FUNCTIONAL ASSESSMENT OF WHEELED MOBILITY AND SEATING INTERVENTIONS: RELATIONSHIP OF SELF-REPORT AND PERFORMANCE-BASED ASSESSMENTS

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The main objective of this study was to investigate associations, concordance and differences among self-report and performance-based measures, and reveal new factors associated with changes in wheelchair function. The Functioning Everyday with a Wheelchair (FEW); a self-report measure, the FEW-Capacity (FEW-C); a performance-based measure for the clinic, and the FEW-Performance (FEW-P) that measures clients' skills in the home were the measures used in this study.

Relevant literature yielded few studies that examined the associations and concordance between subjective and objective methods of assessment with wheelchair users. We conducted secondary analyses of data collected by Mills et al. (2002) and Schmeler (2005), in which participants were assessed with their current wheelchairs at pretest, and later at posttest after they received their new wheelchairs. The strength of the associations varied by time, item, and environment, and there was a stronger association between the three tools at the pretest when compared with the posttest, perhaps due to the familiarity of their current wheeled mobility device and their desire for a new wheelchair. Exhaustive CHAID analysis revealed new factors that were significantly associated with pretest to posttest changes in wheelchair function, and should therefore be assessed at pretest and targeted for intervention, namely, independence, number of physical assists, safety, and tasks related to Outdoor Mobility at pretest. Furthermore,

for total scores, at pretest, there was no significant difference between the FEW-C and the FEW-P, whereas, at posttest, the Clinic total safety and quality scores were significantly better than the Home scores. We also found that the FEW-C was more concordant with the FEW-P compared to the FEW; therefore, clinicians may get a more accurate estimation of performance in the home from a clinic assessment compared to self-report. Clinically, the FEW tools provide complementary data which can contribute to clinical and research assessments of clients' everyday functioning with their wheelchairs.

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PREFACE

"And say: "My Lord! Increase me in Knowledge." (Qur'an, Ta-Ha 20:114)

It was once said "Acquire knowledge; it enables its professor to distinguish right from wrong...It guides us to happiness". I have always enjoyed the study of health sciences. It seemed that throughout my studies and career, the further I advanced, the more I longed for knowledge. Getting the PhD has been always my motive in life that pushed me forward.

This work would have never been possible without the outstanding, continuous, and noble support, understanding, and patience of Dr. Margo B. Holm, PhD, OTR/L who I do consider as not only my work and academic advisor but as my family here in the United States. Dr. Holm, thank you for the great person you are, thank you for making my family's humble dream come true, and thank you for being there for all of us. I am where I am today because of you, and I will be forever thankful.

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Finally, I dedicate this work to my precious family. To the dearest and closest persons to my soul and mind, to the greatest parents ever; my dad, Izzeddin Sarsak, and my mum, Faiqa Sarsak, whose presence creates beautiful sounds in my heart. To my siblings; Khaled, Majed, Emad (may our dear God in heaven rest your soul in peace), Mohammed, Amjad, Majeda, Jehan, Ghassan, and Palestine. I miss you always and I cannot wait to cross the ocean and be with you. Your inspirations are the motivation behind all of this. Thank you for your love and for adding meaning to my life.

1.0 INTRODUCTION

The wheelchair is viewed as one of the most important assistive technology (AT) devices used in rehabilitation (Kirby, Swuste, Dupuis, MacLeod, & Monroe, 2002). Wheelchairs, both manual and power, are enablers of community participation and are used to enhance function, to improve independence, and to enable a person to successfully live at home and in the community (Wee & Lysaght, 2009). Wheelchair evaluation is a continuous process requiring re-assessment of wheelchair fit as users age and their functional conditions change (Karmarkar, Collins, Kelleher, & Cooper, 2009). Research has shown that during this thorough process, clinicians need to take factors into consideration that are associated with functional performance, such as wheelchair characteristics and client demographics. It is the dynamic interactions between these factors that pose the challenge for clinicians and wheelchair users as they decide on the best wheeled mobility interventions (Oyster et al., 2011). Although clients seeking a wheeled mobility device are assessed before a device is prescribed, research has not focused on the everyday functional performance of the clients with their wheelchairs. Rather, instead of focusing on the ability of the device to enable activities and participation, research has focused on a wheelchair skills, propulsion, abandonment, cost, policy, and wheelchair design (Hammel, Lai, & Heller, 2002; Kittel, Marco, & Stewart, 2002; Putzke, Richards, Hicken, & DeVivo, 2002; World Health Organization [WHO], 2001). Following receipt of a wheeled mobility device, outcomes can be measured using subjective (self/proxy report) or objective (performance-based observation at clinic and home) methods. These assessment methods do not always yield equivalent results with clinical samples, and therefore the level of association among functional subjective and objective methods among clients being assessed for, and receiving, wheeled mobility devices is unclear (Newton, Kirby, Macphee, Dupuis, & Macleod, 2002; Rushton, Kirby, & Miller, 2012; Schmeler, 2005; Warms, Whitney, & Belza, 2008).

Using the Functioning Everyday with a Wheelchair (FEW, a self-report measure), the FEW-Capacity (FEW-C, a performance-based measure for the clinic), and the FEW-Performance (FEW-P, a performance-based measure for the home) outcome measurement instruments, the study objectives were to:

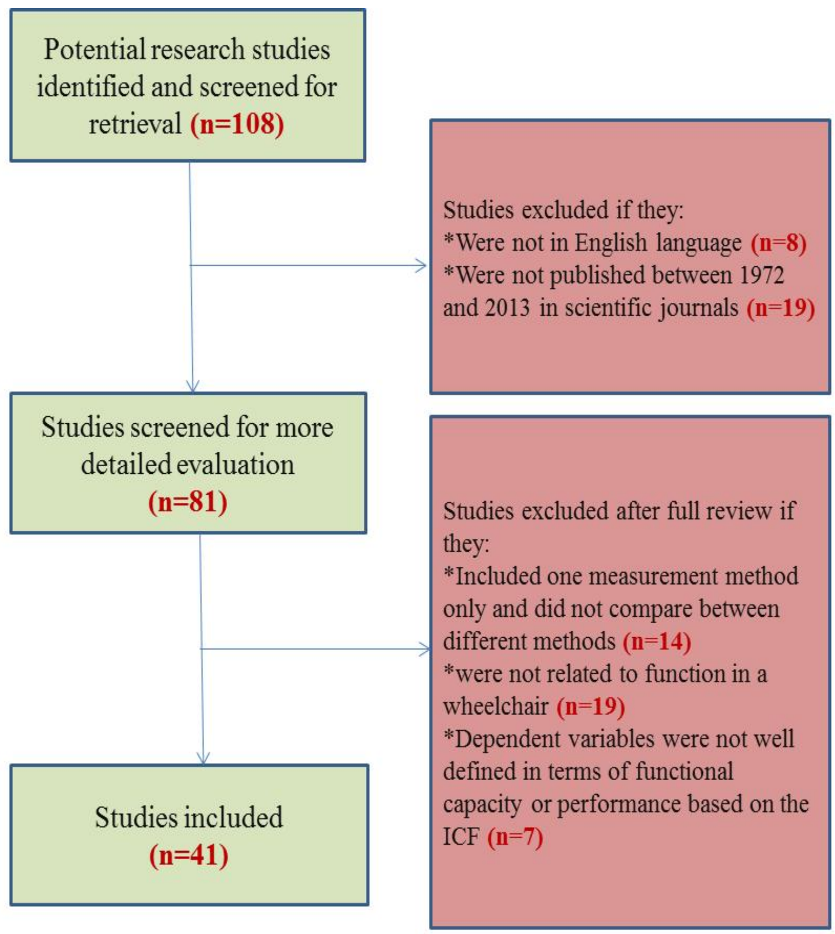
1. Examine the associations among the FEW, the FEW-C, and the FEW-P instruments at pretest and posttest following the provision of a new wheeled mobility and seating device provided by a qualified interdisciplinary team of clinicians.
2. Examine specific demographics, wheelchair characteristics, and functional status indicators associated with change scores of three target variables (FEW, FEW-C, and FEW-P).
3. Examine the concordance of the FEW and the FEW-C with the FEW-P as the criterion measure, and investigate the differences between the FEW-C and the FEW-P at pretest and posttest following the provision of a new wheeled mobility and seating device.

The literature review in Chapter 2 synthesizes research studies that describe assessment of functioning with a wheelchair, and examine associations, concordance, and comparisons between the different methods used to assess everyday functional abilities of wheelchair users. Chapter 3 describes the associations among the three FEW instruments at pretest and posttest. Chapter 4 examines specific demographics, wheelchair characteristics, and functional status indicators associated with better and worse outcomes of the FEW instruments. Chapter 5 investigates the concordance of the FEW and the FEW-C with the criterion instrument, the FEW-P, and examines the differences between the FEW-C and the FEW-P at pretest and posttest. Finally, Chapter 6 provides a summary of all study objectives and results as well as implications for future research using the FEW instruments.

2.0 BACKGROUND AND LITERATURE REVIEW

2.1 SEARCH STRATEGIES AND SELECTED ARTICLES

The following electronic databases were searched to identify literature relevant to this study: PubMed, Ovid (MEDLINE, PsychINFO, and Global Health), and Cumulative Index of Nursing and Allied Health Literature (CINAHL). Search terms (keywords) used were wheelchair combined with functional assessment, function, assistive technology, outcome, skill, performance, self-report, clinic, and home. One hundred eight potential relevant research studies were identified and screened for the literature review (see Figure 1). Research studies were selected and included in the literature review if they were written in the English language and published between 1972 and 2013 in peer-reviewed journals. Based on these criteria, 81 studies out of the 108 were identified and reviewed and 27 studies were excluded. Furthermore, studies were screened again for more detailed evaluation and were included if they involved functional assessments, comparisons between subjective (self/proxy report) or objective (performance-based observation) methods and clinic and home assessments. In addition, previous studies that addressed the psychometric properties of the Functioning Everyday with a Wheelchair (FEW) instruments and focused on measurement of function among wheelchair users were also included. Studies were excluded if they included one measurement method only and did not compare between different methods (e.g., studies which used self-reports only or assessments at home only were excluded), or because the dependent variables were not well defined in terms of functional capacity or performance based on the International Classification of Functioning, Disability and Health (ICF) (World Health Organization [WHO], 2001). Additionally, when the literature review on assessment of functioning with a wheelchair was conducted, studies related only to skills, not functioning in a wheelchair, were excluded. This yielded a total of 41 studies that were included in the literature review and 40 studies were excluded.



Note: ICF: the International Classification of Functioning, Disability, and Health

Figure 1: Flow Diagram of the Literature Review

2.2 ASSESSMENT OF FUNCTIONING WITH A WHEELCHAIR

The most current available data on persons who use wheelchairs comes from the 2008 National Survey of Income and Program Participation, which indicated that there were about 56.7 million people with disabilities (number increased by 2.2 million since 2005) and 3.6 million wheelchair/scooter users in the United States (USA) in 2010 (Brault, 2012). Therefore, given the substantial number of individuals in need of technology solutions, and the increasing demand on providers to meet client needs, appropriate outcome measurements are needed.

AT devices enable people with disabilities to function in multiple contexts and activities (Arthanat, Nochajski, Lenker, & Bauer, 2009) and are used by people with disabilities to facilitate return to as many pre-injury activities as possible (Chaves et al., 2004). Although clinically, a significant increase in improvement associated with AT use exists, a lack of evidence remains on the quantitative benefit and efficacy of AT devices and service delivery (Mills, Holm, & Schmeler, 2007).

The wheelchair is viewed as one of the most important AT devices used in rehabilitation for individuals who cannot ambulate or have difficulty with ambulation (Kirby, Swuste, Dupuis, MacLeod, & Monroe, 2002). More recently, Wee and Lysaght (2009) reported wheelchairs as one of the most influential factors that affect activity in persons with a mobility impairment. Wheelchairs, both manual and power, are enablers of community participation and are used to enhance function, to improve independence, and to enable a person to successfully live at home and in the community. In contrast, a wheelchair could be a limiting factor and restrict participation. Wheelchairs may create problems such as limiting destinations and creating increased dependence on others and can be perceived as negatively impacting a person's life if they do not enable persons to participate fully in social and community activities (Barker, Reid,

& Cott, 2006; Chaves et al., 2004). Additionally, powered mobility, for example, can have a great impact on the lives of persons with mobility impairments. Some previous studies reported that such persons feel empowered, become more productive, enjoy more leisure, and enhance their functional performance in other areas such as self-care. However, other studies showed that powered wheelchair use may restrict accessibility (e.g., maneuverability in the home) and may has some limitations and implications for the safety of the user and of other people and objects in the environment. Therefore, and due to the high cost of powered wheelchairs, a comprehensive evaluation usually takes place of the physical and cognitive-perceptual abilities necessary for use of such a chair before one is prescribed for an individual. Factors including level of intellectual functioning, physical limitations, visual problems and seizure control are all reviewed (Harrison, Derwent, Enticknap, Rose, & Attree, 2002).

Little work has been done to assess the effects of wheelchair interventions on clients. Research has focused on a narrow range of activities and has ignored the role of wheelchairs for enabling activities and participation (Hammel, Lai, & Heller, 2002; Mann, 1996; Putzke, Richards, Hicken, & DeVivo, 2002; Smith, 1996; WHO, 2001). Most literature on wheelchairs is focused around issues of design, client preferences, use, disuse, abandonment, cost, and policy (Kittel, Marco, & Stewart, 2002). What needs further investigation is how wheelchairs prescribed for mobility impairments affect overall participation. Although some studies explored mobility characteristics and activity levels of wheelchair users, more research is needed to further assess the relationship between wheelchair mobility and demographics, type of wheelchair, and participation (Oyster et al., 2011). There is also a need for outcomes research in service provision and activities that support the wheelchairs service provision system. Therefore, the user’s assessment of daily participation as well as wheelchair provision services need to be considered to identify gaps in activity involvement by wheelchair users. For example, older adults commonly use wheelchairs for mobility impairments regardless of their living situations. However, limited outcomes data are available to determine the quality of the wheelchairs that older Americans are receiving, as well as their satisfaction with wheelchair service delivery programs. Level of satisfaction has been identified as an additional outcome measure for evaluating wheelchair prescriptions and service delivery programs (Karmarkar, Collins, Kelleher, & Cooper, 2009).

Wheelchair assessments can be categorized into three different settings: real (daily environments; home, workplace), controlled (clinical setting and obstacle course), or virtual environments (computerized driving simulators) (Routhier, Vincent, Desrosiers, & Nadeau, 2003). Prior research on persons with disabilities and wheelchair users has documented that these different settings could be more or less realistic and could be more or less facilitative/challenging. They may lead to either better or worse performance depending on factors such as the nature and the requirements of the tasks being assessed, the nature of the impairments, the environment's characteristics, and the purpose of the assessment. For example, previous studies showed that when assessing Basic Activities of Daily Living (BADL) and Instrumental ADL (IADL), the familiarity of the home may facilitate overall functional performance. Nonetheless, the standardization of clinical settings may help clients to better perform some tasks. For example, those requiring better lighting and clutter-free spaces rather than environment familiarity to successfully perform the task (Hamed, 2008; Rogers et al., 2003). As another example, simulated environments used for training purposes, when compared to the real (e.g., home) or the controlled (e.g., clinic) environment, represent a potentially useful means of assessing and training novice powered wheelchair users. Hence, they may prove more motivating, less challenging, and safer, and would reduce the danger of collisions during the training phase because the client would not actually be moving (Harrison et al., 2002).

There are many assessments of global function in the rehabilitation field such as the Functional Independence Measure (FIM) (Hamilton,Laughlin, Fiedler, & Granger, 1994; Linacre, Heinemann, Wright, Granger, & Hamilton, 1994; Ottenbacher, Hsu, Granger, & Fiedler, 1996) and the Barthel Index (BI) (Collin, Wade, Davies, & Horne, 1988; McGinnis, Seward, DeJong, & Osberg, 1986; Shinar et al., 1987). Few assessments, however, specifically consider the functional abilities of wheelchair users (Mills, 2003; Schmeler, 2005). The Wheelchair Physical Functional Performance (WC-PFP) is a valid and reliable performance-based tool used to measure the manual wheelchair users' physical function and the ability and the time required to perform important tasks for independent living. The WC-PFP includes 11 tasks in the domains of upper body strength, upper body flexibility, balance-coordination, and endurance (e.g., lift and transfer pan of weight, put on and remove a jacket, carry groceries 70 meters, transfer to a standard chair). However, the WC-PFP assesses these tasks based on time required for task completion, distance travelled, and the amount of weight carried, not independence, safety or quality of performance (Cress, Kinne, Patrick, & Maher, 2002). The Wheelchair Skills Test (WST) is another valid and reliable tool that evaluates manual wheelchair skills and provides useful information about the ability of wheelchair users to perform skills relevant to their daily lives successfully and safely. The most recent version (4.1) has 32 individual skills and includes tasks, such as rolling, turning, reaching a high object, ascending and descending curbs, and ascending and descending stairs. The WST also rates safety, but not levels of independence or quality. A questionnaire version (WST-Q) is also available (Kirby et al., 2004; Rushton, Kirby, & Miller, 2012). The Wheelchair Users Functional Assessment (WUFA) is another example of a valid and reliable tool that measures the wheelchair skills needed for independent living in the home and community. The WUFA consists of 13 performance-based items that measure level of independence in different skills such as, door management, street crossing, bed/toilet/floor transfer, reaching, and upper and lower body dressing (Stanley, Stafford, Rasch, & Rodgers, 2003). The WUFA independence score is unique in that it includes a timing criterion for each task. However, the WUFA does not address safety and quality.

2.3 WHY THE FEW INSTRUMENTS WERE SELECTED FOR THIS STUDY

There is currently a lack of comprehensive outcome measures that focus on everyday functioning with a wheelchair. The WC-PFP, WST, and WUFA are valid and reliable performance measures used to assess client's skills or function while using a manual wheelchair (Cress et al., 2002; Kirby et al., 2004; Rushton et al., 2012; Stanley et al., 2003). None of these measures address the quality of functional performance or provide individual scores for independence and safety for both manual and power wheelchair users. Furthermore, these measures do not fully represent all the important tasks wheelchair users identified as important to perform in a seating-mobility device --- Comfort Needs, Reach for multiple levels, Transfers to/from multiple levels, and Transportation (Mills et al., 2002; Mills, 2003; Schmeler, 2005).

In response to the need for more comprehensive outcome measures to document function for third-party payers, and evaluate the efficacy of wheeled mobility interventions, a team of researchers at the University of Pittsburgh developed the FEW (a self-report measure), the FEW-Capacity (FEW-C, a performance-based measure for the clinic), and the FEW-Performance (FEW-P, a performance-based measure for the home) outcome measurement instruments. The

FEW-C and FEW-P were structured after the Performance Assessment of Self-Care Skills (PASS) because of its measurement parameters (independence, safety, and adequacy) and its focus on four domains of functioning: Functional Mobility (FM), Activities of Daily Living (ADL) including self-care, Instrumental ADL (IADL) with a physical emphasis (PIADL), and IADL with a cognitive emphasis (CIADL).

