

Evaluation of the incidence of failures in depot-style WCs in a pediatric rehabilitation facility in Mexico

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ABSTRACT

This study investigated the failures in 23 depot-style wheelchairs (WCs) used by children aged 3 to 14 over the course of 8-48 months and returned to a rehabilitation facility in Mexico during July 2011 for a replacement WC. One aim of this study was to understand the most common WC failures and develop strategies to reduce their occurrence. Both caregiver self-reported measure of failures and a systematic evaluation using the WC Assessment Checklist (WAC) were performed. Findings showed that the brakes (n=18), the seat (n=11) and back sling upholstery (n=7), and the armrest (n=14) failed most frequently. We found significant association between number of self-reported failures and how often a WC was used to travel over dirt roads or paths ($\chi^2(21)=36.67$, $p=0.018$). Significant correlations were also found between WAC score and number of adverse events ($r_s=-0.544$, $p=0.007$). Our results show that the WAC could be used as a tool to systematically assess and alert the depot staff when a WC requires major repairs.

BACKGROUND

An appropriate, well-designed and fitted WC can enhance mobility and community participation for individuals with mobility impairments (Armstrong et al., 2008). Daily use exposes the WC to weather conditions, topographic obstacles, and user factors that often result in WC failures (Cooper, Wolf, Fitzgerald, Kellerher, & Ammer, 2004; Fitzgerald et al., 2005). When the WC is in stage of disrepair or requires frequent repairs, the individual's function can be reduced; the individual can get injured or even left out without any form of mobility (Constantine, Hingley, & Jowitt, 2006; McClure et al., 2009). Additionally, when the WC has poor performance user satisfaction is significantly reduced and it is more likely to be abandoned (Phillips & Zhao, 1993). This is especially problematic in developing countries where users often do not have access to an alternative WC and therefore a broken WC represents a loss of mobility. Several studies in the US have investigated, both in manual and power WCs, the prevalence of WC failure, repairs and related adverse events such as injuries and reduction in participation (Fitzgerald, et al., 2005; Gaal, Rebholtz, Hotchkiss, & Pfaelzer, 1997; McClure, et al., 2009). Component failure has been reported as a cause of adverse events by 33% of the study participants (Gaal, et al., 1997). Self-reported repairs in the

past 6 months ranged from 26 to 45% (Fitzgerald, et al., 2005; McClure, et al., 2009). Adverse consequences due to WC breakdown have been reported by 9% of the study participants (McClure, et al., 2009). In these studies the majority of the manual WCs were light or ultralight WCs. None of the studies found correlation between WC age and number of repairs (Fitzgerald, et al., 2005; McClure, et al., 2009). These results are difficult to generalize to less resourced settings since the availability and quality of WCs are limited and the environment is different. WC available in these settings are often designed for indoor use (Kim & Mullholland, 1999). Therefore, it is most likely that the WC will be used in unpaved roads or humid climate conditions that may put more considerable strain on the device that it will not withstand (Constantine, et al., 2006; Kim & Mullholland, 1999). One aim of this study was to characterize the type and frequency of WC failures in a cohort of devices returned to a Mexican pediatric rehabilitation facility. We hypothesized that factors related to WC utilization (device usage characteristics and type of terrain) would be predictably associated with different types of self reported WC failures.

METHODS

We recruited a convenience sample of WC users receiving services at a rehabilitation facility in central Mexico who reported having a WC with a failure to their social worker to exchange their used WC for a new WC. We administered in-person surveys to the WC user caregivers that included questions about length of time that the WC had been used; whether or not the WC was new or used when they received it; what repairs or modifications had been done performed to the WC; how many repairs were made completed in the past six months; and to point out in an image what parts they identified as currently broken. Figure 1 presents a line drawing of one of the damaged WCs we evaluated. We also asked about adverse events as consequence of WC failure using an adapted version of the questionnaire used by McClure et al (2009). Participants were given 5 choices of possible consequences: (1) no consequences, (2) been stranded (either at home or away from home), (3) been injured, (4) missed school, or (5) missed a medical appointment. Participants were instructed to select all choices that applied. All questionnaires and materials were presented in Spanish and all in person interviews were conducted in Spanish. The study was approved by two

university institutional review boards in the US and by an ethics panel on site in Mexico.

