ORIGINAL ARTICLE

Is There a Relationship Between Fatigue Questionnaires and Gait Mechanics in Persons With Multiple Sclerosis?

Jessie M. Huisinga, PhD, Mary L. Filipi, PhD, Kendra K. Schmid, PhD, Nicholas Stergiou, PhD

ABSTRACT. Huisinga JM, Filipi ML, Schmid KK, Stergiou N. Is there a relationship between fatigue questionnaires and gait mechanics in persons with multiple sclerosis? Arch Phys Med Rehabil 2011;92:1594-601.

Objective: To evaluate reported fatigue levels and gait deficits in patients with multiple sclerosis (MS) to determine the relationships that may exist between fatigue in patients with MS and alterations in gait mechanics.

Design: Cross-sectional.

Setting: Biomechanics laboratory.

Participants: Subjects with MS (n=32) and age- and sex-matched controls (n=30).

Interventions: None.

Main Outcome Measures: Fatigue Severity Scale (FSS), Modified Fatigue Index Scale (MFIS), and 36-Item Short Form Health Survey (SF-36) to assess fatigue and general health. Biomechanical gait analysis was performed to measure peak joint torques and powers in the sagittal plane at the ankle, knee, and hip. Correlations were performed between fatigue measures and degree of deficit within each patient with MS for each joint torque and power measure.

Results: FSS score significantly correlated with deficits in ankle power generation at late stance and walking velocity. MFIS score significantly correlated with deficits in peak knee extensor torque and knee power absorption at early stance. SF-36 subscale scores correlated with several joint torque and power variables.

Conclusions: Subjective fatigue rating scale scores alone should not be used as an indicator of motor disability or disease progression as it affects walking performance of patients with MS.

Key Words: General health; Joint power; Joint torque; Neurologic disease; Rehabilitation.

FATIGUE IS ONE OF THE most common symptoms of multiple sclerosis (MS). It is reported by up to 90% of patients and is described as increased weakness with exercise; or as the day progresses, an abnormal constant and persistent sense of tiredness; or fatigable weakness exacerbated by activity or heat.[1-3] Measurement of fatigue in patients with MS is based primarily on the patient's own report, and as a result, the measures are inherently subjective. Fatigue ratings in patients with MS may be affected by the individual's performance self-efficacy and altered sensory input during activity. Also, ratings may be affected if an observer rates the fatigue based on reports of decreased effort due to impaired motor control capabilities.[4]

Because fatigue is a subjectively reported symptom, there currently are no tests or objective signs allowing clinicians to quantify its severity outside of fatigue-related questionnaires.[5] Studies to investigate relationships between fatigue scores have reported weak correlations and noted that fatigue is a multifactorial symptom that may not be explained fully by 1 fatigue scale or another.[1,2] Additionally, changes in fatigue ratings do not correlate with changes in walking performance, which led researchers to suggest monitoring reports of fatigue by using more objective measures.[6] Lack of correlation between fatigue ratings and walking performance may exist because self-reported fatigue scales rely on subjective reporting by patients and therefore cannot differentiate the inability to generate or maintain voluntary force from unwillingness to do so.[4]

MS fatigue symptoms likely are due to central fatigue, which indicates a problem with the neural drive to sustain muscle force.[4] Neural drive also is required to facilitate walking and thus it is feasible to expect fatigue to be reflected as alterations in walking mechanics when patients with MS are compared with healthy controls. This association between specific reports of fatigue and the gait mechanics of patients with MS has not been investigated previously.

The purpose of this study was to evaluate both reported fatigue levels in patients with MS and these patients' deficits in gait mechanics to determine whether relationships exist between fatigue in patients with MS and alterations in gait mechanics. It was hypothesized that because both fatigue in patients with MS and neural control of gait are mediated by supraspinal and spinal inputs,[4,7-9] there would be a significant relationship between reported fatigue levels and alterations in gait mechanics of patients with MS. Additionally, alterations in walking mechanics could lead to increased metabolic cost and overall greater energy expenditure during walking.[10,11] Thus, persons with MS who have greater alterations in walking

List of Abbreviations

A2	peak ankle power generation
EDSS	Expanded Disability Status Scale
FSS	Fatigue Severity Scale
K1	peak knee power absorption
KET	extensor torque at the knee
MFIS	Modified Fatigue Index Scale
MS	multiple sclerosis
SF-36	36-Item Short Form Health Survey

From the Department of Neurology, Oregon Health and Science University, Portland, OR (Huisinga); College of Nursing (Filipi) and Department of Biostatistics, College of Public Health (Schmid, Stergiou), University of Nebraska Medical Center, Omaha, NE; and Nebraska Biomechanics Core Facility, University of Nebraska at Omaha, Omaha, NE (Stergiou).

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Correspondence to Jessie Huisinga, PhD, Dept of Neurology, Oregon Health and Science University, NSI Bldg, Rm 1107, 505 NW 185th Ave, Beaverton, OR 97006, e-mail: *huisinga@ohsu.edu.* Reprints are not available from the author.

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mechanics could have greater fatigue levels. In addition to fatigue measures, general health measures also were investigated and compared with gait measures to determine whether general health perceptions of patients with MS are related to gait mechanics. Because general health perceptions likely are influenced by fatigue levels, it was hypothesized that general health perceptions also are related to deficits in gait mechanics.

METHODS

Patients With MS

The study included 32 patients with MS and 30 age-, weight-, sex-, and height-matched healthy controls. All participants were recruited by our clinicians at the university's medical center Department of Neurology and through advertisements placed with the local chapter of the National MS Society. They provided informed consent in accordance with procedures approved by the university's medical center Institutional Review Board.