The trio of FEW tools has been used in research and proved to be reliable, valid, and useful (Mills et al., 2002; Mills, 2003; Mills, Holm, & Schmeler, 2007; Schein et al., 2011; Schein, Schmeler, Holm, Saptono, & Brienza, 2010; Schmeler, 2005). A study of 25 subjects showed that both the self-report FEW and FEW-C were able to detect significant changes in function over time following the provision of a new wheeled mobility and seating device. However, the FEW often significantly underestimated function compared to the FEW-C, and therefore documented greater changes in function over time. (Schmeler, 2005). Underestimation may have occurred because it is not unusual for individuals who are seeking interventions to underestimate their capabilities to obtain services or products (Cress et al., 1995). The FEW tools have been used in telerehabilitation studies and also proved to be reliable, and effective in that venue. A study of 98 adults with mobility impairments using wheeled mobility and seating devices (manual wheelchair, power wheelchair, scooter) were tested to determine whether or not the telerehabilitation (TR) treatment condition at remote clinics was equally effective when compared to the standard in-person (IP) treatment at local clinics. The study findings were based on the level of function the participants showed with their new wheeled mobility and seating devices as measured by using the FEW outcome tool. They found that the telerehabilitation treatment condition was equally effective on all items except for the FEW Transportation item (Schein et al., 2010). Another study of 46 subjects with mobility impairments using wheeled mobility and seating devices evaluated the interrater reliability between a generalist clinician using the FEW-C in person (IP) and an expert clinician observing through Telerehabilitation (TR) from a remote clinic. The expert clinician, located more than 100 miles away, was able to accurately evaluate the functional mobility needs of clients being assessed for new mobility devices (Schein et al., 2011).

Although there are several assessments of wheelchair skills, none address independence, safety and adequacy of performance of everyday tasks with a wheelchair. The FEW, FEW-C and FEW-P were developed to address the need for a more comprehensive assessment and outcomes tool for clients seeking and receiving wheeled mobility devices.

3.0 ASSOCIATION OF SELF-REPORT AND PERFORMANCE-BASED INSTRUMENTS TO MEASURE FUNCTIONAL PERFORMANCE AMONG WHEELCHAIR USERS

3.1 BACKGROUND

Outcomes of seating-mobility interventions can be measured using subjective (self/proxy report) or objective (performance-based observation) methods. Subjective methods are the quickest methods of measurement, but they are highly vulnerable to subjective bias (over and/or underestimation of performance) and may be influenced by cognitive status and the perceived abilities of the reporters (Newton, Kirby, Macphee, Dupuis, & Macleod, 2002). Objective performance methods have the potential advantage of minimizing subjective aspects associated with self/proxy reports by allowing clinicians to directly observe function across a range of basic to complex tasks in different settings (clinic or community setting). However, objective performance methods may be limited by: (a) their dependence on the client's motivation to perform, (b) the frequency of performance (administration at only one single time versus multiple times), and (c) the time, space, and equipment needed (Rushton, Kirby, & Miller, 2012). Both subjective and objective methods are useful and are complementary. Decisions on which of these assessment methods to use are based on the purpose of the evaluation and, clinically, a combination of methods is typically used. Research has shown that the use of data obtained from objective and subjective methods should be interpreted with caution because they do not always yield equivalent results among various clinical populations (Cress et al., 1995; Rogers & Holm, 1994; Sager et al., 1992), including wheelchair users (Mills, 2003; Schmeler, 2005; Warms, Whitney, & Belza, 2008).

The extent of agreement between subjective self-report methods and objective performance methods remains an open question. For example, in a recent study, Rushton, Kirby and Miller (2012) hypothesized that the total scores of the Wheelchair Skills Test (WST) version 4.1 (Lindquist et al., 2010), an observer-rated scale of wheelchair performance, and the Wheelchair Skills Test Questionnaire (WST-Q) version 4.1 capacity score (can you do this skill?) (Mountain, Kirby, & Smith, 2004), a self-report of wheelchair skills, were highly correlated. They had a sample of 89 community-dwelling, experienced manual wheelchair users ranging in age from 21 to 94 years. Participants used their own manual wheelchairs and the WST was conducted in one testing session following completion of the WST-Q. They found that the WST and WST-Q capacity total scores were highly correlated ($r_s = .89$, $p = .000$), with the WST-Q scores slightly higher due to what the authors attributed to over-estimation of participant self-reports. For the 32 individual skills, the percent agreement between the WST and WST-Q capacity scores ranged from 82% to 100% (Rushton et al., 2012). Another study, using the same instruments, tested the hypothesis that therapists' estimates of clients' abilities to perform manual wheelchair skills accurately reflected the results from objective testing. Twenty-four hours prior to viewing videotapes of their clients' WST, occupational therapists were asked to provide a global assessment of their clients' manual wheelchair skills using a 100-mm visual analog scale. The therapists then viewed the videotapes of their clients (n = 66) and scored the WST. Their global estimates were then correlated with the users' WST capacity scores (version

2.4) (Kirby et al., 2004). The results indicated only fair correlations between therapists' estimates and wheelchair users' WST scores (r_s = .39, p value not reported). Verbal reports by therapists about the clinical utility of the objective WST, however, were quite positive. Because perceptions of the therapists were only fairly correlated with the wheelchair users' objective performance skills, the authors noted that the therapists believed that use of the objective WST for training as well as assessment would be preferred. They found that objective measurement was especially important when assessment of specific manual wheelchair skills is required (e.g., moving the armrests away, reaching a high object, transferring out of and into the wheelchair, folding the wheelchair, and negotiation of irregular surfaces) in addition to propulsion.

Some may assume that objective methods of assessing wheelchair skills are more valid than subjective methods, but it is important to recognize that the converse could be true. If the wheelchair users experienced anxiety during objective performance testing, if they were tired or unwell, or if the test environment did not closely mirror the wheelchair users' usual settings, the assessment may not have been valid. Therefore, the extent and nature of subjective-objective associations, and any bias based on method of assessment, should be measured rather than assumed (Newton et al., 2002). Although many studies have examined associations between subjective and objective methods of assessing the wheelchair skills (e.g., propulsion, wheelies) of persons who use wheeled mobility devices, few have examined the associations between subjective and objective methods used to assess the ability of wheelchair users to carry out everyday activities with their wheelchairs (Newton et al., 2002; Rushton et al., 2012; Warms et al., 2008) . Because subjective and objective wheeled mobility assessments differ in the amount of time and resources needed, it is important to evaluate their associations to determine if the methods of assessment are interchangeable and if associations remain stable from pretest to posttest. Therefore, this study focuses on examining associations between subjective and objective methods of data collection for documenting the everyday functional task performance of persons who use wheelchairs.

The specific aim of this study was to examine the associations among three tools which were used to assess task independence of wheelchair users by different methods: self-report (Functioning Everyday with a Wheelchair Beta Version 2.0 (FEW), clinic performance (Functioning Everyday with a Wheelchair – Capacity (FEW-C), and home performance (Functioning Everyday with a Wheelchair – Performance (FEW-P), before and following the provision of a new wheelchair provided by a qualified interdisciplinary team of clinicians. The FEW, FEW-C and FEW-P are used to assess a wheelchair user's independence in performing nine tasks: ability to adjust wheelchair to meet comfort needs, ability to carry out health maintenance in the wheelchair, ability to operate the wheelchair, ability to reach various surface heights from the wheelchair, ability to transfer to various surface heights from the wheelchair, ability to perform personal care tasks from the wheelchair, ability to manage indoor mobility with the wheelchair, ability to manage outdoor mobility in the wheelchair, and ability to access personal and public transportation with the wheelchair. Clinically, given limited healthcare resources, our findings may provide guidance as to which methods are interchangeable for which items during the initial wheeled mobility assessment, and likewise for measuring outcomes after provision of the wheeled mobility device.

3.1.1 Hypothesis

We hypothesized that there would be a stronger association among the assessment method scores on the FEW, FEW-C, and FEW-P instruments at the pretest, when participants used their customary wheelchairs, than at posttest, when participants used their new wheelchairs, due to familiarity with the wheeled mobility device.

3.2 METHODS

3.2.1 Design

This was a secondary analysis of data collected in two previous studies (Mills, 2003; Schmeler, 2005). The primary goals of these studies were to develop the FEW, the FEW-P (Mills, 2003), and the FEW-C (Schmeler, 2005). The same participants were tested in both studies. Mills reported on the FEW and FEW-P, and Schmeler the FEW and FEW-C. The current study examines the associations among the different methods used with the FEW, FEW-C and FEW-P at pretest and posttest (see Figure 2).

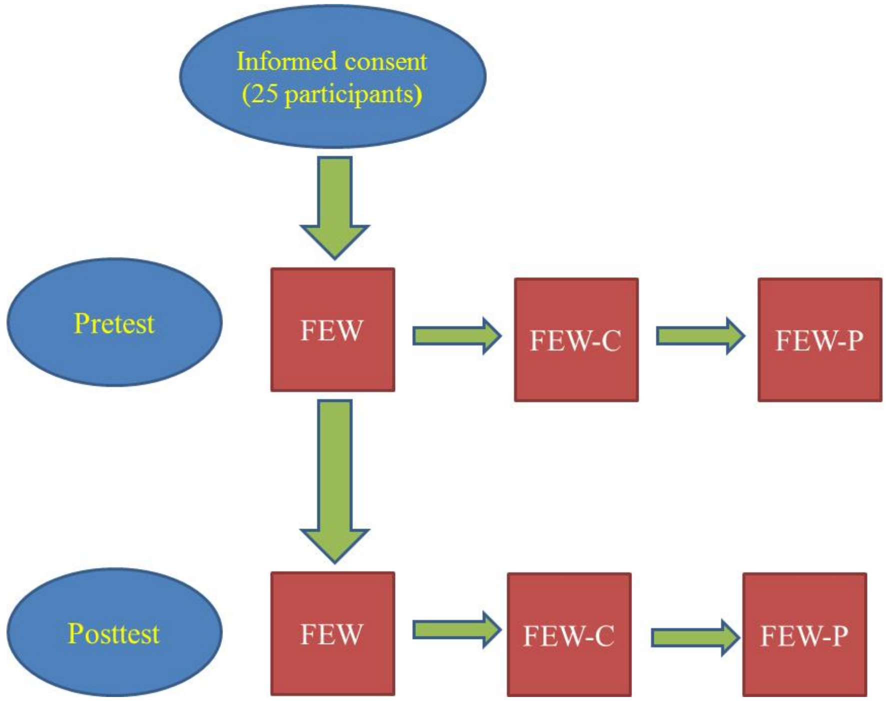


Figure 2: Flow Diagram of the FEW, FEW-C, and FEW-P Data Collection
N.B. FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version); FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version)

3.2.2 Participants

Participants in studies by Mills (2003) and Schmeler (2005) were recruited from the University of Pittsburgh Medical Center, Center for Assistive Technology (CAT) in Pittsburgh, Pennsylvania, the Hiram G. Andrews Center (HGAC), and the Center for Assistive and Rehabilitative Technology (CART) in Johnstown, Pennsylvania. All participants were seen at the three sites for provision of a wheeled mobility and seating device.

Participants for the current study were a subset of participants from the studies by Mills (2003) and Schmeler (2005). The inclusion criteria for participants recruited for these studies were (a) existing manual/power wheelchair or scooter user, who had experienced a change in functional status; (b) 18 years of age or older; and (c) adequate cognitive and language status, that is participants would be able to understand and verbally respond to questions and carry out the tasks in the FEW, FEW-C and FEW-P. Cognition and language status were determined by information provided by team members from the Center for Assistive Technology (CAT) and the Center for Assistive and Rehabilitative Technology (CART). Although informed consent was obtained from 25 participants, only 19 participants had complete data for all three instruments, and therefore the secondary analyses were conducted with data from those 19 participants.

3.2.3 Instruments

The FEW, FEW-C, and FEW-P were the measures used in this study. Item 1 of the three tools is self-report and items 2 through 10 of the FEW-C and FEW-P are performance-based observation items that yield three distinct category scores: independence, safety, and quality. The current study is delimited to the category of independence for the performance-based items (2 – 10).

3.2.3.1 FEW

The FEW Beta Version 2.0 is a 10 item structured self-report outcome measurement tool (see Table 1) that was developed based on input and validation from wheelchair users. The FEW can be self-administered, administered as an interview or administered by telephone. Items 2-10 of the FEW measure perceived functional independence of individuals who use a wheelchair or scooter as their primary mobility and seating device and have progressive or non-progressive conditions. For example, the OPERATE item is "The size, fit, postural support and functional features of my wheelchair/scooter allow me to operate it as independently… as possible: *(e.g., do what I want it to do when and where I want to do it).* The items are scored using a 6 point scale of 6 = completely agree to 1 = completely disagree, and a score of 0 = does not apply. The FEW enables clients to identify the degree of problems they have performing 9 functional tasks in their daily lives while using their wheelchairs (manual/power wheelchair/scooter). It has excellent test-retest reliability (ICC = 0.92). In addition, the FEW has excellent content validity because it was generated by input from both consumers and clinicians, validated by several samples of wheelchair/scooter users, and shown to be capable of detecting users' perceived function with a wheelchair over time (Mills, 2003; Mills, Holm, & Schmeler, 2007; Mills et al., 2002).

Table 1: Items of the FEW, FEW-C, and FEW-P

Items/tasks
1. Stability, Durability, Dependability
2. Comfort Needs
3. Health Needs
4. Operate
5. Reach
6. Transfer
7. Personal Care
8. Indoor Mobility
9. Outdoor Mobility
10. Transportation

3.2.3.2 FEW-C

The FEW-C is a performance-based observation tool, for use by clinicians and researchers to measure functional outcomes of wheelchair and seating interventions in the clinical setting. Items 2 - 10 were structured using the criterion-referenced approach of the Performance Assessment of Self-Care Skills (PASS) (Holm & Rogers, 1999; Rogers & Holm, 1989) and designed to match the items of the FEW. The FEW-C was designed to measure function based on the International Classification of Functioning, Disability and Health (ICF) construct of capacity, namely, a person's ability to execute a task under standardized conditions (World Health Organization [WHO], 2001). The FEW-C has demonstrated excellent interrater reliability

(ICC = 0.99), excellent internal consistency ($\alpha = 0.97$), and fair to good convergent validity when compared with tools measuring similar traits (e.g., the FEW, and the Functional Abilities in a Wheelchair (FAW) tools) by different methods (Schmeler, 2005).

3.2.3.3 FEW-P

The FEW-P is a performance-based observation tool, for use by clinicians and researchers to measure functional outcomes of seating and wheeled mobility interventions in the home/community. Items 2 – 10 are performance-based, as in the FEW-C. The FEW-P was designed to measure function based on the ICF construct of performance in the "lived in" environment (WHO, 2001). The FEW-P has demonstrated excellent inter-rater reliability and internal consistency ($\alpha = 0.95$) (Mills et al., 2003).

3.2.3.4 FEW-C and FEW-P data: independence

Summary scores are based on a predefined 4-point ordinal scale for independence and scores are hierarchical, ranging from 3 (no assists given for task initiation, continuation, completion) to 0 (three physical assists or total assistance given for task initiation, continuation, or completion). (Mills, 2003; Schmeler, 2005) (see Table 2). For each item, the assessor observes the wheelchair user perform the task and rates the level of independence based on the type and number of assists given. The manual provides detailed information on the administration, scoring, and interpretation for each item (Mills, 2003).

Table 2: Summary independence scores of the FEW-C and FEW-P

Score	Independence data
3	No assists
2	No physical assists; Occasional verbal and/or Visual assists
1	Occasional physical assists; Continuous verbal and/or Visual assists
0	Continuous physical assists; Total assistance

3.2.4 Procedures

Prior to the start of each study, University of Pittsburgh Institutional Review Board approval was obtained and once potential participants were recruited, study procedures were explained and written informed consents were obtained from those willing to participate.

Participants were assessed with their current wheelchairs at pretest, and later at posttest when they received their new wheelchairs. The FEW was administered first followed by the FEW-C and the FEW-P (see Figure 2). Mean duration between pretest and posttest for the three tools was 57 days (SD ± 46) with a median of 44 days and a range from 9 to 189 days. Time between pretest and posttest assessments varied based on insurance funding, transportation resources to the clinic, and the duration the participants had to wait to get their new wheelchairs. Participants had to have their new mobility device a minimum of 2 weeks before the posttest.

The FEW and FEW-C pretest assessments occurred on a regularly scheduled clinic visit for a seating evaluation, followed by the FEW-P (home) assessment within 1 week. The posttest assessments occurred in the same sequence (FEW, FEW-C, FEW-P) after receiving the new wheelchair (Mills, 2003; Schmeler, 2005). A fixed rather than a random order of assessment methods was followed, with self-report before performance because perceptions (self-reports) are more likely to be biased by performance than the reverse.

3.2.5 Data Analysis

Descriptive statistics of the item and total independence mean scores of the three tools (FEW, FEW-C, and FEW-P) were calculated at pretest and posttest (mean, standard deviation, range, and confidence interval for the mean). For the FEW, the 6-point scale was recoded to a 4-point scale to match scores yielded from both the FEW-C and FEW-P (6 was recoded to 3, 5-4 were recoded to 2, 3-2 were recoded to 1, and 1 was recoded to 0).

We then examined the associations among the total scores and the items of the FEW, FEW-C, and FEW-P at pretest and posttest (see Figure 3) using Spearman correlation coefficients. As a general guideline, correlations ranging from 0.00 to .25 indicate a poor relationship; those from .26 to .50 suggest a fair degree of relationship; values of .51 to .75 are moderate; and values that are .76 and above are considered excellent (Portney & Watkins, 2009). We defined statistical significance as $p < .05$. Given our small sample size, and adjustment was not applied for multiple correlations.

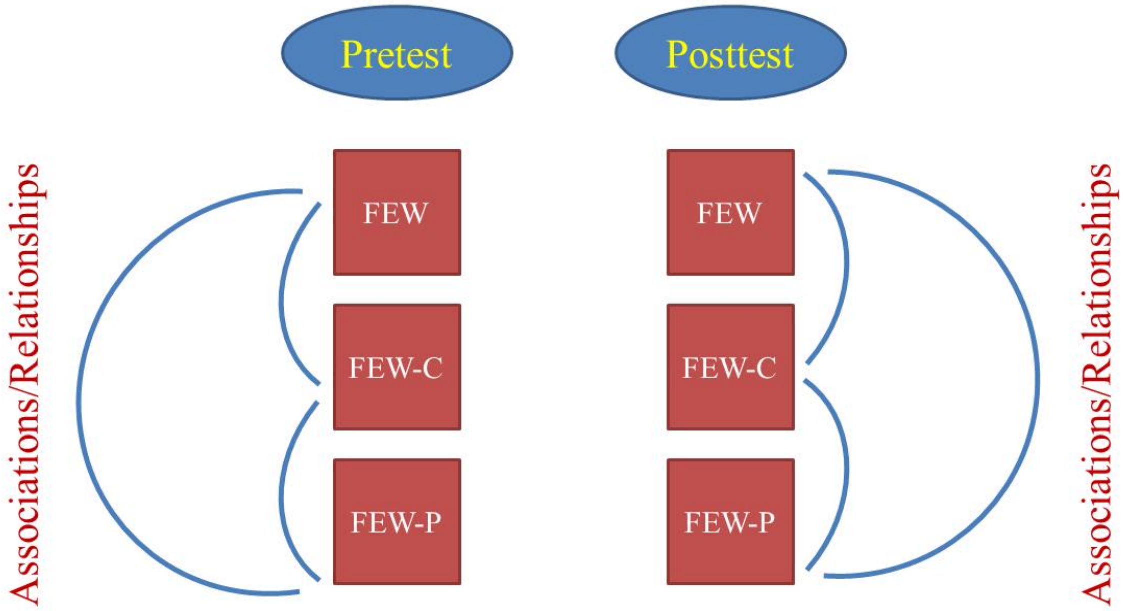


Figure 3: Association of the FEW, FEW-C, and FEW-P Instruments at Pretest and Posttest
N.B. FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version);
FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version)

3.3 RESULTS

3.3.1 Participants

The study sample consisted of 19 wheeled mobility and seating device users with progressive or non-progressive conditions who needed a new wheeled mobility and seating device (e.g., loss of strength, new living environment, and chronic shoulder pain).

