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Testing a Potential Marker of Attention for the Diagnosis of Functional Movement Disorders

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Abstract

Background: The diagnosis of Functional Movement Disorders (FMD) mostly relies on clinical expertise, with a paucity of confirmatory tests available. More objective markers are needed. We determine whether an in-clinic attention task can aid in diagnosis.

Methods: A single-site study comparing subjects with FMD, essential tremor (ET), and healthy controls (HC). Subjects completed a modified Stroop Interference task and standardized questionnaires assessing mood symptoms. Level of disability was estimated by modified Rankin Score (mRS). The primary endpoint was the difference in error rate and response time on the Stroop between groups. Data was analyzed using Wilcoxon test or Fisher's exact test.

Results: 50 subjects were screened and 35 recruited (12 FMD, 11 ET, and 12 HC). No significant differences were seen in task performance between groups, although the FMD group made the most errors and had the longest median response time. Significant between-group differences were found in reported symptom severity and health concerns, despite a similar mRS between FMD and ET groups.

Discussion:

A modified Stroop task was not able to distinguish with significance between FMD, ET, and HC. Self-reported questionnaire responses showed significant differences with higher prevalence of depression and anxiety and greater perceived disability in patients with FMD despite similar mRS.

Keywords: Functional; Psychogenic; Tremor; Stroop

1. Background

Functional neurological disorders are common and account for 1-10% of neurologic diagnoses in hospitals and even higher numbers in certain specialized neurologic settings [1, 2]. Patients with functional movement disorders (FMD) can experience debilitating motor symptoms including either a loss of movement or abnormal movements. FMD present with abnormal movements, such as tremors, jerks, or abnormal gait; are variable and distractible in presentation; and are not compatible with organic movement disorders [3]. Although the movements are perceived as involuntary, they are not due to structural damage in the nervous system and can be reversed with adequate therapy [4]. Although no longer considered a "diagnosis of exclusion", the recognition of FMD can be challenging and relies on clinical expertise due to the limited scope of objective confirmatory tests [5, 6]. Revised diagnostic criteria by Espay and Lange focus on the presence of "positive signs" on neurologic exam, such as tremor variability and entrainment, rather than the presence of psychologic stress factors [7], but there is a need for objective diagnostic markers to confirm a diagnosis of FMD across different phenotypes.

In the last decade, investigators have demonstrated that alterations in multiple neural systems, including motor, sensory, limbic, extrapyramidal, executive, and attentional networks, may be implicated in the pathophysiology of functional neurological disorders. Changes in attention, in particular, have long been associated with FMD and may represent a common pathway in the development of aberrant movements across phenotypes. Clinical observations of attentional irregularities have shaped the diagnostic criteria for FMD. Movements that are significantly altered by distraction or non-physiological maneuvers are considered characteristic of FMD and are implied as part of the accepted diagnostic criteria. Additionally, FMD often appear deliberate or effortful, as if attention is being directed towards them, despite a lack of perceived self-agency on the part of the patient. Through observation of videos of patients with tremors, van Popellen et al. determined that there was significantly greater visual attention to limbs (based on time spent looking at limbs) in patients with functional tremor compared with neurologic tremor [8].

Edwards and colleagues have proposed that functional movements are triggered by abnormal self-directed attention which increases the relevance of a "prior", or expectation, at the expense of attention to "bottom-up" sensory data. They demonstrated that subjects with FMD performed normally on a learning task which was un-cued and unpredictable, but when there was an opportunity for attention towards movement production, such as when the task was highly predictable, they performed poorly [9]. More objective physiological-anatomic evidence for altered attentional activation has been provided by some fMRI and PET scan studies [3, 10-12], however, there is

considerable heterogeneity among these studies in terms of types of functional disorders included, tasks performed, and activation patterns reported.

