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ORIGINAL RESEARCH

Power wheelchair driving challenges in the community: a users' perspective

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Abstract

Purpose: There is limited information on the difficulties individuals experience in manoeuvring their power wheelchairs during daily activities. The aim of this study was to describe the nature and context of power wheelchair driving challenges from the perspective of the user. *Methods*: A qualitative design using semi-structured interviews with power wheelchair users. Qualitative content analysis was used to identify themes. *Results*: Twelve experienced power wheelchair users were interviewed. Findings revealed that power wheelchair driving difficulties were related to the accomplishment of activities of daily living, and the influence of environmental context. Four key themes emerged: (1) difficulties accessing and using public buildings-facilities, (2) outdoor mobility, (3) problems in performing specific wheelchair mobility tasks/manoeuvres and (4) barriers and circumstances that are temporary, unforeseen or specific to a particular context. *Conclusion*: This qualitative study furthers our understanding of the driving difficulties powered wheelchair (PW) users experience during daily activities. This knowledge will assist clinicians and researchers in two areas: in choosing assessment measures that are ecologically valid for power wheelchair users; and, in identifying and refining the content of training programs specific to the use of power wheelchairs.

➤ Implications for Rehabilitation

A better understanding of the everyday challenges individuals experience in driving their power wheelchair will assist clinicians and researchers in:
- Choosing assessment measures and identifying training programs for this population.
- Refining the content of power wheelchair training programs.

Keywords

Community, interviews, mobility, power wheelchair, qualitative research

History

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Introduction

Activity limitations resulting from mobility impairments occur in people of all ages [1]. In 2010, an estimated 3.7 million community-dwelling individuals were wheelchair users in USA [2] and an additional 264 000 in Canada [3]. In USA alone, an estimated 15% of community dwelling wheelchair users require a powered wheelchair (PW) [4]. A PW, propelled by an electric motor and controlled by a joystick, is instrumental in facilitating independence, promoting participation in meaningful life activities [5,6], and in decreasing the burden on care providers [7,8].

Theoretical models, such as the Human, Activity and Assistive Technology (HAAT) model [9] and the International Classification of Functioning, Disability and Health (ICF) [10], emphasize that functional outcomes using assistive technology result from the interaction between an individual's abilities in using the device, the demands of the task involving usage of the device and the challenges of the environment in which the task is being performed. As such, PW use necessitates the acquisition of basic skills such as joystick control [11,12], and more complex ones including obstacle avoidance, route finding, and performing activities of daily living (ADLs) while seated in the PW [13]. However, PW users reported having problems accomplishing daily activities, particularly those taking place outside of the home [14,15]. Similarly, clinicians reported that ~10% of PW users experience significant difficulties or are unable to use their PW to execute ADLs [16]. Specifically, 40% of PW users had problems steering when, e.g. manoeuvring within and through small spaces such as doorways and elevators. While PW users likely experience additional and/or other specific difficulties with wheelchair manoeuvres when accomplishing ADLs, these have barely been documented particularly in relation to the specific

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context in which such tasks are being performed [17,18]. Thus a clearer understanding of the difficulties PW users encounter is warranted so that researchers and clinicians can develop better PW training programs as current ones are insufficient [19–22]. The purpose of this qualitative study was therefore to describe the nature and context of PW driving challenges from the PW user's perspective.

Methodology

Design

A qualitative research approach with semi-structured interviews was used [23].

Participants

A purposive sample of community-dwelling adult PW users living in a Canadian urban city was recruited according to the following inclusion criteria: fluent in either French or English, and, self-described regular PW users with at least 2 years of experience with a PW. All participants provided their informed consent. The study and recruitment process were approved by an institutional ethics board.

Semi-structured interviews

A semi-structured interview guide was designed by the investigators using an open-ended interview approach [23]. It consisted of two open-ended questions with specific probes regarding current or past experiences as PW users. The first question was: ''Tell me about the use of your power wheelchair. I would like you to tell me what works and what does not work for you''. Prompts related to this question included: ''What type of challenges do you encounter indoors/outdoors/when visiting friends/in a mall/etc?'' and ''What activities do you refrain from doing while in a PW?''. The second question was: ''When you first learned how to drive a PW, what was especially difficult?''. Prompts for this second question included: ''Were there activities you avoided or did not like?'' and ''Were there situations you avoided or did not like?''.

Interviews were conducted and audio recorded in a quiet room by an occupational therapist experienced in the area of assistive technology. Basic socio-demographic information was collected including age, gender, main clinical diagnosis and years of experience with a PW.