Descriptive statistics related to participants' demographics and specific wheelchair characteristics were calculated. Of the 19 participants, 9 were male and 10 were female. The average participant was 53.1 years old, Caucasian, and had used a wheelchair for 9.5 years. Participants with multiple sclerosis comprised over one third of the sample (see Table 3).

At pretest, 3 of the wheelchairs were power and 16 were manual. The manual wheelchairs, on average, were 3.7 years old with sling seats (n = 15), and no seat functions other than manual elevating leg rests. At posttest, all wheelchairs used by the participants were power chairs. The power wheelchairs were equipped with power elevating foot supports (n = 10), full-length adjustable height arm supports (n = 10), and multiple seat functions (n = 9) (see Tables 4 and 5 for detailed characteristics of the participants' wheelchairs).

Table 3: Study participants' demographics at baseline (n=19)

Demographics	Mean (SD) [range]	n
Age (mean, SD) [range]	53.1 (± 11.0) [36 – 72]	
Gender		
Male (n)		9
Female (n)		10
Race		
Caucasian (n)		17
African American (n)		2
Years using a wheelchair (mean, SD)	9.5 (± 11.3) [1 – 45]	
Age of current wheelchair (mean, SD)	3.74 (± 2.5) [1 – 9]	
Number of wheelchairs owned currently		
1 (n)		11
2 (n)		7
3 (n)		1
Primary medical condition		
Above Knee Amputation (n)		1
Cardiac Disease (n)		1
Cerebral Palsy (n)		1
Cerebral Vascular Accident (n)		2
Lupus (n)		1
Mitochondrial Disease (n)		1
Multiple Sclerosis (n)		7
Orthopedic Disorder (n)		1
Parkinson Disease (n)		1
Spina Bifida (n)		2
Traumatic Brain Injury (n)		1

Table 4: Type of wheelchair at pretest and posttest (n=19)

Characteristics	Pretest n	Posttest n
Manufacturer and model		
Permobil	0	2
Permobil Chairman Entra	0	4
Permobil Chairman 2k	0	1
Permobil C2K Stander	0	3
Permobil Street	0	1
Quickie Breezy	1	0
Quickie Breezy 600	1	1
Quickie 200	1	0
Quickie P220	1	0
Quickie 2	1	0
Quickie Lx1	1	0
Guardian Easy Care 4000	0	1
Invacare	1	0
Invacare TDX3	1	2
Invacare XF 9000	1	0
Invacare 9000 XT	4	0
Invacare K0011	0	1
Invacare Tracer	0	1
Jazzy Mini	1	0
Jazzy 1121	1	0
Jazzy 1122	0	2
Ranger X	1	0
Everest and Jennings	2	0
ETAC Cross	1	0
Type of wheelchair		
Manual	16	0
Power	3	19
Scooter	0	0
Weight of manual wheelchairs		
Standard	8	0
Lightweight	3	0
High strength lightweight	4	0
Ultra-lightweight	1	0
Power wheelchair		
Front-wheel drive	1	9
Mid-wheel drive	1	6
Rear-wheel drive	1	2
Missing data	0	2

Table 5: Specific characteristics of study participants' wheelchairs, at pretest and posttest (n=19)

Characteristics	Pretest n	Posttest n
Back supports		
Sling upholstery	15	0
Adjustable tension back	1	1
Rigid back	1	8
Custom-contoured back	0	2
Captain-style seat	1	3
Other (e.g. standard, back cover, cushion)	1	6
Foot supports		
Power elevating	0	10
Manual elevating	7	1
Fixed	1	3
Swing-away	7	2
Flip-up	1	4
Removable	3	1
Arm supports		
Full-length, fixed height	6	0
Full-length, adjustable height	1	10
Desk-length, fixed height	6	2
Desk-length, adjustable height	3	3
Swing-away	0	3
Flip-up	4	9
Removable	5	0
Other (e.g. front anti-tippers)	3	0
Seatbelt		
Yes	1	1
No	18	18
Seat functions		
Power tilt in space only	1	3
Power reclining backrest only	0	0
Power seat elevator only	1	1
Tilt-in-space and reclining back only	0	1
All of the above	0	9
All of the above plus passive standing	0	1

3.3.2 Descriptive statistics (FEW, FEW-C, FEW-P)

Descriptive statistics of the total independence mean scores of the three tools (FEW, FEW-C, FEW-P) and each individual item at pretest and posttest for the 19 subjects are represented in Tables 6 and 7. As shown in the tables, at pretest, the FEW documented lower levels of function indicated by lower total and individual item scores when compared to the performance-based FEW-C and FEW-P tools. Specifically, at pretest the confidence intervals indicate that total FEW item mean was significantly lower than the FEW-P mean, but at posttest there were no significant differences in total scores among the tools.

Table 6: Descriptives of total FEW scores and total independence mean scores of the FEW-C and FEW-P at pretest and posttest

Tool	Pretest	95% CI	Posttest	95% CI
FEW	1.35 ± 0.67 (0.00-2.44)	[1.04, 1.70]	2.43 ± 0.36 (1.67-3.00)	[2.26, 2.61]
FEW-C	1.90 ± 0.74 (0.17-2.91)	[1.55, 2.27]	2.59 ± 0.32 (1.67-3.00)	[2.43, 2.74]
FEW-P	2.12 ± 0.67 (0.59-3.00)	[1.80, 2.44]	2.45 ± 0.43 (1.39-3.00)	[2.25, 2.66]

Note: FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version); FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version; the criterion).

Table 7: Descriptives of items 2-10 for the scores for the FEW, FEW-C and FEW-P at pretest and posttest

Item	Pretest	95% CI	Posttest	95% CI
		FEW		
Comfort	1.47 ± 0.96 (0.00-3.00)	[1.01, 1.94]	2.68 ± 0.48 (2.00-3.00)	[2.45, 2.91]
Health	1.47 ± 0.96 (0.00-3.00)	[1.01, 1.94]	2.74 ± 0.56 (1.00-3.00)	[2.50, 3.01]
Operate	1.32 ± 1.11 (0.00-3.00)	[0.78, 1.85]	2.68 ± 0.48 (2.00-3.00)	[2.45, 2.91]
Reach	0.74 ± 0.93 (0.00-2.00)	[0.29, 1.20]	2.00 ± 1.05 (0.00-3.00)	[1.50, 2.51]
Transfer	1.74 ± 1.10 (0.00-3.00)	[1.21, 2.27]	2.37 ± 1.01 (0.00-3.00)	[1.88, 2.86]
Personal Care	1.63 ± 1.12 (0.00-3.00)	[1.10, 2.17]	2.21 ± 0.92 (0.00-3.00)	[1.77, 2.65]
Indoor	1.63 ± 1.01 (0.00-3.00)	[1.14, 2.12]	2.58 ± 0.61 (1.00-3.00)	[2.30, 2.87]
Outdoor	0.74 ± 0.87 (0.00-3.00)	[0.32, 1.16]	2.53 ± 0.96 (0.00-3.00)	[2.10, 2.99]
Transportation	1.47 ± 1.22 (0.00-3.00)	[0.89, 2.10]	2.11 ± 1.20 (0.00-3.00)	[1.53, 2.68]
		FEW-C		
Comfort	2.29 ± 0.92 (0.00-3.00)	[1.85, 2.73]	2.89 ± 0.27 (2.00-3.00)	[2.77, 3.02]
Health	2.37 ± 0.75 (1.00-3.00)	[2.01, 2.73]	2.83 ± 0.41 (1.33-3.00)	[2.63, 3.03]
Operate	2.29 ± 1.13 (0.00-3.00)	[1.74, 2.83]	2.95 ± 0.18 (2.25-3.00)	[2.86, 3.03]
Reach	2.26 ± 1.15 (0.00-3.00)	[1.71, 2.82]	2.71 ± 0.45 (1.67-3.00)	[2.49, 2.93]
Transfer	1.66 ± 1.32 (0.00-3.00)	[1.02, 2.29]	2.13 ± 0.97 (0.00-3.00)	[1.66, 2.60]
Personal Care	2.30 ± 0.94 (0.00-3.00)	[1.84, 2.75]	2.56 ± 0.76 (0.00-3.00)	[2.19, 2.93]
Indoor	2.21 ± 1.04 (0.00-3.00)	[1.71, 2.71]	2.89 ± 0.23 (2.25-3.00)	[2.79, 3.00]
Outdoor	0.78 ± 1.19 (0.00-3.00)	[0.19, 1.37]	2.88 ± 0.26 (2.00-3.00)	[2.76, 3.00]
Transportation	0.87 ± 1.12 (0.00-3.00)	[0.31, 1.43]	1.30 ± 1.27 (0.00-3.00)	[0.65, 1.96]
		FEW-P		
Comfort	2.50 ± 0.78 (0.00-3.00)	[2.12, 2.88]	2.82 ± 0.42 (1.50-3.00)	[2.62, 3.02]
Health	2.40 ± 0.86 (0.00-3.00)	[1.99, 2.82]	2.78 ± 0.45 (1.50-3.00)	[2.57, 2.99]
Operate	2.61 ± 0.84 (0.00-3.00)	[2.20, 3.01]	2.61 ± 0.84 (0.00-3.00)	[2.20, 3.01]
Reach	2.75 ± 0.58 (0.67-3.00)	[2.48, 3.03]	2.75 ± 0.58 (0.67-3.00)	[2.48, 3.03]
Transfer	1.79 ± 1.24 (0.00-3.00)	[1.19, 2.39]	2.05 ± 1.18 (0.00-3.00)	[1.49, 2.62]
Personal Care	2.46 ± 0.83 (0.00-3.00)	[2.06, 2.86]	2.46 ± 0.75 (0.33-3.00)	[2.10, 2.82]
Indoor	2.33 ± 1.01 (0.00-3.00)	[1.84, 2.81]	2.79 ± 0.44 (1.50-3.00)	[2.58, 3.00]
Outdoor	0.91 ± 1.19 (0.00-3.00)	[0.34, 1.48]	2.32 ± 1.08 (0.00-3.00)	[1.80, 2.84]
Transportation	0.81 ± 1.24 (0.00-3.00)	[0.02, 1.59]	0.97 ± 1.23 (0.00-3.00)	[0.23, 1.72]

Note: FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version); FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version; the criterion).

3.3.3 Relationships among the FEW, FEW-C and FEW-P at pretest and posttest

The results of Spearman's rho correlation coefficients of the overall mean independence scores indicated that there were moderate to excellent significant relationships among the three tools at pretest. At posttest, relationships were significant, ranging from fair to moderate (see Table 8).

Table 8: Relationships among the FEW, FEW-C, and FEW-P for total scores at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.69**	---	Post	FEW-C	.61**	---
Pre	FEW-P	.76**	.64**	Post	FEW-P	.47*	.63**

Note. Pre = Pretest. Post = Posttest. Number of participants (N = 19). * $p < .05$. ** $p < .01$

The Spearman's rho correlation coefficients for the individual items indicated that 16 correlations were stronger at pretest than posttest, and 11 were stronger at posttest than pretest. At pretest, the relationships among all three tools were stronger than at posttest for Indoor Mobility and Outdoor Mobility, but all three were significant only for Outdoor Mobility. At posttest, the relationships among the three tools were stronger than at pretest for Comfort Needs and Transportation, but all three were significant only for Transportation (see Tables 9, 15-17). At pretest, no significant relationships among the three tools were found for Comfort Needs or Transportation, and at posttest, no significant relationships were found for Operate, Reach, Indoor Mobility or Outdoor Mobility.

At pretest, four FEW and FEW-C individual items were significantly and moderately correlated with each other, namely, Operate, Transfer, Indoor Mobility, and Outdoor Mobility, and Reach had a significant and fair relationship. For the FEW and FEW-P, only three items were significantly and moderately correlated: Operate, Transfer, and Outdoor Mobility. The FEW-C and FEW-P items of Personal care and Outdoor Mobility were significantly correlated at an excellent level of strength while significant and moderate relationships were found for Health Needs, Reach, and Transfer. The rest of the items were not significantly correlated.

At posttest, for the FEW and FEW-C only two individual items were significantly and moderately correlated --- Personal Care, and Transportation, and one item, Transfer, had a significant and fair relationship. For the FEW and FEW-P, only two items were significantly and moderately correlated --- Transfer and Transportation. Four FEW-C and FEW-P individual items were significantly correlated: Comfort Needs, and Transportation with excellent relationships, and Health Needs, and Transfer with moderate relationships.

Table 9: Relationships among the FEW, FEW-C, and FEW-P for Comfort Needs at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	-.06	---	Post	FEW-C	-.29	---
Pre	FEW-P	.02	.39	Post	FEW-P	-.10	.87**

Note. Pre = Pretest. Post = Posttest. Number of participants (N = 19). ** $p < .01$

Table 10: Relationships among the FEW, FEW-C, and FEW-P for Health Needs at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.44	---	Post	FEW-C	.05	---
Pre	FEW-P	.36	.59**	Post	FEW-P	-.07	.63**

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). ** p < .01

Table 11: Relationships among the FEW, FEW-C, and FEW-P for Operate at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.67**	---	Post	FEW-C	.16	---
Pre	FEW-P	.52*	.30	Post	FEW-P	.46	.37

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). * p < .05. ** p < .01

Table 12: Relationships among the FEW, FEW-C, and FEW-P for Reach at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.46*	---	Post	FEW-C	-.02	---
Pre	FEW-P	.06	.60**	Post	FEW-P	-.18	.09

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). * p < .05. ** p < .01

Table 13: Relationships among the FEW, FEW-C, and FEW-P for Transfer at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.68**	---	Post	FEW-C	.48*	---
Pre	FEW-P	.71**	.59**	Post	FEW-P	.62**	.62**

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). * p < .05. ** p < .01

Table 14: Relationships among the FEW, FEW-C, and FEW-P for Personal Care at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.37	---	Post	FEW-C	.59**	---
Pre	FEW-P	.28	.87**	Post	FEW-P	.17	.38

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). ** p < .01

Table 15: Relationships among the FEW, FEW-C, and FEW-P for Indoor Mobility at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.73**	---	Post	FEW-C	.11	---
Pre	FEW-P	.42	.29	Post	FEW-P	.21	.26

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). ** p < .01

Table 16: Relationships among the FEW, FEW-C, and FEW-P for Outdoor Mobility at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.56*$_a$	---	Post	FEW-C	-.14	---
Pre	FEW-P	.58**	.82**$_b$	Post	FEW-P	.34	.08

Note. Pre = Pretest. Post = Posttest. Number of participants (N=19). $_a$ = number of participants (N=18). $_b$ = number of participants (N=18). * p < .05. ** p < .01

Table 17: Relationships among the FEW, FEW-C, and FEW-P for Transportation at pretest and posttest

	Tool	Pre FEW	Pre FEW-C		Tool	Post FEW	Post FEW-C
Pre	FEW	---		Post	FEW	---	
Pre	FEW-C	.25$_a$	---	Post	FEW-C	.64**$_d$	---
Pre	FEW-P	.38$_b$	.58$_c$	Post	FEW-P	.64*$_e$	.81**$_f$

Note. Pre = Pretest. Post = Posttest. $_a$ = number of participants (N=18). $_b$ = number of participants (N=12). $_c$ = number of participants (N=11). $_d$ = number of participants (N=17). $_e$ = number of participants (N=13). $_f$ = number of participants (N=13). * p < .05. ** p < .01

3.4 DISCUSSION

Given that the FEW is a self-report measure of functional performance and there are ongoing questions related to self-report measures and whether self-reported measures are associated with performance-based measures (Cress et al., 1995; Rogers et al., 2003), the primary purpose of this study was to examine the associations among the self-report (FEW), and the performance-based

(FEW-C, FEW-P) measures at pretest and posttest, before and after the provision of a new wheeled mobility and seating device provided by a qualified interdisciplinary team of clinicians.

Our hypothesis that there would be a stronger association between the FEW, FEW-C, and FEW-P at the pretest than the posttest due to the familiarity with the wheeled mobility device was partially confirmed. Overall, the relationships among the self-report (FEW) and the performance-based (FEW-C, FEW-P) total independence scores were significantly associated at both pretest and posttest as were the relationships between the two performance-based tools. However, these significant relationships were stronger at the pretest compared to the posttest.

Although familiarity with their wheeled mobility device could be one explanation for the stronger relationship at pretest, our data suggested another possible explanation. The participants tended to underestimate their capabilities at the pretest self-report compared to pretest performance, which is not unusual for individuals who are seeking interventions to obtain health services or a new product and/or equipment (Cress et al., 1995; Schmeler, 2005).

The relationships among individual items of the three tools indicated that for 7 of the 9 items, the mean strength of the relationships among the three tools was greater at pretest than posttest, however 13 of 27 relationships were statistically significant at pretest and 9 of 27 relationships were significant at posttest. This might be due to the fact that 16 of the participants changed from a manual chair to a power chair, and the new power wheelchairs were given to the clients a minimum of 2 weeks before the posttest and they were less familiar with operating them. Only one item, Transfer, had significant relationships among the three tools at both pretest and posttest, and for only one item, Health Needs, relationships were significantly associated among the FEW-C and FEW-P indicating that the two tools had similar ratings regardless of time or the environment.

At pretest, Transfer (moderate relationship) and Outdoor Mobility (moderate to excellent relationship), and at posttest, Transfer (fair to moderate relationships) and Transportation (moderate to excellent relationships), had significant relationships among all three tools, indicating that participant perceptions were significantly associated with their performance in the clinic and the home. In contrast, at pretest, there were no significant relationships among the tools for Transportation, and at posttest there were no significant relationships among the tools for Outdoor Mobility.

