Development of a training program for manual wheelchair skills and an assessment of effects of training on participation

Keri DeGroot

Completed for:
David Gray, Ph.D.

Rough Draft 6/30/05
Problem/Issue

Several different factors affect the participation of those using manual wheelchairs. The type of chair, physical ability of the user, and kinds of support the user has can all influence engagement in life activities (Coolen, et al, 2004). Environmental factors can drastically affect the participation of individuals using manual wheelchairs. Natural and architectural barriers encountered may include curbs, narrow aisles, tight spaces, poor sidewalks, and high-pile carpets (Routhier, et al, 2003). While laws are now in place to require removal of many of these barriers, MacPhee and colleagues (2004) note that, “An alternative and complementary approach to enhancing access is to teach wheelchair users the skills they need to overcome these barriers safely and efficiently.” For example, a curb may be a major barrier to a person in a manual wheelchair, but if that person has the ability to pop a wheelie and power him or herself over the curb, the curb is no longer a significant barrier. Other obstacles that a wheelie or partial wheelie may help overcome include: thresholds, uneven surfaces, and inclines (Kirby, et al, 2001). Attention should be paid to the quality of training people are given when they receive a wheelchair. Not only do manual wheelchair users need to know basic skills such as propelling up inclines and manipulating features of the wheelchair, but they need to know how to perform more advanced skills and how to effectively propel their wheelchairs in order to increase participation and decrease the risk of injury due to repetitive stress. Training may make an enormous impact on a person’s independence (Kilkens, et al, 2004, Kilkens et al, 2003) and should not be confined to rehabilitation settings, but should be available to people with mobility impairments living in the community and carried out within natural environments (Routhier, et al, 2003).

Testing of mobility skills for manual wheelchair users can be examined under the three “tenses” of function, the hypothetical, or “can do,” the experimental, or “could do,” and the
enacted, or “do do” (Glass, 1998). Examples of these tenses would be asking someone if they could perform a wheelie (“can do”), requiring someone to perform a wheelie in a clinical setting (“could do”), and observing a person in everyday life to see if he or she uses wheelies (“do do”). Current training programs and assessments of wheelchair skills only get at the “could do,” or “experimental” tense of function, but performance of those skills in a controlled environment says nothing of whether the person actually performs those skills on a daily basis. Researchers currently do not follow participants and evaluate them in the home and community, so no assessments exist to show what people are actually doing in their everyday life. In evaluating wheelchair training programs, the enacted skills of daily life need to be examined (Glass, 1998). Excellent!!

Several different kinds of measures exist for evaluating the skills of manual wheelchair users. Many skills tests for manual wheelchair users do not include functional skills needed for independence in the home and community (Stanley, et al, 2003). Some measures involve performance of the skills in a clinic, others use virtual reality, and very few others test within the home or community (Routhier, 2003). The majority of existing measures of manual wheelchair skills do not include measures of participation an outcome. The performance of the skill in a controlled environment is of importance to researchers, not whether or not the person performs those skills on a daily basis, or if the acquisition of those skills has changed his or her life in any way. An ideal measurement would include engagement in life activities as an outcome.

Theories

Factors affecting the mobility of manual wheelchair users are complex and numerous. Routhier, et al (2003) concluded that an assessment of skills needs to encompass all influences, including, “the user’s profile, the wheelchair, the environment, the daily activities and social roles and the assessment and training received.” This view fits well within a person-environment-
occupation (PEO) framework. The PEO theory explains that person factors (abilities, limitations, motivation, etc.), environment factors (support, architecture, attitudes, etc.), and occupation factors (what the person wants and needs to do) all interact to influence occupational performance. Few measures exist, however, which measure all of these components which influence manual wheelchair users’ mobility and participation.

The Independent Living Paradigm rests on the philosophy that people with disabilities have the right to maximum control over their own lives and are entitled to the same rights and respect as able-bodied people (Martinez, DeJong, 1979). The medical model is refuted by the IL-paradigm, as the model suggests that disability comes from within a person’s ability, and is not the fault or responsibility of society. The IL movement has thus influenced thinking about environmental barriers and society’s responsibility to remove them. The medical model emphasizes treatment in the acute phase, but not beyond out into the community, which is what type of care people with disabilities need (DeJong, 1979). Wheelchair skills training should be made available and assessed well passed the acute and rehabilitation phases of people with disabilities. DeJong believes that those with disabilities can reach adequate independence without the help of therapists. This in an extreme viewpoint and people with disabilities who use wheelchairs can most likely become more independent through training by rehabilitation professionals. Caution must be taken, however, to ensure that training and assessment of wheelchair skills is done within the context of a partnership between therapist and client and is performed in the user’s natural environment in order to maximize independence and give a holistic view of the person.

