Physical Fitness, Walking Performance, and Gait in Multiple Sclerosis

Brian M. Sandroff, Jacob J. Sosnoff, & Robert W. Motl
Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign

Introduction
Walking impairment and deconditioning are prevalent and life-altering physical features of both early and advanced stages of multiple sclerosis (MS). There has been recent speculation that physiological deconditioning (i.e., reductions in aerobic capacity, balance, and muscular strength) contribute to walking and gait impairments in this population.

Purpose
The current study examined the associations among aerobic capacity, balance, and lower limb strength asymmetries, walking performance, and spatiotemporal parameters of gait in persons with MS and controls.

Participants
The sample included 31 cases of MS and 31 controls matched by age, sex, height, and weight (Table 1).

Measures
Aerobic capacity: Aerobic capacity was expressed as VO\(_2\)peak (ml/kg/min) based on an incremental exercise test on a cycle ergometer (Lode BV, Groningen, The Netherlands) using an open-circuit spirometry system (TrueOne, Parvo Medics, Sandy, UT, USA) for analyzing expired gases.

Muscular Strength: Bilateral isometric knee extensor and flexor peak torque were measured using a Humac Norm isokinetic dynamometer (Csmi Solutions, Stoughton, MA, USA).

Balance: Balance was quantified with a force platform (Kistler model 928/B11) and balance was expressed as the total area (cm\(^2\)) of a 95% confidence ellipse of the center of pressure (COP).

Walking Performance: Measures of walking performance included the T25FW and 6MW tests.

Procedure
The study protocol involved two testing sessions with a seven-day period separating the sessions. During the first testing session, the participants completed the T25FW, gait kinematics assessment, balance testing, and 6MW, followed by the assessment of muscle strength asymmetry. One week later, participants returned to our laboratory and completed a demographics form, followed by an incremental exercise test on a cycle ergometer to measure peak oxygen consumption.

Data Analysis
Data were analyzed in PASW Statistics version 18.0 (SPSS Inc., Chicago, IL) using independent-samples t-tests; bivariate Pearson product-moment correlations (r); hierarchical linear regression with direct entry to examine if fitness accounted for group differences in walking performance and gait parameters; and multiple linear regression analyses with stepwise entry to examine the independent contributions of fitness for explaining variance in walking performance and gait parameters in only the MS sample.

Results
There were significant differences in fitness, walking, and gait variables between persons with MS and matched controls (Table 1). Aerobic capacity, balance, and knee extensor asymmetry were associated with walking performance and gait in the overall sample (r’s = -0.2 - -0.7) and in persons with MS (r’s = -0.2 - -0.6) (Table 2). Aerobic capacity and knee extensor asymmetry explained group differences in T25FW performance (\(\Delta R^2 = 0.28\)), 6MW distance (\(\Delta R^2 = 0.29\)), and step length (\(\Delta R^2 = 0.30\)), whereas aerobic capacity alone explained group differences in gait velocity (\(\Delta R^2 = 0.27\)) and time spent in double support (\(\Delta R^2 = 0.34\)) (Table 3).

Conclusions
Such results support (1) the hypothesis that physiological deconditioning might impair walking and gait kinematics in persons with MS and (2) the implementation of multimodal exercise training interventions as a modifiable approach for improving mobility outcomes in this population.