Powered Wheelchair Skills Training for Persons with Stroke: A Randomized Controlled Trial

Anita Mountain, R. Lee Kirby, Cher Smith, Gail Eskes, Kara Thompson

Division of Physical Medicine and Rehabilitation (Mountain, Kirby) and Research Office (Thompson), Department of Medicine, Department of Psychology (Eskes), Dalhousie University, Department of Occupational Therapy, Capital District Health Authority (Smith), Halifax, NS, Canada

ABSTRACT

To test the hypothesis that people with stroke using powered wheelchairs who receive formal wheelchair skills training improve their wheelchair skills to a significantly greater extent than participants in a control group who do not, we conducted a randomized controlled trial. Seventeen participants (including 9 with spatial neglect) who were engaged in inpatient stroke rehabilitation were randomly allocated to the Intervention (n=9) or Control (n=8) groups. Those in the Intervention group received powered wheelchair-skills training in up to 5 30-minute sessions. At baseline (T1), the mean total percentage Wheelchair Skills Test (WST) 4.1 scores for the Intervention and Control groups were 57.4% and 55.8%. A rank order Analysis of Covariance (ANCOVA) on the post-training (T2) WST score, having adjusted for the T1 score and the presence of spatial neglect, showed a significant effect due to group (p = 0.020) but not due to neglect. People with stroke, including those with spatial neglect, who receive formal powered wheelchair skills training improve their powered wheelchair skills to a significantly greater extent (39%) than participants who do not (3%).

BACKGROUND

The World Health Organization (WHO) has published guidelines on the provision of wheelchairs that include an 8-step service delivery process (WHO, 2008), one of which is user training. The Wheelchair Skills Training Program (WSTP) is a training protocol that is applicable to both manual and powered wheelchairs (Kirby et al, 2013). The WSTP combines recommendations on how to perform each skill with recommendations on how to teach motor skills. The WSTP has been shown in several randomized controlled trials (RCTs) to result in larger improvements in manual wheelchair skills than standard rehabilitation programs (MacPhee et al, 2004; Best et al, 2005; Tangasagulwatthana et al, 2010; Ozturk et al, 2011; Routhier et al, 2012).

However, for powered wheelchairs there have only been 2 small uncontrolled studies of the WSTP. In the first study, Mountain et al (2010) carried out a pilot study of 10 people with stroke (6 with neglect), examining the participants'

abilities to safely learn to use a powered wheelchair. The participants each received 5 30-minute WSTP training sessions. The total percentage Wheelchair Skills Test (WST) 3.2 capacity score improved from a mean of 25% at baseline (a median of 6.0 weeks post-stroke) to 72% post-training (p = 0.002). In the second study, Archambault et al (2010) carried out a study on 5 new powered wheelchair users, each of whom had 3 one-hour sessions of WSTP training. The total percentage WST 4.1 capacity score improved from a mean of 84% at baseline to 97% post-training. These preliminary studies suggest that people (including those with stroke) can improve their performance of powered mobility skills with training.

PURPOSE

The primary objective of this study was to test the hypothesis that people with stroke who receive formal powered wheelchair skills training improve their wheelchair skills to a significantly greater extent than participants in a control group who do not. Our secondary objective was to explore the influence of neglect on the capacity to learn powered wheelchair skills.

METHODS

Study Design
This was a randomized controlled trial (RCT).

Ethical Issues
The study was approved by the Research Ethics Board of the Capital District Health Authority. All participants provided informed consent.

Recruitment and Screening
Potential participants were initially approached by clinicians involved in their care. Screening was done by these clinicians and a research assistant using data gathered from chart review and interview. Each participant met the following inclusion criteria: was a person with a primary diagnosis of stroke; was competent to provide informed consent; was willing and able to participate (as evidenced by completion of at least the baseline assessment); required no more than minimal assistance for communication; was able to attend during a 20-minute therapy session; was able to be

safely seated in the powered wheelchair that we used for the study; had no significant visual impairment; was not currently using a power wheelchair; and had no physical or mental health conditions that would make participation dangerous.

Demographic, Clinical and Wheelchair-Usage Data

To describe the sample, we collected demographic, clinical and wheelchair-usage data. We also performed some relevant baseline cognitive and perceptual tests, specifically the Montreal Cognitive Assessment (MOCA) (0-30), a standardized test of overall cognitive ability, the Behavioral Inattention Test (BIT) (0-139), a widely used standardized test of spatial neglect and the Test of Praxis (0-10), a measure of motor planning and programming that reflects on one's ability to learn new motor skills.

Powered Wheelchair

All participants used the same mid-wheel-drive powered wheelchair for the testing and training activities. This wheelchair had tilt function, but not recline. The wheelchair was fitted with an attendant emergency shut-off switch that could be activated if any serious safety concerns arose.

Group Allocation

We used a stratified block randomization strategy. Using a computer-generated table of random numbers, participants were allocated into two equal-sized groups (Intervention and Control) and stratified by the presence or absence of spatial neglect (defined as an impaired score on at least one subtest of the BIT).

