Symptomatic Correlates of Six-Minute Walk Performance in Persons with Multiple Sclerosis

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Introduction

There has been increased interest in applying walking performance tests as outcomes in research and practice involving persons with MS. This is based on the associations among walking, disease progression, independence, and quality of life in persons with MS. The 6-minute walk (6MW) test, in particular, has been identified as a valid, reliable, and reproducible test of endurance walking performance. The 6MW test lasts long enough to elicit steady-state aerobic metabolism and 6MW distance has been associated with mobility disability and walking impairment. The 6MW distance further has differentiated between persons with MS and controls.

To date, little information is available regarding symptomatic variables as correlates of 6MW performance. There are empirical, theoretical, and pragmatic reasons for these considerations. Symptoms of fatigue, pain, and depression are prevalent in MS, and symptomatic fatigue and bodily pain have explained differences in parameters of gait mechanics between persons with MS and controls. One recent large-scale survey further indicated that 75% of persons with MS reported fatigue as a symptom that affects mobility. The Theory of Unpleasant Symptoms indicates that symptoms such as fatigue, pain, and depression might influence performance outcomes such as walking, and research based on this theory has indicated that these symptoms were associated with free-living ambulatory activity in persons with MS. Pragmatically, symptoms might represent modifiable targets of endurance walking performance for clinical research and practice, and this is important given that 6MW performance correlates with disability status and community ambulation.

Method

Sample

The sample with MS was recruited from a pool of persons with confirmed diagnoses of MS who had volunteered for previous research studies on physical activity, symptoms, or quality of life over the past 8 years and who resided within the local community (i.e., 50 mile radius of the University). The controls were recruited through a separate e-mail announcement that was distributed amongst University staff, faculty, and administrators. The inclusion criteria for the MS sample were diagnosis of MS, age between 18 and 65 years, and ambulatory with minimal assistance (i.e., walk independently or with a cane or crutch, but not a walker). The inclusion criteria for the control sample were absence of a neurological disorder and matching a previously tested person with MS based on age, sex, height, and weight. There were 33 persons with MS and 33 matched controls who completed the research testing session.

Measures

6MW: The 6MW test was performed in a square, accessible hallway with four corridors that exceeded 50 meters in length and allowed participants to walk without any obstacles or restrictions. Participants were instructed to walk as fast and far as possible, and when necessary, participants used an assistive device. One member of the research team followed approximately 3-5 feet behind the participant with a measuring wheel (Stanley MS50, New Briton, CT) and quantified the total distance travelled in feet.

Fatigue: Fatigue was measured with the Fatigue Severity Scale (FSS).

Pain: Pain was measured with the Short-Form McGill Pain Questionnaire (SF-MPQ).

Depression: Depressive symptoms were measured by the Hospital Anxiety and Depression Scale (HADS).

Neurological impairment: Neurological impairment was measured in persons with MS for descriptive purposes using the Patient Determined Disease Steps (PDDS) scale.

Procedures

Participants completed the battery of questionnaires that included the FSS, SF-MPQ, and HADS-D, and those with MS further completed the PDDS. We collected height and weight data using a stadiometer and all participants then performed the 6MW. Participants received $20 remuneration upon completion of testing.

Method (cont.)

Data analysis

We conducted independent samples t-tests for examining differences in 6MW distance, FSS, SF-MPQ, and HADS-D values between MS and controls. We examined the associations between 6MW distance and FSS, SF-MPQ, and HADS-D values in the overall sample and two subsamples of MS and control. This estimation of non-parametric Spearman rho correlation coefficients (p). We performed a multiple linear regression analysis whereby we regressed 6MW distance on group (MS vs. Controls) in Block 1 followed by FSS, SF-MPQ, and HADS-D in Block 2. If the standardized regression weight for group was attenuated and approached zero between Blocks 1 and 2, this would provide evidence that symptoms accounted for the difference in 6MW distance between persons with MS and controls.

Results

Sample characteristics

There were no differences in age (p=.96), height (p=.73), weight (p=.78), or sex (p=1.00) between samples. The sample with MS consisted of persons with relapsing-remitting MS (85%) who had minimal neurological impairment based on PDDS scores (median score = 2.0, SD = 0.7) and short disease duration (8.3 ± 6.7 years).

Group Differences in 6MW and Symptoms

There were significant differences between groups in 6MW distance (p<.001), FSS (p<.001), and SF-MPQ (p<.002), but not HADS-D (p=.08).

Multiple Sclerosis Sample (n=33)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean score</th>
<th>Standard deviation</th>
<th>Range of scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>6MW (feet)</td>
<td>1524</td>
<td>464</td>
<td>365-2830</td>
</tr>
<tr>
<td>FSS</td>
<td>4.6</td>
<td>1.6</td>
<td>1.3-6.9</td>
</tr>
<tr>
<td>SF-MPQ</td>
<td>5.6</td>
<td>6.8</td>
<td>1-35</td>
</tr>
<tr>
<td>HADS-D</td>
<td>4.5</td>
<td>3.6</td>
<td>0-14</td>
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</tbody>
</table>

Matched Control Sample (n=33)

<table>
<thead>
<tr>
<th>Measure</th>
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<th>Standard deviation</th>
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</thead>
<tbody>
<tr>
<td>6MW (feet)</td>
<td>2136</td>
<td>525</td>
<td>1066-2909</td>
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<tr>
<td>FSS</td>
<td>2.7</td>
<td>1.1</td>
<td>1.0-5.0</td>
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<tr>
<td>SF-MPQ</td>
<td>3.5</td>
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<td>0-18</td>
</tr>
<tr>
<td>HADS-D</td>
<td>2.9</td>
<td>3.3</td>
<td>0-12</td>
</tr>
</tbody>
</table>

Results (cont.)

Bivariate Correlation Analysis

Overall sample: 6MW distance was correlated with FSS (p<.001), SF-MPQ (p<.001), and HADS-D (p<.001) scores. See scatter plot of 6MW and FSS in Figure 1.

MS sample: 6MW distance was correlated with only FSS (p<.001) scores.

Control sample: 6MW distance was correlated with only FSS (p<.001) scores.

Linear Regression Analysis

Group explained a significant (p<.001) portion of variance (R²=37) in 6MW distance (p=.60). The addition of FSS, SF-MPQ, and HADS-D scores explained significantly (p<.001) and incrementally (ΔR²=16) more variance in 6MW distance than group alone. Only group (p=.32) and FSS scores (p=.53) explained variance in 6MW distance.

Conclusion

This study provides new insight into the symptomatic correlates of 6MW performance and identifies fatigue as a possible target of interventions designed to improve walking endurance in MS. Clinicians and practitioners might consider targeting fatigue as a method of managing compromised endurance walking in persons with MS.

Acknowledgments

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