The International Classification of Functioning (ICF) was developed to go along with as a companion classification to address health issues beyond those in the International Classification of Disability (ICD) in order to give health care professionals and others an impression of the impact
that a disease or condition has on one’s life. In other words, the ICF gives a picture of the “lived experience” (Gray & Hendershot, 2000). The ICF gives a loose definition of participation and includes the role of environment in influencing participation of people with disabilities. Adding these components helps people look at wheelchair skills and the factors that affect them in a more holistic way. The flaw in the ICF, however, is that participation is viewed only as limitation and not as what a person is actually doing (Gray, et. al, in review). Measurement of wheelchair skills must include the notion that participation can positive as well.

**Review of Current Wheelchair Skills Training Programs and Assessments**

Several tests and training programs for wheelchair skills exist. In addition to those specifically reviewed in this paper, Harvey et al, (1998) developed six core skills for testing with people who have paraplegia, and several others have been developed such as the Tufts Assessment of Motor Performance (TAMP), and the Wheelchair Obstacle Course (WOC) (Kilkens, et al, 2003). Three assessments and training programs will be reviewed for the purposes of this paper.

DEVELOP THESE FOR PUBLICATION VERSION?

The Wheelchair Skills Training Program (WSTP) and Wheelchair Skills Test (WST) version 2.4 were developed in Nova Scotia by Kirby and colleagues. Several studies are published on the development and evaluation of this measure (MacPhee, et. al, 2004, Coolen, et. al, 2004, Kirby, et. al, 2004). The WST has four levels of wheelchair skills: basic, maneuvering and ADL, obstacle-negotiating, and advanced. Skills evaluated within these categories include brakes, armrests, footrests, level propulsion, turns in place, moving turns, 3-point turns, parallel parking, reaching floor, reaching knapsack, reaching high objects, transfers, fold/open wheelchair, doors, threshold, side slope, incline, gravel, irregular surface, curb (low), stationary wheelie, wheelie, forward/backward, wheelie, turn in place, wheelie, moving turns, and curb (high). Version 2.4 of
the WST includes 50 items in contrast to the 33 in version 1.0. Scoring is done on a 3-point scale: 0 for failure, a 1 for pass, and N/A for non-applicable skills. Participants undergoing the WSTP showed significant improvement over a group receiving standard skills training, and the WSTP was proved to be a safe and effective training program. (MacPhee, et. al, 2004). One big advantage to this assessment is administration time. In one study, administration took an average of 27 minutes, making this assessment practical for many settings (Kirby, et al, 2004). Criticisms of this program and test include that many of the items are non-functional (Kilkens, et. al, 2004, Stanley, et al, 2003), and participants are not followed after rehabilitation discharge. This means that the researchers are getting at the “could do,” but not the “do, do” of wheelchair skills and participation. Further modifications to this test may be published in the future (Kirby, et al, 2004).

The Wheelchair Circuit, developed by Kilkens, et al, (2004) is another test of manual wheelchair mobility. The eight components of wheelchair mobility measured are: figure of 8 shape, crossing a doorstep, mounting a platform, 15m sprint, 3% slope, 6% slope, wheelchair propulsion, and transfer (Kilkens, et. al, 2004). Most items are scored on an ability scale of 1 or 0, 0 meaning the participant cannot perform the item within the specified amount of time, and 1 meaning the participant could perform the item correctly within the amount of time specified. The Wheelchair Circuit includes performance time and physical strain in the evaluation in addition to performance ability on many of the items in the test. This scoring is a valuable component to wheelchair skills testing, as a person can only be truly independent if he or she can perform a functional task within an acceptable period of time. A person may be able to complete a task before and after training, but may improve drastically on the time needed to complete the task. The addition of these measures makes this test more responsive to changes and improvements and provides a more detailed description of the person’s wheelchair skills. One criticism of this test, however, is that the tool was
developed for and tested on mainly individuals with spinal cord injury. Although this population makes up a large part of manual wheelchair users, several other conditions exist which result in the need to use a wheelchair. Tests of wheelchair skills should reflect this and be developed for a variety of mobility impaired populations.