Inclusion criteria for patients with MS included cognitive competency to give informed consent as determined by our MS clinician (M.L.F.), age range of 19 to 65 years, and Expanded Disability Status Scale (EDSS) score of 1 to 6.0.[12] There was no requirement for MS disease type for inclusion in the study. Healthy controls were aged 19 to 65 years and free of neurologic, orthopedic, or other comorbid condition that could affect walking mechanics. Exclusion criteria for patients with MS and healthy controls included inability to give informed consent; pregnant, breast-feeding, or within 3 months post partum at the initiation of the study; another neurologic or vestibular disorder; and other comorbid conditions that would affect gait mechanics. Controls were recruited from family members of subjects with MS and through the community to match overall MS group characteristics, but were not matched to individual subjects.

Data Collection Protocol

To evaluate gait mechanics, joint torques and powers from the lower extremities were used to evaluate overall joint muscular contributions and their responses during locomotion. Joint torques and powers were used successfully to classify gait mechanics in the elderly and patients with osteoarthritis, total joint replacement, and anterior cruciate ligament deficiency[13-16] to make surgical decisions[17] and evaluate treatment outcomes in pathologic populations.[18,19] For all data collections, subjects (patients and controls) arrived at the laboratory, where informed consent was obtained. Next, anthropometric data for the lower extremities were obtained and reflective markers were placed according to anatomic location.[20] Figure 1 shows the marker set-up from the frontal plane only. Subjects walked through a 10-m walkway equipped with an embedded force platform (Kistler 9281B)[a] and surrounded with an 8-camera Motion Analysis system (Eagle system).[b] Figure 2 shows a subject walking with a foot striking the force platform. The subject walked through the walkway from the determined starting position while real-time marker position (60Hz) and force platform (600Hz) data were collected simultaneously. When the trial was completed, the patient with MS rested for at least 1 minute. The same process was repeated at least 4 more times to obtain 5 good trials with the subject's footfall landing completely within the forceplate without altering stride. After 5 successful trials, data for the other leg were collected by using the same process. Participants typically needed to complete a total of 15 walking trials to obtain 5 good trials on each side. Finally, patients with MS completed 2 fatigue-specific questionnaires and a general health survey, the 36-Item Short Form Health Survey (SF-36) questionnaire, which are described next.

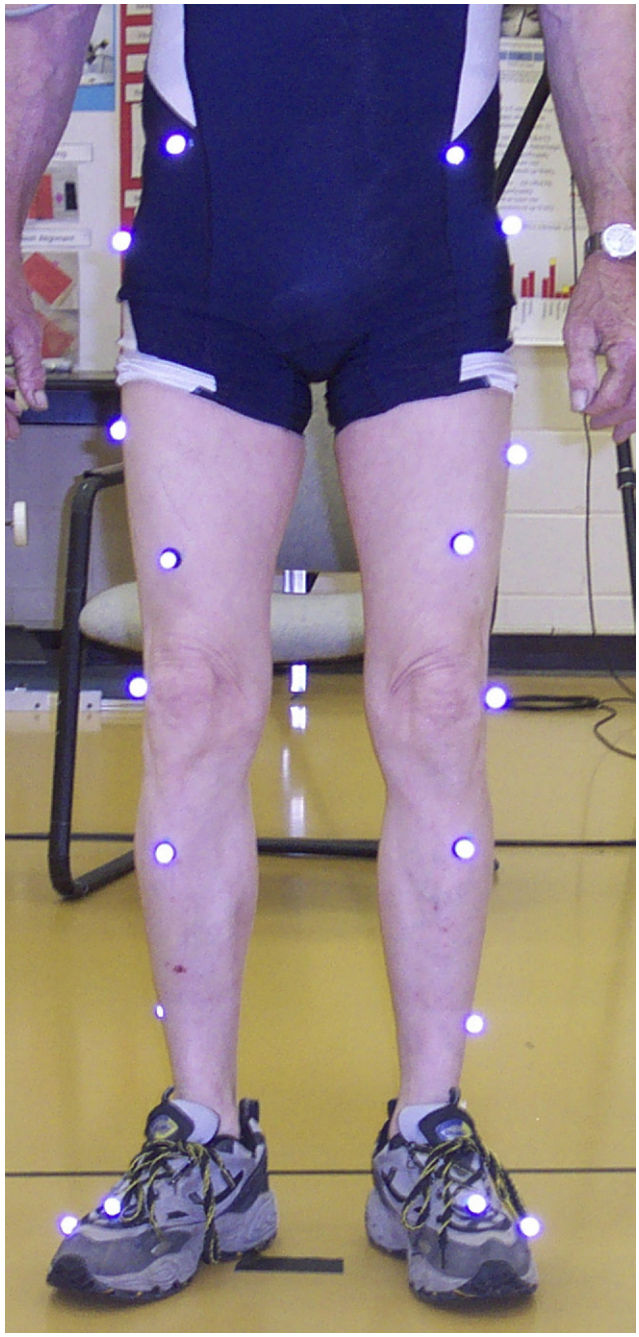

Fig 1. Marker set from the frontal plane.

Qualitative Measures

Fatigue Severity Scale. The Fatigue Severity Scale (FSS) is a method of evaluating fatigue in patients with MS and other conditions, including chronic fatigue immune dysfunction syndrome and systemic lupus erythematosus. The FSS is designed to differentiate fatigue from clinical depression because both share some of the same symptoms. The FSS questionnaire is composed of 9 statements related to patients' subjective per-