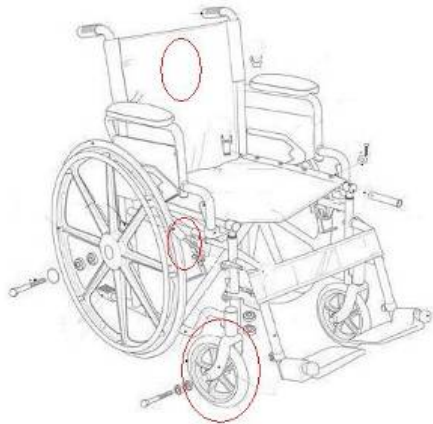


Figure 1. Example of WC with damaged back support, brake, and caster circled by a survey participant

In addition, we utilized a translated version of The WC Assessment Checklist (WAC) to systematically evaluate each WC in a consistent way. The WAC is a screening procedure that consists of a checklist and scoring system for categorizing WCs, based on their physical and working conditions; the WAC helps to identify and classify problems related to component failure (Kamarkar, 2009). The checklist is divided into six domains that correspond to a WC frame or part: WC frame and attachments, wheels and casters, postural seating and support, propulsion interface, wheel locks, and user WC interface. Each component is scored from 1 to 3 where 3 is poor condition, 2-fair condition, 3-perfect condition.

Data analysis

We conducted basic descriptive statistics to assess the number of repairs needed in the past 6 months and identify the consequences of WC breakdowns. The distribution of repairs was broken down into a categorical variable to determine the number of persons who completed 1 repair, 2 to 3 repairs, or 4 or more repairs. The specific type of adverse consequence was also investigated. To test our hypothesis, we ran two separate tests with SPSS and set the significance level at .05. First we ran a chi-square test to evaluate if there was a significant association between the number of self-reported failures and the frequency of WC use in a rough or bumpy terrain, and dirt roads or paths. Next, we ran a spearman-rho test to evaluate if there was a significant correlation between the number of self-reported failures and the number of 1) steep curbs the WC traveled over daily, 2) the number of hours the WC was used per day, and 3) the length of time the WC was used.

RESULTS

We received 23 returned WCs. The majority (n=15) of caregivers reported that they made modifications or repairs

to the WC during the time their child used it and the remaining eight did not report any modification or repair. The participants exchanged WCs that had modifications and repairs (n=6), only repairs (n=4), and only modifications (n=5).

Modifications: the majority (n=10) were positioning modifications which included adding a cushion and a seatbelt. The other modification was to add a tray to allow the child to eat and study on the wheelchair.

Repairs: Table 1 contains the information of self-reported number of repairs done to the WC in the past six months.

Table 1. Self-reported number of WC repairs done in the past 6 months.

# of WC repairs	# of caregivers who reported this # of WC repairs	%
1-2 times	4	17%
3-5 times	2	9%
More than 5	1	4%
Not sure	1	4%
None	15	65%

Of the 23 WCs we evaluated 87% (n=20) showed some kind of damage. The remaining 13% (n=3) did not show any damage and instead were being returned because they were the incorrect size; these WCs were not the right size for their users and therefore unusable. We cataloged failed parts commonly reported to have a high frequency of failure and compared the results with the results from the WAC.

Brakes were among the most common failures reported by caregivers (n=17). With the WAC we found that five of the WCs had the brakes in disrepair, and five needed maintenance such as rotating the rubber or the break forward.

Caregivers reported frequent failures of the back support (n=6) and seat upholstery (n=11). Reasons for failures most commonly include the back support and seat upholstery shifting from its original place and becoming deformed over time, and this information is supported by the data reported in the WAC.

The most common arm support failure was the arm support pad (n=9) and followed by the arm support release lever (n=3). The arm support weld point and the arm support rear receiver were reported once each as broken.

Caregivers reported damage in the rear wheel tires (n=7) and in the casters (n=4). From the WAC we found three wheels and three broken casters. Additionally, with the WAC we found some rear wheels (n=7) and front casters

(n=4) to be worn out.