It is unclear why Outdoor Mobility would be more strongly associated at pretest, with the majority of subjects using a manual wheelchair, and less so at posttest when all subjects used a power wheelchair, which would require less strength and endurance. Moreover, all wheelchairs were properly fitted as they were prescribed by qualified clinicians. Properly fitted and correctly prescribed wheelchairs benefit the users and aid in provision of the best quality wheelchairs (Brienza et al., 2010; Karmarkar et al., 2009; Smith, McCreadie, & Unsworth, 1995). These power wheelchairs were equipped with multiple power seat functions such as seat elevator, tilt in space, and recline or passive standing. Perhaps the complexity and adjustment required to use these wheelchairs might have led to a lower strength of the relationships among the three tools at posttest when compared with pretest where all participants had used more familiar and simpler manual wheelchairs with no seat functions. Additionally, at the pretest, participants did not engage in outdoor mobility activities because their current wheelchairs did not support them. Hence the stronger correlation.

Similarly, it is unclear why perceptions and performance were more strongly associated for Transportation at posttest when a van is needed to transport a power wheelchair versus pretest when a manual wheelchair can be stored in the trunk of a car. However, the

Transportation results should be interpreted with caution. The correlations for this specific item might be misrepresented because of the missing data. Several participants were not able to complete all subtasks related to this item due to unavailability of personal and/or public transportation, inability to get the wheelchair out of the house, fatigue, or due to bad weather conditions at the time of the assessment. It is also possible that these new wheelchairs met the participants' transportation needs and stronger relationships among the three tools at posttest for this item.

For some items at both pretest and posttest, no significant relationships were found among ratings on the three tools. At pretest no significant relationships were found for Comfort Needs and Transportation, and at posttest no significant relationships were found for Operate, Reach, Indoor Mobility or Outdoor Mobility.

Because there are differences in the resources required for self-report versus performance assessments, examining the relationships among the FEW, FEW-C, and FEW-P at two time points has clinical significance. Our findings suggest that asking clients about their independence in Transfer and Outdoor Mobility during an intake interview will be almost as accurate as a performance test, however for Comfort Needs and Transportation, self-report may not be associated with their current performance. Following provision of a wheeled mobility device, for Transfers, our data indicate that self-report of current independence may be just as accurate as performance, and so may self-report of Transportation. However, self-report of independence for Operate, Reach, Indoor Mobility and Outdoor Mobility may not be associated with current performance. Finally, for Health Needs, performance assessment in the clinic was significantly associated with performance in the home, which again could save on resources needed for a home visit.

For some items at both pretest and posttest, no significant relationships were found among ratings on the three tools. At pretest no significant relationships were found for Comfort Needs and Transportation, and at posttest no significant relationships were found for Operate, Reach, Indoor Mobility or Outdoor Mobility.

At pretest, the clinical significance of our findings provides guidance as to which methods are interchangeable for which items. At posttest, the clinical significance of our findings provides guidance as to which items (outcome measures) should be performance tested. Thus, our findings indicate that there are differences in the level of associations among the three methods of assessing wheeled mobility independence, and that the strength of the associations varied by item, time and environment.

3.4.1 Study limitations and future directions

There were several limitations to this study. A major limitation was the small sample size and the missing data for some participants. In order to generalize and support the results of this study, future studies with larger samples are needed to confirm the relationships among the three tools. The study sample might also be considered a limitation. The sample mostly consisted of an experienced group of manual wheelchair users. Because our sample did not include new manual wheelchair users, the results should be generalized with caution. The inclusion of both experienced and less-experienced wheelchair users in future studies may strengthen the generalizability of the results of this study. Our sample also had adequate cognitive and language status so our findings may not be relevant to those with cognitive or communication impairments.

3.5 CONCLUSIONS

Our hypothesis that there would be a stronger association between the FEW, FEW-C, and FEW-P at the pretest when compared with the posttest due to the familiarity with the wheeled mobility device was accepted for the total scores but was only partially confirmed for the individual items of these tools. Our findings indicate that both methods (self-report and performance-based) can yield useful information, may have potential roles in clinical and research settings, and may have complementary relationships. These findings add to the work of previous related studies (Mills et al., 2002; Mills, 2003; Mills et al., 2007; Schein et al., 2011; Schein, Schmeler, Holm, Saptono, & Brienza, 2010; Schmeler, 2005) that supported the effectiveness of the FEW, FEW-C, and FEW-P. The FEW, FEW-C and FEW-P can play an important role and could bring unique information to wheeled mobility and seating interventions. Future work is needed to address the study limitations.

4.0 FACTORS ASSOCIATED WITH CHANGE IN FUNCTIONAL PERFORMANCE AMONG WHEELCHAIR USERS

4.1 BACKGROUND

While performing the wheelchair evaluation process (functional assessment, wheelchair fitting and delivery, training, and follow-up), clinicians need to take various factors into consideration. These factors include (1) the client's profile (medical and physical status, personality, attitude, temperament, and socio-cultural relations), (2) wheelchair characteristics (wheelchair design, brakes, frames, seat, seat functions, back height, footrests and armrests, positioning devices [i.e., cushions, seatbelts, lateral, head and back supports], propulsion techniques, etc.), (3) the environment (physical and socio-cultural environments), and (4) the daily activities and social roles that the client performs (Routhier, Vincent, Desrosiers, & Nadeau, 2003). To ensure the accuracy of wheelchair prescription, all these factors need to be evaluated to help clinicians make the best possible fit between the client's needs, goals, and social roles and the wheelchair selected (Rogers & Holm, 1991; Routhier et al., 2003). A properly fitted and correctly prescribed wheelchair benefits both client and caregiver (Brienza et al., 2010; Smith, McCreadie, & Unsworth, 1995) and clients use their wheelchairs more often if they receive them from an expert clinician who uses a multifactorial assessment-intervention process. Hoenig et al. (2005) described this process as a thorough evaluation that takes into account all the factors and is based on medical record review and self-reported and physical performance measures, individualization and modifications/adjustments of the wheelchair, home modifications as needed, client education, and follow-up. To aid in provision of the best quality wheelchairs and service delivery programs, Karmarkar et al. (2009) suggested that assessment of wheelchair fit is a continuous process requiring re-assessment of wheelchair fit as users age and their functional conditions change.

Specific wheelchair characteristics (i.e., wheelchair type and design) are considered essential factors that can play a vital role in the wheelchair evaluation process. Differences in wheelchair type and design can lead to differences in a client's performance of functional mobility skills. Choice of wheelchair may affect a client's ability to be independent in a community setting. Research has shown that changes in the design of a wheelchair can result in positive changes in energy cost, joint kinematics and propulsion biomechanics (Cooper, Boninger, & Rentschler, 1999). For example, the high degree of adjustability of the ultra-light wheelchairs (UWC), namely the ability to adjust the seat height in relation to axle position as well as place the axle forward of the center of gravity of the user, has been shown to increase the mobility of the user by decreasing rolling resistance, increasing propulsion efficiency and smoothness, and preserving upper extremity integrity (Rogers, Berman, Fails, & Jaser, 2003). Cooper and his team also reported that the high degree of adjustability of the UWC can increase the mobility of the user and reduce the risk of secondary injury or disability (Cooper et al., 1999; Cooper et al., 1997; Cooper et al., 1996).

Although these studies explored mobility characteristics and activity levels of wheelchair users, more research is needed to further assess the relationship between functional performance, wheelchair mobility, demographics, wheelchair characteristics, and indicators of function, namely, the critical assessment subtasks associated with a clients' abilities to carry out everyday tasks with their wheelchair. It is the dynamic interactions between these factors that pose the challenge for clinicians and wheelchair users as they decide on the best wheeled mobility interventions (Oyster et al., 2011).

Decision analysis methods, such as Exhaustive Chi-Squared Automatic Interaction Detector (CHAID) are analytic strategies that provide a mechanism for examining dynamic interactions among several variables, such as those just described (SPSS Inc., 2001). Decision analysis methods have been used in research such as assessment and intervention for Basic Activities of Daily Living (BADL) and Instrumental ADL (IADL) and to develop models to enhance stroke rehabilitation (Huang et al., 2013; Skidmore, Rogers, Chandler, & Holm, 2006a; Skidmore, Rogers, Chandler, & Holm, 2006b). Despite the usefulness of decision analysis methods such as CHAID, few studies have applied these methods with wheelchair users. Allegretti (2008) utilized CHAID to conduct a secondary analysis of demographic and clinical data, from the Randomized Clinical Trial on Preventing Pressure Ulcers with Seat Cushions, to identify risk factors associated with acquiring/not acquiring a pressure ulcer in elderly long-term care residents, who were provided with custom fit wheelchairs and pressure-reducing cushions to prevent pressure ulcers. CHAID analyses confirmed known risk factors such as musculoskeletal/neurological/psychiatric illnesses, history of pressure ulcer, moisture, and independence in transfer, immobility, and identified new risk factors (e.g., Braden Activity/Mobility score, and type of wheelchair propulsion), that are associated with pressure ulcer development. Furthermore, Allegretti concluded that the CHAID decision-making tree could help rehabilitation clinicians identify and take into consideration the different pressure ulcer risk factors when assessing new clients for wheeled mobility devices.

The specific aim of this study was to examine demographics, wheelchair characteristics, and functional status indicators associated with pretest to posttest change scores of three target variables (1) the self-report Functioning Everyday with a Wheelchair Beta Version 2.0 (FEW) tool, (2) the performance-based Functioning Everyday with a Wheelchair – Capacity (FEW-C) tool, and (3) the performance-based Functioning Everyday with a Wheelchair – Performance (FEW-P) tool. This study is exploratory, with no hypothesis.

By identifying the demographics, wheelchair characteristics, and functional status indicators significantly associated with changes in wheelchair function from pretest to posttest, we hope to identify the factors clinicians must address during the pretest assessment. Likewise, the factors that are most strongly associated with (predict) changes in wheelchair function can provide guidance to clinicians about where to focus potential interventions to bring about change.

4.2 METHODS

4.2.1 Design

Data for this study were collected from two previous studies (Mills, 2003; Schmeler, 2005) (see Chapter 3). Data in this study were examined to explore the association between the change scores (Posttest minus Pretest) of the FEW, FEW-C, and FEW-P (target variables) and demographics, wheelchair characteristics, and functional status indicators (predictor variables), utilizing Exhaustive CHAID. Seven models were generated; one for the FEW, three for the

FEW-C (Independence, Safety, and Quality), and three for the FEW-P (Independence, Safety, and Quality).

4.2.2 Participants

The 19 participants for this study were a subset of participants from the studies by Mills (2003) and Schmeler (2005). Each had been referred to a wheeled mobility and seating clinic to be assessed for a new wheelchair. At pretest, 16 of 19 participants were using manual wheelchairs and 3 were using power wheelchairs. The average age of the participants was 53.1 years, 17 of 19 were Caucasian and 2 were African American. One third of the sample had been diagnosed with multiple sclerosis (see Chapter 3, Table 3 for complete details).

4.2.3 Procedures

Following provision of informed consent, participants were tested at two time points, pretest and posttest. In between testing participants were prescribed and received a new power wheelchair (see Chapter 3, Tables 3 and 4 for pretest and posttest wheelchair characteristics).

4.2.4 Instruments

The FEW, FEW-C, and FEW-P were the measures used in this study. The FEW is a self-report tool consisting of 10 questions about how independently clients carry out everyday tasks with their wheelchairs. The FEW-C is a performance based tool consisting of 1 self-report item and 9 performance items that match the items on the FEW, and are scored for three categories of performance: independence, safety and quality. It is meant to be used in a clinic. The FEW-P is also a performance based tool consisting of 1 self-report item and 9 performance items that match the items on the FEW, and like the FEW-C, is scored for three categories of performance. It is meant to be administered in the home. Each of the tools is valid and reliable (see Chapter 3 for specific details about the items and scoring for each tool). The current study is delimited to items 2 – 10 of each tool because these are the performance items on the FEW-C and FEW-P.

Prior to both pretest and posttest, participants from the studies by Mills (2003) and Schmeler (2005) were asked two questions regarding their health status on an average day over the last three months and how they felt they were able to function and carry out their daily routines on the day of testing. This was done to ascertain if testing was being done on a day in which their health was significantly different from an average day. Both questions were scored using a visual analog scale of 0-100, with 0 representing the worst participants felt, and 100 indicating the best they felt.

4.2.5 Data Analysis

Descriptive statistics for change scores (mean, standard deviation, range, and confidence interval for the mean) for the FEW, FEW-C, and FEW-P were calculated to prepare for the Exhaustive CHAID analysis. Exhaustive CHAID analysis was used to develop seven models (one for the FEW, three for the FEW-C; Independence, Safety, and Quality, and three for the FEW-P; Independence, Safety, and Quality) to identify specific demographics, wheelchair characteristics, and functional status indicators associated with more or less favorable outcomes among the three outcome measures. Exhaustive CHAID Analysis is used to determine associations between multiple independent predictor variables (categorical or continuous) and a single target outcome measure. One of the advantages of Exhaustive CHAID analysis is that it works for all types of variables and can generate a decision tree of the relationships between the target (dependent) variable and the related factors. The root is the target outcome and describes the target variable. The decision tree branches identify the demographics, wheelchair characteristics, and functional status indicators that are most strongly associated with the target variable and divide the tree into the most favorable functional outcomes on the left and the least favorable functional outcomes on the right. Exhaustive CHAID evaluates all the values of the potential predictor variables using the significance of a statistical test as a criterion for entering the model. The statistical test used depends on the measurement level of the target variable, and because all target variables in this study were continuous, an *F* test was used. Exhaustive CHAID was used in this study because it is exploratory, and its thorough iterative process enhances the possibility of finding more variables (demographics, wheelchair characteristics, and functional status indicators) associated with more and less favorable outcomes of the target outcome (change scores for the FEW, FEW-C, and FEW-P). The strength of Exhaustive CHAID analysis is that it reduces researcher bias in identifying the final predictor variables and the cutoff scores of the predictor variables (Kass, 1980; SPSS Inc., 2001). Given the small sample size in this study, validation of the models generated by Exhaustive CHAID analyses was conducted through the *n*-fold cross-validation procedure. The *n*-fold method is an established cross-validation method and is ideal for use with small sample sizes. The *n*-fold procedure involves random division of the sample into smaller subsamples from which the model is regenerated. The output of the cross-validation procedure is a table displaying the Risk Estimate and the Standard Deviation (SD) of the Risk Estimate for the Risk Statistics and Cross-validation. The closer the values of the Risk Estimate for the Risk Statistics and Cross-validation, the stronger the predictive value of the model (SPSS Inc., 2001).

To explain our findings, paired t-tests were used to examine differences between pretest and posttest perceptions of participants' health status on an average day over the last three months and on the day of testing. We defined statistical significance as $p < .05$. Spearman's rho correlation coefficients were then used to examine relationships between change in participants' average health status over the past three months and day of testing and change in participants' function on the FEW, FEW-C, and FEW-P. We defined statistical significance as $p < .05$ and with the Bonferroni adjustment statistical significance was $p < .01$ (Field, 2009).

4.2.6 Exhaustive CHAID target variables

The target variables for the seven models were the mean pretest to posttest change scores for the FEW, the three FEW-C category scores (Independence, Safety, and Quality), and the three FEW-P category scores (Independence, Safety, and Quality).

4.2.7 Exhaustive CHAID predictor variables

The predictor variables of the pretest to posttest change scores for the FEW included demographic variables of participants, specific characteristics of wheelchairs, and functional status as indicated in the data derived from items 2-10 of the FEW pretest and FEW posttest. The predictor variables of the pretest to posttest change scores for the FEW-C included demographic variables of participants, specific characteristics of wheelchairs, and functional status as indicated in the data derived from items 2-10 of the FEW pretest and FEW posttest, and the FEW-C pretest and FEW-C posttest. The predictor variables of the pretest to posttest change scores for the FEW-P included demographic variables of participants, specific characteristics of wheelchairs, and functional status as indicated in the data derived from items 2-10 of the FEW pretest and FEW posttest, the FEW-C pretest and FEW-C posttest, and the FEW-P pretest and FEW-P posttest. Demographics included age, gender, race, years using a wheelchair, age of current wheelchair, number of wheelchairs owned, and primary medical condition. Wheelchair characteristics included manufacturer and model, type of wheelchair, weight of wheelchair, power chair drive type, back supports, foot supports, arm supports, seatbelt, and power seat functions. Functional status indicators consisted of the FEW independence scores for items 2-10, and the independence, safety and quality scores for items 2 – 10 of the FEW-C and FEW-P (see Chapter 3, Tables 1 through 5 for more detailed information).

4.3 RESULTS

4.3.1 Descriptive statistics of change scores (FEW, FEW-C, FEW-P)

Descriptive statistics of change scores for the FEW, FEW-C, and FEW-P are presented in Table 18. As shown in the table, the means for the change score were larger for the FEW followed by the FEW-C and then the FEW-P. This trend indicates that at pretest, in general, the scores were worse for the FEW when compared with the FEW-C and FEW-P. Also, this indicates that most participants improved (scored higher) at posttest.

Table 18: Descriptives of change scores for the FEW, FEW-C, and FEW-P (N=19).

Tool	Pretest	Posttest	Change score	Range	95% CI
FEW	1.35 ± 0.67	2.43 ± 0.36	1.08 ± 0.59	(0.22-2.22)	[0.79, 1.36]
FEW-C					
Independence	1.90 ± 0.74	2.59 ± 0.32	0.69 ± 0.63	(-0.13-2.33)	[0.38, 0.99]
Safety	1.96 ± 0.73	2.68 ± 0.36	0.72 ± 0.84	(-0.33-3.00)	[0.31, 1.12]
Quality	1.57 ± 0.69	2.55 ± 0.47	0.99 ± 0.77	(-0.11-2.78)	[0.62, 1.36]
FEW-P					
Independence	2.12 ± 0.67	2.45 ± 0.43	0.33 ± 0.45	(-0.24-1.34)	[0.12, 0.55]
Safety	1.97 ± 0.63	2.37 ± 0.37	0.40 ± 0.61	(-0.44-1.78)	[0.11, 0.70]
Quality	1.62 ± 0.60	2.26 ± 0.40	0.64 ± 0.55	(0.00-2.00)	[0.38, 0.90]

Note. FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version); FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version; the criterion); Change score = posttest minus pretest.

4.3.2 Exhaustive CHAID analyses

4.3.2.1 FEW change score outcome

In the Exhaustive CHAID model (see Figure 4), for the FEW change score target variable, the Outdoor Mobility task for the FEW at pretest was the functional indicator most strongly associated with the FEW change score outcome ($F = 15.67$, $p = 0.006$), separating the sample into two significantly different subsamples; participants who completely disagreed that the size, fit, postural support and functional features of their wheelchair allowed them to get around outdoors as independently, safely, and efficiently as possible ($n = 9$), and participants whose responses ranged from mostly disagreed to completely agreed that the size, fit, postural support and functional features of their wheelchair allowed them to get around outdoors as independently, safely, and efficiently as possible ($n = 10$).