A neuropsychological test to increase the diagnostic certainty of FMD would be helpful in making a clinical diagnosis with greater confidence. Our aim is to better understand the attention bias of FMD, and we propose that the underlying pathology in this group of disorders will involve abnormalities in attentional circuitry. In this study, we investigated whether there were measurable clinical differences on performance of an attentional task between patients with FMD, patients with neurologic movement disorders, and healthy controls. We predicted poorer performance on attentional tasks in FMD patients compared to controls because of the difficulty shifting from an internal self-focus on physical symptomatology to an external task-focus. Furthermore, we predicted that these differences would be independent of any mood or disability measures. Specifically, we hypothesized that it would be difficult for patients with FMD to complete an emotional Stroop interference task. Compared to patients with neurological movement disorders and healthy control patients, those with an FMD would be expected to take longer to complete an emotional Stroop interference task and would also have longer response times to complete the task and poorer response accuracy. If this is true, the addition of this simple in-office neuropsychological task could serve as a marker in favor of a diagnosis of FMD to supplement clinical judgement.

2. Methods

This study was conducted at a single movement disorders center at an academic institution and was approved by the local IRB. Subjects with FMD, subjects with neurological movement disorders, and family healthy controls were identified by fellowship-trained movement disorders specialists in the practice during routine visits and consented for the study. Subjects with FMD were defined by Fahn and Williams' criteria as either "clinically documented" or "clinically established" [13]. Subjects with benign essential tremor were chosen as neurological movement disorder controls based on established diagnostic criteria. Healthy controls were defined as family members of patients who denied any neurological, psychiatric, or musculoskeletal disorders.

This was a single visit study. Subjects with FMD, essential tremor (ET), or healthy controls (HC) were only included if they were aged ≥ 18, had at least an 8^{th} grade level of education, and demonstrated the ability to complete 30 button pushes in 60 seconds on a laptop as this was required for task completion. Subjects were excluded if they had a Beck Depression Inventory (BDI) score of greater than 17 [14, 15], a Montreal Cognitive Assessment (MoCA) of less than 24, [16] history of a severe and untreated psychiatric disorder, or were colorblind. Participants who met eligibility criteria were administered questionnaires, including Neuro-Quality-of-Life (Neuro-QOL) (well-being, depression, and anxiety questionnaires), [17] Health-Related Quality-of-Life (HRQ), [18] Health Care Visits (HCV),[19] Overall Well-Being (WB), [20] Body Vigilance Scale (BV), [21] Emotional Response (ER), [22] Health Concerns (HC), [23] Difficult Experiences (DE), [24] and Sexual and Physical Abuse (SA or PA), [25] and the emotional Stroop task. Perceived illness severity and level of disability was rated with the Sheehan Disability Scales

[26]. Accuracy (error rate), total task completion time, and mean response time in the emotional Stroop task were calculated.

All subjects completed a computerized emotional Stroop interference task designed specifically for this study. As with the conventional Stroop Interference task, the subject must correctly select the color of a word. In a typical Stroop task, the word list consists of color words, such as “red” or “orange” or “green” [27]. However, in our emotional Stroop Interference task, the word list consists of neutral words, consisting of items found in a household (e.g., “toaster”, “magazine”, “wallet), and symptom words, consisting of words related to illness (e.g., “stutter”, “fatigue”, “confused”). The emotional Stroop task presents words in a random order with an equal number of words from each word list. Words are presented in rounds of 10 words with a fixation cross between rounds. Each word is presented for 1.5 seconds with a 0.3 second break in between words.

A modified Rankin score to assess level of disability was also recorded. All tests were performed in a uniformly lit room, in a noise-free environment with controlled temperature to avoid distraction and increase the comfort level of the subject. We aimed to recruit 12 subjects in each group for a total of 36 subjects. This was based on resources available. Previous studies on the Stroop task have been able to demonstrate statistically significant differences in task performance and fMRI activation patterns with only 11 subjects in one group and 8 subjects in the other [28]. A difference of 184 ms in reaction time on the Stroop task was statistically meaningful in another study of 24 subjects [29].

