a different room without knowing the previous results, using the following measures: (1) the PD-CRS[5] (possibly with the assistance of the person accompanying the patient), (2) the Hospital Anxiety and Depression Scale (HADS),[16] (3) the Parkinson's Impact Scale (PIMS),[17] (4) the Scales for Outcomes in Parkinson's Disease (SCOPA) (SCOPA-Psychosocial),[18] and (5) the modified Parkinson's Psychosis Rating Scale (PPRS).[19]

All patients were evaluated at the time of best functionality (*on* state). The patients were asked to return 7 days later for the test-retest (performed by the researcher who evaluated the patient at the first assessment) of the PD-CRS.

The PD-CRS[5] is a specific neuropsychological battery for evaluating cognitive deterioration in patients with PD. It consists of 9 tests or items: (1) Immediate Verbal Memory (free recall; score range, 0–12), (2) Confrontation Naming (score range, 0–20), (3) Sustained Attention (score range, 0–10), (4) Working Memory (score range, 0–10), (5) Spontaneous Clock Drawing (score range, 0–10), (6) Clock Copying (score range, 0–10), (7) Delayed Verbal Memory (free recall; score range, 0–12), (8) Alternating Verbal Fluency (score range, 0–20), and (9) Action Verbal Fluency (score range, 0–30).

It has a total score of 134 (best score). The sum of the scores for test items 1, 3, 4, 5, 7, 8, and 9 is the *subcortical score*, and the sum of scores for items 2 and 6 is the *cortical score*. The maximum subcortical and cortical scores are 104 and 30 points, respectively.

Semantic Equivalence

The PD-CRS was developed in Castilian Spanish (as spoken in Spain). Prior to this validation, a pilot study was performed with 50 patients to check semantic equivalence. Consequently, the word "taburete" was replaced with "banco" (different words used for "stool"), the word "bombillo" was replaced with "foco" (different words used for "light bulb"), the word "cereza" was replaced with "capuli" (different words used for a small red fruit), and the word "cerrojo" was replaced with "aldaba" (different words used for the "door lock").

Patients were diagnosed as demented based on the MDS-TF[3,4] criteria at levels I and II.

Statistical Analysis

Validation of the PD-CRS

Data Quality and Acceptability. (1) Missing data must not exceed 5%; (2) computable data must be greater than 95%; (3) the mean-median difference must be ≤ 10% of the maximum score; and (4) the floor and ceiling effects must not exceed 15%.[20]

Reliability. (1) Internal consistency: The homogeneity index of the items must be ≥ 0.3.[21] (2) Reliability: An adequate reliability coefficient was obtained using the suggestions of Feldt and Charter[22] and Helms et al.[23]

As an extension of reliability, we obtained the standard error of measurement (SEM) (SEM = SD × $\sqrt{1}$ − reliability coefficient), where SD indicates decision time. The SEM was compared with 0.5 of the standard deviation. It was accepted that it must be less, which yielded a precision ≥ 75%.[24]

Stability. The test-retest correlation was analyzed using the intraclass correlation coefficient (ICC) for absolute correspondence (2-way, for randomization purposes).

Validity. Validity was evaluated using: (1) convergent validity,[25] (2) discriminant validity,[26] and (3) known-group validity.[27] For this study, we used the H&Y stage as a segmentation variable. For statistical analysis using the Kruskal-Wallis test, P values ≤ 0.05 were accepted as significant.

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Other Analyses

The sample was also segmented according to age (into 2 categories: ≤ 65 years and ≥ 66 years), by education (into 2 categories: ≤ 9 years and ≥ 10 years), and by time with the illness (into 2 categories: ≤ 8 years and ≥ 9 years). Either the Mann-Whitney *U* test or a *t* test was performed, depending on whether the variables had a normal distribution. *P* values ≤ 0.05 were accepted as significant.

A receiver operating characteristic curve was obtained to observe the area under the curve.[28] This was performed using the MDS-TF dementia criteria,[3] and the sample was divided into those with and without dementia. The PD-CRS cutoff score was the point that had the best properties of sensitivity, specificity, and maximum verisimilitude indicators.

Finally, the patients who had PD without dementia were compared with those who had PD with dementia (PDD). Either the Mann-Whitney *U* test or the *t* test was used, depending on whether the variables had a normal distribution (Kolmogorov-Smirnov test). In either case, *P* values ≤ 0.05 were accepted as significant.

