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ORIGINAL ARTICLE

Reliability of the Test of Wheeled Mobility (TOWM) and the Short Wheelie Test

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Abstract

Objective: To assess the reliability of the Test of Wheeled Mobility (TOWM) and the Wheelie test.

Design: Cohort study.

Setting: Gymnasium.

Participants: Manual wheelchair users (N = 30, age 23–53y) with a spinal cord injury.

Intervention: Participants performed the 30 skills of the TOWM and the 8 skills of the Wheelie test twice. Ability, time, and anxiety scores were assessed on field. Quality scores were assessed by video analysis.

Main Outcome Measures: Test-retest reliability was evaluated for the ability, time, anxiety, and quality scores of both tests. Intrarater and interrater reliability were determined on the basis of quality scores of 20 participants. Intraclass coefficient and nonparametric statistics were applied, as well as standard error of measurement, method error (ME), coefficient variation of ME, minimal detectable change (95% confidence), and technical error of measurement.

Results: Test-retest reliability: no significant differences between t1 and t2 in the ability, quality, and time scores, except for anxiety scores. Standard error of measurement, ME, coefficient variation of ME, and minimal detectable change (95% confidence) values were low for the ability and quality total score and higher for the time and anxiety total score. Intrarater and interrater reliability interclass correlation coefficients of both tests ranged between .91 and .99. Interrater relative technical error of measurement for the TOWM and the Wheelie test total quality score was 3.7% and 6.3%, respectively, and intrarater relative technical error of measurement was 4.3% and 6.1%, respectively. Interclass correlation coefficients per individual tasks ranged between .88 and 1.00, except for "level propulsion forward," which showed low interclass correlation coefficient scores (interrater: .49; intrarater: .44; test-retest: .43).

Conclusions: Based on ability and quality total scores, the TOWM and the Wheelie test are reliable when assessing the wheeled mobility of manual wheelchair users with spinal cord injury. The quality criteria of 1 task from the TOWM and 3 tasks from the Wheelie test need to be refined.

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Wheeled mobility (WM) is a key to independence for a large group of people with a handicap, especially for those who will not return to walking again, such as individuals with a complete spinal cord injury (SCI).[1] Learning wheelchair skills performance is an important part of the rehabilitation process, because for many people with SCI, the wheelchair will serve as the main device for mobility.

WM is defined by the *International Classification of Functioning, Disability, and Health* as "Moving around using equipment: moving the whole body from place to place, on any surface or space, by using specific devices designed to facilitate moving or create other ways of moving around, such as moving down the street in a wheelchair or a walker."[2(p146)]

Participation is also an important rehabilitation outcome for persons with SCI. In the *International Classification of Functioning, Disability and Health*,[2] participation is defined as "involvement in life situations," including, for example, work and school, social relations, and community organizations. Participation restrictions are the problems that an individual may face in involvement in life situations. From the literature, it is known

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that persons with activity limitations experience participation restrictions in daily life and there is a positive relationship between WM skills and participation in persons with SCI.[3]

Therapists should have a valid, reliable, and sensitive measuring tool at their disposal to objectively and systematically assess their patient's level of WM performances, before, during, and after interventions. Currently, several wheelchair skills tests are available, based on actual performance.[4-16]

In a recently published systematic literature review on wheelchair skills tests,[17] results showed that only a few tests focus explicitly on WM in persons with SCI.[8,11,13,14] Wheelchair skills tests that were aimed at the general wheelchair users' populations failed to differentiate between levels of performance and resulted in a "ceiling effect," mainly in individuals with paraplegia.[17] The review study revealed a lack of a broadly accepted wheelchair skills tests, and disclosed large inconsistencies among the current available tests, which made comparison of study results impossible.[17] Furthermore, different scales were applied to express test scores. Some tests used qualitative scales, whereas others used quantitative scales.

