BRIEF REPORT

Do Performance-Based Wheelchair Propulsion Tests Detect Changes Among Manual Wheelchair Users With Spinal Cord Injury During Inpatient Rehabilitation in Quebec?

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Abstract

Objective: To quantify and compare the responsiveness and concurrent validity of 3 performance-based manual wheelchair propulsion tests among manual wheelchair users with subacute spinal cord injury (SCI) undergoing inpatient rehabilitation.

Design: Quasi-experimental repeated-measures design.

Setting: Publicly funded comprehensive inpatient SCI rehabilitation program.

Participants: Consenting adult manual wheelchair users with a subacute SCI admitted and discharged from inpatient rehabilitation (N=14).

Intervention: Participants performed 20-m propulsion at both self-selected natural and maximal speeds, the slalom, and the 6-minute propulsion tests at rehabilitation admission and discharge.

Main Outcome Measures: Time required to complete the performance-based wheelchair propulsion tests. Standardized response means (SRMs) were computed for each performance test and Pearson correlation coefficients (r) were calculated to explore the associations between performance tests.

Results: The slalom (SRM=1.24), 20-m propulsion at maximum speed (SRM=.99), and 6-minute propulsion tests (SRM=.84) were the most responsive. The slalom and 20-m propulsion at maximum speed were strongly correlated at both admission ($r=.93$) and discharge ($r=.92$).

Conclusions: The slalom and 6-minute propulsion tests best document wheelchair propulsion performance change over the course of inpatient rehabilitation. Adding the 20-m propulsion test performed at maximal speed provides a complementary description of performance change.

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Most individuals with subacute spinal cord injury (SCI) are taught to propel a manual wheelchair as their primary means of independent mobility during inpatient rehabilitation.[1] During this period, many rehabilitation interventions are concurrently introduced and expected to optimize manual wheelchair propulsion.[1] These interventions often include upper-limb strength and seated postural stability along with optimal wheelchair fitting and positioning combined with basic and advanced manual wheelchair skill or propulsion technique training.[1] Availability, accessibility, acceptability, and quality of these interventions are likely to vary considerably across inpatient rehabilitation programs depending on health care delivery and funding models, for example. Nonetheless, it is essential that physical or occupational therapists quantify how manual wheelchair propulsion performance changes over time, particularly during inpatient rehabilitation.

Currently, they most commonly use functional independence questionnaire(s) with categorical scales (eg, Spinal Cord Independence Measure) or wheelchair skills inventory and assessment tools[2,3] that are often based on dichotomous (eg, Wheelchair Skill Test)[4] or ordinal scales. Although these aforementioned instruments provide valuable information to clinicians, they remain limited in their capability to provide sufficient information for therapists to refine therapeutic interventions and to differentiate or detect change in manual wheelchair propulsion capacity, especially when individuals are judged to be independent at baseline. To overcome these limitations, the use of timed performance-based manual wheelchair propulsion tests appears to be relevant for clinical practice and research protocols.

Inspired by the fact that wheelchair propulsion speed is a good predictor of wheelchair skills[5,6] and the pragmatic characteristics of the most commonly used timed performance-based walk tests, a few manual wheelchair propulsion tests have been proposed over the past years.[7-10] There is a need to determine which manual wheelchair propulsion test can best detect changes in manual wheelchair propulsion performance during inpatient rehabilitation while also considering other barriers to implementation, including assessment time, cost, or needs for specialized equipment and space. Hence, the main objective of this pilot study was to compare the responsiveness of 3 performance-based manual wheelchair propulsion tests (20-m propulsion test, slalom test, and 6-min propulsion test) among manual wheelchair users with subacute SCI during inpatient rehabilitation. Ultimately, this study aims to inform decision-making processes regarding which performance-based manual wheelchair propulsion test best quantifies performance changes during inpatient rehabilitation of manual wheelchair users with subacute SCI.