Results

Seventy percent of the sample was made up of men (156 participants). The distribution of the total number of patients was as follows: 11 patients had in H&Y stage I disease; 49 had stage II disease; 139 (62.33%) had stage III disease; and 24 had stage IV disease.

The patients had the following average values: age, 69.4 years; disease duration, 7.7 years; and dosage of L-dopa, 716.96 mg/daily. The average scores on the PD-CRS were as follows: subcortical, 51.5; cortical, 24.4; and total, 76. Most variables did not show a normal distribution, with the following exceptions: age; section 1 of the SPES-Scopa and total SPES-Scopa scores; the PIMS; and the subcortical, cortical, and total scores on the PD-CRS (see Table 1).

Fifty-three patients (23.7%) were categorized with dementia in accordance with MDS-TF criteria.[3] The mean time for evaluation with the PD-CRS was 19.72 minutes (range, 13.89–22.67 minutes). The test-retest was performed with a mean difference of 6.71 days (range, 5.32–9.54 days).

Data Quality and Acceptability

There were no missing data, and 100% of the data were analyzed. The mean-median difference surpassed the standard of ≤ 10% of the maximum score, except for the items Sustained Attention and Clock Copying. A floor effect was noted in the items Sustained Attention, Working Memory, Immediate Verbal Memory, and Alternating Verbal Fluency. A ceiling effect was noted in the item Clock Copying (see Table 2).

Reliability

Internal Consistency. The homogeneity index of the items was greater than the standard of ≥ 0.3. The reliability index

TABLE 1 Demographic and clinical characteristics of the sample

Characteristic	Median	Mean ± SD	95% CI (Mean)	Skewness	Kurtosis	CV
Age, y	71	69.4 ± 9.9	68.0–70.7	−0.5	0.2	0.1
Education, y	8.0	9.2 ± 4.7	8.6–9.8	0.6	−0.5	0.5
Disease duration, y	7.0	7.7 ± 5.4	6.9–8.4	1.5	3.3	0.7
Levodopa						
Treatment duration, y	5.0	6.0 ± 4.6	5.4–6.6	0.9	0.4	0.7
Dose, mg/d	750.0	716.9 ± 306.7	676.4–757.4	−0.1	0.2	0.4
SPES-Scopa						
Section 1	18.0	18.0 ± 5.5	17.3–18.7	0.2	−0.5	0.3
Section 2	8.0	9.2 ± 3.5	8.7–9.7	0.8	1.1	0.3
Section 3	4.0	3.6 ± 2.9	3.2–4.0	0.5	−0.4	0.8
Total	31	30.8 ± 10.9	29.4–32.2	0.5	−0.1	0.3
Schwab & England	70.0	69.3 ± 15.0	67.3–71.3	−1.1	1.3	0.2
MMSE	25.0	23.4 ± 4.9	22.7–24.0	−1.9	5.2	0.2
HADS						
Anxiety	6.0	7.3 ± 3.4	6.9–7.8	0.6	−0.1	0.4
Depression	7.0	6.8 ± 3.7	6.3–7.3	0.4	−0.5	0.5
PIMS	19.0	19.8 ± 9.4	18.5–21.0	0.1	−0.6	0.4
SCOPA-Psychosocial	9	10.2 ± 5.9	9.5–11.0	0.6	−0.4	0.5
PPRS	1.0	1.5 ± 1.5	1.3–1.7	1.3	1.7	0.9
CISI	11.0	11.3 ± 4.4	10.8–11.9	0.6	0.5	0.3
PD-CRS						
Subcortical	51.6	51.5 ± 16.3	48.6–54.5	−0.4	0.2	0.3
Cortical	24.4	24.4 ± 4.2	23.9–25.0	−0.4	−0.1	0.1
Total	76.0	76.0 ± 19.3	72.5–79.5	−0.4	0.1	0.2

SD, standard deviation; CI, confidence interval; CV, coefficient of variation; SPES-Scopa, Short Parkinson's Evaluation Scale-Scales for Outcomes in Parkinson's Disease; MMSE, Mini-Mental Status Examination; HADS, Hospital Anxiety and Depression Scale; PIMS, Parkinson's Impact Scale; SCOPA, Scales for Outcomes in Parkinson's Disease; PPRS, Parkinson's Psychosis Rating Scale; CISI, Clinical Impression of Severity Index; PD-CRS, Parkinson's Disease Cognitive Rating Scale.

