Issues for the Selection of Wheelchair-Specific Activity and Participation Outcome Measures: A Review

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Historically, wheelchair use and participation in everyday activities were inversely related, because wheelchairs were difficult to propel and there were many problems with environmental access.¹ Although recent advances in wheelchair technology are promising,^{2, 3} currently individuals who use wheelchairs encounter many barriers to participation including accessibility problems^{4–7} low rates of employment,⁴ social isolation⁵ and stigma.^{8, 9} Given these issues and in light of a rapid increase in the number of wheelchair users,¹⁰ it is critical to develop better ways to measure and to understand barriers and facilitators to participation in this population.¹¹

New technology has increased wheelchair and wheelchair seating options, but it has also made the selection process more difficult for prescribers and their clients and more expensive for funding agencies. As the prescription process becomes more complicated and funding agencies begin to demand evidence to support the need for equipment, outcome measurement is becoming increasingly necessary. When attempting to decide on an appropriate measure, researchers and clinicians must choose from an increasing array of potential instruments.

A rigorous analysis of existing measurement tools should cover conceptual, reliability, validity and practical considerations.^{12–15} Because no studies have critically evaluated activity and participation outcome measures for individuals who use wheelchairs, a comprehensive review was undertaken using the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF)¹⁶ as a framework.

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Portions of this paper have been presented at the 12th Annual North American Collaborating Centre Conference on ICF, June 6 & 7, 2006, Vancouver, BC, Canada and the Festival of International Conferences on Care giving, Disability, Aging and Technology, June 16 – 19, 2007 in Toronto, ON.

We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on us or on any organization with which we are associated AND, if applicable, we certify that all financial and material support for this research and work are clearly identified in the title page of the manuscript.

The ICF was developed to create a common language to explain function and health. The ICF model describes “functioning [...] as] an umbrella term encompassing all body functions, activities and participation,” (p. 3)¹⁷ which results from a dynamic interaction between health conditions, personal and environmental factors. In the ICF, body function is defined as the physiological function of body systems and psychological functioning of the individual. Activity is defined as the execution of a task or action, and participation is defined as involvement in a life situation.¹⁶ The term “capacity,” which is associated with activity, describes what an individual can do, while the term “performance,” which is associated with participation, describes what an individual normally does do in their natural environment. Capacity assessments often take place in controlled settings, so that the person’s ability without personal assistance can be determined.¹⁶

Although a variety of generic measures of participation exist, reviews of these measures have identified a number of general limitations. First, many do not include all of the ICF activity participation domains (e.g., Craig Hospital Scale and Reporting Technique, Re-integration to Normal Living, Impact on Participation and Autonomy, World Health Organization Disability Assessment Schedule 2.¹⁸ Second, older instruments that focus on the construct of handicap (as participation restriction) may not fully capture the full scope of the concept of participation in the ICF.¹¹ Third, in their review of 100 rehabilitation outcome measures, Rust and Smith found that 30% ignored the impact of assistive technology, 44% reduced scores for individuals who used assistive technology (e.g., Functional Independence Measure(FIM) and Sickness Impact Profile), and only 22% incorporated the use of the assistive technology in the outcome measure¹⁹. In light of such findings, Harris concluded that “current [generic] measures of participation are inadequate to the task of measuring activity and participation among wheeled mobility users” (p. 137) and advocated for the use of measures that captured device-specific information.¹¹ To advance research in this area, this review provides a conceptual, psychometric, and pragmatic critique of a variety of activity and participation outcome measures, intended exclusively for individuals who use wheelchairs, that are employed clinically and in research.

METHODS

We searched the literature systematically and extracted relevant data about outcome instruments that are used to measure activity and participation of individuals who use wheelchairs. The measures included in this study came from peer-reviewed articles that reported on wheelchair-specific measures, which covered the ICF activity and participation domains. Measures were included only if the articles were in English and subjects were older than 18.

Search Strategy

We searched CINAHL, PsychInfo, EMBASE, Google Scholar and Medline databases to identify peer-reviewed articles using keywords that included: function, activity, assistive technology, wheelchair(s), psychometrics, responsiveness, sensitivity to change, questionnaires, participation, outcome assessment, outcomes, treatment outcomes, reproducibility of results, validity, and validation studies. No time limits were imposed on

the search, but it was completed in August 2007 and therefore does not include measures published after this time. Titles of articles were screened and, if they fit the criteria, an abstract was retrieved. If the abstract was deemed relevant, the article was obtained. When a wheelchair-specific activity or participation outcome measure was identified, all related publications on the development and testing of the measure, including grey literature such as conference proceedings, thesis publications and the instruction manuals (if available) were acquired.