Methods

Participants

Fourteen adult participants with sensorimotor impairments resulting from a traumatic neurologic level of injury (range, C6-L1) with complete or incomplete lesion to the spinal cord (ASIA Impairment Scale grade A, B, or C) consented to participation on admission to an inpatient multidisciplinary SCI rehabilitation program at the Institut de réadaptation Gingras-Lindsay-de-Montreal, Quebec, Canada (table 1). Individuals with SCI were eligible to participate if they used a manually propelled wheelchair as their primary source of mobility (≥2h/d), had the ability to maintain an unsupported sitting position for at least 30 seconds, had an activity tolerance of at least 45 minutes, where multiple rest periods were available, and were within 2 weeks of rehabilitation admission. Potential participants were excluded if they wore a postoperative thoracolumbar orthosis, had debilitating pain or secondary musculoskeletal impairments involving their trunk or upper extremities, or had any other conditions limiting their ability to complete the manual wheelchair propulsion tests (eg, postural hypotension). Ethical approval was obtained from the Research Ethics Committee of the Centre for Interdisciplinary Research in Rehabilitation of Greater Montreal. Participants

List of abbreviations:

SCI	spinal cord injury
SRM	standardized response mean

Table 1 Characteristics of participants (N=14)

Outcome Measure	Value	Min–Max
Age (y)	32.5±9.8	23.2–58.5
Height (m)	1.77±0.12	1.42–1.91
Weight (kg)	77.2±13.3	59.1–102.7
Body mass index	24.8±4.5	18.3–32.3
ASIA grade		
Motor–total (/100)	46.5±10.7	18–56
Sensory–total (/224)	109.1±44.9	32–172
Neurologic level	C6-L1	
Rehabilitation length of stay (d)	77.3±21.4	46–127
Time to rehabilitation admission (d)	33.6±19.2	11–87

NOTE. Values are mean ± 1 SD or as otherwise indicated.
Abbreviations: ASIA, American Spinal Injury Association; Max, maximum; Min, minimum.

reviewed and signed an informed consent form before entering the study.

Performance-based manual wheelchair propulsion tests

All manual wheelchair propulsion tests were administered by a single physical therapist according to a standardized protocol in an unobstructed indoor smooth and level tiled corridor. Participants completed the 3 performance-based wheelchair tests in a random order within 72 hours after study enrollment and within 72 hours before discharge after a brief familiarization period using their temporary manual wheelchair. Each temporary manual wheelchair was adjusted according to specific wheelchair and seating recommendations made by the multidisciplinary rehabilitation team. These recommendations were periodically reviewed, and wheelchair or seating modifications were made whenever indicated during inpatient rehabilitation (ie, part of routine rehabilitation interventions). During this period, all participants also received approximately 1 hour of physical therapy and 1 hour of occupational therapy direct treatment time during the weekdays. No standardized manual wheelchair skill or propulsion technique training program was offered at the time of the study.

20-m propulsion test

Participants were instructed to propel their wheelchair at both a self-selected natural velocity and at a self-selected maximal velocity from a specified start line until they crossed a finish line set 20m further down the corridor (fig 1A). The average time required to complete the two 20-m wheelchair propulsion tests at a self-selected natural velocity trials and the two 20-m wheelchair propulsion tests at maximal velocity trials, expressed in seconds, was calculated. The 20-m wheelchair propulsion test at a self-selected natural velocity and the 20-m wheelchair propulsion test at maximal velocity were found to be reliable (reliability indices, ≥.981) and precise (relative minimal detectable change, 8.5%).[11] Because the 20-m manual wheelchair propulsion test was performed both at natural and maximum speeds, a 20-m wheelchair propulsion test reserve was also computed as follows: $\{MWPT_{20m\text{-}RESV} = [(MWPT_{20m\text{-}MAX} - MWPT_{20m\text{-}NAT})/MWPT_{20m\text{-}NAT}] \times 100\}$, where $MWPT_{20m\text{-}RESV}$ is the 20-m wheelchair propulsion test reserve, $MWPT_{20m\text{-}MAX}$ is the 20-m wheelchair propulsion test at maximal velocity, and $MWPT_{20m\text{-}NAT}$ is the 20-m wheelchair propulsion test at a self-selected natural velocity.