The self-reported data from the Caregiver Survey showed damaged or problematic WC folding mechanisms (n=1). The WAC data showed that four of the WC were difficult to fold, and one was no longer foldable. The WAC highlighted problems with the frontal post that prevent folding mechanism from working properly and indicates that oiling the frontal posts is an important preventative maintenance activity to prolong the usable life of folding mechanisms.

Caregivers did not report any damage in the pushrims; yet, through the WAC analysis we found 18 WCs rough pushrims that did not pose a threat of acute injuries and two WCs with rough pushrims that posed a threat.

Adverse events: Table 2 contains the frequency counts of the number of adverse events.

Table 2. Number of adverse events self-reported by caregivers due to a WC breakdown.

Adverse event	# of self-reported events
Stranded (at home or away)	6
Injured	8
Missed school	4
Missed medical appointments	3
Other (total)	5
A broken brake made the child afraid to use her WC	1
The child fell when trying to unfold the chair.	1
The WC got wet from the rain and took long to dry, and the child stood without a chair.	1
Had difficulty moving	1
The child slips out of the chair due to lack of a belt to hold he legs and hips.	1

Our analysis showed that there was a significant association between the number of self-reported failures and how often the WC was used to travel over dirt roads or paths ($\chi^2(21)=36.67, p=0.018$). We did not find a significant association between the number of self-reported failures and how often the WC was used to travel over rough or bumpy terrain ($\chi^2(21)=24.06, p=0.290$); however, the survey respondents that reported the greatest number of failures (7 respondents), also frequently traveled over rough or bumpy terrain. Similarly, we found no significant correlation between the: 1) number of times per day the user went over a steep curve, 2) the daily hours of total WC use, or 3) the number of months the WC was used and the number of failures reported ($r_s > 0.02, p > 0.107$).

We conducted spearman-rho tests and found a significant negative relationship between the WAC score and the number of adverse events ($r_s = -0.544, p = 0.007$). The results also showed a negative trend between the WAC score and the frequency of WC repairs in the past six months ($r_s = -0.389, p = 0.074$). We did not find significant correlation between WC age and number of failures.

DISCUSSION

The difference between our study and similar ones is that we compared self-reported WC failure with the results of a detailed evaluation. More than one third of our sample (35%) reported at least one repair in the last 6 months, which falls in the range of previous studies (Fitzgerald, et al., 2005; McClure, et al., 2009). Our results support that of other studies did not find significant relationship between older WCs and more repairs (Fitzgerald, et al., 2005). Most concerning are the brake and seat sling and/or back support failures that threaten the child’s safety and wellbeing. Seat sling and/or back support failures can lead to injury and compromises the postural support, which is necessary for many pediatric clients.

Over time upholstery failure can lead to back and neck pain, as well as spinal and pelvic deformities. The sling seat and back are designed for short-term use and are made of stretchable material that can encourage pathologic postures that users become accustomed too.

Our results show that the WAC could be used as a tool to systematically assess and alert the depot staff when a WC requires major repairs. This agrees with another study that demonstrated that since WC users might be unable to determine when adjustments may be needed; therefore, an active intervention significantly reduces accidents (Hansen, Tresse, & Gunnarsson, 2004).

There could be an underestimation of the number of repairs because we used a method of recall (Fitzgerald, et al., 2005; Gaal, et al., 1997; McClure, et al., 2009). Our results showed that there are differences between the self-reported method and the WAC, we also saw that the self-reported method overestimates the degree of damage. Another limitation of our study is that our WC sample is biased because the devices were returned because they were broken; Fitzgerald et al (2005) and McClure et al (2009) a random sample of WC users.

Maintenance is an important step in protecting the usable life of WCs, and, more importantly, reducing potential threats to user safety (Gaal, et al., 1997). There is evidence that there was a greater risks of accidents in those who failed to maintain their wheelchair regularly (Chen et al., 2011). We suggest that frequent preventive maintenance can increase the life cycle of WCs. For instance, proper and frequent maintenance to the front casters and rear wheels

greatly improves performance. Cleaning and oiling casters supports both the user and caregiver's ability to easily maneuver the WC.

Future work should be to measure and test WCs by the ANSI/RESNA WC Standards. Also, user usability testing should be performed, where folding and lifting the chair, repositioning adjustable parts, and maintenance and repair are evaluated.

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