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RESEARCH ARTICLE

A Simplified Version of the Psychogenic Movement Disorders Rating Scale: The Simplified Functional Movement Disorders Rating Scale (S-FMDRS)

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Abstract: **Background:** The Psychogenic Movement Disorders Rating Scale (PMDRS) has potential as a useful objective assessment in clinical research, but the current scale has limitations. We developed a simplified version (S-FMDRS) and assessed inter-rater reliability, concurrent validity, and sensitivity.
Methods: Fifty-two videos of subjects with functional (psychogenic) movement disorders (FMD) were rated according to the PMDRS and S-FMDRS by three neurologists. Inter-rater reliability was assessed using intraclass correlation coefficient (ICC). Agreement of symptomatic body regions and movement disorder classification was assessed using Light's kappa. Spearman's correlation coefficient was used to assess concurrent validity. A physiotherapist also rated videos on the S-FMDRS. The simplified scale was piloted in a feasibility study of physiotherapy for FMD to assess sensitivity.
Results: ICC of total scores was 0.84 for the original scale and 0.85 for the simplified scale. Light's kappa for agreement of symptomatic body regions and movement disorder classification was moderate to low. Concurrent validity was demonstrated by Spearman's correlation between the two scales ranging from 0.84 to 0.95. The simplified scale was sensitive to change, with an effect size in the feasibility study of 0.79. Inter-rater reliability between physiotherapist and neurologist was high (ICC 0.85).
Discussion: Both versions of the scale had good inter-rater reliability for the total score. Low agreement on movement disorder classification and identification of symptomatic body regions support our argument for a simplified scale.
Conclusions: The S-FMDRS has high inter-rater reliability and good sensitivity to change. Further psychometric evaluation is warranted.

There is increasing research interest in the treatment of patients with functional (psychogenic) movement disorders (FMD). This research shows promising outcomes and includes a diverse range of treatments including physiotherapy, psychological therapy, multidisciplinary rehabilitation, novel biofeedback treatment, supported self-help, and therapeutic sedation.[1–11] A significant limitation of this literature is a lack of consistency in the use of objective outcome measures.

Measuring outcome in FMD is problematic, as the illness experience varies considerably among individuals. Patients can

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experience problems in physical, psychological, and or social domains. Multiple comorbidities may account for differing proportions of an individual's illness burden, such as migraine, chronic pain, chronic fatigue, bladder and bowel symptoms, anxiety, and depression. In addition, the severity of functional motor symptoms is inherently variable, making "snapshot" measures potentially unreliable.

The Psychogenic Movement Disorders Rating Scale (PMDRS) is one of very few outcome measures specifically designed for FMD.[12] It aims to provide a snapshot symptom severity score and provide information on phenomenology, anatomical distribution, duration, and functional impact of abnormal movement. The creators of this scale found it had excellent inter-rater reliability, good sensitivity, and good construct validity.[12] Scoring works by identifying the movement abnormality in 14 body regions; classifying the abnormal movement as one of 10 movement disorder phenomena (resting tremor, dystonia, chorea, athetosis, etc.); and then scoring the movement according to perceived severity, duration, and incapacitation. Gait and speech are also scored according to severity, duration and incapacitation. Scoring is based on 0 to 4 ordinal scales. Scores are added together with a global incapacitation and severity score. See Figure 1 for the PMDRS scoring table.

We believe that a number of features limit the usefulness of the PMDRS. The scale excludes functional weakness, one of the most common functional neurological symptoms. This may be a pragmatic decision based on the difficulty of assessing weakness by observation, or it may be related to a purist definition of "movement disorder" that does not include weakness. However, we would argue that patients with functional weakness as the dominant symptom share a common etiology with other functional motor symptoms, and that weakness is part of the symptom burden of many with FMD. The PMDRS assumes high-level expertise in movement disorders to classify movement phenomena. It is therefore likely that the high inter-rater reliability reported by Hinson et al.[12] may not be generalizable to health professionals other than experienced movement disorder specialists, whereas treatment (and therefore objective assessment) is likely to be performed by physiotherapists, occupational therapists, and psychologists. In any case, the categories of movement disorder used in the scale are defined by their association with neurological disease and are therefore arguably not very relevant to movement impairment resulting from FMD. Symptoms of FMD might resemble movement disorder resulting from organic disease, however repeated kinematic analysis of FMD has shown inconsistency in the movement pattern,[13] which throws into question the usefulness and reliability of highly specific categorization. The symptom severity score ranges from 0 to 4 (none, minimal, mild, moderate, severe), but in our opinion the difference between minimal and mild is unclear. We also question the usefulness of the incapacitation score. Incapacity was defined as "how functionally relevant the observed abnormal movement is." It is not clear how this can be differentiated from severity, nor judged by a discrete observation without observation of performance during functional tasks.

