Effect of wheelchair maintenance on the total rolling resistance of manual wheelchair

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ABSTRACT

Wheelchair maintenance is generally poor, which negatively affects wheelchair performance and efficiency of manual wheelchair use over time. This may contribute to overuse injuries. Unfortunately, many users lack the knowledge and skills needed to maintain their wheelchairs. This study examined changes in wheelchair rolling resistance pre and post peer-based, wheelchair maintenance training.

Fifteen manual wheelchair users participated in this study. We measured the rolling resistance of their wheelchair before and after wheelchair maintenance training. Trained peer mentors who provided one session of one-on-one wheelchair maintenance training, which included maintenance of users' current wheelchairs, provided maintenance training.

The mean rolling resistance decreased significantly ($p < .001$) from 13.3 N (pre-test) to 11.6 N (post-test) post training. The results suggest that wheelchair maintenance training may significantly reduce rolling resistance. Future experimental studies should confirm these findings and evaluate potential long-term health benefits that may be experienced with wheelchair maintenance.

INTRODUCTION

Wheelchair rolling resistance is affected by variety of factors. Wheelchair rolling resistance may increase when rear wheels are under inflated tires or axles and/or bearings in rear wheels or front casters are poorly maintained (Kwarciak, Yarossi, Ramanujam, Dyson-Hudson, & Sisto, 2009; Sauret et al., 2012; Sawatzky, Kim, & Denison, 2004). Increased rolling resistance increases the work that users need to perform using their wheelchairs (Kauzlarich & Thacker, 1985).

Many manual wheelchairs are not properly maintained and maintenance training has been recommended for users ("WHO | Wheelchair Service Training Package - Basic level," 2013). A wheelchair maintenance program was developed to teach clinicians how to teach maintenance skills, but the impact on wheelchair users was not evaluated (Toro Hernandez, 2016). Peer mentorship has been recommended, as a means of learning new skills (Standal & Jespersen, 2008). Best et al. reported a positive influence of peer training in the wheelchair skill training for manual wheelchair users (Best, Miller, Huston, Routhier, & Eng, 2016).

The purpose of this study was to determine the effect of manual wheelchair maintenance peer training program (I-Wheel) on wheelchair efficiency, primarily, rolling resistance.

Hypothesis

We hypothesized that manual wheelchair maintenance peer-training program would reduce the rolling resistance of participants' wheelchairs.

METHODS

The study used a pre-post test design.

Participants

Participants were recruited via posters and advertisement on the research center's website. A convenience sample of 15 wheelchair users were recruited. To be part of the study users needed to be >18 years, wheelchair users, able to provide their own consent and use a wheelchair as their primary means of mobility. Participants were required to attend the research center three times on three non-consecutive days with their manual wheelchair. (Two visit for data collection and one visit for wheelchair maintenance training). They were allowed to bring an assistant or ask for an assistant to complete the wheelchair training session (second visit). Participants completed their maintenance training during the second visit. All participants were informed and signed the university approved consent form.

Data collection/Procedure

To perform the Drag test (de Groot, de Bruin, Noomen, & van der Woude, 2008), we mounted a force transducer (OMEGA Engineering, Inc., Stamford, CT, USA) on wheelchair treadmill (Max Mobility, LLC, Antioch, TN, USA) and then connected the participant's wheelchair frame to the force transducer using non-elastic rope. A drag force test was performed while participant, sat passively in their wheelchair on a treadmill at a constant speed of 1.1m/s (Cowan, Boninger, Sawatzky, Mazoyer, & Cooper, 2008). Results from the drag test and recorded mass (combined wheelchair and participant) were used to calculate the rolling resistance. The wheelchair drag test was performed during pre and post training visits.

Intervention

Mentors were trained during an intensive full-day workshop, which was performed by an experienced equipment specialist. Each mentor was provided with a maintenance toolkit and an I-WHEEL maintenance-training syllabus, which was used during all training sessions (Eshraghi, Mortenson, Ian, & Sawatzky, 2016). Each mentor provided three hours of hands-on manual wheelchair training to each mentee.

STATISTICAL ANALYSIS

We performed paired T-test to determine if there was a significant difference between pre and post training sessions for rolling resistance.

RESULTS

Table 1 reports the demographic information about the participants. The participants mean age was 51 years, and 80% of them were male.

Table 1: Demographic table

Parameter	***Mean /(Count)***
	Participant
Age (Y)	51
Sex (Male)	(12)
Length of Injury (Y)	15
Hrs. of wheelchair use/ day	10

As noted in Figure 1, the mean rolling resistance decreased significantly ($p < .001$) from 13.3 N (pre-test) to 11.6 N (post-test) post training.

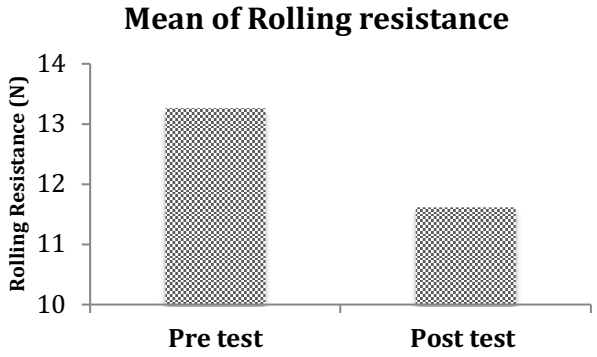

Figure 1: Pre and Post Rolling Resistance

DISCUSSION

Results from this study supported our hypothesis that following peer mentorship, a maintained manual wheelchair would have less rolling resistance. This suggests that peer training may be effective ways of improve

wheelchair efficiency, but this would need to be verified in future research.

Declaration of interest

The authors declare no conflict of interest.

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