The Wheelchair Users Functional Assessment (WUFA) was developed to address the need for a “performance based functional measurement tool” which does not penalize people for the use of a wheelchair and incorporates home and community skills in testing (Stanley, et al, 2003). Thirteen items are tested: Tight space, uneven terrain, door management, street crossing, negotiating a ramp, negotiating a curb, bed transfer, toilet transfer, floor transfer, bathing, upper and lower extremity dressing, reaching, and picking up objects/sweeping. Although some of these tasks involve moving the wheelchair and some are doing other tasks while in a wheelchair, all are applicable skills needed to be independent in the home or community. The WUFA uses a scoring scale of independence much like the Functional Independence Measure (FIM), but the difference between a 6 and a 7, the highest levels of independence, are based on time taken for the person to complete the task. Like the Wheelchair Circuit, the WUFA’s inclusion of time is helpful. Another big advantage to the WUFA is that the test was created with several different mobility limited populations in mind, instead of only considering people with spinal cord injury. The authors of this test sought to improve on the weaknesses of other current measures, but the test takes 1-1.5 hours to complete, and may not be practical for many settings. The authors state, “Like the FIM, the WUFA is a performance-based tool versus a capacity-based tool. This means that the individuals actually perform the task versus just saying they could do it even if they usually do not.” What the authors do not realize is that they are still not getting at the “do do” of function that Glass (1998) advocates is so passionate about. Performance-based measures have moved beyond the
hypothetical “can do,” but have stopped at the experimental “could do” in a laboratory setting without measuring what people are actually doing in their daily lives. WONDERFUL

A combination of the components of these three measures of wheelchair skills may prove the most comprehensive measurement tool. For example, a new measure should include the performance time and physical strain components of the Wheelchair Circuit in order to ensure responsiveness to change. Functional items should be used instead of many of the WST’s wheelchair parts skills. Several of the tests took place in standard wheelchair (Kilkens, et. al, 2004, MacPhee, et. al, 2004). If one is measuring what the person actually can do, the testing and training should be carried out in one’s own wheelchair. All of these measures, and several others in the literature, are still missing participation as an outcome and assessment in the enacted tense of function. Even if a measurement is responsive to changes over time, researchers need to be evaluating the “so what?” If time taken to wash one’s face at a sink using a wheelchair is reduced, does that mean that the person has more time to go out and do the things he or she likes to do? In order to comprehensively assess the effectiveness of wheelchair skills training, a person’s participation must be considered (Kilkens, et al, 2003), and ability should be measured objectively in the participant’s natural environment.

One problem with using these measures on participants who have been using a wheelchair for at least one year is that basic wheelchair skills training is most likely not needed. However, two components of training in wheelchair skills may prove beneficial to this population. More advanced skills, such as wheelies, are only mastered by few manual wheelchair users (Coolen, et al, 2004) and can be incredibly helpful in negotiating obstacles (Kirby, et al, 2001). Also, not all manual wheelchair users have very efficient pushrim propulsion, which may increase their risk of repetitive
stress injury to the shoulder, elbow, or wrist (Robertson, et al, 1996). A wheelchair skills training program for individuals already accustomed to their wheelchairs should include these elements.

Wheelies are an advanced wheelchair user skills that few know how to do because of fear, disinterest in learning, or deficient training/skills (Kirby, et. al, 2004, Kirby, et al, 2003). Wheelies have been trained using different strategies of balance: the reactive balance strategy (RBS) and the proactive balance strategy (PBS) (Bonaparte, et. al, 2004). RBS is a strategy of balancing in one place, and only making movements to react to displacement in order to get ones’ center of gravity under the base of support, while PBS is a strategy of rhythmic backward and forward movements while balancing. Although neither strategy was found superior to the other in terms of time taken and success rate in learning the wheelie, a study done by Bonaparte, et. al (2004) suggests that teaching both methods to people learning this advanced skill may be beneficial as different subjects employed different balancing strategies.

For those too fearful of learning, an aided wheelie may be a better option (Bonaparte, et. al, 2004). Although the anti-tip bars seen on many wheelchairs are considered wheelie aids, these devices can actually hinder the wheelie skill in everyday activities such as popping up and descending curbs, and pose danger to surrounding people because the bars protrude behind the wheelchair. Because of this, a new wheelie aid device which self-employs DEPLOYS when the wheelchair user tips backwards, but stays out of the way otherwise, was developed (Kirby, et. al, 2001). The device was proven effective in wheelchair users learning wheelie skills faster and performing the skills safer. A wheelchair skills training program may be enhanced if aided wheelies are presented as an option for those who need or want to learn, but have fear of tipping backwards or physical problems in performing the skill.
The efficiency of a wheelchair user’s push may improve with training, possibly decreasing the risk of repetitive stress injuries as propulsion technique and injury have been reported to be related (Robertson et al, 1996, Coolen, et al, 2004, Boninger, et al, 2000, Boninger, et al, 2002). However, even though this relationship exists and is documented, little or no training is done with manual wheelchair users to ensure the most efficient and safe push strategy is being used (Boninger, et al, 2002). The SMARTwheel is a tool developed to measure the kinematics of wheelchair propulsion in hopes of identifying injury causes, optimizing efficiency, and improving performance (Asato, et al, 1993). The computer within the manual wheelchair wheel measures pushrim force and torque, and studies have been published identifying types of stroke patterns (Boninger, et al, 2002). Besides these measurements, subjects are often videotaped with reflective markers to evaluate stroke kinematics (Asato, et al, 1993, Boninger, et al, 2002). These assessment techniques should be used in training for manual wheelchair users in order to evaluate propulsion technique and efficiency, and intervene, reducing injury and resulting in greater participation.