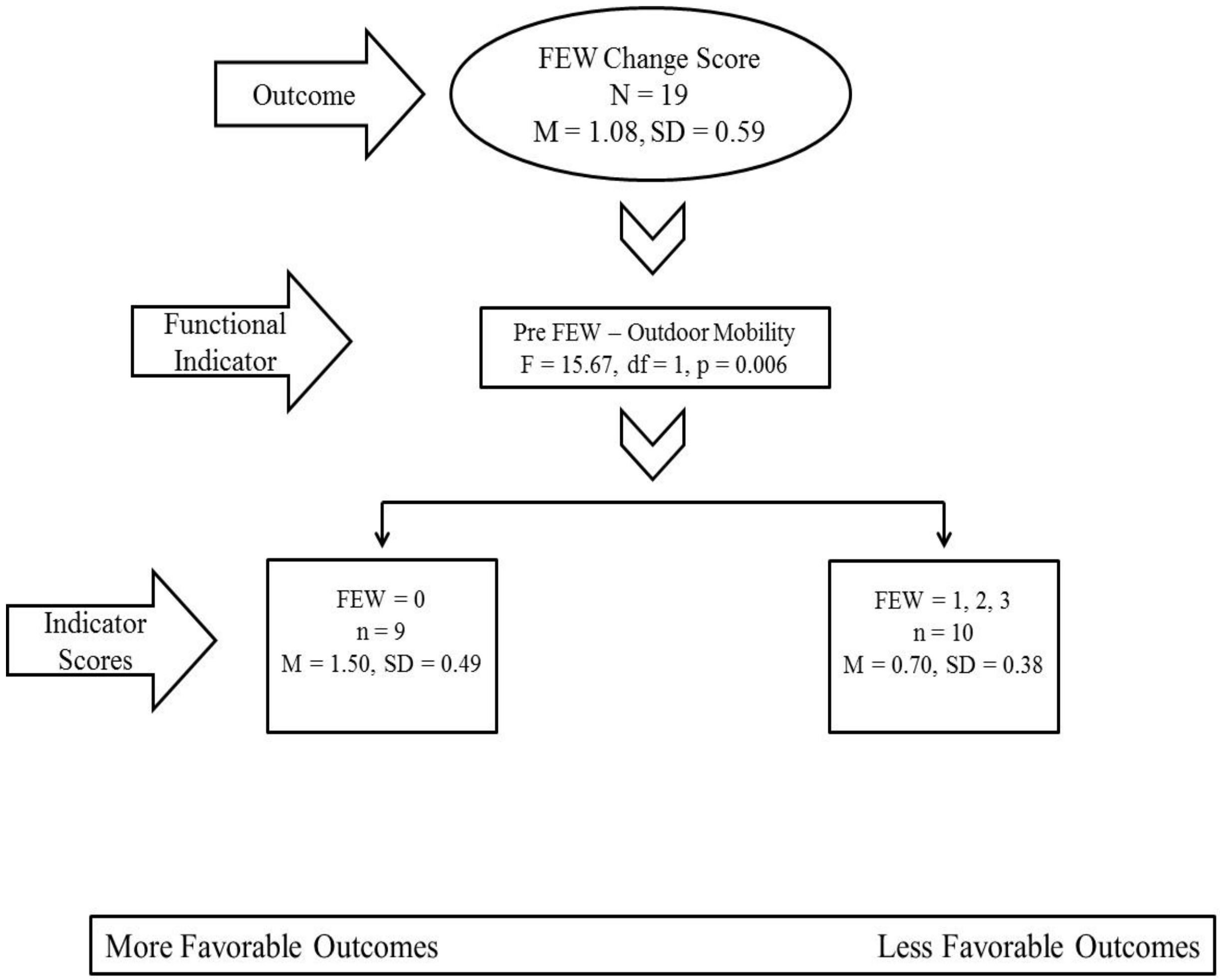


Figure 4: Exhaustive CHAID Analysis of the FEW Change Score: Functional Indicators Associated with More and Less Favorable Outcomes

N.B. Pre = Pretest; FEW: the Functioning Everyday with a Wheelchair tool (the self-report version); (FEW: 0 = completely disagree; 3 = completely agree).

Table 19 outlines the results obtained from the *n*-fold cross validation procedure for the FEW change score model. As displayed in the table, the difference between the Risk Estimate for the Risk Statistics and Cross-validation was 0.01 suggesting reasonable confidence in the validity of the model.

Table 19: Cross-validation results for the FEW model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.17	0.18
Standard deviation of Risk Estimate	0.04	0.05

Note. FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version).

4.3.2.2 FEW-C change score outcomes

For the FEW-C Independence change score model (see Figure 5), the Operate task of the FEW-C at pretest, more specifically the number of physical assists needed to turn the wheelchair, was the functional indicator most strongly associated with FEW-C change score outcome ($F = 17.88$, $p = .0006$), separating the sample into two significantly different subsamples: participants who needed one, two, or three physical assists to turn their wheelchairs ($n = 6$) and participants who turned their wheelchair with no physical assists ($n = 13$). For participants who were able to turn their wheelchair with no physical assists, the next strongest functional indicator was the Transfer task for the FEW-C at pretest, more specifically the number of physical assists required to transfer back from a surface with the same height as the wheelchair (Easy Transfer) ($F = 17.01$, $p = .005$). Exhaustive CHAID divided this subsample into two significantly different subsamples: participants who needed one, two, or three physical assists to transfer ($n = 6$) and participants who transferred with no physical assists ($n = 7$).

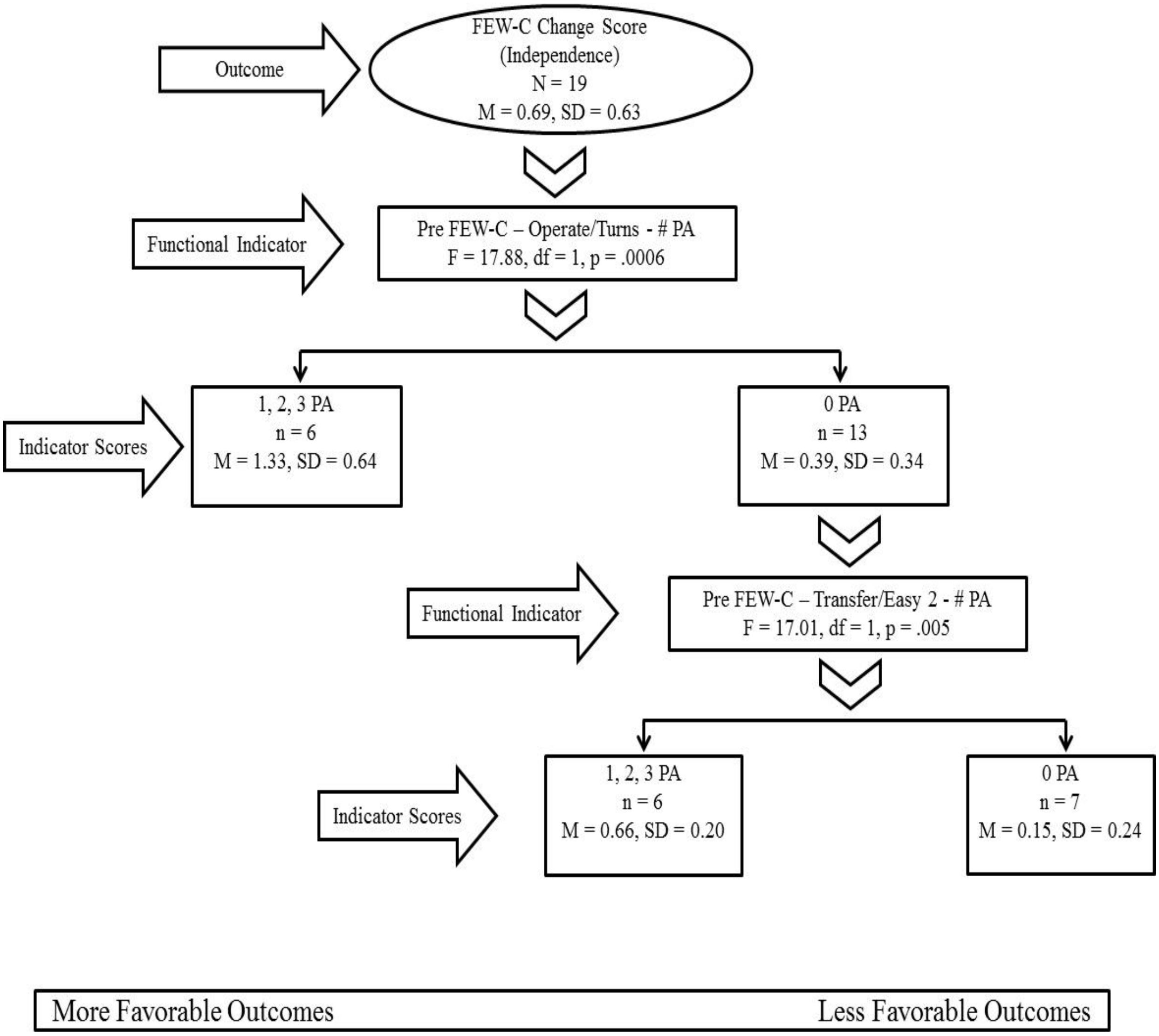


Figure 5: Exhaustive CHAID Analysis of the FEW-C Change Score (Independence): Functional Indicators Associated with More and Less Favorable Outcomes

N.B. Pre = Pretest; FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version); # PA = Number of physical assists; Easy 2 = transfer back from identified surface to wheelchair (same height).

Table 20 outlines the results obtained from the *n*-fold cross validation procedure for the FEW-C Independence change score model. As displayed in the table, the difference between the Risk Estimate for the Risk Statistics and Cross-validation was 0.12 suggesting reasonable confidence in the validity of the model.

Table 20: Cross-validation results for the FEW-C (independence) model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.14	0.02
Standard deviation of Risk Estimate	0.05	0.01

Note. FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version).

For the FEW-C Safety change score model (see Figure 6), the ability to perform the FEW-C Indoor Mobility task safely at pretest (the safety summary score), was the functional indicator most strongly associated with the FEW-C Safety change score outcome ($F = 24.93$, $p = .0007$), separating the sample into two significantly different subsamples: participants who were at severe risk ($n = 6$) and participants who had a potential risk, minor risk, or demonstrated safe practices ($n = 13$). For participants who had a potential risk, minor risk, or had safe practices the next strongest functional indicator was the Personal Care task of the FEW-C at pretest, more specifically the quality summary score ($F = 10.36$, $p = .02$). Exhaustive CHAID again divided the subsample into two significantly different subsamples: participants whose Personal Care quality score was acceptable with standards met ($n = 6$), and participants whose Personal Care quality scores were unacceptable with standards not met, standards partially met, or standards acceptable with improvement possible ($n = 7$).

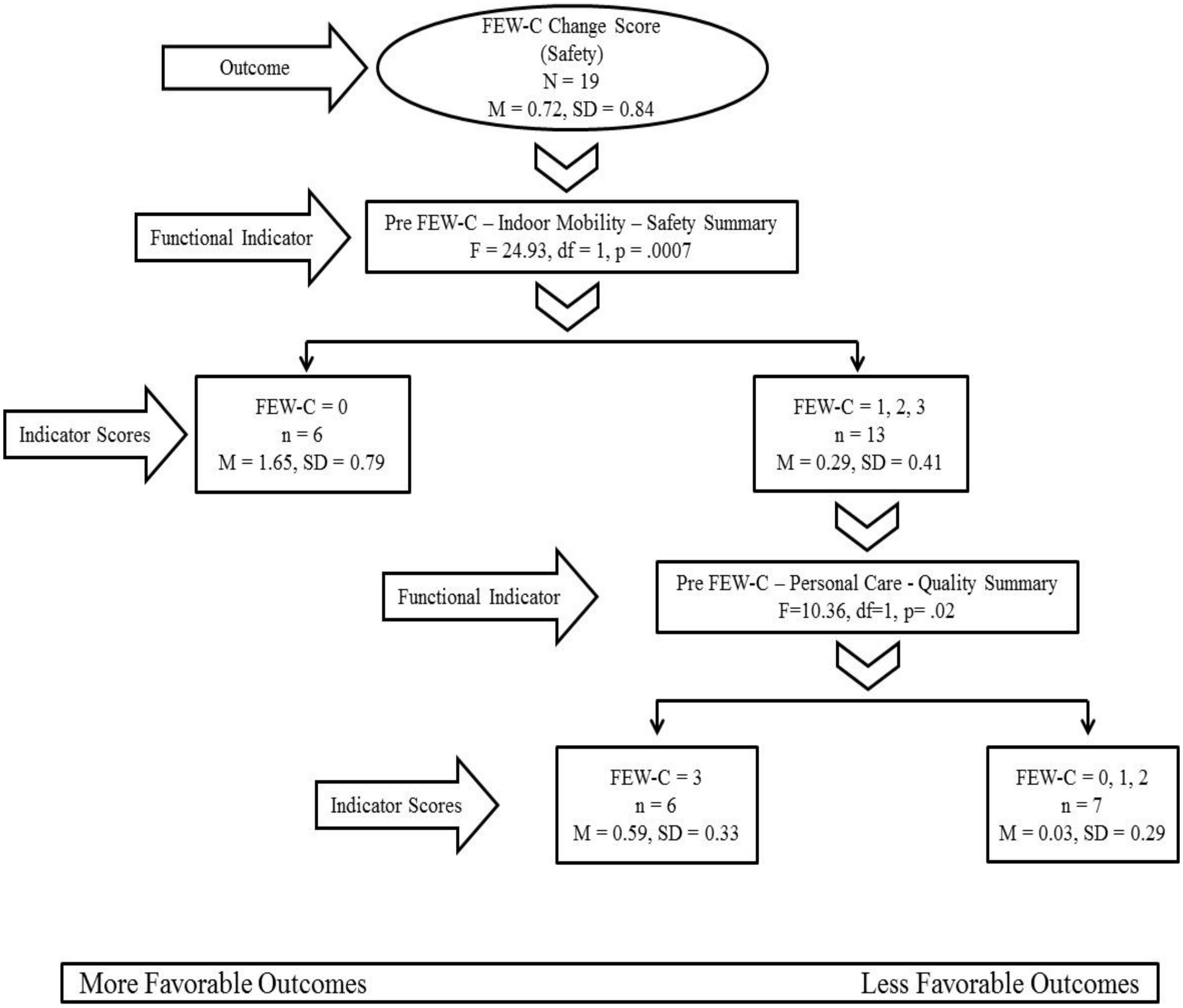


Figure 6: Exhaustive CHAID Analysis of the FEW-C Change Score (Safety): Functional Indicators Associated with More and Less Favorable Outcomes

N.B. Pre = Pretest; FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version); (safety summary: 0 = severe risks; 3 = safe practices); (quality summary: 0 = unacceptable (standards not met; 3 = acceptable (standards met).

Table 21 outlines the results obtained from the *n*-fold cross validation procedure for the FEW-C Safety change score model. As displayed in the table, the difference between the Risk Estimate for the Risk Statistics and Cross-validation was 0.06 suggesting reasonable confidence in the validity of the model.

Table 21: Cross-validation results for the FEW-C (safety) model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.22	0.16
Standard deviation of Risk Estimate	0.09	0.08

Note. FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version).

For the FEW-C Quality change score model (see Figure 7), the ability to perform the FEW-C Indoor Mobility task safely at pretest (i.e., safety summary score), was the functional indicator most strongly associated with the FEW-C Quality change score outcome ($F = 22.02$, $p = .001$), separating the sample into two significantly different subsamples: participants who were at severe risk ($n = 6$) and participants who had a potential risk, minor risk, or demonstrated safe practices ($n = 13$). For participants who had a potential risk, minor risk, or demonstrated safe practices the next strongest functional indicator was the ability to perform the FEW-C Outdoor Mobility task safely (i.e., safety summary score) at posttest ($F = 10.70$, $p = .007$). Exhaustive CHAID again divided the subsample into two significantly different subsamples: participants who demonstrated safe practices ($n = 8$) and participants who had severe risk, minor risk, or a potential risk ($n = 5$).

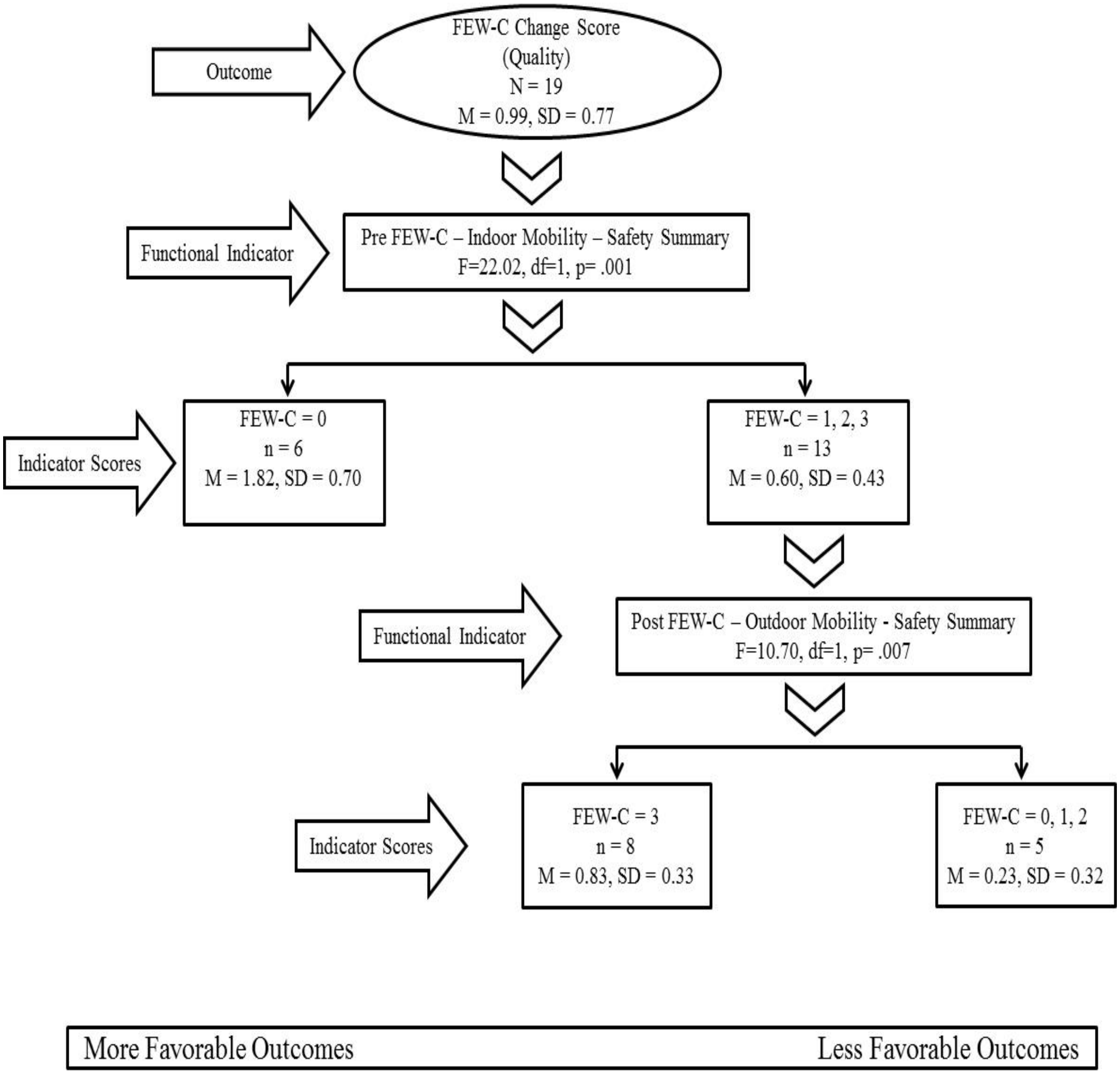


Figure 7: Exhaustive CHAID Analysis of the FEW-C Change Score (Quality): Functional Indicators Associated with More and Less Favorable Outcomes

N.B. Pre = Pretest; Post = Posttest; FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version); (safety summary: 0 = severe risks; 3 = safe practices).