Descriptive statistics for all variables of interest were calculated. Categorical variables were summarized with frequencies and percentages, and continuous variables were summarized with medians and interquartile ranges. Primary analyses utilized Wilcoxon test for continuous variables and Chi-Squared test or Fisher’s exact test (depending on the number) for categorical variables, as appropriate, to examine the association between variables of interest and the groups in comparison. As we were not interested in comparing FMD and ET, and instead compared overall group differences, we used pairwise comparison on FMD vs. HC and ET vs. HC. In addition, the analyses were deemed exploratory overall and thus we did not consider p-value corrections for multiple testing.

3. Results

50 subjects were screened and 35 were recruited: 12 subjects with FMD, 11 subjects with ET, and 12 HC. 11 subjects with FMD failed the screening due to BDI scores that were greater than 17. One subject with FMD failed the screening because he did not complete the MoCA. Another subject with FMD withdrew consent from the study after completion. A subject with ET accidentally completed the study twice so the second dataset was excluded. Another subject with ET failed the screening because he did not complete the emotional Stroop task. The study closed after that subject, leaving only 11 subjects in the ET group.

The demographics and clinical characteristics of the subjects are summarized in (Table 1). Most subjects were white, middle-aged females. Those with ET were significantly older than those with FMD (Median: 69.00 vs. 58.00, p=0.05). FMD and ET subjects had similar levels of disability on mRS, and as predicted both had greater disability compared to healthy controls (2.00 vs. 0.00, p<0.01).

Table 1: Subject demographics and clinical characteristics.

	Functional (N=12)	**Essential Tremor (N=11)**	**Control (N=12)**	**P-value**	
Demographics	**N(%) Median(IQR)**	**N(%) Median(IQR)**	**N(%) Median(IQR)**	**Functional VS Essential Tremor**	**Functional VS Control**
Age	58.00 (47.50, 63.00)	69.00 (53.00, 73.00)	55.50 (51.00, 71.00)	0.05	0.42
Gender				0.32	1.00
Female	11 (91.67)	8 (72.73)	10 (83.33)		
Male	1 (8.33)	3 (27.27)	2 (16.67)		
MoCA	26.50 (24.50, 28.50)	27.00 (25.00, 29.00)	28.00 (27.00, 29.00)	0.47	0.11
BDI	5.50 (3.00, 13.50)	4.00 (2.00, 15.00)	3.00 (1.00, 4.50)	0.71	0.06
mRS	2.00 (1.00, 2.00)	2.00 (1.00, 3.00)	0.00 (0.00, 0.00)	0.97	<0.01
Married				1.00	0.37
Yes	7 (58.33)	7 (63.64)	10 (83.33)		
White				1.00	1.00
Yes	9 (75.00)	9 (81.82)	10 (83.33)		
Employment				1.00	0.41
Yes	4 (33.33)	4 (36.36)	7 (58.33)		
Above High School				0.32	0.32
Yes	8 (66.67)	10 (90.91)	11 (91.67)		
Duration of sxs				0.07	<0.01
< 1 year	6 (50.00)	1 (9.09)	3 (30.00)		
> 1 year	6 (50.00)	10 (90.91)	0 (0.00)		
N/A			7 (70.00)		
Family History				1.00	<0.01
Yes	4 (33.33)	4 (36.36)	10 (90.91)		

Table 1: Demographic data and clinical characteristics of subjects with functional movement disorders, subjects with essential tremor, and healthy controls. MoCA=Montreal Cognitive Assessment, BDI=Beck Depression Inventory, mRS=modified Rankin Scale, sxs=symptoms.

The results from the emotional Stroop task are summarized in (Table 2). No statistically significant differences were seen in task performance between the groups. The FMD group made the most errors (median errors FMD = 30.50, ET =24.00, HC = 18), and had longer response times (median response time FMD = 938.65 ms, ET = 929.96 ms, HC = 848.53 ms), but neither of these were statistically significant. Subjects with FMD also took longer to respond when symptom words (as opposed to neutral words) were presented (FMD = 963.49 ms, ET = 835.00 ms, HC = 870.88 ms), but once again, this was not statistically significant.

Table 2: Emotional stroop task data.