To address some of these concerns with the PMDRS, we developed a simplified version, and we compared the inter-rater reliability and criterion-related validity to the original scale. In addition, we piloted the simplified scale in a feasibility study of physiotherapy for FMD. In line with suggested changes in terminology,[14] we named our simplified version of the PMDRS as the Simplified Functional Movement Disorders Rating scale (S-FMDRS).

Method

Participants

Participants for the reliability study were drawn from subjects enrolled in a randomized feasibility study of physiotherapy for FMD.[15] The inclusion criteria were: a clinically established diagnosis of FMD according to the Fahn-Williams criteria[16]; age ≥18 years; completed diagnostic investigations; acceptance of the diagnosis; symptom duration of at least 6 months; and symptoms severe enough to cause distress or impairment in social or occupational functioning. The exclusion criteria were: inability to understand English; pain or fatigue judged as the primary cause of the patient's disability; prominent dissociative seizures for which the patient required assistance to manage; clinically evident anxiety or depression that was believed to require assessment before starting physiotherapy treatment; and high level of disability preventing participation in an outpatient/day hospital environment. Approval was obtained from the National Research Ethics Service Committee London—City Road and Hampstead (14/LO/0572). All participants provided written informed consent.

Procedures

Each participant completed a battery of assessments including a standardized video of movement, 10-meter timed walk, and Short Form 36[17] at baseline (before treatment) and at 6-months follow-up. In the standardized video of movement, participants were filmed according to a protocol based on that reported by Hinson et al in 2005.[12] The items filmed were: full body view of the participant sitting in a chair with arm rests (15 seconds); close up of face and neck (15 seconds), the participant was then asked to recite the months of the year; full body view sitting with hands supine resting on thighs (15 seconds); arms extended at shoulder height with hands in pronation (10 seconds); finger-nose test (5 repetitions); thumb and index-finger finger taps (15 seconds); heel taps (15 seconds); moving from sitting to standing; standing with posture uncorrected (10 seconds); standing with feet touching (10 seconds); and finally walking 5 meters, turn and walking back to the starting position (using aids if necessary). All video was filmed in a frontal view.

A sample of 52 videos was randomly selected (from the feasibility study data), using an online randomization application, for the reliability and validity assessment. Three neurologists with clinical experience in movement disorders (L.R., A.M.M., and

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Part 1: Phenomena

	Rest tremor	Action tremor	Dystonia	Chorea	Brady-kinesia	Myoclonus	Cerebellar	Ballism	Athetosis	Tics
Upper face										
Lips/perioral										
Jaw										
Tongue										
Neck										
Head										
Left shoulder										
Right shoulder										
Left upper extremity										
Right upper extremity										
Left lower extremity										
Right lower extremity										
Trunk										
Other region										
Global severity										
Duration factor										
Global incapacitation										

Part 2: Function

	Gait disorder	Speech disorder
Severity		
Duration factor		
Incapacitation		

Part 3: Total Scores

1. Total Phenomenology Score	
2. Total Function Score	
3. Total Psychogenic Movement Disorder Score (1+2)	

Scoring

Severity	Duration factor	Incapacitation
0 – none	0 – none	0 – none
1 – minimal	1 < 25% of the time	1 – minimal
2 – mild	2 – 25-50% of the time	2 – mild
3 – moderate	3 – 50-75% of the time	3 – moderate
4 – severe	4 > 75% of the time	4 – severe

Figure 1 The Psychogenic Movement Disorders Rating Scale (Hinson et al. 2005).[12]

T.T.) independently rated each video according to the PMDRS and a simplified version (S-FMDRS). The original PMDRS was scored according to the instructions in the manuscript.[12] The order of scoring for each scale was alternated between each video. In addition, a physiotherapist rated the videos using the S-FMDRS only. The rater was instructed to watch each video in full, and they were then permitted to review relevant sections as required.

