TEST-RETEST RELIABILITY OF THE 3-CONE TEST

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ABSTRACT

There are assessments for measuring wheelchair user skills and propulsion techniques, however, there no assessments of wheelchair maneuverability available for clinical practice. We developed a "3-cone test" would be quick and reliable. The aim of this study was to assess the test-retest intra-rater reliability of the 3-cone test.

A convenience sample of five wheelchair users and seventeen able-bodied completed this study. Each participant completed two 3-cone test trials approximately two weeks apart with a standardized manual wheelchair. Intra-class Correlation Coefficients (ICCs) for the 3-cone test revealed excellent reliability for wheelchair users (ICC= 0.97) as well as able-bodied population (ICC= 0.88).

The 3-cone test is quick, easy to administer and reliable to implement in a rehabilitation setting. The reported ICC values for wheelchair users exceeded the required for individual comparison. This measure of maneuverability appears reliable, but further testing is needed to evaluate its responsiveness to wheelchair modifications.

INTRODUCTION

Wheelchair mobility, which reflects all the activities and participation of wheelchair user (van der Woude, de Groot, & Janssen, 2006) is influenced by a variety of factors including user characteristics (e.g., skill) and wheelchair characteristics (e.g., rolling resistance, maneuverability). Most maneuverability tests assess the linear propulsion ability of wheelchair users (Callahan, Nash, & Cowan, 2011; Cowan, Callahan, & Nash, 2012), or their manual wheelchair skills (Kirby, Keeler, Wang, Thompson, & Theriault, 2015; Smith, Giesbrecht, Mortenson, & Miller, 2016). One laboratory measure to assess wheelchair maneuverability is the turning resistance test (Frank & Abel, 1989). This measure can evaluate the performance of the front caster, but specialized testing equipment is needed, which is not commonly available in clinical settings. There are no clinical assessments that examine the maneuverability of the wheelchair, which is important

We developed the "3-cone test" to assess wheelchair maneuverability quickly and reliably. The purpose of this study was to determine the test-retest, intra-rater reliability of the 3-cone test. Our hypothesis was that the reliability of the 3-cone test would be considered reliable, thus having an intra-class correlation coefficient (ICC) of more than 0.80.

METHODS

Twenty-two, 19 years or older participants were recruited to participate in the study. Convenient sampling was used to recruit both wheelchair users and able-bodied individuals.

Data collection/Procedure

All participants used an *ultralight* elevation wheelchair with a 4-inch caster to perform the 3-cone test. The seat height was adjusted so that participants had adequate contact with the wheelchair rims. During the second session, the wheelchair height was adjusted to the same height. Participants came to the research center two times, approximately two weeks apart. Each participant completed three, 3-cone test trials during each visit.

3-cone test

Three cones were positioned in a straight line, one meter apart from each other. Each cone was placed at the center of a 50cm radius marked circle. The starting point (*point A*) was set 10 meters from the first cone. Participants were requested to wheel from *point A* toward the cones in a straight line and then around the cones in a figure-8 type pattern. After the third cone, participants going around the cones in the opposite direction and moved toward the point B. Participants completed the 3-cone test 3 times and results (in seconds) of all the trials were recorded.

STATISTICAL ANALYSIS

Only data from the last (third) trial were used for analysis. To describe the sample we calculated the mean difference as well as the standard deviation for the third trial of the baseline and second visit for both wheelchair user and able-bodied groups.

We used an intera-class correlational coefficient ($ICC_{2,2}$; two-way mixed) to calculate test-retest intra-rater reliability of the 3-cone test for each group (wheelchair user and able-bodied) separately as well as all participants together.

RESULTS

Error! Not a valid bookmark self-reference. provides the details of the participants. The total wheelchair users were older than able-bodied individuals.

Table 1: Demographic table

Parameter	Mean /(Count)	
	Wheelchair user	Able-bodied
Age (Y)	45	28
Sex (Male)	(4)	(9)
Time since injury (Y)	20	
Hrs. of WC use/ day	11	

The test-retest reliability results yielded a higher $ICC_{2,2}$ for wheelchair user group (.98 for the wheelchair user and .88 for the able-bodied groups). Calculated $ICC_{2,2}$ for all participants was .91 with a 95% confidence interval.

DISCUSSION

This study evaluated the reliability of a novel measure of manual wheelchair maneuverability. The observed $ICC_{2,2}$ values in this study showed excellent intra-session reliability for 3-cone test and verified the presented hypothesis. The 3-cone test is very simple to implement in any rehabilitation setting.

In the future, the 3-cone could be used to evaluate the outcomes of wheelchair-related interventions such as manual wheelchair maintenance programs, since caster maintenance is frequently part of these programs.

Declaration of interest

The authors declare no conflict of interest.

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