	Functional (N=12)	Essential Tremor (N=11)	Control (N=12)	P-value	
Stroop	Median(IQR)	Median(IQR)	Median(IQR)	Functional VS Essential Tremor	Functional VS Control
Errors (total)	30.50 (20.50, 46.50)	24.00 (11.00, 48.00)	18.00 (12.50, 28.00)	0.81	0.17
Errors (neutral)	17.50 (9.50, 22.00)	11.00 (6.00, 20.00)	7.00 (5.00, 15.00)	0.80	0.15
Errors (symptom)	15.00 (9.50, 23.00)	16.00 (5.00, 28.00)	9.00 (7.00, 16.00)	0.98	0.24
Task Completion Time (total)	150184.0 (132637.5, 164515.0)	148794.0 (138411.0, 161062.0)	135765.5 (121260.0, 148712.0)	0.41	0.10
Response Time Average (total)	938.65 (828.98, 1028.22)	929.96 (865.07, 1006.64)	848.53 (757.88, 929.45)	0.41	0.10
Response Time Average(neutral)	930.28 (797.76, 1042.82)	1032.75 (955.50, 1195.00)	806.00 (705.00, 892.50)	0.34	0.14
Response Time Average (symptom)	963.49 (839.84, 1043.84)	835.00 (671.50, 1067.50)	870.88 (742.25, 1003.63)	0.44	0.17

Table 2: Emotional stroop task data of subjects with functional movement disorders, subjects with essential tremors, and healthy controls.

The results from all health questionnaires are available in appendix A under (Table A.1). Significant between-group differences were found in perceived symptom severity, health-related quality-of-life, number of health care visits, well-being, emotional responses, and health concerns. Subjects with FMD reported significantly more self-perceived severity in their symptoms in the past week than subjects with ET (4.00 vs. 2.00, $p=0.02$) or HC (4.00 vs. 1.00, $p<0.01$). Subjects with FMD felt their work was significantly more impaired because of their problems than subjects with ET (5.00 vs. 0.00, $p<0.01$) or HC (5.00 vs. 0.00, $p=0.01$). Subjects with FMD felt their social lives were significantly more impaired because of their problems than subjects with ET (5.50 vs. 0.00, $p<0.01$) or HC (5.50 vs.

0.00, p<0.01). Subjects with FMD felt their family lives and home responsibilities were significantly more impaired because of their problems than subjects with ET (4.50 vs. 0.00, p<0.01) or HC (4.50 vs. 0.00, p<0.01). Subjects with FMD felt that poor physical or mental health kept them from doing their usual activities (self-care, work, or recreation) on significantly more days than subjects with ET (8.50 vs. 0.00, p=0.03) or HC felt (8.50 vs. 0.00, p<0.01). Subjects with FMD visited a hospital emergency room in the past six months significantly more times than subjects with ET (1.00 vs. 0.00, p=0.01) or HC did (1.00 vs. 0.00, p=0.01). They also stayed overnight or longer in a hospital in the past six months significantly more times than subjects with ET (0.00 [0.00-1.00] vs. 0.00 [0.00-0.00], p=0.05) or HC (0.00 [0.00-1.00] vs. 0.00 [0.00-0.00], p=0.04).

Subjects with FMD rated their physical well-being (fatigue, activity, etc.) significantly worse than subjects with ET (5.00 vs. 9.00, p=0.01) or HC (5.00 vs. 10.00, p<0.01). Subjects with FMD rated their emotional well-being (depression, anxiety, stress, etc.) significantly worse than subjects with ET (5.00 vs. 9.00, p=0.04) or HC (5.00 vs. 10.00, p=0.02). Subjects with FMD rated their intellectual well-being (ability to think clearly, to concentrate, to remember, etc.) significantly worse than subjects with ET (7.50 [4.50-8.50] vs. 10.00 [8.00-10.00], p=0.05) or HC (7.50 [4.50-8.50] vs. 10.00 [9.50-10.00], p<0.01). Subjects with FMD rated their overall well-being as significantly worse than subjects with ET (4.00 vs. 9.00, p<0.01) or HC did (4.00 vs. 10.00, p<0.01).