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TABLE 2 Characteristic metrics of the items, domains, and total scores on the Parkinson's Disease Cognitive Rating Scale

Variable	Score			10% Score Maximum	Floor Effect	Ceiling Effect
	Mean	Median	Difference: Mean-Median			
Immediate Verbal Memory (free recall)	6.4	6.0	0.4	1.2	4.0	0.9
Confrontation Naming	15.4	17.0	−1.6	2.0	2.2	0.9
Sustained Attention	4.1	2.0	2.1	1.0	39.4	1.7
Working Memory	5.2	5.0	0.2	1.0	15.7	1.7
Spontaneous Clock Drawing	8.6	8.0	0.6	1	6.2	6.2
Clock Copying	7.9	9.0	−1.1	1.0	4.9	32.2
Delayed Verbal Memory (free recall)	2.7	2.0	0.7	1.2	39.4	1.7
Alternating Verbal Fluency	5.1	5.0	0.1	2.0	29.6	0.9
Action Verbal Fluency	15.5	13.0	2.5	3.0	7.6	0.9
Score subcortical	51.5	51.6	−0.1	10.4	1.3	0.9
Score cortical	24.4	24.4	0.0	3.0	2.2	2.6
Total score	76.0	76.0	0.0	13.4	2.6	1.7

TABLE 3 Reliability coefficient and items characteristics

Guttmann λ = 0.821	Homogeneity Index	Guttmann λ if Item Deleted
Immediate Verbal Memory (free recall)	0.61	0.80
Confrontation Naming	0.70	0.78
Sustained Attention	0.63	0.79
Working Memory	0.70	0.79
Spontaneous Clock Drawing	0.38	0.81
Clock Copying	0.54	0.80
Delayed Verbal Memory (free recall)	0.43	0.81
Alternating Verbal Fluency	0.62	0.79
Action Verbal Fluency	0.71	0.83

obtained at the end was a Guttman's lambda (Guttman's λ) value of 0.821, which also surpassed the standard minimum of ≥ 0.7; the λ value rose to 0.831 with the elimination of the Action Verbal Fluency item (see Table 3). Regarding precision, we obtained a value for the SEM (SEM = $19.37 \times \sqrt{1} - 0.821 = 8.2$) of less than 9.7 (a result of 0.5 × 19.37).

Stability. The test-retest correspondence was 0.81 (95% confidence interval [CI], 0.77–0.85; $f = 5.01$; $P \leq 0.000$).

Validity. The maximum convergent validity of the PD-CRS was 0.763 with the MMSE. Overall, the convergence values varied between 0.3 and 0.59 (see Table 4).

Known-Groups Validity. Depending on the H&Y stage, the PD-CRS scores varied significantly. We also found significant differences between the 2 age groups ($P \leq 0.05$) and according to the level of education. We did not find differences according to years with the disease.

The receiver operating characteristic curve showed an area under curve value of 0.89. The PD-CRS cutoff score that obtained the best efficiency (98%) for differentiating patients with PDD from those without dementia was 62. At that value, we obtained sensitivity of 94%, specificity of 99%, a positive predictive value of 96.7%, a negative predictive value of 98.1%, a positive likelihood ratio of 94, a negative likelihood ratio of 0.06, and a prevalence and bias-adjusted κ value of 0.96.

When patients who had PPD were compared with those who had PD without dementia, significant differences were found ($P \leq 0.05$) in the clinical and demographic variables, with the exception of years on L-dopa ($P \leq 0.244$) and section 3 of the SPES-Scopa ($P \leq 0.98$) (see Table 5).

Discussion

When analyzing our results and comparing them with results from previous publications about PD-CRS (mean values),[3–5,29,30] we observed that both age (69.4 years in our patients and 67.4 years in patients from the other publications) and disease duration (7.4 years in our patients and 7.2 years in those reported in previous publications) were very similar.

