

THE IMPACT OF HOME MODIFICATIONS AND WHEELCHAIR USABILITY ON ACTIVITY AND PARTICIPATION

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INTRODUCTION

With the adoption of the revised ICF by the World Health Organization, the environment has emerged as a key variable in determining an individual's engagement in activity (i.e., execution of a task) and participation in everyday life (i.e., involvement in life situations) [1]. The physical environment can act as a barrier to wheeled mobility users (e.g., lack of curb cuts) or as a facilitator (smooth travel surfaces). Similarly the "fit" of a wheelchair (e.g., maneuverability, comfort, safety) may enhance the user's ability to perform activities essential to participation. This study reports the preliminary results of a cross-sectional study measuring the impact of home modifications and wheelchair usability on the activities and participation of 78 people who rely on a wheelchair for the majority of their mobility needs.

BACKGROUND

Research on the relationship between activity / participation and environmental facilitators / barriers is challenged both conceptually and methodologically by multiple factors impacting outcomes across a wide range of disability populations. Previous studies have used different instruments and methods in different settings and populations with varying results [2].

In addition, the relationship between the environment and mobility devices is not well understood or articulated, even in the ICF. Hoenig notes that research is complicated by the heterogeneity of wheeled mobility user populations, the specific environments in which devices are used, and the devices themselves [3]. This suggests that effective measurement of activity and participation among wheeled mobility users requires a device-specific and environment-specific methodology.

The interaction between mobility device and environment is most important in the home where the majority of wheelchair use takes place [4]. Environmental facilitators in the home have been demonstrated to affect activity performance there [5]. Conversely, problems in the performance of mobility related activities of daily living (MRADLs), such as toileting and dressing, have been linked to unmet needs for home modifications [6]. The performance of basic tasks at home can also be critical to community participation.

METHODOLOGY

This cross-sectional study administered three self-report instruments during a single telephone interview. Inclusion criteria required that subjects be experienced wheelchair users (i.e., >1 year of use) who rely on a wheelchair as their primary means of mobility. Both manual and power wheelchair users were recruited. Potential subjects were excluded if they did not speak English or could not understand experimental procedures. The institution's Institutional Review Board approved this study and all subjects were consented.

Self-Report Instruments

1. The *Assistive Technology Outcome Measure (ATOM)*. The ATOM is a reliable and valid, device-specific measure developed to meet the need for a practical clinical tool to assess wheelchair usability in a short, easy-to-administer format [7]. It consists of 18 questions designed to capture a range of outcomes from a wheeled mobility intervention. These include: 1) wheelchair usage in different environments; 2) community participation; 3) frequency of use; 4) function; 5) assistance; 6) comfort and 7) hassle.

2. *Comprehensive Assessment and Solution Process for Aging Residents (CASPAR)* was adapted as a study-specific survey to assess home modification needs necessary to perform tasks in 6 home domains: 1) getting in and out of the house; 2) moving around the house; 3) toileting; 4) bathing; 5) grooming; 6) using the bedroom [8].

3. *Impact on Participation and Autonomy (IPA)*. The IPA is a valid and reliable, person-perceived measure that assesses participation-restriction across multiple domains [9]. The authors of the IPA base their understanding of participation on autonomy. It asks subjects whether they have sufficient control over a range of activities, with or without the use of personal aide or assistive technologies. It assesses participation-restriction in five subscales: 1) *Autonomy Outdoors* (visiting friends and relatives, trips and holidays, leisure time, living life the way one wants; 2) *Social Life and Relationships* (helping/supporting others, talking to people on equal terms, quality of relationships, respect from others, intimate relationships; 3) *Work and Education* (chances of achieving and keeping a position, doing work one wants; 4) *Family Role* (ability to look after ones home, to perform tasks, get minor/major repairs done); and 5) *Autonomy Indoors* (getting washed, dressed, getting up and going to bed, toileting, eating, drinking).

Analysis

Independent samples t-tests were conducted to examine the relationship of met and unmet home modification needs and participation. Pearson correlation coefficients were conducted to look at the impact of wheelchair usability on participation.

