

Reliability of the Performance and Safety Scores of the Wheelchair Skills Test Version 4.1 for Manual Wheelchair Users

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ABSTRACT. Lindquist NJ, Loudon PE, Magis TF, Rispin JE, Kirby RL, Manns PJ. Reliability of the performance and safety scores of the Wheelchair Skills Test Version 4.1 for manual wheelchair users. *Arch Phys Med Rehabil* 2010;91:1752-7.

Objective: To evaluate the interrater, intrarater, and test-retest reliability of the total performance and safety scores of the Wheelchair Skills Test version 4.1 (WST 4.1) for manual wheelchairs operated by adult wheelchair users.

Design: Cohort study.

Setting: University research setting.

Participants: People (N=11) who used manual wheelchairs for community locomotion.

Interventions: Not applicable.

Main Outcome Measure: Participants were videotaped as they completed the WST 4.1 (30 skills) on 2 separate occasions 1 to 2 weeks apart. Subsequently, raters scored the WST 4.1 from the video recordings and each participant received a total score for performance and safety. Using those scores, interrater, intrarater, and test-retest reliability were determined by using intraclass correlation coefficients (ICCs). Percentages of agreement between raters for individual skills also were calculated.

Results: Mean \pm SD overall WST 4.1 scores for performance and safety were 80.1% \pm 8.5% and 98.0% \pm 2.8%. ICCs for the interrater, intrarater, and test-retest reliability of the performance component were .855, .950, and .901 ($P < .001$). Safety component ICC scores were .061 ($P = .243$), .228 ($P = .048$), and .254 ($P = .041$). Percentages of agreement between raters for each test item for both the performance and safety scales ranged from 68% to 100%.

Conclusions: Reliability of the performance component of the WST 4.1 was excellent, whereas ICCs for the safety component indicated only slight to fair agreement, probably because of the low variability in safety scores. Additional study is needed to further evaluate the reliability of the safety component with a larger and more diverse sample group.

Key Words: Outcome assessment (health care); Rehabilitation; Reproducibility of results; Wheelchairs.

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THERE WERE 2.7 MILLION noninstitutionalized users of wheeled mobility devices in the United States in 2002. Using a conservative rate of growth (5.2% a year), this number was estimated to have increased to 3.86 million by 2009.¹ Up to 36% of wheelchair users reported that obstacles such as curbs, uneven terrain (eg, grass, mud, ice), door handles, flooring surfaces, and thresholds were barriers to mobility.² Specific training of wheelchair skills may help overcome some or all of these barriers for selected persons. In rehabilitation or community settings, in which the goal is to improve wheelchair skills, the WST³ can be used to identify skill deficiencies and design interventions that appropriately target those deficiencies. The WST then can be used to assess the results of training or other interventions. Several studies have shown that assessment and training of wheelchair skills leads to improvements in those skills.⁴⁻⁷

Since its inception in 1996, the WST has evolved, with 4 versions (1.0, 2.4, 3.2, and 4.1) released for general use.^{3,8-10} The evolution of the WST has been based on clinical and research experience, feedback from users, and assessments of its measurement properties. The most recent 3 versions include dichotomous grading (pass/fail) of the performance of a set of wheelchair skills necessary for successful wheelchair locomotion in the community. The skill set has evolved by deletions, additions, and combinations of skills. The number of skills assessed has decreased to the current 32. The most recent version (4.1) includes more difficult tasks, such as getting up off the floor and ascending and descending stairs. These were added to better assess advanced wheelchair users and avoid a ceiling effect. However, the most notable difference in version 4.1 compared with previous versions is the inclusion of a safety component. Wheelchair users now receive both a performance and a safety score for each skill, and the number of skills passed for performance and safety are totaled separately to provide 2 total percentage scores.

Inclusion of a safety component for the assessment of wheelchair skills is largely without precedent in the wheelchair

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List of Abbreviations

ICC	intraclass correlation coefficients
R1	first viewing of a trial (rating 1)
R2	second viewing of a trial (rating 2)
T1	first trial
T2	second trial
WSP	Wheelchair Skills Program
WST	Wheelchair Skills Test
WST 4.1	Wheelchair Skills Test version 4.1

literature. Aspects of safety, such as physical strain measured by means of heart rate, perceived task difficulty, and physical cost, have been discussed previously in a systematic review regarding outcome parameters of WSTs.¹¹ However, no test has included a score specific to the safety of the performance of individual tasks. The safety component was added to the WST to reward wheelchair users for improvements in safety or good judgment related to safety, even when the skill was not successfully performed. The addition of the safety component allows a distinction to be made between failure because of unsafe performance and failure because of inadequate yet safe performance. For example, as a result of training, a wheelchair user might progress from an unsafe failure (by attempting the curb descent skill and needing to be caught by the spotter) to a safe failure (by declining to attempt the skill) by learning that he/she was not capable of performing the task without tipping over.

