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Physical activity in pediatric onset multiple sclerosis: Validating a questionnaire for clinical practice and research

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ABSTRACT

Background: Knowledge regarding physical activity (PA) and its benefits in pediatric onset multiple sclerosis (POMS) is growing and suggests high levels of inactivity. The utility of a validated screening tool for clinical settings is unknown. This study evaluated the Godin Leisure-Time Exercise Questionnaire (GLTEQ) as a measure of PA in POMS.
Methods: POMS patients (n=27) and healthy controls (n=45) wore an accelerometer over a 7-day period and then completed the GLTEQ.
Results: The GLTEQ captured expected group differences in PA for vigorous, moderate, and moderate-to-vigorous physical activity (MVPA), confirmed by accelerometry. There was a large, positive correlation between GLTEQ and accelerometry scores for vigorous PA in POMS (r=0.736, p=0.001), and a nearly significant and moderate, positive correlation between MVPA scores (r=0.319, p=.053).
Conclusion: We provide evidence that supports the validity of GLTEQ scores as measures of vigorous and MVPA in POMS. Researchers and clinicians might adopt this scale for measuring PA.

1. Introduction

Pediatric onset multiple sclerosis (POMS) constitutes approximately 3–5% of all cases of multiple sclerosis (MS) (Chitnis et al., 2009). POMS is characterized by higher disease burden on magnetic resonance imaging (MRI) (Yeh et al., 2009; Chabas and Pelletier, 2009) and slower time to irreversible motor deficit compared with adult onset MS (Renoux et al., 2007; Simone et al., 2002). Youth with POMS experience cognitive dysfunction (Amato et al., 2008), frequent and severe relapses, high rates of fatigue and depression, and reduced quality of life (QOL) (Simone et al., 2002; Amato et al., 2008; Parrish et al., 2013; Goretti et al., 2012). There is evidence that physical activity participation in adults with MS aids in the management of the manifestations of this disease (Motl et al., 2015) and thus can be promoted through healthcare providers (Vollmer et al., 2012). There is a need for similar evidence in POMS, and this necessitates a validated assessment of physical activity levels for researchers as well as clinicians interested in screening whether or not POMS patients are active enough for health benefits.

Increasing knowledge suggests that certain lifestyle attributes, including physical activity, may affect outcomes in POMS (Yeh et al., 2015). This interest in lifestyle is based, in part, on observations that high body mass index (BMI) was associated with POMS (Gianfrancesco et al., 2014; Langer-Gould et al., 2013) and strenuous physical activity participation, as measured by the Godin Leisure-Time Exercise Questionnaire (GLTEQ), was associated with outcomes such as lower T2 lesion volumes and relapse rates in POMS (Grover et al., 2015) as well as the evidence of the benefits of physical activity participation in adults with MS (Motl et al., 2015). Nevertheless, much scientific inquiry still needs to be undertaken regarding physical activity and POMS. The continued study of physical activity in POMS has been highlighted in a recent review (Yeh et al., 2015) and requires measures with evidence for the validity of score inferences (Motl et al., 2015). Indeed, the scientific study of physical activity among adults with MS was significantly accelerated based on evidence establishing the construct validity of scores from self-report outcomes such as the GLTEQ (Godin and Shephard, 1985; Motl et al., 2006). Such evidence of validity is necessary in POMS because its manifestations (e.g., cognitive impairment, fatigue, and depression) could influence the validity of self-report measures of physical activity, and

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one cannot simply assume that the evidence for adults with MS (Gosney et al., 2007) or children from the general population (Koo and Rohan, 1999) support applications in POMS.

The validity of the GLTEQ in POMS can be established by comparison with objective accelerometry using a two-part approach, namely the known-groups and construct validity paradigms (Motl and Sandroff, 2010). This two-part approach requires (a) comparing mean scores from the GLTEQ and accelerometry for capturing expected differences of vigorous, moderate and MVPA between POMS and healthy controls (HCs) and (b) examining and comparing the magnitude of the correlation between scores from the GLTEQ with accelerometry in combined samples of POMS and HC and POMS separately. Accordingly, evidence of score validity (i.e., the degree to which scores from a measurement can be interpreted as a measure of the intended construct) (Messick, 1995) can be established based on the expectation of capturing (a) lower levels of vigorous, moderate and MVPA in POMS than HC with the GLTEQ, which are confirmed with accelerometry, considering the presence and the degree of disease manifestation such as cognitive impairments, fatigue and depression (Parrish et al., 2013; Goretti et al., 2012) and (b) moderate or strong correlations between scores from the GLTEQ with accelerometer outcomes in the combined samples of POMS and HCs that are confirmed in the POMS sample alone.

