



Physical Activity and Its Correlates in Youth with Multiple Sclerosis

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Objectives To investigate physical activity levels in youth with multiple sclerosis and monophasic acquired demyelinating syndromes ([mono-ADS], ie, children without relapsing disease) compared with healthy controls and to determine factors that contribute to engagement in physical activity. We hypothesized that greater physical activity goal setting and physical activity self-efficacy would be associated with greater levels of vigorous physical activity in youth with multiple sclerosis.

Study design A total of 68 consecutive patients (27 multiple sclerosis, 41 mono-ADS) and 37 healthy controls completed fatigue, depression, Physical Activity Self-Efficacy Scale, perceived disability, Exercise Goal-Setting scale, and physical activity questionnaires, and wore an accelerometer for 7 days. All patients had no ambulatory limitations (Expanded Disability Status Scale, scores all <4).

Results Youth with multiple sclerosis engaged in fewer minutes per day of vigorous ($P = .009$) and moderate and vigorous physical activity ($P = .048$) than did patients with mono-ADS and healthy controls. A lower proportion of the group with multiple sclerosis (63%) reported participating in any strenuous physical activity than the mono-ADS (85%) and healthy control (89%) groups ($P = .020$). When we adjusted for age and sex, the Physical Activity Self-Efficacy Scale and Exercise Goal-Setting scale were associated positively with vigorous physical activity in the group with multiple sclerosis. Fatigue and depression did not predict physical activity or accelerometry metrics.

Conclusions Youth with multiple sclerosis participate in less physical activity than their counterparts with mono-ADS and healthy controls. Physical activity self-efficacy and exercise goal setting serve as potentially modifiable correlates of physical activity, and are measures suited to future interventions aimed to increase physical activity in youth with multiple sclerosis. (*J Pediatr* 2016;179:197-203).

The onset of multiple sclerosis during childhood or adolescence is associated with a high disease burden, as demonstrated by findings on magnetic resonance imaging, frequent relapses early in the disease,^{1,2} and the risk of irreversible motor disability by early or mid-adulthood.³ Children with multiple sclerosis often suffer from depression, fatigue, or cognitive impairment.^{4,5} Physical activity has beneficial effects in adults with multiple sclerosis, including effects on disability progression,⁶ fatigue, quality of life,⁷ and depression.⁸ Physical activity also may have beneficial effects in children with multiple sclerosis, yet little is known about physical activity in children with multiple sclerosis.⁹

We recently documented that youth with multiple sclerosis self-report lower levels of strenuous physical activity than youth with monophasic acquired demyelinating syndromes (mono-ADS). Reduced participation in strenuous exercise was associated with greater disease activity based on lesion load and relapse rate.¹⁰ To date, the observation of lower physical activity in pediatric-onset multiple sclerosis has not been confirmed by objective measurement, such as accelerometry, and we know little about correlates of physical activity in youth with multiple sclerosis. Such information is necessary to justify and design behavioral interventions that increase levels of physical activity and optimize health outcomes in children with multiple sclerosis.

Researchers have applied social-cognitive theory to identify correlates of physical activity in adults with multiple sclerosis and in healthy children. This research has identified self-efficacy,^{11,12} goal-setting,¹¹ and perceived disability¹² as correlates of physical activity. Toward that end, we evaluated physical activity using

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CPM	Counts per minute
EGS	Exercise Goal-Setting Scale
FDI	Functional Disability Inventory
GLTEQ	Godin Leisure Time Exercise Questionnaire
HCS	Health contribution score
METS	Metabolic equivalents
mono-ADS	Monophasic demyelinating syndrome
MVPA	Moderate and vigorous physical activity
PASES	Physical Activity Self-Efficacy Scale

objective and self-report measures in consecutive children with multiple sclerosis, healthy control participants, and children with mono-ADS. The patients with mono-ADS share the experience of central nervous system demyelination but not the chronic, relapsing symptoms of the group with multiple sclerosis and act as a disease comparison group to inform on physical activity engagement. We further assessed correlates of physical activity, including demographic (age, sex, and access to recreational facilities) and clinical characteristics (disease duration, disability, depression, and fatigue) and theory-related determinants, namely self-efficacy, goal-setting, and perceived impediments.¹³