Previous versions of the WST have been found to be valid, reliable, safe, and practical tools to assess functional skills of manual wheelchair mobility.^{8,9} However, the reliability of the WST 4.1, with the slightly revised skill set and the additional safety component, has not been tested. The primary purpose of this study was to determine the interrater, intrarater, and test-retest reliability of the total performance and safety scores of the WST 4.1 for manual wheelchairs operated by adult wheelchair users. Our secondary objectives were to assess the percentage of agreement among raters for individual skills and identify any sources of unreliability.

METHODS

Participants

We studied 11 manual wheelchair users, a sample of convenience. The estimated sample size was determined by means of a power analysis using intrarater ICC values (ICC=.959 and ICC=.950) from previous WST reliability studies,^{8,9} α level of .05, and target power of .80. This analysis showed that a sample size of 9 was recommended to ensure adequate power.¹²

Recruitment and Screening

Participants were recruited through an exercise center for individuals with disabilities and by contacting wheelchair users who had participated in previous research studies through the Physical Therapy Department at the University of Alberta. Inclusion criteria were age older than 16 years, use of a manual wheelchair for more than 1 year and for most personal transport, use of the present wheelchair for more than 1 week, medically stable, and able to perform the WST on 2 separate occasions. Demographic and clinical data were recorded for participants (sex, age, height, weight, diagnosis accounting for wheelchair use) and their wheelchairs and wheelchair-use patterns.

Ethical Issues

The study was approved by the Health Research Ethics Board of the University of Alberta. Each participant was informed of the purpose of the study and signed an informed consent form.

Safety of Testing

To ensure the safety of participants and testers, we took measures included in the spotter procedures of the WSP. A spotter strap was used to prevent backward tips of the wheelchair user during skills with a high risk for tipping. Although these measures decrease the likelihood of injury, they do not

interfere with the ability to assess safety because the spotter does not intervene until a safety criterion has been violated. Adverse incidents were recorded.

Administering the WST 4.1

Each of 4 testers administering and scoring the WST 4.1 received training and certification from the WSP before testing. Training involved a study of the WST 4.1 manual and completion of scoring of 3 sample test videos. Scoring of these videos was discussed later during a teleconference with test developers at Dalhousie University to provide clarification about scoring rules. Certification was received after each individual completed an examination on the WSP administered by the WSP team at Dalhousie.

The WST for manual wheelchair users was administered according to the WST 4.1 manual. There were at least 3 testers on site to perform the testing: 1 to conduct the WST, a second to videorecord the WST, and a third to manage equipment, provide moving obstacles, and provide spotting help as necessary. Testing was conducted at 2 public locations at the University of Alberta, the location dependent on space availability. Of note was the absence of 5° and 10° ramps within the facilities; therefore, 4 skills were omitted (ascent and descent of each). Instead, ascent and descent of a 7.5° ramp was substituted. With this adjustment, we tested 30 skills (listed later) instead of the usual 32 skills in the WST 4.1 for manual wheelchair users. In addition, a minimum of 2 steps was substituted for the minimum of 3 steps outlined in the WST 4.1 manual to conform to available equipment at the 2 facilities.

T1 and T2 were scheduled a minimum of 1 week and a maximum of 2 weeks apart for each participant to minimize learning effects and the effects of natural skill improvement. Each participant completed both WST trials in normal attire and with his/her normal wheelchair configuration. Participants used their own wheelchairs during testing and the same wheelchair for both trials. Tire pressure was assessed at each session and changed if necessary to ensure the same tire pressure for both trials. All trials were videotaped using camera positions that were as consistent as possible.

Skills were performed in an order that minimized location changes and increased efficiency. Before the performance of more difficult tasks (eg, 15-cm curb), screening questions were asked according to the protocol set out in the WST 4.1 manual³ to determine whether the task should be attempted. For example, participants were asked "Can you get your wheelchair down a 15-cm curb? How?"

WST Scoring by Different Raters

After completion of all WST trials, copies of the video recordings were made and distributed to each of 4 raters (A, B, C, D). Video recordings were scored individually according to the WST 4.1 manual, which includes general and specific criteria for performance and safety. For skills for which screening questions were asked, if a participant stated that he/she could not perform a skill, he/she was given a fail grade for performance of that task, but a safe grade for safety. If he/she described a method of performing the skill that the tester deemed unsafe on the basis of criteria set out in the WST 4.1 manual, he/she was given a fail grade for performance of that task and an unsafe grade for safety. Each trial was rated twice (R1 and R2). Each rater viewed the recordings in order from participant 1 to 11. Viewing was permitted during multiple sessions, and raters were allowed to stop and rewind the recordings as necessary to make appropriate judgments. All 4 raters initially viewed T1 of all participants (T1-R1). After a

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