This study examined the validity of scores from the GLTEQ in POMS patients. We validated the scores using an objective measure of physical activity (i.e., accelerometry) in combination with a nomological net (i.e. hypothesized pattern of differences between groups and correlations among scores) (Cronbach and Meehl, 1955; Landy, 1986). We opted for comparison with accelerometry, as this is a validated and commonly used outcome of physical activity in pediatric populations (Crouter et al., 2013; Puyau et al., 2004) and provides objective metrics for comparison with self-reported behavior. Of note, we have focused on validating scores from the GLTEQ so that this simple and practical measure is amenable for use by clinicians to determine POMS physical activity risk and for inclusion in large, population-based studies of PA in POMS and applications wherein researchers and clinicians do not have resources or experience to include accelerometry.

2. Methods

2.1. Participants

The procedures for this study were approved by the Hospital for Sick Children Research Ethics Board, and all participants and legal guardians provided written informed consent and/or assent. We recruited a sample of 72 subjects for this study (POMS=27; HC=45). The POMS patients were recruited from the Pediatric MS and Neuroinflammatory Clinic at The Hospital for Sick Children, Toronto, Canada. HCs subjects were recruited via word of mouth and flyers around the hospital campus. POMS participants were included if they were (a) 8–18 years old, (b) had Expanded Disability Status Scale (EDSS) scores <4.0, (c) had not received steroids or experienced a relapse in the last 30 days, and (d) if their MS was considered stable. Participants were excluded if there was a presence of non-specific white matter abnormalities and metabolic or infectious etiologies for white matter abnormalities. HCs were included if they (a) were 8–18 years of age and (b) had no previous neurological problems. The demographic and clinical characteristics of the participants are provided in Table 1.

Table 1
Demographic characteristics of POMS and HC.

Variable	POMS ($N=27$)	HCs ($N=45$)	p-Value	Statistic
Sex (% female (n))	18/66.7	30/66.7	1.000	$X^2=0.000$
Age (years)	15.73(3.2)	14.76(3.8)	0.030	$z=0.051$
Race (% white (n))	12/44.4	33/73.3	0.027	$X^2=6.009$
MS Duration (years)	2.03(2)			
EDSS	1.5 (0.5)			

Note. Values are reported as median (IQR) and were analyzed using the Mann-Whitney U Test (age) or chi-square test (sex and race). POMS=pediatric-onset multiple sclerosis; HCs=healthy controls; EDSS=Expanded Disability Status Scale.

2.2. Instruments

GLTEQ. The GLTEQ is comprised of three open-ended questions that measure the frequency (0–7) of strenuous (e.g. jogging), moderate (e.g. fast walking) and mild (e.g. easy walking) exercise for sessions more than 15 min during one's free time in the preceding week (Godin, 2011). The weekly frequencies of strenuous, moderate, and mild activities are multiplied by 9, 5 and 3 metabolic equivalents (METs), respectively, and then summed into a measure of total leisure activity (0–119) in MET/min per week. Importantly, the score of 9 for vigorous/strenuous reflects one, 15-minute bout per week, whereas the score of 9 for light/mild reflects three, 15-minute bouts per week. The health contribution score (i.e., equivalent of time spent in MVPA) is calculated from the frequency of only strenuous and moderate activities. The frequencies for strenuous and moderate activities are multiplied by 9 and 5 METs, respectively, and then summed into a health contribution score (0–98) that reflects MET/min per week. The scores are then classified into three categories: active (substantial benefits; 24 or more MET/min per week), moderately active (some benefits; 14–23 MET/min per week), and insufficiently active (less substantial or low benefits; 13 or fewer MET/min per week) (Godin, 2011).

2.3. Accelerometer

We used the ActiGraph model 7164, accelerometer (ActiGraph Corporation, Pensacola, Florida) as an objective measure of physical activity based on monitoring over a seven-day period under free-living conditions. The device is a small ($2.0 \times 1.6 \times 0.6$ in.) and lightweight (1.5 ounces) accelerometer worn in a pouch on a snug elastic belt around the waist on the non-dominant hip. The single, vertical axis piezoelectric bender element within the accelerometer generates an electrical signal proportional to the force acting on it that is converted into activity counts over a pre-specified period of time (epoch) and then stored in random access memory within the device. The epoch in this study was set to be 1 min. The data from the accelerometers were processed using ActiLife software. The data from each participant's accelerometer were processed into 2 separate Microsoft Excel (Microsoft, Redmond, Washington) files representing wear time and time spent participating in differing levels of physical activity indicated by the number of counts per minute (CPM) recorded during each epoch: sedentary (i.e., ≤ 799 CPM), light (i.e., 800-3199 CPM), moderate (i.e., 3200-8199 CPM), and vigorous (i.e., ≥ 8200 CPM) (Puyau et al., 2002). Accelerometer wear time data were checked against participant recorded wear times from the log sheet, and only valid days (≥ 10 h of wear time without periods of continuous zeros exceeding 60 min indicative of compliance) were included in the analysis. The outcomes for the analyses were average daily minutes for total wear time and minutes of light, moderate and vigorous physical activity per day across valid days of data.

2.4. Procedures

Participants underwent a neurologic exam by a neurologist