Table 22 outlines the results obtained from the *n*-fold cross validation procedure for the FEW-C Quality change score model. As displayed in the table, the difference between the Risk

Estimate for the Risk Statistics and Cross-validation was 0.05 suggesting reasonable confidence in the validity of the model.

Table 22: Cross-validation results for the FEW-C (quality) model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.19	0.14
Standard deviation of Risk Estimate	0.06	0.08

Note. FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version).

4.3.2.3 FEW-P change score outcomes

For the FEW-P Independence change score model (see Figure 8), the ability to independently perform the Personal Care task of the FEW-P at pretest, more specifically the independence summary score of upper body dressing sub-task (the ability to take off shirt/coat/jacket independently while seated in a wheelchair), was the functional indicator most strongly associated with the FEW-P Independence change scores outcome ($F = 23.07$, $p = .001$). Exhaustive CHAID separated the sample into two significantly different subsamples: participants who needed either total assistance, continuous verbal and/or visual assists or occasional physical assists, or occasional verbal and/or visual assists ($n = 5$) and participants who were able to take off a shirt/coat/jacket while seated in a wheelchair with no assists ($n = 14$). For participants who were able to take off a shirt/coat/jacket while seated in a wheelchair with no assists the next strongest functional indicator was the ability to safely perform the FEW-P Outdoor Mobility task at pretest, more specifically the ability to travel safely on flat easy terrain ($F = 24.91$, $p = .0009$). Exhaustive CHAID divided the subsample into two significantly different subsamples: participants who had severe risks, minor risks, or a potential risk ($n = 7$) and participants who demonstrated safe practices ($n = 7$).

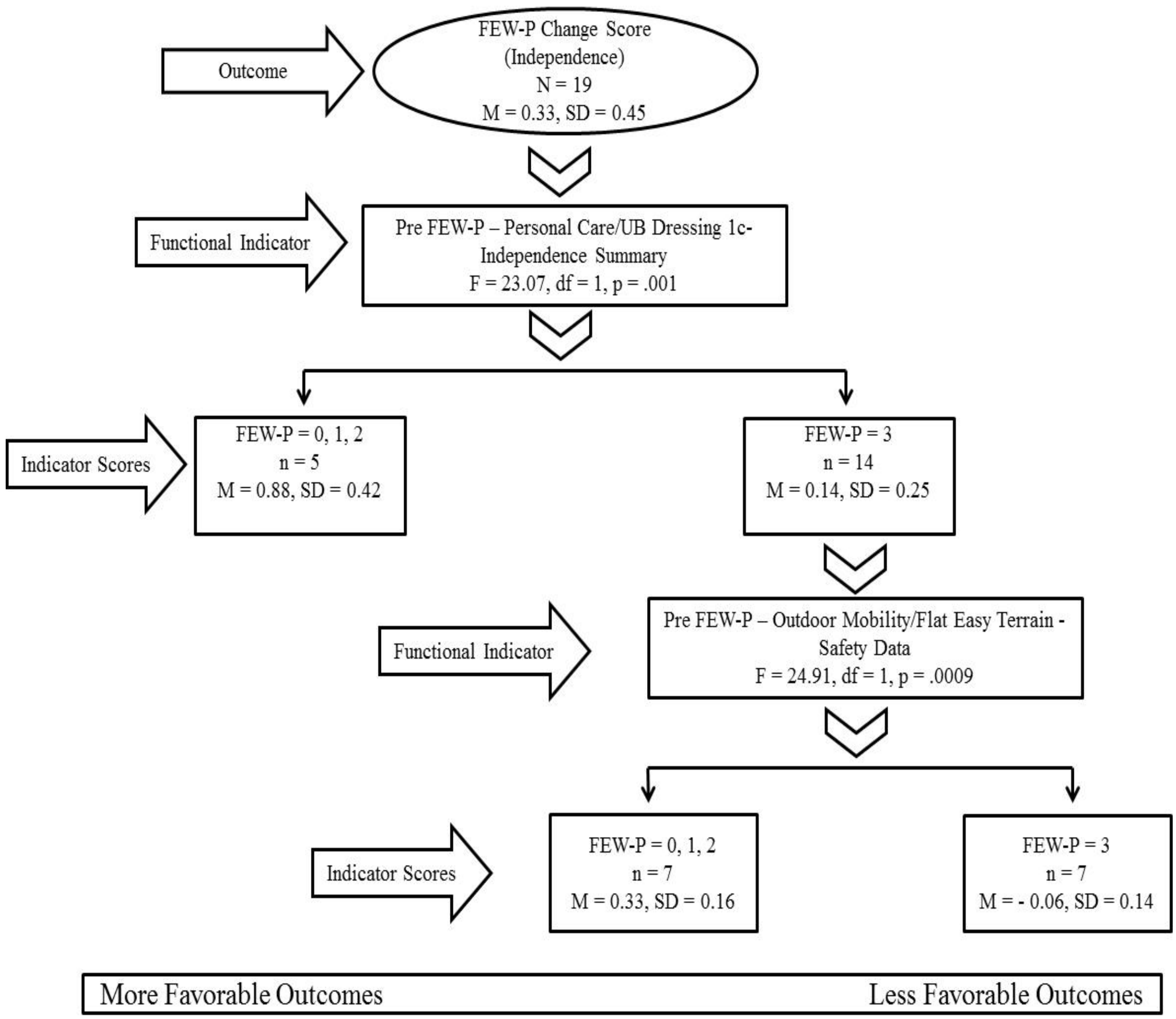


Figure 8: Exhaustive CHAID Analysis of the FEW-P Change Score (Independence): Functional Indicators Associated with More and Less Favorable Outcomes

N.B. Pre = Pretest; FEW-P: the Functioning Everyday with a Wheelchair tool - FEW-Performance (the home-version); UB Dressing 1c: upper body dressing (takes off shirt/coat/jacket while seated in a wheelchair); (independence summary: 0 = total assistance; 3 = no assists); (safety data: 0 = severe risks; 3 = safe practices).

Table 23 outlines the results obtained from the *n*-fold cross validation procedure for the FEW-P Independence change score model. As displayed in the table, the difference between the Risk Estimate for the Risk Statistics and Cross-validation was 0.02 suggesting reasonable confidence in the validity of the model.

Table 23: Cross-validation results for the FEW-P (independence) model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.05	0.07
Standard deviation of Risk Estimate	0.02	0.02

FEW-P: the Functioning Everyday with a Wheelchair tool - FEW-Performance (the home-version)

For the FEW-P Safety change score model (see Figure 9), the FEW Outdoor Mobility task at posttest was the functional indicator most strongly associated with FEW-P Safety change score outcome ($F = 19.13$, $p = .001$), separating the sample into two significantly different subsamples: participants who completely disagreed to mostly agreed that the size, fit, postural support and functional features of their wheelchair allowed them to get around outdoors as independently, safely, and efficiently as possible ($n = 5$) and participants who completely agreed that the size, fit, postural support and functional features of their wheelchair allowed them to get around outdoors as independently as possible ($n = 14$). For participants who completely agreed that their wheelchair allowed them to get around outdoors as independently as possible, the next strongest functional indicator was the FEW-C Health Needs task Quality score at posttest, more specifically the ability to adequately and efficiently elevate legs while seated in a wheelchair ($F = 27.08$, $p = .001$). Exhaustive CHAID again divided the subsample into two significantly different subsamples. Participants whose quality of performance was acceptable with improvement possible or acceptable with standards met ($n = 9$) and participants whose quality of performance was unacceptable with standards not met or with standards partially met ($n = 5$).

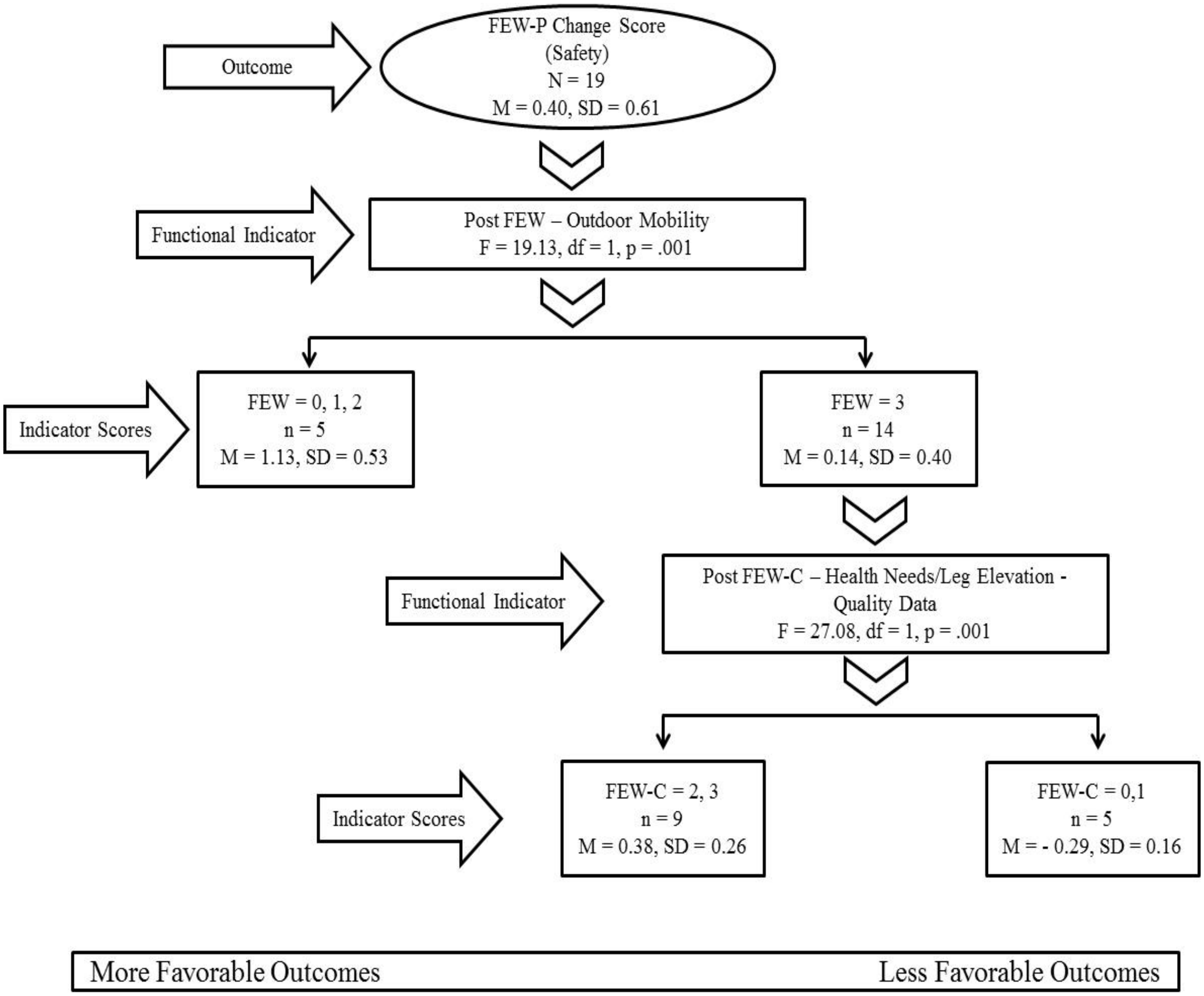


Figure 9: Exhaustive CHAID Analysis of the FEW-P Change Score (Safety): Functional Indicators Associated with More and Less favorable outcomes

N.B. Post = Posttest; FEW: the Functioning Everyday with a Wheelchair tool (the self-report version); FEW-C: the Functioning Everyday with a Wheelchair tool - FEW-Capacity (the clinic-version); FEW-P: the Functioning Everyday with a Wheelchair tool - FEW-Performance (the home-version); (FEW: 0 = completely disagree; 3 = completely agree); (quality data: 0 = unacceptable (standards not met; 3 = acceptable (standards met).

Table 24 outlines the results obtained from the *n*-fold cross validation procedure for the FEW-P Safety change score model. As displayed in the table, the largest difference between the Risk Estimate for the Risk Statistics and Cross-validation was 0.03 suggesting reasonable confidence in the validity of the model.

Table 24: Cross-validation results for the FEW-P (safety) model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.09	0.11
Standard deviation of Risk Estimate	0.03	0.06

FEW-P: the Functioning Everyday with a Wheelchair tool - FEW-Performance (the home-version)

For the FEW-P Quality change score model (see Figure 10), the presence of an arm support at pretest, more specifically the removable arm support, was the wheelchair characteristic variable most strongly associated with the FEW-P Quality change score outcome ($F = 7.72$, $p = .01$), separating the sample into two significantly different subsamples: participants whose wheelchairs did not have a removable arm support at pretest ($n = 14$) and participants whose wheelchair had a removable arm support at pretest ($n = 5$). For participants whose wheelchair did not have a removable arm support at pretest the next strongest functional indicator was independence performing the FEW-P Outdoor Mobility task at pretest, more specifically the number of physical assists needed to travel on flat easy terrain ($F = 6.88$, $p = .02$). Exhaustive CHAID again divided the subsample into two significantly different subsamples: participants who needed one, two, or three physical assists to travel on flat easy terrain ($n = 9$) and participants who traveled on flat easy terrain with no physical assists ($n = 5$).

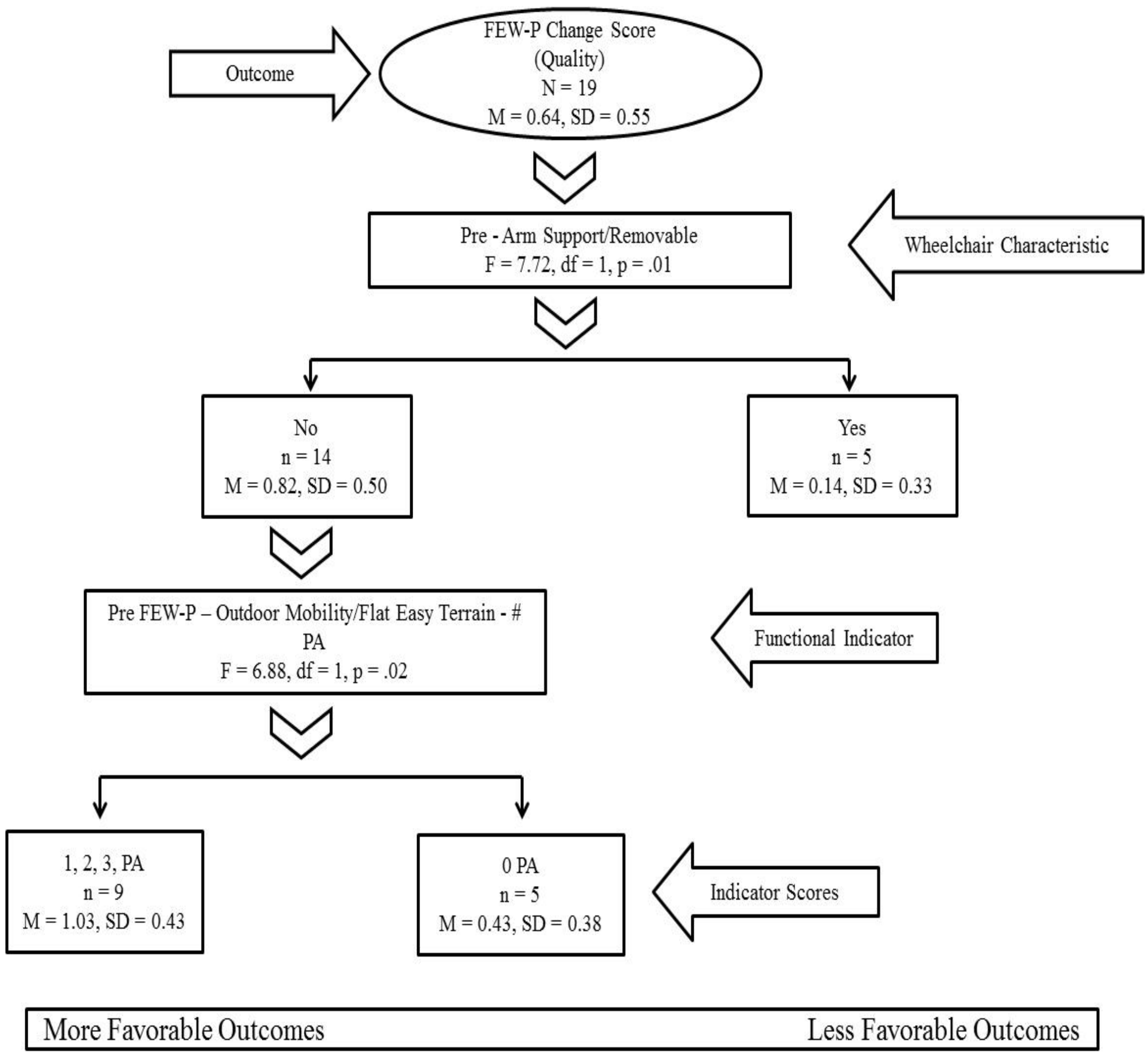


Figure 10: Exhaustive CHAID Analysis of the FEW-P Change Score (Quality): Functional Indicators and Demographics Associated with More and Less Favorable Outcomes

N.B. Demographic (Yes: with arm support/removable; No: without arm support/removable); Pre = Pretest; FEW-P: the Functioning Everyday with a Wheelchair tool - FEW-Performance (the home-version); # PA = Number of physical assists.

Table 25 outlines the results obtained from the *n*-fold cross validation procedure for the FEW-P Quality change score model. As displayed in the table, the largest difference between the Risk Estimate for the Risk Statistics and Cross-validation was 0.10 suggesting reasonable confidence in the validity of the model.

Table 25: Cross-validation results for the FEW-P (quality) model.

	Risk Statistics	Cross-Validation
Risk Estimate	0.13	0.03
Standard deviation of Risk Estimate	0.04	0.02

FEW-P: the Functioning Everyday with a Wheelchair tool - FEW-Performance (the home-version)

Table 26 summarizes the results from the seven Exhaustive CHAID models. Pre-post change variables, significant predictors, and more or less favorable outcomes are identified.

Table 26: Summary of Exhaustive CHAID models.