4. Discussion

In this study, a simple in-clinic neuropsychiatric task of attention-a modified emotional Stroop Interference task-as not able to distinguish with statistical significance between subjects with FMD, ET, and HC. Evaluation of the trend in the data, however, suggests that a larger sample may be beneficial for further investigation. Self-reported questionnaire responses showed significant differences between groups, reinforcing the value of neuropsychiatric assessments in patients with FMD to gain insights into psychiatric comorbidities and possible predisposing, precipitating and maintaining factors. There is a great deal of speculation regarding how abnormalities of attention may lead to disorders of movements, and whether physiological changes seen on functional imaging [10-12] are a cause or an effect of the disorder. Some have subscribed to the Freudian theory that abnormal internally directed attention serves as a defense against focusing attention on a psychological stressor. Others have proposed that a physical or emotional precipitant leads to an “expectation” of a movement that becomes conditioned to the point where it takes precedence over external “bottom-up” sensory data [3, 30]. Through this conditioning, it is proposed that a person learns to focus attention inwardly on the body, as if looking for internal danger. This abnormal fight-or-flight response impairs motor control, and the patient develops a misconnection between what they expect their body to do with what it is actually doing. The patient may begin to overthink normally automatic actions and new movement patterns may become subconsciously programmed and learned by the brain [3]. The intention of this study was not to prove causality but simply to establish whether abnormalities of attentional networks can serve as an ancillary signature to improve physician confidence in the diagnosis of FMD. Unfortunately, this particular dataset cannot support that hypothesis. While the trend suggests that a larger sample size may yield more significant

results, it is also possible that the emotional Stroop interference task which we developed is not the optimal task for identifying attentional bias in this population.

Our exploratory analysis using the health questionnaires yielded several interesting results. First, subjects with FMD demonstrated worse perceived symptom severity despite being matched on level of disability with their ET counterparts. Subjects with FMD also felt they had poorer health and well-being, and more hospital stays compared to the other groups, related to greater anxiety or negative thoughts about health [2, 31]. Depression and anxiety more frequently co-occur in patients with FMD [32], but our study excluded those with BDI scores > 17, so these findings cannot be purely attributed to depression. We did have to exclude a large number of FMD patients due to high BDI scores which were often seen in the absence of endorsement of mood disorder. It is possible that excluding these potentially more typical FMD subjects may have also limited our ability to distinguish between groups on the emotional Stroop task. Our study was primarily limited by small sample size and difficulty recruiting due to exclusion of those with higher BDI scores. We felt that the effect of depression could influence attention independently, thereby biasing our results [33]. Related to the small sample size, we were unable to match our groups for age and gender, but we did match our ET and FMD groups for disability on the mRS which we felt was most important. Since the study occurred at one center, results may not be generalizable to all patients with FMD. Finally, the task we used to measure attention bias was not validated for this purpose and lack of significant findings may suggest limitations of the task itself.

In the future, a study better powered to detect differences between groups should be recruited, and additional attention tasks may be considered. If significant differences can be demonstrated in attentional task performance, subsequent studies may be designed to examine structural and functional changes on MRI to determine which networks are involved and which networks correlate with the proposed dysfunction. In prior studies, tasks of attention have been associated with activation of the anterior cingulate cortex, as well as areas of the dorsal attentional network such as the parietal cortex [28, 34]. Functional imaging studies have demonstrated hypoactivity in the temporoparietal junction (TPJ) associated with FMD. The TPJ is responsible for informing a person if a movement is their own; hypoactivity in this region may result in a perception that a movement is involuntary [3]. Comparing activation of these regions between groups may be of interest in developing an fMRI biosignature or biomarker for FMD.

5. Conclusion

A modified emotional Stroop task was not able to distinguish with statistical significance between subjects with FMD, ET, and HC. Self-reported questionnaire responses showed worse physical and emotional well-being in FMD despite similar estimated disability levels in patient groups, stressing the importance of comprehensive neuropsychiatric evaluations for assessment and treatment planning.

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Conflicts of Interest

The authors have no relevant conflicts of interest for this topic.

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Table A.1: Data from health questionnaires (Appendix document).