Interviews lasted on an average 40 min and were recorded. Each interview was transcribed verbatim and verified for accuracy by two of the investigators by comparing the audio recordings with the verbal transcriptions.

Data analysis

Qualitative content analysis [23] was undertaken by the principle investigator and a trained research assistant. All transcripts were read a first time and notes (i.e. keywords or short phrases) were made in the margin about key findings to develop the coding categories. This initial coding was based on a priori knowledge of theoretical models, namely the HAAT [9] and ICF [10]. Codes not included in these models were also considered. Two of the researchers then discussed the initial set of codes until a consensus was reached. Each transcript was read a second time in order to proceed to the formal coding, which was done in English regardless of the language of the interview.

To achieve a more in depth understanding of the data, two of the researchers discussed the relationships between the codes and reached a consensus about the overarching themes [24]. This process was further validated during two meetings with three of the investigators. Finally, salient quotes were abstracted from the recordings to illustrate the key themes.

Results

A total of 12 individuals participated (8 males, 4 females) and had a range of primary diagnoses including: multiple sclerosis ($n = 3$), muscular dystrophy ($n = 2$), cerebral palsy ($n = 1$), rheumatoid arthritis ($n = 2$), spinal cord injury ($n = 1$), osteoarthritis ($n = 1$); five participants were between the ages of 65 and 90 years, three between 45 and 64 years and four between 20 and 44 years of age. Most had less than high school education. In terms of experience driving a PW, three participants had >25 years, four had 10 or more years and five <9 years. Three participants lived alone, six with a spouse/partner, two with their mother and/or father, and another with one or more friends and a paid helper. One-third lived in a house and two-thirds in an apartment. The occupation of each participant varied – three were students, two were employed, one was unemployed and six were retired. Of the later, one participant was retired due to a disability and the others retired because of their age. One-third of the interviews were conducted in English, the remainder were in French.

Four main themes emerged from the analysis: (1) difficulties accessing and using public buildings facilities, (2) outdoor mobility, (3) problems in performing specific wheelchair mobility tasks/manoeuvres – no context specified and (4) barriers and circumstances that are temporary, unforeseen or specific to a particular context. The following sections report the findings relative to each theme.

Difficulties accessing and using public buildings facilities

Participants identified specific community places or infrastructures where they described experiencing frequent challenges when using their wheelchair. These include wheelchair ramps, public washrooms, stores and elevators. Typical difficulties related to: (1) manoeuvring inside a constrained space, (2) going through doorways and (3) avoiding obstacles. As illustrated by the following quote, one participant reported having difficulties ''... on some ramps there's like a big, like pothole. So ... it's a little bit scary ...''. The same participant also reported having problems using public washrooms in shopping malls as ''they're not wide enough ... to fit inside with your chair'' even if designed for people with disabilities. Two additional participants reported similar difficulties using public washrooms including getting in and out, avoiding obstacles inside the washroom (e.g. garbage can), and transferring from the wheelchair onto the toilet due to lack of space.

When going to stores, five participants reported difficulties using their wheelchair for entering and exiting, manoeuvring in small spaces, and avoiding obstacles. For example, one participant indicated the ''absence of curbs'' to get onto a sidewalk facing a series of store entrances, and the presence of a garbage can on a sidewalk leading up to a drugstore entrance such that there was ''... limited space ...'' which required ''... driving at a slow speed ...'' to get inside the store. Once inside stores, challenges to manoeuvring included narrow aisles, promotional displays and other objects taking extra space. For example, objects such as ''shopping baskets left throughout the store'' by other customers caused participants problems with obstacle avoidance. Additionally, one participant reported feeling challenged by other ''people in shopping malls who did not always look where they were going''.

Participants also indicated having difficulties entering and exiting elevators due, e.g. to the ''... doors closing too quickly at times ...''. Participants also reported that other people being inside the elevator caused problems such that ''... trying

to squeeze in . . . was stressful because you don't want to step on them''.

Difficulties with outdoor mobility

Participants reported four specific situations where they experienced significant difficulties manoeuvring outdoors: (1) using streets and sidewalks, (2) going through crowds, (3) using adapted modes of transportation and (4) dealing with rain or snow conditions. Seven participants reported difficulties negotiating either uneven surfaces on streets or on sidewalks. Examples of uneven surfaces included holes, cracks, bumps and height of sidewalk curbs. Two participants indicated having problems avoiding oncoming traffic when crossing streets and one participant in negotiating a sidewalk when objects (e.g. garbage) take up space.