RESULTS

Data were collected from 78 wheelchair users between 2009 and 2010. Subjects' ages ranged from 20 to 76 years (mean=46.13 years; SD=13.728) and thirty-one (39.7%) were male. Most (71.8%) lived in single-family homes. Medical reasons for using a wheelchair included SCI (52.6%), neuromuscular degenerative disease (15.4%), Spina Bifida (9.0%), Polio (6.4%), MS (3.8%), RA and other

inflammatory polyarthropathies (2.6%), TBI (2.6%), CVA (1.3%), CP (1.3%), and other (5.1%). Fifty nine percent (59%) subjects used power chairs and 41% used manual chairs. Most subjects had been using a wheelchair 10 years or longer (74.4%) and spent more than 10 hours a day in their chairs (88.5%).

IPA: Participation-restriction

Table I shows the range of values across the IPA's five subscales. For simplicity's sake, we collapsed the 5 point IPA scores into two categories. "Very Good" and "Good" represent a single score and "Fair", "Poor" and "Very Poor" denote a second score.

Table 1: Participation-Restriction (IPA Scores)

| N=78 | Mean | SD | More restrictive (≥2) | Less restrictive (<2) |
|----------------------------------|-------|------|-----------------------|-----------------------|
| Autonomy Indoors (MRADL) | 0.519 | 0.58 | 2 (3%) | 76 (97%) |
| Family Role | 1.015 | 0.72 | 6 (8%) | 72 (92%) |
| Autonomy Outdoors | 1.426 | 0.82 | 24 (31%) | 54 (69%) |
| Social Life/Relationships | 0.639 | 0.57 | 2 (3%) | 76 (97%) |
| Work/Education | 0.869 | 1.14 | 10 (13%) | 68 (87%) |

Subjects' scores reflected the least participation restriction across three subscales: Autonomy Indoors, Family Role and Social Life and Relationships. The most restriction was found in Autonomy Outdoors, followed by Work and Education.

CASPAR: unmet modification needs and participation

Most subjects did not report significant unmet home modification needs. However, 19 people reported unmet needs in one or more areas. Table 2 shows the breakdown of unmet needs within each area. At 15.4%, unmet needs were highest for grooming activities, followed by getting in and out of the house (5.1%), toileting (5.1%), moving around the

house (3.8%), using the bedroom (3.8%), and bathing / showering (1.3%).

Table 2: Home Modification (CASPAR scores)

| N=78 | Home Mods | Unmet need | Do not need / NA |
|---|------------------|-------------------|-------------------------|
| A. Getting in / out of the house | 73 (93.6%) | 4 (5.1%) | 1 (1.3%) |
| B. Moving around the house | 66 (84.6%) | 3 (3.8%) | 9 (11.5%) |
| C. Toileting | 54 (69.2%) | 4 (5.1%) | 20 (25.7%) |
| D. Bathing / Showering | 75 (96.1%) | 1 (1.3%) | 2 (2.6%) |
| E. Grooming, etc. | 48 (61.5%) | 12 (15.4%) | 18 (23.1%) |
| F. Using the bedroom | 60 (76.9%) | 3 (3.8%) | 15 (19.2%) |

However, individuals with unmet home modification needs (as compared with those who did *not* have unmet needs) reported more participation restrictions across all IPA subscales, with significantly more restrictions in: (1) Autonomy Indoors ($p=.037$), (2) Autonomy Outdoors ($p=.030$), and (3) Social Life and Relationships ($p=.021$).

ATOM: Wheelchair usability and participation

The mean for ATOM scores was .81 (SD=.098), indicating good wheelchair usability. Wheelchair usability was negatively correlated with participation restriction across all IPA subscales: (1) Autonomy Indoors ($p=.000$); (2) Family Role ($p=.002$); (3) Autonomy Outdoors ($p=.000$); (4) Social Life and Relationships ($p=.002$); (5) Work and Education ($p=.000$).