	Functional (N=12)	**Essential Tremor (N=11)**	**Control (N=12)**	**P-value**	
Survey	**N(%) Median(IQR)**	**N(%) Median(IQR)**	**N(%) Median(IQR)**	**Functional VS Essential Tremor**	**Functional VS Control**
SS1	4.00 (3.50, 5.00)	2.00 (1.00, 4.00)	1.00 (1.00, 1.00)	0.02	<0.01
SS2	5.00 (2.00, 10.00)	0.00 (0.00, 2.00)	0.00 (0.00, 0.00)	<0.01	<0.01

SS3	5.50 (0.50, 8.00)	0.00 (0.00, 1.00)	0.00 (0.00, 0.00)	<0.01	<0.01
SS4	4.50 (1.50, 8.00)	0.00 (0.00, 1.00)	0.00 (0.00, 0.00)	<0.01	0.01
HRQ1	3.00 (2.00, 3.50)	4.00 (2.00, 5.00)	4.50 (4.00, 5.00)	0.30	<0.01
HRQ2	7.00 (0.00, 30.00)	0.00 (0.00, 10.00)	0.00 (0.00, 0.00)	0.37	<0.01
HRQ3	2.00 (0.00, 15.00)	0.00 (0.00, 5.50)	0.00 (0.00, 2.50)	0.51	0.33
HRQ4	8.50 (0.00, 30.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.03	<0.01
HRQ5				1.00	0.15
Yes	5 (41.67)	4 (36.36)	1 (8.33)		
HCV1	7.50 (3.00, 12.50)	5.00 (2.00, 6.00)	1.00 (1.00, 2.00)	0.39	<0.01
HCV2	1.00 (0.00, 1.50)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.01	0.01
HCV3	0.00 (0.00, 1.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.05	0.04
HCV4	0.00 (0.00, 2.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.06	0.04
WB1	5.00 (3.00, 7.50)	9.00 (7.00, 10.00)	10.00 (10.00, 10.00)	0.01	<0.01
WB2	5.00 (3.50, 9.00)	9.00 (7.00, 10.00)	10.00 (8.50, 10.00)	0.04	0.02
WB3	9.00 (4.50, 9.50)	10.00 (8.00, 10.00)	10.00 (9.00, 10.00)	0.26	0.05
WB4	7.50 (4.50, 8.50)	10.00 (8.00, 10.00)	10.00 (9.50, 10.00)	0.05	<0.01
WB5	4.00 (3.50, 7.50)	9.00 (8.00, 10.00)	10.00 (9.00, 10.00)	<0.01	<0.01
BV1	8.00 (5.00, 10.00)	7.00 (5.00, 9.00)	5.00 (3.00, 8.00)	0.66	0.10
BV2	7.00 (5.00, 8.50)	7.00 (5.00, 9.00)	4.50 (3.00, 8.00)	0.90	0.27
BV3	0.10 (0.00, 0.25)	0.00 (0.00, 0.10)	0.00 (0.00, 0.11)	0.30	0.13
ER1	4.00 (4.00, 4.00)	3.00 (1.00, 4.00)	4.00 (3.00, 4.00)	0.04	0.58
ER2	3.00 (2.00, 4.50)	2.00 (2.00, 4.00)	3.00 (2.00, 4.00)	0.72	1.00
ER3	4.00 (3.50, 4.00)	3.00 (1.00, 4.00)	4.00 (4.00, 4.50)	0.06	0.52
ER4	2.00 (1.00, 2.50)	1.50 (1.00, 2.00)	1.50 (1.00, 3.00)	0.57	0.85
ER5	4.00 (3.50, 5.00)	4.00 (3.00, 5.00)	4.00 (4.00, 4.00)	0.68	0.60
ER6	2.00 (2.00, 3.00)	2.00 (2.00, 3.00)	2.00 (1.00, 3.00)	0.94	0.52
ER7	4.00 (4.00, 4.00)	4.00 (3.00, 4.00)	4.00 (3.50, 4.00)	0.68	0.92
ER8	4.00 (4.00, 4.00)	4.00 (3.00, 4.00)	4.00 (3.00, 4.50)	0.49	0.92
ER9	2.00 (2.00, 4.00)	2.00 (1.00, 3.00)	2.00 (2.00, 3.00)	0.25	0.58
ER1	4.00 (3.00, 4.00)	4.00 (2.00, 4.00)	4.00 (3.50, 4.00)	0.66	0.63
HC1	2.00 (2.00, 3.00)	2.00 (1.00, 2.00)	2.00 (1.00, 2.00)	0.11	0.03
HC2	2.00 (2.00, 2.00)	2.00 (1.00, 4.00)	2.00 (1.00, 2.00)	1.00	0.17
HC3	2.50 (2.00, 3.00)	2.00 (2.00, 3.00)	2.00 (1.00, 2.00)	0.65	0.01
HC4	2.00 (1.00, 3.00)	2.00 (2.00, 2.00)	1.50 (1.00, 2.00)	0.92	0.14
HC5	1.00 (1.00, 1.50)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	0.82	0.35
HC6	1.00 (1.00, 1.00)	1.00 (1.00, 2.00)	1.00 (1.00, 1.50)	0.26	0.30
HC7	1.50 (1.00, 2.00)	1.00 (1.00, 2.00)	1.00 (1.00, 1.00)	0.35	0.03