Difficulty avoiding people when driving in crowded environments was reported by three participants along with the associated fear of ''. . . hurting someone''. Problems using adapted modes of transportation were identified by four participants including ''going up the ramp into the car'', ''getting onto the elevating platform backward'' and entering into a taxi van when ''another wheelchair is already inside''.

In terms of weather conditions, four participants indicated having problems using their wheelchair in the winter. Note that Montreal, Canada, where this study was conducted has cold, long winters with substantial snow. Participants reported having difficulties manoeuvring on surfaces covered with snow and through uncleared paths, which led to falling off the sidewalk at times.

Difficulties performing specific wheelchair mobility tasks/ manoeuvres – no specific context

Four types of difficulties, unrelated to a specific context, were identified including: (1) controlling the PW's joystick, (2) avoiding obstacle, (3) manoeuvring backwards and (4) going through small doorways. Three participants reported difficulties with controlling the joystick (stick or micro switches). For example, one participant had ''never driven with a joystick before'' as he had been ''using micro-switches previously''. One participant reported having problems when ''hitting obstacles with one of the wheelchair's back wheel'' causing the chair to wobble, one participant with ''manoeuvring backwards'' and another with ''manoeuvring through small doorways''.

Barriers and circumstances that are temporary, unforeseen or specific to a particular context

Participants reported difficulties that may be considered temporary, unforeseen or specific to a particular context. For example, problems reported with entering into a store due to a garbage can taking up space is unlikely to occur at all stores and may not permanently occur at a given store as it can be removed. Similarly, difficulties getting in and out of adapted vehicles due to the presence of other passengers may not interfere systematically every time. When it comes to displays taking extra space in store aisles, this is often temporary (e.g. holiday celebrations). Other problematic situations that may not occur on a regular basis that participants pointed out include backing out of an elevator while carrying shopping bags, using elevators when other people are inside, and encountering electrical doorways that are out of order. One of these situations was described by one participant in the following way: ''It's true that when backing up, there are, ah, there are many things that can happen. Ah, well for example, if you have, like, shopping bags on each side of the chair. Well of course the elevator doors are not wide enough. And then you crush all your stuff. That has happened to me''.

Difficulties encountered as novice PW users

All participants were asked whether they had experienced specific difficulties when they first started learning how to use their PW. Overall, the difficulties participants reported having as novice PW users were similar to the difficulties they continue to experience.

Discussion

The purpose of this qualitative study was to better understand the day to day challenges of driving a PW from the user's perspective. Our findings suggest that some PW users have difficulties executing basic PW driving tasks such as controlling the joystick and manoeuvring backward. However, our participants' difficulties occurred primarily in the context of complex task performances; were specific to community mobility; and primarily consisted of accessing and using public establishments, as well as executing outdoor mobility tasks. As such, participants' difficulties mainly involved manoeuvring within a constrained space (e.g. public washroom, shopping aisles and adapted transport elevating platform), going through doorways (e.g. public washroom), avoiding static (e.g. garbage can) and dynamic (e.g. people, crowds and traffic) obstacles, and managing uneven (e.g. curbs and potholes) or slippery (e.g. rain and snow) surfaces. These types of difficulties are not specific to our participants. In a previous study [15], individuals reported facing more challenges using their PW to execute community-related activities (e.g. shopping and visiting public buildings) and outdoor mobility tasks (e.g. driving though streets and sidewalks) as compared to activities done within the home or at work/school. These same participants indicated problems accessing places where they shop, public buildings, sidewalks, and encountering outdoor barriers such as uneven surfaces and adverse climatic conditions (i.e. snow, mud and rain). Other researchers have also shown that the difficulties that PW users experience driving in the winter can contribute in part to a decrease in community participation [6]. Additional findings further support PW users' difficulties in manoeuvring their wheelchair outdoors [17,18].

As depicted in the Human Activity Assistive Technology (HAAT) model [9], functional outcomes involving the use of assistive technology result from the interaction between the person's abilities, the nature of the task being performed, the assistive technology being used (the PW), and the environmental context in which these interactions occur. Several reasons may therefore explain the difficulties reported by the participants of our study including the design and manoeuvrability of the PW, a mismatch between the person's abilities and the type and programming of the wheelchair control, the partial or complete inaccessibility of the environment, and the lack of PW driving training. Indeed some individuals may be disadvantaged by the design of their equipment as the manoeuvrability of certain PW can be worse for indoor and/or outdoor use as compared to other models [25]. Additional evidence suggests that a lack of fit between a person's abilities and his/her PW equipment may explain problems that some individuals encounter when they execute activities of daily living or steering tasks [16]. Thus, in the event of a proper fit between personal abilities and the PW equipment (i.e. positioning, type and programming of joystick control) individuals can acquire or resume their PW driving independence [26,27].