**Specific Aims**

A review of current wheelchair skills literature reveals three needed improvements: a functional, responsive assessment combining components of the WST, WUFA, and Wheelchair Circuit with the addition of propulsion efficiency training, participation used as an outcome measure, and an objective “do do” measurement.

I hope to develop a manual wheelchair skills training and evaluation protocol which incorporates functional skills needed for manual wheelchair users to function independently at home and in the community. A combination of the skills presented in the WST, WUFA, and Wheelchair circuit will be used, assessing based on ability, performance time, and physical strain.
I will look at how a wheelchair skills training program influences subjective self-report measures of participation using the Community Participation and Perceived Receptivity Survey. This measure is based on the view that disability is often a result of mismatch between the person and environment and aims to collect information about what a person does in his or her lived environment. The CPPRS was created specifically for a diverse, mobility limited population. Through this outcome measure, I seek to answer the question: do enhanced wheelchair skills due to training predict a higher score in participation on the CPPRS?

An ideal measure of the wheelchair skills of manual wheelchair users would, according to Routheir, et al (2003), “measure the actual performance and not just the capability.” I aim to develop an objective measure of the “do do,” or enacted function of participation for people using manual wheelchairs. Existing literature falls short in evaluating whether interventions and assessment tools truly influence and capture participation in every day life. The CPPRS seeks to move beyond the “can do” and into the “do do” by asking participants questions about what they actually do in their lived environment. This measure still, however, relies on the subjective reports of people with disabilities and as Newton et al (2002) state, “The extent and nature of the subjective-objective correlations should be measured rather than assumed.” Sufficient information about the functioning and skills of a person requires that evaluation not be conducted outside of that person’s context or environment (Glass, 1998). A few measurements exist for measuring the skills of powered-mobility users within their natural environment, but none exist for manual wheelchair skills assessment (Routhier, et al, 1996). Glass (1998) states, “By integrating qualitative data collected in naturalistic settings with large scale survey data, a level of richness and insight can be achieved which is lacking when either type of data is examined alone.” Although the measure I seek to use will be an objective one, evaluation will take place in the person’s own context.
Comparisons will be made between the self-report measures and the new objective measure to see if the two correlate. The synthesis of the two forms of data should give a more complete view of a person’s participation in life activities. NOT THAT WE CAN DO THIS BUT WOULDN’T THE REAL PROOF OF THE USE OF WHEELCHAIR SKILLS IN CONTEXT BE A STUDY WHERE SOMEONE FOLLOWED A MANUAL WHEELCHAIR USER AROUND? MAYBE WE COULD DO SOME PILOT WORK BY GETTING DATA RECORDERS THAT CAN DETECT WHEN A MANUAL WHEELCHAIR USER USES A WHEELIE DURING HIS/HER DAILY ACTIVITIES. ALSO A GPS SYSTEM FOR DETERMINING THE ROUTES TAKES.

**Occupational Therapy Implications**

The implications for occupational therapy from the reviewed literature are many. Occupational therapists are especially concerned with people’s occupational performance and participation in life, so they should be involved in the development, implementation, and evaluation of training programs and assessments for manual wheelchair skills. In keeping with the principles of the Independent Living Movement, therapists must learn to teach skills in collaboration with clients instead of following the medical model of service delivery. The need for enhanced wheelchair skills training in rehabilitation and the community suggests that better wheelchair skills training should be done in occupational therapy curriculums (Coolen, et al, 2004). Occupational therapy as a profession has the opportunity and responsibility to get involved in this important area of maximizing independence for people with disabilities.

**References**


Martinez, K. The Road to Independent Living in the USA: an historical perspective and contemporary challenges. http://www.disabilityworld.org/09-10_03/il/ilhistory.shtml


Kerri, your paper is as near perfect as I have ever read by a student at your point in training. I would suggest that you add a paragraph or two on the number of manual wheelchair uses, the etiologies, the age distribution, general activity characterizations, and other information to give the reader an idea what the size of the population is.