However, while wheelchair usability was significantly correlated with less participation-restriction across all IPA subscales among individuals *without* unmet modification needs ($n=59$), wheelchair usability was not correlated with participation-restriction across IPA subscales among those *with* unmet modification needs ($n=19$). Table 3 shows correlations between wheelchair usability and all IPA scores.

Table 3: Wheelchair Usability and Participation

| | Correlations with Wheelchair Usability | | | | |
|--------------------------------|---|------------------|------------------|------------------|-------------|
| | Aut. Ind. | Fam. Role | Aut. Out. | Soc. Life | Work |
| All (N=78) | P=.000 | P=.002 | P=.000 | P=.002 | P=.000 |
| No unmet need (n=59) | P=.000 | P=.002 | P=.000 | P=.001 | P=.000 |
| With unmet needs (n=19) | N.S. | N.S. | N.S. | N.S. | N.S. |

Age

Unlike wheelchair usability and home modification needs, age did not appear to be a significant factor in this preliminary analysis. Younger subjects (<45 years old, $n=39$) and older ones (≥ 45 years old, $n=39$) showed no significant differences in unmet modification needs, wheelchair usability (ATOM scores), and participation restrictions (IPA scores). Interestingly, however, younger individuals with unmet modification needs reported more participation restrictions in social life and relationships (mean=1.00) and work/education (mean=1.13) than older people with unmet modification needs (social life, mean=.081; work, mean=.096).

In addition, while wheelchair usability is significantly correlated with all IPA subscales among individuals aged 45 and older, only 4 out of 5 IPA subscales were significantly correlated with wheelchair usability among younger individuals. Family role does not appear to be significantly correlated with wheelchair usability among those under 45 years old.

Table 3: Younger vs older groups

| | Correlations with Wheelchair Usability | | | | |
|------------------------------------|---|------------------|------------------|------------------|-------------|
| | Aut. Ind. | Fam. Role | Aut. Out. | Soc. Life | Work |
| <45 (n=39) | P=.044 | N.S. | P=.005 | P=.034 | P=.001 |
| ≥ 45 (n=39) | P=.002 | P=.002 | P=.001 | P=.022 | P=.003 |

DISCUSSION

Results suggest that both wheelchair usability and home modifications are important factors in supporting participation within the home, community, work, and in the social roles and relationships of subjects.

In particular, wheelchair usability appears to be a consistently important variable as individuals age. The fit between a person and his or her wheelchair ties directly into their comfort and ability to take advantage of home modifications, which, in turn, are necessary to perform essential activities in the home and participate in key social roles. Yet, the effect of wheelchair usability on participation diminishes when modification needs are not met.

It is clear that effective home modifications supported greater participation in both home MRADLs (autonomy indoors) and community activities such as visiting friends/relatives and performing leisure activities (autonomy outdoors). They were also associated with a higher degree of quality and respect in their relationships with family and friends. However, effective home modifications did not significantly affect participation in family roles or work/education. The former could be explained by the fact that family roles, in part, involve performing instrumental activities of daily living (IADLs) many of which (e.g., shopping, traveling independently) are not *directly* tied to modifications made to the home. And work and education may be affected by other unrelated factors such as lack of work experience, education and training, employer discrimination and the absence of or inadequate work accommodations [10].

CONCLUSION

This paper shows a strong relationship between home modifications, wheelchair usability and activity and participation. As the aging population increases and more people continue to work into their later years, future research should concentrate on examining home modifications that may support, among other things, a person's work environment in the home, (e.g., telecommuting). For example, many work accommodations take the form of flexible schedules allowing an employee to work from home.

In addition, more research is needed to elaborate the relationship between wheelchair usability and home modifications as they impact participation in home and community activities. And, lastly, clinicians would benefit from a more detailed understanding of the interaction between specific wheelchair characteristics (e.g. turning radius, weight, and height), and home modifications (e.g., width of a door or height of a counter) that would allow them to better anticipate environmental needs during wheelchair evaluations and prescription.

ACKNOWLEDGEMENTS

This research was conducted as part of the RERC on Wheeled Mobility, which is supported by Grant H133E080003 from the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education

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