In regards to environmental accessibility, recent results obtained in USA indicate that 37% of PW users would be unable to execute a 90° turn and 19% unable to do a U-turn in an environment meeting the minimum US national accessibility

guideline [28]. In addition to restrictive accessibility guidelines, store managers or employees may place objects at inconvenient locations for PW users (e.g. garbage and displays) as they may not understand the needs of PW users. Inaccessibility may also result from broken equipment (e.g. broken electrical doors or elevators) while alternative routes may not be available.

The participants of our study had an average of 14 years of experience in using a PW and were still encountering problems in manoeuvring their wheelchair when executing their daily activities and outdoor mobility tasks in the community. They may therefore did not have the opportunity to participate in a training program specific enough to their activities and community environment. Although human and financial resources are often limited in the context of rehabilitation service delivery, clinicians should be aware of, and when possible consider utilizing a number of additional intervention strategies with PW users. For example, clinicians could provide more real life practice opportunities in the person's community if possible, including but not limited to problem solving through general problematic situations. Training could also consist of anticipating problematic situations and planning ahead of time to avoid them. Clinicians may therefore want to ensure that PW users and their caregivers are familiar with and know how to use available resources such as community organizations with interests in accessibility, or websites with information about local accessible public locations.

Power wheelchair users, their caregivers and therapists may be in a good position to run accessibility campaigns, targeting store managers, employees and the general public, to raise awareness about the environmental barriers that PW users encounter and strategies that can be used to alleviate them. This may help the general public to remain aware and helpful about the challenges that PW users are facing and to do what they can to limit these challenges.

Once PW users complete their initial training and live in their own community environment, they would likely benefit from a systematic follow-up. On-going or new problems could therefore be addressed while specifically focusing on community participation. Over time, depending on the PW users' situation, the person's skills may need to be enhanced, the type of PW changed, the type and/or programming of the wheelchair control changed, or information provided to key individuals within the PW users' environment (e.g. store managers) and to decision makers, so that the environment can be made more accessible.

A promising approach to prepare users to the challenges of PW driving which may not require clinicians direct involvement is the use of a virtual-reality simulator [29,30]. Virtual reality offers the possibility of practicing PW driving in complex situations, such as crowded environments, while insuring the safety of the participant. Making the use of virtual reality even more interesting is that newer simulators can now function on a standard personal computer, sharply decreasing cost while increasing usability. There is mounting evidence on the effectiveness of VR on functional skills such as post-stroke upper extremity (e.g. reaching and grasping) and lower extremity retraining (e.g. walking and avoiding obstacles) [31]. Archambault and collaborators are currently working on a new PW simulator, which will include challenging tasks, identified in this study, as a complement to usual PW training.

Study limitations and future directions

In addition to a small sample size, participants were all older than 22 years, had >3 years of experience in using a PW, were all from the same geographical location, and half were retired. As such the results may not be generalizable to PW users who are younger, less experienced, from a different geographical location, and to those who are employed or going to school. Given the amount of time gone by since participants started using a PW, the difficulties they recalled having as novice users may not be accurate and exhaustive. Future directions could explore PW users' difficulties longitudinally from the time that they acquire their first PW. This would be helpful to characterize their difficulties in driving their wheelchair at different point in time as they gain experience and to adjust training programs accordingly. Additionally, examining existing PW training programs such as the Wheelchair Skills Program [32] would be helpful to identify if they address the difficulties reported by our participants, and determine if there is a need to add to them or create new ones. Future studies should also look at the efficiency and effectiveness of the proposed clinical interventions so that managers, clinicians and community stakeholders can make better evidence based informed decisions when selecting intervention strategies to meet the needs of PW users.

Conclusion

This qualitative study contributed to further our understanding in regards to the driving difficulties that experienced PW users continue to face during the execution of their daily activities. Four central themes emerged. Most difficulties reported were specific to the execution of a daily task and/or to the environmental context. Multiple underlying causes for these difficulties are possible and have been discussed. If these causes remain unaddressed PW users' level of activity and participation may remain lower than what, in fact, it could become. As such, clinicians should continue to periodically monitor the fit between individuals' abilities and their PW equipment in relation to their functional needs, identify the causes of a mismatch, and intervene accordingly. The novelty of these findings may assist clinicians and researchers in two areas: in choosing assessment measures that are ecologically valid for PW users, in terms of the difficulties they are likely to meet in their community; and, in identifying and refining the content of training programs specific to the use of PW.

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Declaration of interest

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