Wheelchair Skills Training

Participants in the Intervention group completed up to 5 30-minute one-on-one training sessions, at a target frequency of 3-5 sessions per week, aimed at improving their powered wheelchair skills. The training sessions were conducted using the principles and procedures of the WSTP 4.1 (Kirby et al, 2013). Control-group participants received no training sessions with a powered wheelchair other than what they may have received as part of their standard rehabilitation. Although we recognized that the participants in the Intervention group received attention as part of the skills training, we elected not to use an active Control intervention because we did not believe that attention alone would have an effect on the outcome measure used (an objective test of wheelchair skills).

Outcome Measure

The outcome measure was the total percentage capacity score of the powered wheelchair version of WST 4.1. The measurement properties of the WST have been reported. WST 4.1 for powered wheelchairs is a standardized assessment of 32 powered wheelchair skills. Each skill was objectively assessed (pass/fail) on the basis of explicit evaluation criteria (Kirby et al, 2013). The total percentage WST score was the number of passed scores divided by the number of possible skills x 100%. As noted above, the wheelchair used in this study did not have a recline function so the study was carried out on 31 skills.

Procedure

After recruitment and informed consent, we collected demographic, clinical and wheelchair-usage data from the participant and chart review. The participant then underwent a series of evaluations (the MOCA, BIT, Test of Praxis and WST) to determine his/her baseline (T1) status. The Intervention group received training. After a minimum of 3 days post-training for those participants in the Intervention group, the T2 WST was administered. Control-group participants completed the T2 WST two weeks after the first test (comparable to the latency between the pre- and post-training WSTs for the Intervention group).

Data Analysis

Group comparability was assessed by comparing variables from the baseline assessments. To address the study objectives, we performed a rank order analysis of covariance (ANCOVA) (because the data did not meet the assumption of normality and homogeneity of variance) on the outcome of WST change score (T2 minus T1), treating the T1 score as a covariate. The group x T1 WST score interaction was also evaluated, thereby looking at any influence of T1 score within the groups. A secondary analysis was performed including spatial neglect (presence or absence) as an additional factor.

RESULTS

During the period of enrollment, there were 256 patients with a primary diagnosis of stroke admitted to our rehabilitation center. Assuming that ~40% of them were wheelchair-using, the potential pool of participants was ~102. Of these, 28 were formally screened, of whom 5 did not meet the inclusion/exclusion criteria. The remaining 23 were enrolled and randomly allocated to group. There were 6 drop-outs between T1 and T2, 3 from each group. There were no obvious differences between the people who dropped out and those who did not.

For the 17 participants who completed the study (9 from the Intervention and 8 from the Control group), the mean age was 54 years, 71% were men, the mean time since the strokes was 41 days, there were more right than left hemisphere strokes, most of the strokes were ischemic in etiology, the mean MOCA score was 23/30, the mean BIT score was 120/139, 47% of the participants had neglect, the mean Test of Praxis score was 9.6/10, the median duration of wheelchair use was 4.8 weeks, the median hours of wheelchair use was 7 hrs/day and 71% of participants had previous automobile-driving experience. There were no

significant differences between the Intervention and Control groups at baseline, with the exceptions that the mean MOCA score was higher in the Intervention group (p = 0.027) and there was a slightly higher proportion of people with strokes due to hemorrhage in the Control group (p = 0.043).

Regarding the total WST scores, there was no difference between the Intervention and Control groups at baseline with mean values of 57.4% and 55.8% respectively (p = 0.887). The WST change score value (T2-T1) for the Intervention group was significantly higher than that for the Control group with median values of 22.6% and 1.6% respectively (p = 0.041) on the Wilcoxon test. The relative improvements (mean change score/mean T1 score x 100%) were 39% for the Intervention group and 3% for the Control group. The rank order ANCOVA on the T2 WST score, having adjusted for the T1 score and neglect, showed a significant effect due to group (p = 0.020) but no significant difference related to the presence of spatial neglect.

DISCUSSION

We accomplished our study objectives, corroborating the hypothesis that people with stroke using powered wheelchairs who receive formal wheelchair skills training improve their wheelchair skills to a significantly greater extent than participants in a control group who do not. There was no significant impact on improvement related to the presence of spatial neglect. The magnitude of the improvements seen in this study are consistent with those of the uncontrolled study on powered wheelchairs for people with stroke carried out by Mountain et al (2010) and greater than the magnitude of improvements seen in RCTs carried out on manual wheelchairs.

Study limitations include the small sample size, the absence of an active control, the use of a single powered wheelchair, the lack of opportunity to practice between training sessions and the lack of follow-up data. Future studies will be needed to address these study limitations and to extend this work to other groups of powered wheelchair users.

Despite the study limitations and the need for further study, this is the first RCT looking at the WSTP for powered wheelchairs. Our findings are significant in lending evidence for the training step of the WHO service-delivery process, in extending the promise of formal wheelchair skills training from manual to powered wheelchairs and in reassuring clinicians that many people with stroke, even those with spatial neglect, can learn to use powered wheelchairs.

CONCLUSIONS

People with stroke, including those with spatial neglect, who receive formal powered wheelchair skills training improve their wheelchair skills to a significantly greater extent than participants who do not. This finding has significance for the wheelchair-provision process for people with stroke.

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