Pre-post Change	Significant Predictor(s)	More Favorable	Less Favorable
FEW	Pre FEW Outdoor Mobility	0 (Completely disagree)	1,2,3
FEW-C Independence	Pre FEW-C operate/turn WC/Independence	1,2,3 physical assists	0 physical assists
	Pre FEW-C easy transfer/ind[1]	1,2,3 physical assists	0 physical assists
FEW-C Safety	Pre FEW-C Indoor Mobility/Safety	0 (severe risks)	1,2,3
	Pre FEW-C Personal care/quality[2]	3 (acceptable)	0,1,2
FEW-C Quality	Pre FEW-C Indoor Mobility/Safety	0 (severe risks)	1,2,3
	Post Few-C Outdoor Mobility/Safety[3]	3 (safe practice)	0,1,2
FEW-P Independence	Pre FEW-P Upper Body Dressing/ Independence	0,1,2 physical assists	3 physical assists
	Pre Few-P Outdoor mobility/Safety[4]	0,1,2	3 (safe practice)
FEW-P Safety	Post FEW Outdoor Mobility	0,1,2	3 (completely agree)
	Post FEW-C leg elevation/quality[5]	2,3 (3=completely acceptable)	0,1
FEW-P Quality	Removable arm support pre	No	Yes
	Pre FEW Outdoor Mobility /Independence[6]	1,2,3 physical assists	0 physical assists

[1]Within group with less favorable outcome based on Pre FEW-C Operate/turn WC/Independence; [2]Within group with less favorable outcome based on Pre FEW-C Indoor Mobility/Safety; [3]Within group with less favorable outcome based on Pre FEW-C Indoor Mobility/Safety; [4]Within group with less favorable outcome based on Pre FEW-P Personal Care/UB Dressing/Independence; [5]Within group with less favorable outcome based on Post FEW Outdoor Mobility; [6]Within group with less favorable outcome based on removable arm support pretest

4.3.3 Differences in health status between pretest and posttest

The results of paired t-tests indicated that there were significant differences between pretest and posttest in both participants' perceived health status on an average day over the last three months and participants' perceived health status on the day of testing (see Table 27). There were no significant differences between participants' perceived health today and average health at either pretest or posttest (data not shown).

Table 27: Differences between pretest and posttest in average health and health today.

Outcome	Pretest	Posttest	95% CI	t	df	p
Average health	59.24 ± 18.92	66.76 ± 16.20	[-14.93, -0.13]	-2.16	16	.04
Health today	54.41 ± 20.30	66.76 ± 21.57	[-23.60, -1.11]	-2.33	16	.03

Note. Average health: participants' health status on an average day over the last three months; Health today: participants' health status on the day of testing; Number of participants (N=17)

4.3.4 Relationships between change in health status and change in function

The results of Spearman's rho correlation coefficients indicated that there were no significant relationships between change in participants' health status on an average day over the last three months and day of testing and change in participants' function on the FEW, FEW-C (Independence, Safety, Quality), and FEW-P (Independence, Safety, Quality) (data not presented).

4.4 DISCUSSION

This study is unique because it is the first to apply Exhaustive CHAID methods to examine the dynamic associations among demographics, wheelchair characteristics, and functional status indicators, and change scores of the FEW, FEW-C, and FEW-P tools that measure “functioning every day with a wheelchair”. At first glance we note that, most of the factors identified in each model were derived from the pretest indicating that it was the pretest status that was driving the change. Also, in all models, worse scores at pretest on the FEW, FEW-C, and FEW-P were associated with larger change scores and thus more favorable outcomes, except in three instances, where better scores at pretest in the FEW-C Safety and Quality models and at posttest in the FEW-P Safety model were associated with greater change. Additionally, in all models, when applicable, the greater the number of physical assists needed at pretest, the larger the change score. Clinically, the poorer the wheelchair fit and performance at pretest, the greater the changes in fit and performance at posttest because the participants’ new power chairs were prescribed and custom fit by qualified wheeled mobility and seating professionals.

Another interesting finding was that Outdoor Mobility was a significant predictor in five models which highlights the importance of this specific item and related tasks/skills (i.e., the ability to travel safely on flat easy terrain) in changes in functional performance of wheelchair users. This finding confirms the work of previous studies which highlighted the role of outdoor mobility and its related tasks/skills and reported that involvement in outdoor activities such as being active in the community help wheelchair users maintain wheelchair skills and are positively associated with their functional performance (Kilkens, Post, Dallmeijer, van Asbeck, & van der Woude, 2005).

Our data also showed that the amount of change was larger for the FEW when compared to the FEW-C and FEW-P and it was the pretest scores that were driving the change. An explanation for that could be because the participants in Mills (2003) and Schmeler (2005) studies had come to a clinical setting to be evaluated for a new wheeled mobility and seating device, their perceptions of their function as indicated on the FEW may have been worse than their actual performance as indicated on the FEW-C and FEW-P. These participants tended to underestimate their capabilities on the FEW self-report tool compared to their pretest performance, which is not unusual for individuals who are seeking interventions to obtain health services or a new product and/or equipment (Cress et al., 1995; Schmeler, 2005).

Furthermore, although participants' perceived health status improved significantly at posttest, the results of Spearman's rho correlation coefficients indicated that there were no significant relationships between change in participants' perceived health status and change in participants' function. This suggests that improvement in participants' performance at posttest was not associated with their improved health status, but rather due to the effect of the new properly fitted wheelchairs provided by a qualified interdisciplinary team of clinicians.

For Independence predictor variables, worse independence scores and more physical assists needed to perform different tasks at pretest (Outdoor Mobility, Operate, Transfer, Personal Care) and posttest (Outdoor Mobility) were associated with larger change scores (more favorable outcomes) and that was consistent among the three models for the FEW, FEW-C, and FEW-P. For Safety predictor variables, worse safety scores while performing different tasks (Indoor Mobility, Outdoor Mobility) at pretest were associated with larger change scores (more favorable outcomes) and that was consistent among the two models for the FEW-C, and FEW-P. However, worse safety scores while performing the Outdoor Mobility task at posttest was associated with smaller change scores (less favorable outcomes) as indicated in the FEW-C Quality change score model. For Quality predictor variables, at both pretest and posttest, better quality scores were always associated with larger change scores (more favorable outcomes) as indicated in both the FEW-C Safety change score model --- Personal Care quality summary, and the FEW-P Safety change score model ---Health Needs/Leg Elevation quality data.

Clinically, the most prominent finding from our models suggests that independence, number of physical assists, safety, and tasks related to Outdoor Mobility at pretest are functional indicators of great importance for change in perceptions and performance in everyday tasks of wheelchair users. Therefore, if these indicators are assessed and targeted for intervention, perceptions and performance of wheelchair users may be developed and lead to improved everyday functioning. Another relevant clinical finding is that worse independence and safety scores and a greater number of physical assists needed to perform different tasks at pretest were associated with larger change scores (more favorable outcomes) which is considered a potential area for intervention that needs to be focused on when prescribing a new wheelchair.

The utility of Exhaustive CHAID methods was evaluated by examining the validity of the factors identified in each analysis through the *n*-fold cross-validation procedure. Examining the factors identified in each analysis provides some support for the validity of the methods. For all analyses, the values of the Risk Estimate for the Risk Statistics and Cross-validation were fairly close with relatively small differences, providing strong and reasonable confidence in the validity of these models.

With Exhaustive CHAID, even though it is an iterative process, variables that had missing data such as the Transportation task did not enter any of the models. Also, even though no data were missing, surprisingly, no demographics were indicated and only one wheelchair characteristic was included in the Exhaustive CHAID analyses, namely, whether the participants had a removable arm support at pretest. This finding is not consistent with the current body of literature (Cooper et al., 1999; Cooper et al., 1997; Cooper et al., 1996; Cooper et al., 2002; Oyster et al., 2011; Rogers et al., 2003) which reports that demographic variables such as age, race, employment status, and type of wheelchair can contribute to different functional performance outcomes. This finding warrants further investigation to examine the dynamic interaction between the various demographics and wheelchair characteristics and change scores of the FEW, FEW-C, and FEW-P tools that measure functional performance of wheelchair users.

4.4.1 Study limitations and future directions

There were several limitations to the present study. When examining associations among the various factors and their influence on change scores for the FEW, FEW-C, and FEW-P, Exhaustive CHAID methods offer distinct advantages over traditional linear methods (e.g. multiple regressions). These advantages are the ability of Exhaustive CHAID methods to identify which factors most strongly associate with the outcomes, and identify favorable and unfavorable outcomes without researcher bias. However, our small sample may limit the generalizability of our findings, even though our cross-validation data confirmed the validity of our models.

Moreover, the generalizability of our findings may be limited due to our inclusion of a homogeneous sample of experienced manual wheelchair users that did not demonstrate cognitive or language impairments. Our sample was also limited in terms of the diversity of diagnoses of the participants. In 2002, the Disability Statistics Center reported that osteoarthritis, stroke, multiple sclerosis, absence or loss of lower extremity as the most prevalent primary conditions causing disability among wheelchair users (Kaye, Kang, & LaPlante, 2002). Furthermore, each year an estimated 12,000 people in the United States sustain spinal cord injuries (SCI) with a prevalence rate of approximately 259,000 in any given year (National Spinal Cord Injury Statistical Center, 2009). Many persons with SCI use a wheelchair for mobility in daily life and may completely depend on a wheelchair for their mobility (Kilkens et al., 2005). The inclusion of wheelchair users stratified to represent primary wheelchair user groups in future studies would strengthen the generalizability of future findings.

4.5 CONCLUSIONS

The findings of this study shed light on and reveal new factors (functional status indicators, and one wheelchair characteristic) that were significantly associated with change scores of the FEW, FEW-C, and FEW-P tools that measure daily activities with a wheelchair. Independence, number of physical assists, safety, and tasks related to Outdoor Mobility at pretest were the functional status indicators found to be of greatest importance and significantly associated with changes in perceptions and performance of everyday tasks over time in our models. Whether the participants had a removable arm support at pretest was the only wheelchair characteristic that proved to be significant in our models. Examining these factors closely in a clinical setting in wheelchair users during the seating evaluation and intervention process is necessary and may better enhance understanding of the effect of such indicators on wheelchair users' perceptions and functional performance. Decision analysis methods are helpful and may be used to examine the dynamic interaction among various client demographics, wheelchair characteristics, and functional status indicators of everyday task performance with a wheelchair. Simple decision trees can be generated which may identify priorities for further clinical inquiry in wheeled mobility and seating interventions. These methods may suggest specific focus areas for assessment and intervention and may highlight the importance of some factors that influence changes in functional performance among clients who have been referred for, and prescribed, a wheeled mobility device.

5.0 CONCORDANCE OF SELF-REPORT AND PERFORMANCE-BASED MEASURES OF FUNCTION AND DIFFERENCES BETWEEN CLINIC AND HOME AMONG WHEELCHAIR USERS

5.1 BACKGROUND

Rehabilitation clinicians frequently use performance assessments in a clinic setting to make predictions about clients' ability to safely and independently perform activities of daily living (ADL) and instrumental ADL (IADL) in their home environment. Despite this common practice, research has shown that performance-based observation conducted in clinic setting often yields different results from those conducted in clients' homes (Park, Fisher, & Velozo, 1994; Raina, Rogers, & Holm, 2007; Rogers et al., 2003; West, Rubin, Munoz, Abraham, & Fried, 1997). Prior research has documented both better performance in the home compared to the clinic and better performance in the clinic compared to the home, depending on the nature of the impairments and the supportiveness of the environment (Leonardi, Bickenbach, Ustun, Kostanjsek, & Chatterji, 2006; Rogers et al., 2003). Additionally, rehabilitation clinicians use self-report of clients' abilities to perform ADL and IADL to augment performance-based measures (Newton, Kirby, Macphee, Dupuis, & Macleod, 2002; Rogers et al., 2003; Rushton, Kirby, & Miller, 2012). Research has suggested that if the outcome from self-report and performance-based methods is comparable, self-reports might be preferred because they are easy to learn, require less skill to administer, are less time consuming, and are less costly (Newton et al., 2002; Rogers et al., 2003). However, research suggests that there is low to moderate agreement between data obtained by self-report and performance-based observation in the home (Kempen, Sullivan, van Sonderen, & Ormel, 1999; Myers, Holiday, Harvey, & Hutchison, 1993; Wijlhuizen & Ooijendijk, 1999). A study by Rogers et al. (2003) showed different rates of concordance for self-report and clinic performance with the criterion in-home performance, depending on the tasks being assessed. Activities with a cognitive component and personal care activities (i.e., cleansing, trimming toenails) showed greater concordance between self-report and home compared to clinic. In contrast, activities with a predominantly motor component (i.e., toilet transfer, bath transfer, shower transfer, sweeping, taking out garbage) showed greater concordance between clinic and home compared to activities with a predominantly cognitive component (i.e., paying bills, managing medication). When clinic performance was not concordant with home performance, it consistently underestimated it, suggesting greater disability. The authors suggested that the low concordance between the clinic and home assessments was likely due to environmental factors (standardization of the clinic and familiarity of the home environment).Poor concordance between clinic and home has been demonstrated in other clinical populations, such as community dwelling older adults (Park et al., 1994), older women with major depression (Hamed, 2008), older women with heart failure (Raina et al., 2007), and older adults with visual impairments (West et al., 1997). These studies found that the familiarity of the home seemed to facilitate overall functional performance. In contrast, the standardization of clinical settings may help clients to better perform some specific tasks (e.g. stairs use) that require better lighting and clutter-free spaces. Their findings suggested that the impact of the environment on activity performance can be neutral, enabling, or disabling depending on the level of analysis, and the activity being analyzed. Also, they concluded that if a rehabilitation clinician wants to know how a person performs IADLs, the clinician should evaluate that person's performance in the environment in which the client will be functioning. In contrast to the previous studies, in a sample of adults with diagnosed or suspected dementia, they found no overall difference in IADL performance between the clinic and home settings (Nygard, Bernspang, Fisher, & Winblad, 1994).

Overall, research studies comparing performance for ADL and IADL between clinic, self-report, and home settings yielded conflicting results. Despite the importance of assessing functional performance in persons who have been prescribed wheeled mobility and seating device, little is known about the relative concordance of the different methods used to obtain this information (self-report and performance-based outcome measures). Previous studies have reported that self-reports of performance with a wheeled mobility and seating device do not always agree with clinic and home measures of the same performance (Newton et al., 2002; Rushton et al., 2012; Warms, Whitney, & Belza, 2008). A comparison study of self-report and performance-based instruments to measure change in function following the provision of wheeled mobility and seating interventions for adults with disabilities who used manual or power wheelchairs or scooter as their primary mobility and seating device showed that both self-report and performance measures at the clinic were able to detect significant changes in function over time following the provision of a new wheeled mobility and seating device. However, the self-report often significantly underestimated function and therefore documented greater changes in function over time than did the performance measure at the clinic (Schmeler, 2005).

The specific aims for this study are (1) to examine the concordance of the self-report; Functioning Everyday with a Wheelchair (FEW) and the FEW-Capacity (FEW-C, a performance-based measure for the clinic) with the criterion measure, the FEW-Performance (FEW-P, a performance-based measure for the home), and (2) to investigate the differences between the clinic and home performance-based measures; the FEW-C and the FEW-P at pretest and posttest following the provision of a new wheeled mobility and seating device.

5.1.1 Hypothesis

Aim 1 is descriptive. For Aim 2, our null hypothesis was that there would be no differences between the FEW-C and the FEW-P for independence, safety, and quality data at pretest and posttest following the provision of a new wheeled mobility and seating device.

5.2 METHODS

5.2.1 Design

This study used secondary data analyses of data collected in two previous studies (Mills, 2003; Schmeler, 2005) (see Chapter 3). Data in this study were examined to explore the concordance of the FEW and the FEW-C with the FEW-P, and to investigate the differences between the clinic and home performance-based measures; the FEW-C and the FEW-P at pretest and posttest following the provision of a new wheeled mobility and seating device.

In-home performance (FEW-P) was selected as the criterion method because 1) the home is the environment where persons usually perform their routine activities of daily living and either offers the most support or challenges functional performance, 2) the home is a familiar real-world environment where persons wish to remain (Rogers, et al., 2003).

5.2.2 Participants

Participants for this study were a subset of participants from the studies by Mills (2003) and Schmeler (2005). Our study sample consisted of 19 wheelchair users with progressive or non-progressive conditions who needed a new wheeled mobility and seating device. Nine were male and 10 were female. The average participant was Caucasian, 53.1 years old, and had used a wheelchair for 9.5 years. Participants with multiple sclerosis comprised over one third of the sample. At pretest, 16 of the wheelchairs were manual and 3 were power. The manual wheelchairs, on average, were 3.7 years old and most of them had no seat functions. At posttest, all participants had power wheelchairs, and most of these wheelchairs were equipped with multiple seat functions (see Chapter 3, Tables 3, 4, and 5 for details).

5.2.3 Instruments

The FEW, FEW-C, and FEW-P were the measures used in this study. The FEW is a 10 item self-report that measures perceived functional independence of individuals who use a wheelchair or scooter as their primary mobility and seating device. The FEW-C is a performance-based measure for the clinic and has 10 items. Items 2 – 10 are performance-based, and item 1 is a self-report. The FEW-C was designed to measure function based on the ICF construct of capacity. The FEW-P is a performance-based measure for the home and has 10 items with items 2 – 10 being performance-based, and item 1 being self-report, as in the FEW-C. The FEW-P was designed to measure function in the "lived in" environment according to the ICF (see Chapter 3 for specific details about the items, scoring, and psychometric properties for each tool).

5.2.4 Procedures

After study procedures were explained and written informed consents were signed, the FEW and FEW-C pretest assessments occurred on a regularly scheduled clinic visit for a seating evaluation, followed by the FEW-P assessment within 1 week. The posttest assessments occurred in the same sequence (FEW, FEW-C, FEW-P) after receiving the new wheelchair. A fixed rather than a random order of assessment methods was followed, with self-report before performance because perceptions (self-reports) are more likely to be biased by performance than the reverse. Mean duration between pretest and posttest was 57 days (see Chapter 3 for details).

5.2.5 Data Analysis

Percent agreement statistics at both pretest and posttest were computed to determine the concordance among items 2-10 of the three instruments (FEW, FEW-C, and FEW-P) for each subject (19 subjects). Percent agreement was calculated by dividing the number of participant agreements by the sum of the number of participant agreements and disagreements. The percentage of items for each method that resulted in either overestimation or underestimation of ability was calculated to identify bias and direction of disagreement.

We then examined the differences between the FEW-C and the FEW-P for independence, safety, and quality data for the 9 items at pretest and posttest following the provision of a new wheeled mobility and seating device by analyzing the average total scores using paired t tests. Differences between the FEW and FEW-C and the FEW and FEW-P have been reported elsewhere (Mills, 2003; Schmeler, 2005). Stability, durability, and dependability item was not included as it is a self-report item and differs from all other items of the FEW-C and FEW-P. To eliminate the effect of multiple comparisons, we used a Bonferroni adjustment (Field, 2009).

5.3 RESULTS

5.3.1 Concordance and bias

Tables 28 and 29 present percent agreement, percent overestimation, percent underestimation, and bias for each of the items 2-10 of the FEW and FEW-C relative to the criterion method (FEW-P) at pretest and posttest respectively.