HC8	1.00 (1.00, 2.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	0.17	0.17
HC9	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.50)	0.49	0.30
HC10	1.00 (1.00, 2.50)	2.00 (1.00, 3.00)	1.50 (1.00, 2.00)	0.23	0.72
HC11	2.00 (1.00, 2.00)	1.00 (1.00, 3.00)	1.00 (1.00, 1.00)	0.87	0.07
HC12	1.00 (1.00, 1.50)	1.00 (1.00, 2.00)	1.00 (1.00, 1.00)	0.83	0.29
HC13	1.00 (1.00, 2.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.50)	0.55	0.69
HC14	2.00 (1.00, 2.00)	2.00 (2.00, 2.00)	2.00 (2.00, 2.00)	0.49	0.64
HC15	1.00 (1.00, 2.00)	1.00 (1.00, 2.00)	2.00 (1.00, 2.00)	0.91	0.44
HC16	1.00 (1.00, 2.00)	1.00 (1.00, 2.00)	1.00 (1.00, 2.00)	0.81	0.82
HC17	1.00 (1.00, 2.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	0.40	0.42
HC18	1.00 (1.00, 1.50)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	0.49	0.74
DE1				0.48	1.00
Yes	2 (16.67)	0 (0.00)	2 (16.67)		
DE2				0.22	0.59
Yes	3 (25.00)	0 (0.00)	1 (8.33)		
DE3				1.00	1.00
Yes	1 (8.33)	0 (0.00)	0 (0.00)		
DE4				1.00	1.00
Yes	1 (8.33)	1 (9.09)	2 (16.67)		
SA1				0.59	1.00
Yes	3 (25.00)	1 (9.09)	2 (16.67)		
SA2				0.59	0.59
Yes	3 (25.00)	1 (9.09)	1 (8.33)		
SA3				1.00	1.00
Yes	3 (25.00)	3 (27.27)	2 (16.67)		
SA4				0.32	0.64
Yes	4 (33.33)	1 (9.09)	2 (16.67)		
SA5				1.00	1.00
Yes	2 (16.67)	1 (9.09)	1 (8.33)		
SA6				1.00	1.00
Yes	2 (16.67)	2 (18.18)	1 (8.33)		
PA1				0.67	0.37
Yes	5 (41.67)	3 (27.27)	2 (16.67)		
PA2				1.00	1.00
Yes	2 (16.67)	2 (18.18)	1 (8.33)		

Table A.1: Data from health questionnaires in subjects with functional movement disorders, subjects with essential tremor, and healthy controls. SS=Symptom Severity, HRQ=Health-Related Quality-of-Life, HCV=Health Care Visits, WB=Well-Being, BV=Body Vigilance, ER=Emotional Responses, HC=Health Concerns, DE=Difficult Experiences, SA=Sexual Abuse, PA=Physical Abuse.

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