Simplified Functional Movement Disorders Rating Scale (S-FMDRS)

The following developments were made to create the simplified scale (see Fig. 2). First, and most important, the nature of the movement disorder phenomenology was removed, and raters were simply required to note the presence or absence of

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abnormal movement in each body region. Second, the number of body regions was condensed from 14 to seven. Third, symptom severity at each body region was rated from 0 to 3 (0 = none, 1 = mild, 2 = moderate, 3 = severe). Fourth, a duration score was assigned to each body region (estimated amount of time in the video during which symptoms are observed at the body region), rated from 0 to 3 (0 = none; 1 = symptomatic movement spotted at least once or only a few times; 2 = symptom is intermittent but frequent, so that there are periods during which it is absent or does not affect purposeful movement; 3 = the symptom is evident continuously). Gait and speech were also rated according to severity and duration. Fifth, the incapacitation score was removed. All severity and duration scores were added to yield a total score.

Feasibility Study Procedures

The feasibility study procedures were reported in full elsewhere.[15] In summary, 60 patients with FMD were randomized to receive a specialized, intensive 5-day intervention (intervention group) or referral to standard community neurophysiotherapy (control group). Video was taken at baseline and at 6 months following treatment.

Analysis

A sample size of 52 patients was chosen using a sample-size calculation based on an estimated intraclass correlation coefficient (ICC) of 0.8, for two raters with a 95% confidence interval width of 0.2.[18]

Inter-rater reliability was assessed using ICC (2-way random effects–absolute agreement, $ICC_{(2,1)}$) for score totals and Light's kappa[19] for agreement on the classification of movement disorder (PMDRS) and the presence of symptoms at each body region/function (both scales). Concurrent validity was explored using Spearman's correlation, comparing total S-FMDRS scores to the PMDRS scores, SF36 Physical Function domain scores, and 10-meter walk times. To assess sensitivity of the S-FMDRS, the mean difference between the intervention and control groups of the feasibility study was assessed using a linear regression model, adjusting for the baseline scores of the measure.[20] A treatment effect was calculated using Cohen's *d*.[21] Statistical analysis was conducted using SPSS version 22.

Results

The mean age of participants in the reliability assessment sample was 43 (SD 13.4), 73% were female, and the mean symptom duration was 5.6 years (SD 6.7). Participants presented with primary complaints of gait disturbance (25%), tremor (20%), weakness (12%), jerks (4%), and mixed movement disorder symptoms (39%). Reliability values are presented in Table 1.

Intraclass Correlation Coefficient

$ICC_{(2,1)}$ for the neurologists was 0.84 (95% CI 0.75, 0.90) for the PMDRS total score, and 0.85 (95% CI 0.77, 0.90) for S-FMDRS total score. $ICC_{(2,1)}$ for the neurologist–physiotherapist S-FMDRS total score comparison was 0.85 (95% CI 0.76, 0.91).

Light's Kappa

Light's kappa for PMDRS movement disorder classification (phenomenology) ranged from no agreement for functional tics, athetosis, and cerebellar-like incoordination to high agreement for resting tremor (ICC 0.80, 95% CI 0.73, 0.87). Agreement for PMDRS symptomatic body regions ranged from 0.10 for the jaw (95% CI 0.09, 0.11) to 0.66 for the trunk (95% CI 0.57, 0.75). Agreement for S-FMDRS body regions ranged from 0.36 for the left lower limb (95% CI 0.32, 0.41) to 0.63 for the trunk (95% CI 0.55, 0.71). Agreement on the presence of symptoms during gait was 0.70 (95% CI 0.62, 0.78) and speech was 0.66 (95% CI 0.57, 0.76) for both scales.

Validity

Spearman's correlation between PMDRS and S-FMDRS total scores was 0.86 ($P < 0.001$) for neurologist one, 0.95 ($P < 0.001$) for neurologist two, and 0.84 ($P < 0.001$) for neurologist three. Spearman's correlation between S-FMDRS

Regions	Severity	Duration	Total
Face & tongue			
Head & neck			
Left UL & shoulder girdle			
Right UL & shoulder girdle			
Trunk & abdomen			
Left LL			
R LL			
Function			
Gait			
Speech			
		TOTAL	

Scoring		
	Severity	**Duration**
0	None	None of the time
1	Mild	Occasionally
2	Moderate	Frequent
3	Severe	Constant

Figure 2 The Simplified Functional Movement Disorders Rating Scale (S-FMDRS). UL, upper limb; LL, lower limb.