There was a difference in the H&Y stage of patients; 62.3% of our patients had stage III disease compared with 20.7% of the other patients. This is why the degree of affectation measured with the SPES-Scopa was an average of 30.8, and that measured with the CISI-PD was 11.3 versus values of 20.6 and 9.5, respectively, obtained by Martínez-Martín et al.[4]

Our patients had a lower educational level. The ratio between patients with high and low educational levels was 2.4/1.0, similar to the ratio reported by Santangelo et al.[5] It is known that the educational level has a significant influence on cognitive performance in patients with PD.[31–34]

The authors of the original work[3] found a ceiling effect in Naming as well as Clock Copying. Santangelo et al.[5] reported a ceiling effect in their study on the items of Attention (25.2%), Clock Drawing (26.7%), and Clock Copying (47.5%). We observed this effect in Clock Copying. It did not occur with all of the cortical scores, which did present a ceiling effect in the study by Martínez-Martín et al.[4] It could be concluded that Clock Copying is an item with a tendency to present a ceiling effect; in other words, it is a "simple" item.

In our patients, we found that 4 items had a floor effect (Table 2). We are not aware of this having been reported before. We do not have an explanation for this, except that maybe, for this sample, those items were "complicated" items. Despite that, the difference between mean and median values, which theoretically should not be more than 10% of the maximum score, met that standard, except for Sustained Attention (Table 2).

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TABLE 4 Convergent validity*

Variable	PD-CRS		Total PD-CDR
	Subcortical	Cortical	
Age, y	−0.54	−0.41	−0.54
Education, y	0.58	0.54	0.58
Disease duration, y	−0.27	−0.14	−0.24
Levodopa			
Time on treatment, y	−0.21	−0.74	−0.18
Dose, mg/d	−0.31	−0.20	−0.29
SPES-Scopa			
Section 1	−0.48	−0.40	−0.47
Section 2	−0.50	−0.45	−0.49
Section 3	−0.22	−0.09	−0.19
Total	−0.47	−0.38	−0.45
Schwab & England	0.51	0.47	0.50
MMSE	0.73	0.71	0.76
HADS			
Anxiety	−0.32	−0.28	−0.34
Depression	−0.36	−0.28	−0.35
PIMS	−0.34	−0.21	−0.33
SCOPA-Psychosocial	−0.36	−0.32	−0.35
PPRS	−0.30	−0.35	−0.34
CISI-PD	−0.59	−0.51	−0.59

*Data are Spearman rho values.
PD-CRS, Parkinson's Disease Cognitive Rating Scale; SPES-Scopa, Short Parkinson's Evaluation Scale-Scales for Outcomes in Parkinson's Disease; MMSE, Mini-Mental Status Examination; HADS, Hospital Anxiety and Depression Scale; PIMS, Parkinson's Impact Scale; SCOPA, Scales for Outcomes in Parkinson's Disease; PPRS, Parkinson's Psychosis Rating Scale; CISI-PD, Clinical Impression of Severity Index for Parkinson's Disease.

Test stability, which was measured by concordance using the ICC, obtained an appropriate value of 0.81 (95% CI, 0.77–0.85). The mean application time was 19.7 minutes for patients with and without dementia, which is a moderate application time.

The reliability index—a Guttmann's λ value of 0.821—was slightly lower than that previously obtained[3–5] but was still higher than the standard of 0.7, which is accepted as adequate. Regarding precision, the SEM value obtained (8.2 < 9.7) indicated adequate values, yielding a reliability of greater than 75%.[24]

Regarding convergent validity, we found an elevated correlation with the MMSE (0.76) in the work by Martínez-Martín et al.,[4] which was 0.53. In general, the values for correlation with tests like the PIMS, the SCOPA-Psychosocial, the HADS (for both anxiety and depression), and the PPRS were between 0.3 and 0.4; whereas the correlation with the CISI–PD was 0.59. This last correlation value is important, because it could be attributed to the fact that the CISI–PD includes a clinical evaluation of cognitive state in its last item.

Discriminative validity (validity for known groups according to H&Y) demonstrated that the PD-CRS adequately and significantly discriminated between participants who had less or more of the evaluated attribute, unlike the previous publication in which this was not found.[4] As an extension, upon analyzing the participants according to age and education, we observed significant differences between them. It is noteworthy that we did not find a correspondence between these differences and the number of years with the illness that was reported in the Italian validation study.[7] This could be because many patients do not remember exactly when their illness began.