Methods

This cross-sectional study included 68 consecutive patients, 27 with multiple sclerosis and 41 with mono-ADS recruited from the Multiple Sclerosis and Neuroinflammatory Clinic at The Hospital for Sick Children, Toronto, Canada, and 37 healthy control subjects who were recruited by advertisement at the hospital and in the community. Inclusion criteria for the patients with multiple sclerosis and mono-ADS included (1) Expanded Disability Status Scale <4.0 (fully ambulatory); (2) 12-18 years of age; and (3) no steroid treatment or relapse in the past 30 days. Healthy controls were included if they were 12-18 years of age and had no history of any neurologic disorder. Patients in the group with multiple sclerosis were diagnosed with multiple sclerosis following consensus criteria.¹⁴⁻¹⁶

Demographic and clinical variables were collected via a standardized case report form. Study data were collected and managed via REDCap (Research Electronic Data Capture) tools hosted at The Hospital for Sick Children.¹⁷ This study was approved by the research ethics board at The Hospital for Sick Children. Written informed consent was obtained from the participants or their parents or guardians. In cases in which written parental consent was obtained, verbal assent also was provided by the child.

Physical Activity

Accelerometry. Participants wore the ActiGraph 7164 accelerometer (ActiGraph, Pensacola, Florida) proximal to nondominant iliac crest during waking hours, except for when getting wet (ie, showering, bathing, swimming), for 7 days. The ActiGraph monitor has been validated for use in both healthy pediatric¹⁸ and adult populations with multiple sclerosis.¹⁹ The number of light (800-3199 counts per minute [CPM]), moderate (3200-8199 CPM), and vigorous (8200+ CPM) minutes of physical activity were recorded per day and averaged over available days of valid data.¹⁸ One or more valid days of wear (10 hours or continuous wear time confirmed by ActiLife software) was required for the analyses.²⁰

Godin Leisure-Time Exercise Questionnaire (GLTEQ). With parental help as needed, participants completed the GLTEQ²¹ at the end of the 7 days of accelerometry wear. The GLTEQ is a widely used self-report questionnaire to assess physical

activity during a 7-day period that has been validated for use in children.^{19,22,23} We calculated the total leisure activity score in metabolic equivalents (METs) using the following formula: (frequency of strenuous physical activity * 9 METs) + (frequency of moderate physical activity * 5 METs) + (frequency of mild physical activity * 3 METs).^{9,21} The health contribution score (HCS) was calculated with the following formula: (frequency of strenuous physical activity * 9 METs) + (frequency of moderate physical activity * 5 METs).²⁴ The HCS were then subdivided into 3 categories: ≥ 24 units (approximately 14 kcal/kg/week or more) – active (having substantial health benefit); 14-23 units (between 7 and 13.9 kcal/kg/week) – moderately active (some health benefit); and <14 units (less than 7 kcal/kg/week) – insufficiently active (less substantial or low health benefit).²⁴

Physical Activity Terms

Terms used in this report to describe levels of physical activity as measured by accelerometry and questionnaire differ. Accelerometry data follow proposed, standardized terminology as noted perviously (light, moderate, and vigorous).²⁵ To distinguish the questionnaire results, we have used nomenclature as specified in the GLTEQ (mild, moderate, and strenuous).

Other Questionnaires Completed by Participants

The Center for Epidemiological Studies Depression Scale for Children. The Center for Epidemiological Studies Depression Scale for Children is a validated, 20-item self-report depression inventory for children. A score greater than 15 represents the presence of clinically significant levels of depressive symptoms.²⁶

The Varni Pediatric Quality of Life Inventory Multidimensional Fatigue. This scale is an 18-item self-report measure of fatigue in pediatric patients.²⁷ This validated measure has been used perviously in the pediatric population with multiple sclerosis.⁴ It has 3 subscales (General, Sleep/Rest, and Cognitive Fatigue) that when summed yield a total score. Fatigue is considered moderate to severe for subscores greater than 11 and total scores greater than 35.⁴

Physical Activity Self-Efficacy Scale (PASES). The PASES is a validated, 8-item self-report questionnaire that measures children's self-efficacy for engaging in physical activity.²⁸

Function and Disability Inventory (FDI). We included the 15-item, self-report measure of functional limitations derived from the Late-Life Function and Disability Instrument.²⁹ The FDI has been used widely in the pediatric population and has been shown to have construct, concurrent, and predictive value in the pediatric population.³⁰ It has 3 subscales: upper extremity function, basic lower extremity function, and advanced lower extremity function.

The Exercise Goal-Setting Scale (EGS). The EGS is a 10-item, self-report questionnaire that assesses whether participants set exercise goals.³¹

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