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TABLE 1 Intraclass correlation coefficient and Light's kappa values

	Rater 1 Mean (SD)	Rater 2 Mean (SD)	Rater 3 Mean (SD)	$ICC_{(2,1)}$
PMDRS				
Phenomenology score	24.6 (18.0)	25.6 (19.9)	21 (17.2)	0.80 (0.70, 0.87)
Function score (gait and speech)	8.2 (5.7)	6.8 (5.1)	7.2 (4.9)	0.89 (0.81, 0.93)
Total score	32.8 (21.2)	32.4 (22.8)	28.4 (20.3)	0.84 (0.75, 0.90)
S-FMDRS				
Body region score	9.1 (6.7)	9.5 (7.1)	9.8 (6.9)	0.78 (0.68, 0.86)
Function score (gait and speech)	4.3 (2.8)	3.6 (2.7)	4.2 (2.6)	0.86 (0.78, 0.91)
Total score	13.4 (8.5)	13.1 (8.7)	14.0 (8.6)	0.85 (0.77, 0.90)
	Rater 1 Mean (SD)	Physiotherapist Mean (SD)		$ICC_{(2,1)}$
S-FMDRS				
Body region score	9.1 (6.7)	9.9 (8.5)		0.81 (0.70, 0.89)
Function score (gait and speech)	4.3 (2.8)	4.3 (2.9)		0.93 (0.88, 0.96)
Total score	13.4 (8.5)	14.2 (10.6)		0.85 (0.76, 0.91)
	Rater 1, No. Observations	Rater 2, No. Observations	Rater 3, No. Observations	Kappa (95% CI)
Phenomenology (PMDRS)				
Resting tremor	21	16	16	0.80 (0.73, 0.87)
Action tremor	24	7	28	0.41 (0.37, 0.45)
Dystonia	27	28	26	0.41 (0.36, 0.46)
Chorea	2	1	2	0.14 (0.12, 0.17)
Bradykinesia	27	43	30	0.38 (0.34, 0.43)
Myoclonus	4	12	4	0.21 (0.18, 0.24)
Cerebellar	0	3	9	0
Ballism	1	2	0	0.22 (0.20, 0.24)
Athetosis	0	1	1	0
Tics	1	7	0	0
Functions (PMDRS)				
Gait	41	37	43	0.70 (0.62, 0.78)
Speech	8	7	11	0.66 (0.57, 0.76)
Body region (PMDRS)				
Upper face	6	9	12	0.33 (0.28, 0.38)
Lips	6	11	10	0.55 (0.47, 0.56)
Jaw	1	0	5	0.10 (0.09, 0.11)
Tongue	0	0	0	
Neck	7	14	13	0.36 (0.31, 0.41)
Head	7	13	10	0.63 (0.54, 0.71)
Left shoulder	0	2	0	
Right shoulder	0	1	1	
Left upper extremity	22	26	34	0.54 (0.49, 0.60)
Right upper extremity	24	26	38	0.52 (0.46, 0.57)
Left lower extremity	29	32	24	0.29 (0.25, 0.32)
Right lower extremity	23	25	28	0.54 (0.48, 0.60)
Trunk	7	12	12	0.66 (0.57, 0.75)
Body region (S-FMDRS)				
Face and tongue	11	14	17	0.48 (0.42, 0.55)
Head and neck	12	23	16	0.54 (0.48, 0.61)
Left upper limb and shoulder girdle	19	28	34	0.50 (0.45, 0.55)
Right upper limb and shoulder girdle	21	26	38	0.53 (0.48, 0.58)
Trunk and abdomen	7	13	14	0.63 (0.55, 0.71)
Left lower limb	28	28	24	0.36 (0.32, 0.41)
Right lower limb	22	25	28	0.49 (0.43, 0.55)
Functions (S-FMDRS)				
Gait	41	37	43	0.70 (0.62, 0.78)
Speech	8	7	11	0.66 (0.57, 0.76)

$ICC_{(2,1)}$, intraclass correlation coefficient; PMDRS, Psychogenic Movement Disorders Rating Scale; S-FMDRS, Simplified Functional Movement Disorders Rating Scale.

and SF36 Physical Function domain was −0.56 ($P = 0.001$) for neurologist one, −0.39 ($P = 0.031$) for neurologist two, and −0.33 ($P = 0.073$) for neurologist three. Spearman's correlation between S-FMDRS and 10-meter walk time was 0.53 ($P < 0.004$) for neurologist one, 0.41 ($P < 0.032$) for neurologist two, and 0.25 ($P = 0.212$) for neurologist three.

Sensitivity—Difference between Intervention and Control Groups

Sensitivity analysis was conducted using the data from the sample of 60 participants enrolled in a feasibility study.[15] The mean intervention group S-FMDRS score at 6 months (post-treatment) was 10.6 (SD 9.1), and the mean control group score

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was 16.6 (SD 8.6). After adjusting for baseline scores, the difference between the groups was 7.4 (95% CI 3.8, 11.0), Cohen's $d = 0.79$.