At pretest, the FEW-C was more concordant with the FEW-P compared to the FEW for 8 of 9 items, the exception being Indoor Mobility. When there was a disagreement, for 7 of 9 items --- all but Outdoor Mobility and Transportation --- clinic underestimated home, and Outdoor Mobility, underestimated and overestimated equally. Moreover, for 8 of 9 items ---all but Transportation ---self-report underestimated home. Overall, when FEW and FEW-C were not concordant with the FEW-P, they consistently underestimated it with the exception of Transportation, which overestimated performance.

At posttest, the FEW-C was more concordant with the FEW-P compared to the FEW for 7 of 9 items --- all except Transfer and Outdoor Mobility. However, when the FEW and FEW-C were not concordant with the FEW-P, they had different tendencies. The FEW-C consistently overestimated the FEW-P, with the exception of Reach. The FEW underestimated the FEW-P for 4 of 9 items --- Comfort Needs, Reach, Personal Care, Indoor Mobility --- and overestimated the FEW-P for 5 of 9 items --- Health Needs, Operate, Transfer, Outdoor Mobility, and Transportation. At both pretest and posttest, the FEW-C was more concordant with the FEW-P for the majority of the items compared to the FEW.

At pretest, the FEW-C was most concordant with the FEW-P for the Personal Care task and was least concordant with the FEW-P for the Indoor Mobility task. In contrast, the FEW was most concordant with the FEW-P for the Outdoor Mobility task and was least concordant with the FEW-P for the Reach task. At posttest, the FEW-C was most concordant with the FEW-P for the Comfort task and was least concordant with the FEW-P for the Transfer task. In contrast, the FEW was most concordant with the FEW-P for the Operate and Indoor Mobility tasks and was least concordant with the FEW-P for the Reach and Personal Care tasks.

Table 28: Percent agreement and bias of the FEW and FEW-C with the FEW-P at pretest.

Item/Task	= FEW-P (home)	> FEW-P (home)	< FEW-P (home)	Bias
Comfort needs				
FEW(self-report)	26.3	10.5	63.2	-52.7
FEW-C (clinic)	42.1	21.1	36.8	-15.7
Health needs				
FEW(self-report)	21.1	10.5	68.4	-57.9
FEW-C (clinic)	63.2	15.8	21.0	-5.2
Operate				
FEW(self-report)	26.3	0.0	73.7	-73.7
FEW-C (clinic)	57.9	15.8	26.3	-10.5
Reach				
FEW(self-report)	10.5	0.0	89.5	-89.5
FEW-C (clinic)	68.4	5.3	26.3	-21.0
Transfer				
FEW(self-report)	42.1	26.3	31.6	-5.3
FEW-C (clinic)	52.6	21.1	26.3	-5.2
Personal care				
FEW(self-report)	36.8	15.8	47.4	-31.6
FEW-C (clinic)	78.9	5.3	15.8	-10.5
Indoor mobility				
FEW(self-report)	36.8	15.8	47.4	-31.6
FEW-C (clinic)	31.6	26.3	42.1	-15.8
Outdoor mobility				
FEW(self-report)	52.6	21.1	26.3	-5.2
FEW-C (clinic)	66.6	16.7	16.7	0.0
Transportation				
FEW(self-report)	50.0	33.3	16.7	+16.6
FEW-C (clinic)	72.7	27.3	0.0	+27.3

Note: = FEW-P (home) = the percent agreement with the criterion (FEW-P); > FEW-P (home) = percent of ratings higher than the criterion (overestimation of performance); < FEW-P (home) = percent of ratings lower than the criterion (underestimation of performance); Bias = direction and magnitude of the rating bias compared with the criterion measure (computed as > FEW-P - < FEW-P); FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version); FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version; the criterion).

Table 29: Percent agreement and bias of the FEW and FEW-C with the FEW-P at posttest.

Item/Task	= FEW-P (home)	> FEW-P (home)	< FEW-P (home)	Bias
Comfort needs				
FEW(self-report)	57.9	15.8	26.3	-10.5
FEW-C (clinic)	89.5	10.5	0.0	+10.5
Health needs				
FEW(self-report)	63.2	21.0	15.8	+5.2
FEW-C (clinic)	73.7	15.8	10.5	+5.3
Operate				
FEW(self-report)	68.4	21.1	10.5	+10.6
FEW-C (clinic)	73.7	26.3	0.0	+26.3
Reach				
FEW(self-report)	31.6	15.8	52.6	-36.8
FEW-C (clinic)	52.6	21.1	26.3	-5.2
Transfer				
FEW(self-report)	63.2	26.3	10.5	+15.8
FEW-C (clinic)	42.1	31.6	26.3	+5.3
Personal care				
FEW(self-report)	31.6	26.3	42.1	-15.8
FEW-C (clinic)	63.2	21.0	15.8	+5.2
Indoor mobility				
FEW(self-report)	68.4	10.5	21.1	-10.6
FEW-C (clinic)	73.7	15.8	10.5	+5.3
Outdoor mobility				
FEW(self-report)	57.9	31.6	10.5	+21.1
FEW-C (clinic)	57.9	31.6	10.5	+21.1
Transportation				
FEW(self-report)	46.2	46.2	7.6	+38.6
FEW-C (clinic)	61.5	30.8	7.7	+23.1

Note: = FEW-P (home) = the percent agreement with the criterion (FEW-P); > FEW-P (home) = percent of ratings higher than the criterion (overestimation of performance); < FEW-P (home) = percent of ratings lower than the criterion (underestimation of performance); Bias = direction and magnitude of the rating bias compared with the criterion measure (computed as > FEW-P - < FEW-P); FEW: the Functioning Everyday with a Wheelchair instrument (the self-report version); FEW-C: FEW-Capacity (the clinic-version); FEW-P: FEW-Performance (the home-version; the criterion).

5.3.2 Differences between the FEW-C and FEW-P at pretest and posttest

Below are the results of the paired t-tests of the FEW-C and FEW-P total independence, safety, and quality scores and of the individual items at pretest and posttest (see Tables 30-39).

For the total scores, at pretest, there was no significant difference between the FEW-C and the FEW-P, whereas, at posttest, the total safety and quality scores differed significantly, with the FEW-C scores being significantly better than the FEW-P scores (see Table 18).

Table 30: Differences between the FEW-C and FEW-P for the total scores at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.40, -0.03]	-2.39	18	.028	[0.02, 0.26]	2.39	18	.028
Safety	[-0.27, 0.24]	-.10	18	.918	[0.12, 0.49]	3.39	18	.003
Quality	[-0.34, 0.23]	-.40	18	.691	[0.10, 0.49]	3.18	18	.005

Note. $p < .01$

For the individual items, the FEW-C and FEW-P, in general, had consistent results at pretest and posttest. At pretest, the FEW-C and FEW-P, did not differ significantly for independence, safety, and quality. At posttest, the FEW-C and FEW-P, did not differ significantly for independence, safety, and quality except for quality scores for the Personal Care item (see Table 36), and safety scores for the Outdoor Mobility item (see Table 38), both of which were significantly better in the clinic (data not shown).

Table 31: Differences between the FEW-C and FEW-P for Comfort Needs at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.69, 0.27]	-.93	18	.366	[-0.04, 0.20]	1.37	18	.187
Safety	[-0.74, 0.64]	-.16	18	.875	[-0.21, 0.53]	.90	18	.380
Quality	[-1.21, 0.05]	-1.93	18	.069	[-0.20, 0.31]	.44	18	.667

Note. $p < .01$

Table 32: Differences between the FEW-C and FEW-P for Health Needs at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.35, 0.28]	-.24	18	.816	[-0.13, 0.23]	.62	18	.546
Safety	[-0.48, 0.90]	-.64	18	.531	[-0.09, 0.62]	1.56	18	.135
Quality	[-0.99, 0.57]	-.57	18	.578	[-0.37, 0.58]	.46	18	.650

Note. $p < .01$

Table 33: Differences between the FEW-C and FEW-P for Operate at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.74, 0.12]	-1.54	18	.141	[-0.07, 0.75]	1.75	18	.097
Safety	[-0.71, 0.29]	-.89	18	.385	[-0.14, 0.25]	.57	18	.578
Quality	[-0.45, 0.66]	-.40	18	.695	[-0.25, 0.35]	.37	18	.716

Note. $p < .01$

Table 34: Differences between the FEW-C and FEW-P for Reach at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.96, -0.02]	-2.19	18	.042	[-0.32, 0.23]	-.33	18	.742
Safety	[-1.17, 0.01]	-2.08	18	.053	[-0.80, 0.17]	-1.37	18	.187
Quality	[-0.94, -0.01]	-2.14	18	.046	[-0.71, 0.29]	-.90	18	.385

Note. $p < .01$

Table 35: Differences between the FEW-C and FEW-P for Transfer at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.64, 0.38]	-.54	18	.593	[-0.35, 0.51]	.39	18	.702
Safety	[-0.54, 0.96]	.59	18	.561	[-0.18, 1.55]	1.66	18	.114
Quality	[-0.47, 1.10]	.84	18	.411	[-0.35, 1.30]	1.21	18	.243

Note. $p < .01$

Table 36: Differences between the FEW-C and FEW-P for Personal Care at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.29, -0.02]	-2.45	18	.025	[-0.32, 0.53]	.52	18	.609
Safety	[-0.05, 0.47]	1.71	18	.104	[-0.04, 0.99]	1.92	18	.070
Quality	[-0.17, 0.59]	1.17	18	.259	[0.32, 1.16]	3.68	18	.002

Note. $p < .01$

Table 37: Differences between the FEW-C and FEW-P for Indoor Mobility at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.56, 0.32]	-.56	18	.584	[-0.10, 0.31]	1.07	18	.297
Safety	[-1.07, 0.23]	-1.36	18	.190	[-0.05, 0.68]	1.84	18	.083
Quality	[-0.99, 0.47]	-.75	18	.461	[0.01, 0.94]	2.14	18	.046

Note. $p < .01$

Table 38: Differences between the FEW-C and FEW-P for Outdoor Mobility at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.36, 0.32]	-.12	17	.910	[0.02, 1.11]	2.19	18	.042
Safety	[-0.13, 0.69]	1.43	17	.172	[0.30, 1.70]	3.00	18	.008
Quality	[-0.19, 0.52]	1.00	17	.331	[0.12, 1.57]	2.45	18	.025

Note. $p < .01$

Table 39: Differences between the FEW-C and FEW-P for Transportation at pretest and posttest.

Pretest					Posttest			
Data	95% CI	t	df	Sig.	95% CI	t	df	Sig.
Independence	[-0.17, 1.20]	1.67	10	.127	[-0.17, 0.56]	1.16	12	.271
Safety	[-0.46, 1.73]	1.30	10	.224	[-0.55, 0.70]	.27	12	.794
Quality	[-0.59, 1.68]	1.07	10	.311	[-0.50, 0.65]	.29	12	.776

Note. $p < .01$

5.4 DISCUSSION

Our hypothesis that there would be no differences between the FEW-C and the FEW-P for independence, safety, and quality data at pretest and posttest was partially confirmed. For the total scores, at pretest there were no significant differences, but at posttest the total safety and quality scores differed significantly. At first glance, these findings may seem unexpected because the same items were used to structure both of the FEW-C and FEW-P to observe functional performance of wheelchair users in both performance situations: the clinic and the home. The primary difference in the testing procedure was that the clinic was an unfamiliar, supportive environment, whereas the home was the familiar, naturalistic one. Hence, the actual performance differences were most likely due to environmental factors and that is consistent with previous literature (Hamed, 2008; Raina, 2007; Rogers, 2003). For the total scores, and individual item scores the results of our study indicated that at pretest, the effect of the environment was neutral. At posttest, however, the supportive environment of the clinic enabled safety and quality significantly, which was most likely driven by the quality scores for the Personal Care item and the safety scores for the Outdoor Mobility item.

Our results indicated that at both pretest and posttest, the clinic performance-based rating, the FEW-C, was more concordant with the in-home performance-based rating, the FEW-P, than the self-report FEW. The greatest concordance between the FEW-C and FEW-P at pretest was for Personal Care and at posttest for Comfort Needs. Moreover, the range of concordance between the FEW-C and FEW-P was 31.6 percent to 78.9 percent at pretest and 42.1 percent to 89.5 percent at posttest. However, the self-report FEW was least concordant with the FEW-P, ranging from 10.5 percent to 52.6 percent at pretest, and 31.6 to 68.4 percent at posttest. Clinically, our findings indicate that rehabilitation clinicians will get a more accurate estimation of performance in the home from a clinic performance assessment compared to a self-report. Based on our findings, there was a distinct discrepancy between what clients said they could do and what they actually did; therefore, information on wheelchair function, obtained from self-report, should be used with caution.

At pretest, when the FEW and FEW-C were not concordant with the FEW-P, both consistently underestimated it with the exception of the Transportation item, suggesting greater disability. The underestimation at pretest was more evident in the FEW suggesting that participants perceived greater disability. Because the sample in our study had come to a clinical setting to be evaluated for a new wheeled mobility and seating device, their perceptions of their function as indicated on the FEW may have been worse than their actual performance as indicated on the FEW-C and FEW-P. Underestimating capabilities on the FEW self-report tool compared to pretest performance, is not unusual for individuals who are seeking interventions to obtain health services or a new product and/or equipment (Cress et al., 1995; Schmeler, 2005).

5.4.1 Study limitations and future directions

There were several limitations to this study. A major limitation was the small sample size. When assessing the concordance and differences among the FEW-C and FEW-P for the Transportation item, the results should be interpreted with caution due to the smaller sample size and missing data. Several participants were not able to complete all subtasks related to this item due to unavailability of personal and/or public transportation, inability to get the wheelchair out of the house, fatigue, or bad weather conditions at the time of the assessment.

Our sample had adequate cognitive and language status so our findings may not be relevant to those with cognitive or communication impairments. Furthermore, not including new manual wheelchair users as well as some of the primary conditions causing disability among wheelchair users, such as osteoarthritis and spinal cord injuries (Kaye, Kang, & LaPlante, 2002; National Spinal Cord Injury Statistical Center, 2009) may limit the generalizability of our findings. Future studies with larger samples, and the inclusion of less-experienced wheelchair users with more diverse diagnoses and cognitive and communication impairments may strengthen the generalizability of future findings.

5.5 CONCLUSIONS

Our results suggested that the FEW-C was most concordant with the FEW-P for majority of the items compared to the FEW. Clinically, rehabilitation clinicians may get a more accurate estimation of performance in the home from a clinic assessment, and they are cautioned that the inclusion of self-report assessment and data obtained from clients' perceptions may be discrepant with actual performance. We also concluded that the impact of the environment on activity performance of wheelchair users can be neutral or enabling depending on time of assessment and tasks being assessed. At both pretest and posttest, for most of the tasks, the FEW-C and FEW-P were comparable suggesting that the environment may have a neutral effect. However, at posttest, the clients' safety scores for the Outdoor Mobility task and the clients' quality scores for the Personal Care task improved significantly suggesting that the standard supportive environment of the clinic may have enabling effect on activity performance. This research needs to be replicated across a wider range of wheelchair users with primary health conditions and cognitive and language deficits to assess the generalizability of the findings.

6.0 SUMMARY

Using the Functioning Everyday with a Wheelchair (FEW, a self-report measure), the FEW-Capacity (FEW-C, a performance-based measure for the clinic), and the FEW-Performance (FEW-P, a performance-based measure for the home) outcome measurement instruments, three studies were conducted to investigate the following objectives:

1. Examine the associations among the FEW, the FEW-C, and the FEW-P instruments at pretest and posttest following the provision of a new wheeled mobility and seating device provided by a qualified interdisciplinary team of clinicians.
2. Examine specific demographics, wheelchair characteristics, and functional status indicators associated with change scores of three target variables (FEW, FEW-C, and FEW-P).
3. Examine the concordance of the FEW and the FEW-C with the FEW-P as the criterion measure, and investigate the differences between the FEW-C and the FEW-P at pretest and posttest following the provision of a new wheeled mobility and seating device.

Prior to these three studies, a literature review was completed and revealed that despite the importance of assessing functional performance in persons who have been prescribed wheeled mobility and seating devices, few studies specifically have considered the everyday functional abilities of wheelchair users. Instead, research focused on a narrow range of activities (i.e., issues of design, abandonment, cost, and policy) and ignored the role of wheelchair interventions for enabling activities and participation. Outcomes of seating-mobility interventions can be measured using subjective (self/proxy report) or objective (performance-based observation at clinic and home) methods. Few studies have examined the associations between these methods among wheelchair users. Therefore, data obtained from different data gathering methods should be interpreted with caution because they do not always yield equivalent results, and the extent of agreement between these methods remains an open question. In response to the need for more comprehensive outcome measures to document function for third-party payers, and evaluate the efficacy of wheeled mobility interventions, a team of researchers at the University of Pittsburgh developed the FEW, the FEW-C, and the FEW-P instruments. The trio of FEW tools has been used in research and proved to be reliable, valid, and useful.

For the first study, we examined associations among the FEW, FEW-C, and FEW-P, and found that the strength of the correlations among the different methods varied by item, time and environment. In general, there were stronger correlations between the three tools at the pretest when compared with the posttest. This might be attributed to familiarity with the wheeled mobility device at pretest. It may also be due to the fact that new power wheelchairs were given to the clients only 2 weeks before the posttest, and they were less familiar with operating them.

For the second study, we examined specific demographics, wheelchair characteristics, and functional status indicators associated with pretest to posttest change scores of the FEW, FEW-C, and FEW-P. Our Exhaustive Chi-Squared Automatic Interaction Detector (CHAID) models showed that independence, number of physical assists, safety, and tasks related to Outdoor Mobility at pretest were most strongly associated with changes in perceptions and performance of everyday tasks over time. Examining these indicators closely in a clinical setting with wheelchair users during the seating evaluation and intervention process is necessary. It may enhance understanding the effect of such indicators on wheelchair users' perceptions and functional performance, as well as guide interventions.

For the third study, our results suggested that the FEW-C and FEW-P did not differ significantly at pretest for independence, safety or quality. However, at posttest, safety and quality ratings of the FEW-C were significantly better than the FEW-P, and driven by two items: Outdoor Mobility safety and Personal Care quality. We concluded that the impact of the environment on activity performance of wheelchair users can be neutral or enabling depending on time of assessment and tasks being assessed. Our results also indicated that the FEW-C was most concordant with the FEW-P for the majority of the items compared to the FEW. Clinically, rehabilitation clinicians may get a more accurate estimation of performance in the home from a clinic assessment, and they are cautioned that the inclusion of self-report assessment and data obtained from clients' perceptions may not be concordant with actual performance.

In summary, the findings of our studies add to the work of previous studies that supported the use of the FEW tools for clinic and research use. The FEW tools have complementary relationships, and each tool could bring unique information to wheeled mobility and seating interventions. The application of Exhaustive CHAID is promising. It may help to highlight the importance of factors that may influence the change in functional performance among wheelchair users, and suggest priorities and specific focus areas for seating interventions. The use of larger samples that include new wheelchair users and those with more diverse diagnoses and cognitive and language limitations, may strengthen the generalizability of future studies.

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