A quantitative measurement can be, for example, the time necessary to complete a task or the percentage of a slope. The qualitative measurement has to be well defined. It is not sufficient to apply only a pass/fail scale, because the same level of difficulty can be completed with a different grade of maturity. In this case, it can be useful to incorporate the term "with difficulties," or to also combine a performance time assessment (quantitative and qualitative measurements within the same test). Still, these scales might not be sensitive enough to detect small changes in WM because they only record whether a person can perform a particular task or whether the task is performed independently. Small improvements in the quality of the skill performance often cannot be scored. Nonetheless, these small changes can be of great importance. The way to overcome this problem would be through developing quality assessment criteria for each WM skill. These criteria (based on key components that compose the skill) will reflect the WM maturity proficiency.

Within the scope of a study aimed at promoting a standardized broadly accepted and applicable WM test, the Test of Wheeled Mobility (TOWM) and the short Wheelie tests were developed.[18] The development of these 2 tests was based on experts' opinions and on the outcome of an international survey among users, aimed to create a sorted list of the most essential WM skills.[19] In addition, a systematic critical literature review of available WM skills tests enabled the development of the new tests, relying on strengths of existing tools.[17] The purpose of the TOWM and the Wheelie test is to assess WM skills in manual wheelchair users with SCI during and after clinical rehabilitation, allowing accurate monitoring and assessment of small changes in WM. The TOWM and the Wheelie test are primarily designed for clinical purposes, but they may also be used in a research setting. Both assessment tools were tested for their feasibility and validity with respect to duration, costs, content, construct, convergent, and predictive validity.[18] The protocols of the TOWM and the Wheelie test with descriptions of the tasks as well as testing equipment and score sheets can be obtained at www.scionn.nl/inhoudp28.htm.

The reliability of any new measurement instrument is critical to ensure that the measurement error is small enough to detect actual changes in what is being measured.[20] The nature of reality is such that because of instrument imprecision and human inconsistencies, measurements are not free of error (ie, perfectly reliable). The aim of this study was to assess the reliability and response stability of the TOWM and the Wheelie test. Responsiveness refers to the ability of a measure to detect clinically meaningful change over time, and provides a means for determining whether an individual's change in score is related to true recovery, or to natural variation in repeated performances. Scale responsiveness is an important concept for clinicians in this time of evidence-based practice, and understanding and interpreting the responsiveness of a scale enables clinicians to discriminate true change from measurement error.[21]

Therefore, the objectives of this study were (1) to determine the test-retest reliability and response stability of the TOWM and the Wheelie test on the basis of 4 scales total scores, (2) to assess the inter- and intrarater reliability of both tests' tasks, on the basis of agreement between and within raters, as well as on technical error of measurement (TEM) index (accuracy assessment), and (3) to determine the minimum detectable change at 95% confidence (MDC_{95}) for both tests in a group of manual wheelchair users with SCI.

List of abbreviations:

CI	**confidence interval**
CV_{ME}	**coefficient of variation of method error**
ICC	**interclass correlation coefficient**
MDC	**minimal detectable change**
MDC_{95}	**minimal detectable change (95% confidence)**
ME	**method error**
SCI	**spinal cord injury**
TEM	**technical error of measurement**
TOWM	**Test of Wheeled Mobility**
WM	**wheeled mobility**

Methods

Participants

Thirty wheelchair users with SCI (convenience sample) were recruited during the first 2 weeks of February 2011. Recruitment was performed by word of mouth, e-mail, and telephone calls. All participants were living in Belgium, were post−clinical rehabilitation, used a hand-rim wheelchair, and were between 18 and 65 years of age. Potential participants were not included if they had a current cardiorespiratory disorder or orthopedic or other medical complications that restricted them from performing the tasks required for the TOWM and the Wheelie test. One participant did not attend the retest (t2) because of a recurrence of an old shoulder injury unrelated to the WM testing; therefore, the results of 29 participants were included in the presented data analysis.

All procedures were performed in accordance with the guidelines of the Declaration of Helsinki. The study was approved by the Medical Ethics Committee of the Catholic University of Leuven, Belgium. Prior to participation, all participants signed an informed consent form. Participants were reimbursed for transportation costs.

Measuring instruments

The TOWM consists of 30 standardized tasks that are conditional to mobility in persons with SCI.[18] The short Wheelie test includes 8 tasks that are related to the ability to perform a mature pattern of a wheelie (balancing on the rear wheels). The TOWM and the Wheelie test tasks present different difficulty levels and are