TABLE 5 Comparison of clinical and demographic characteristics of patients with and without dementia

Characteristic	With Dementia		Without Dementia		*P**
	Mean	95% CI	Mean	95% CI	
Age, y	77.5	75.8–79.1	66.8	65.4–68.3	0.000
Education, y	7.0	6.0–7.9	10.0	9.2–10.7	0.000
Disease duration, y	10.4	8.3–12.4	6.9	6.2–7.5	0.007
Levodopa					
Time on treatment, y	7.3	5.7–8.9	5.7	5.0–6.3	0.244
Dose, mg/d	828.7	727.5–929.9	681.3	639.5–723.0	0.003
SPES-Scopa					
Section 1	20.9	19.3–22.6	17.1	16.4–17.9	0.000
Section 2	11.7	10.5–12.9	8.4	8.0–8.9	0.000
Section 3	3.7	2.8–4.6	3.6	3.1–4.0	0.980
Total	36.4	33.0–39.8	29.1	27.6–30.5	0.000
Schwab & England	58.9	53.4–64.3	72.7	71.0–74.4	0.000
MMSE	17.6	16.0–19.2	25.3	24.9–25.7	0.000
HADS					
Anxiety	8.9	7.9–9.9	6.9	6.4–7.4	0.001
Depression	8.9	7.8–9.9	6.2	5.7–6.7	0.000
PIMS	24.8	22.3–27.3	18.2	16.9–19.6	0.000
SCOPA-Psychosocial	13.3	11.4–15.2	9.3	8.5–10.1	0.000
PPRS	2.6	2.1–3.1	1.2	1.0–1.4	0.000
CISI-PD	15.0	13.6–16.4	10.2	9.7–10.8	0.000
PD-CRS					
Subcortical	22.7	18.3–27.2	56.2	52.4–59.9	0.000
Cortical	19.9	17.2–22.5	25.0	24.1–29.9	0.000
Total	41.7	28.5–48.2	87.4	83.0–91.8	0.000

**P* values were determined using a Mann-Whitney *U* test or a *t* test; in either case, *P* values ≤ 0.05 were considered significant.
CI, confidence interval; SPES-Scopa, Short Parkinson's Evaluation Scale-Scales for Outcomes in Parkinson's Disease; MMSE, Mini-Mental Status Examination; HADS, Hospital Anxiety and Depression Scale; PIMS, Parkinson's Impact Scale; SCOPA, Scales for Outcomes in Parkinson's Disease; PPRS, Parkinson's Psychosis Rating Scale; CISI-PD, Clinical Impression of Severity Index for Parkinson's Disease; PD-CRS, Parkinson's Disease Cognitive Rating Scale.

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The area under the PD-CRS curve was 0.89 (95% CI, 0.84–0.94), which was adequate and highly discriminative. The cutoff point established as the most efficient for separating patients without dementia from those with dementia was 62. The original publication cited that value as 64, but we do not know what the mean was of the scores obtained. With that cutoff point, the scale reached optimum sensitivity (94%), specificity (99%), and likelihood ratio (96.7) values, which means that the post-test probability is very high. With that cutoff point, the prevalence of dementia in our study was 23.7%, which is within the estimated prevalence range of 24.5% (95% CI, 17.4%–31.5%).[35]

It has been stated that the dementia criteria of the Movement Disorders Society are more sensitive than the traditional criteria from the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders*.[10] On the other hand, it has been said that the MDS criteria are not very sensitive, with 100% specificity but only 46.7% sensitivity.[36] That finding has been observed on other occasions[37] and by various investigators; Isella et al.[38] demonstrated a specificity of 95% and a sensitivity of 65%.

It has been proposed that the MMSE should be replaced by tools specifically developed for evaluating cognitive deterioration in PD,[38,39] or, to gain sensitivity, to exclusively employ level 1 of the MDS criteria.[37,39,40] Although the MMSE remains 1 of the fundamental elements for diagnosing dementia in the MDS-TF criteria, from our perspective, it will continue to have low sensitivity if it does not more broadly include subcortical deterioration, which is very important in PD.

This scale requires an average of 19 minutes for its execution, and that time must be taken into account when applying it. This could be an element that complicates its use in general practice.

In conclusion, the PD-CRS has demonstrated adequate measurement properties for evaluating cognitive deterioration and the presence of dementia compared with the criteria proposed by the MDS-TF.

Author Roles

1. Research Project: A. Conception, B. Organization, C. Execution; 2. Statistical Analysis: A. Design, B. Execution, C. Review and Critique; 3. Manuscript Preparation: A. Writing the First Draft, B. Review and Critique.

M.S.-D.: 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B

M.A.: 1C, 2B, 3B

D.V.: 1C, 3A, 3B

D.G.: 1C, 3B

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