Discussion

We assessed the inter-rater reliability of the PMDRS and a simplified version of the scale. Scores for both scales had high inter-rater reliability with ICCs ranging from 0.84 to 0.85. These values are comparable to the ICC for the PMDRS of 0.88, as reported by Hinson et al,[12] and they compare favorably to other clinical outcome measures in neurology—for example, the Berg Balance Scale in stroke (ICC: 0.95),[22] the modified Ashworth Scale (ICC: 0.64–0.87),[23] and the Unified Parkinson's Disease Rating Scale motor score (ICC: 0.82).[24]

Agreement on the classification of movement disorder and the presence of symptoms in body regions was assessed with Light's kappa and was found to be highly variable, with values ranging from no agreement to 0.80. It has been suggested that a kappa value less than 0.60 indicates inadequate agreement, and little confidence should be placed in the measure.[25] In the present study, all movement disorder classifications in the PMDRS, except resting tremor and the presence of symptoms at many body regions for both scales, showed insufficient agreement according to this cut-off value.

The low agreement of movement disorder classification supports our argument for removing this step from our revised scale. The results also support our move to condense the number of body regions in the revised scale, as there were no observed symptoms (or a negligible number) in 4 of 13 regions of the PMDRS. Reducing the number of body region categories in the S-FMDRS appeared to improve agreement, although in our sample only 4 of 7 body regions had a kappa value greater than 0.60. A number of changes could be used to improve agreement on symptomatic body regions in future studies. This might include stricter standardization of the scoring procedure, scoring calibration with an experienced scale user, improving quality or length of video footage, and requiring the rater to double check each score.

Concurrent validity is the extent to which a measure corresponds to a previously established measure. Concurrent validity was demonstrated with a significant high correlation between the S-FMDRS and the original scale and a significant moderate correlation with other measures of disability: SF36 Physical Function domain and a timed 10-meter walk.

When we tested the S-FMDRS in the randomized feasibility study, it proved a sensitive measure of change. The effect size of 0.79 compared favorably to other measures tested in this study, including SF36 Physical Function domain ($d = 0.70$), 10-meter timed walk ($d = 0.72$), and the functional mobility scale ($d = 0.79$).[26]

The S-FMDRS performed similarly to the original scale, but it included certain advantages. It was quicker to complete. It did not require specialist movement disorder training to categorize movement disorder phenomena, allowing use by non-neurologists. This is an important issue in its usefulness, as those administering treatment (and therefore wishing to assess outcome) in patients with FMD are often not movement disorder neurologists, but are other health professionals such as physiotherapists. In this regard, we found high inter-rater reliability between the physiotherapist and movement disorder specialist rater. Last, the revised scale allows the rating of observed movement impairment resulting from weakness; in the original scale, functional weakness of the lower limbs or trunk may be accounted for in the gait score, however there is no equivalent for scoring upper limb weakness within the scoring matrix of the original scale. Further psychometric assessment is recommended to refine the S-FMDRS and to highlight limitations, including the assessment of construct validity and test–retest reliability.

There are a number of limitations to this study. Although the sample size was sufficient to determine inter-rater reliability of total scores, there were insufficient observations of some of the movement disorder categories to assess agreement adequately. Our analysis only compared agreement of three neurologists. We did not assess each video recording for quality, a factor that may have impacted the reliability of scoring. The results can only be generalized to patients meeting the inclusion criteria and therefore do not necessarily extend to patients with significant psychopathology, more extreme disability, and those with a primary complaint of pain or fatigue in addition to functional motor symptoms. These patients were excluded from the current study as they were not considered appropriate candidates for the feasibility study intervention. Finally, both the original and simplified scales are "snapshot" measures, which may have low test–retest reliability because of the variable nature of FMD severity.

Conclusions

Scores obtained from the S-FMDRS have high inter-rater reliability when used by experienced neurologists and physiotherapists. The limitations of the S-FMDRS include low agreement on the presence of symptoms at some body regions and unknown test–retest reliability. With the acknowledgment of these limitations, the S-FMDRS enables a blinded, clinician-rated assessment of overall symptom severity in FMD for research purposes that is sensitive to change. We would recommend that if using either rating scales (PMDRS or S-FMDRS), results are considered along with other measures, including patient-reported outcomes with a set recall period to account for symptom variability, and measures of physical, psychological, and social function. Further work to develop valid and reliable outcome measures for FMD is required.

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G.N.: 1A, 1B, 2A, 2B, 2C, 3A, 3B
L.R.: 1C, 2C, 3B
A.M.M.: 1C, 2C, 3B
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