Appraisal of Measurement Tools

It is necessary to understand the conceptual basis of a tool in order to evaluate it.¹² Although this is related to the content validity of an instrument, the concept of content validity is much narrower and does not invite inter-measurement comparisons on a theoretical level. For conceptual comparisons, each instrument was classified according to the ICF based on the process proposed by Cieza et al.²⁰ All items from all measures were coded independently by two authors; and for items in which there was disagreement, consensus was achieved through discussion. When the potential existed for the use of multiple activity or participation item codes, a single code was selected that best represented the item, was selected. Based on this review, each measure was classified in terms of whether it measured activity or participation or both using the ICF approach 1 (p.234),¹⁶ in which certain domains are designated as activity and certain domains are designated as participation. Instruments with items that assessed mobility, self-care and domestic life domains were deemed activity measures. Measures with items that assessed interpersonal interactions and relationships, major life areas and community, and social and civic life were considered participation measures; and measures which included a balance of items from across all domains were considered to represent both. Jette et al.²¹ provide some empirical support for this approach. Their factor analysis of data from administration of the Late Life Disability and Functioning Instrument revealed a three factor solution: mobility activities, daily activities and social/participation, which suggests activity and participation are distinct constructs. Finally, a determination was made about whether the tool measured capacity or performance. Instruments that measured the wheelchair user's ability (capacity) in his or her natural setting were described as "capacity in natural environment" measures.

Reliability—For the purpose of this review, Andresen's grading criteria¹² were used to compare reliability scores across instruments based on the lowest value reported. In this system, an "A" corresponds to reliability coefficients 0.75 or higher (ICCs or Kappa), "B" ranges between 0.4 and 0.75, and "C" 0.4. "A+" was used for reliability coefficients greater than 0.9, because reliability coefficients of this magnitude have been recommended to allow individual comparisons.²²

Validity—Content, face, criterion and construct validity results and responsiveness data were extracted for each measurement tool. Measures of construct validity indicate whether measurements from the instrument vary in *a priori* hypothesized directions with measurements of related constructs.²³ To compare construct validity scores across instruments, Andresen's grading criteria¹² were used when correlation values were available. According to this grading scheme, an "A" corresponds to correlations with similar

measures or related constructs of 0.60 or higher, “B” ranges between 0.3 and 0.6 and “C” is 0.3 or lower. Tools that only reported positive extreme group validity without additional validity data were given a “B” grade. A widely used measure of responsiveness is the standardized response mean (SRM).²⁴ To compare across instruments, SRM Values 0.8 or higher were graded as “A”, values between 0.5 and 0.8 were graded “B”, and values 0.5 were graded “C”.²⁵ Tools that only reported significant changes over time, as hypothesised, but did not report a SRM were graded as “B.”

Wheelchair Contribution—Another critical element for people who use wheelchair-specific outcome measures is whether the instrument considers the impact of assistive technology on the results obtained, because this potentially confounding variable is frequently overlooked in the field of health measurement and rehabilitation.¹⁹ It is therefore very important to detail how assistive technology is considered in the scoring. In the present paper, we refer to this characteristic as *wheelchair contribution*, which is defined as how well the tool isolates the contribution of the wheelchair to activity and participation. To compare across measures, wheelchair contribution was operationalized as follows; a grade of “A” was assigned when 1) the scoring system involved a dual rating to clearly differentiate the effects of wheelchair use versus no wheelchair use (or different models of wheelchair and other assistive devices) on activity and participation and 2) wheelchair specifications were clearly documented. A grade of “B” was given when procedural instructions documented wheelchair specifications and specified how to assess a person using different methods (such as different models of wheelchairs or components of wheelchairs) but did not support head to head comparisons. A grade of “C” was given when there was no documentation of wheelchair specifications.

Applicability of Measures—Applicability, as a complement to psychometric properties of a measurement instrument, also requires careful appraisal.^{12, 26, 27} Applicability represents the pragmatic qualities of a tool that enable its use with a given population or in a specific context.²⁸ When the applicability of a measurement tool is appraised, many criteria are addressed: respondent burden, administrative burden and format compatibility. Respondent burden corresponds to the level of effort required, acceptance of the items or discomfort caused by the assessment procedure.^{29–31} Administrative burden comprises practical elements that the clinician or researcher considers as advantages or limitations when the measurement tool is applied in a specific context, such as training required, and time to administer and score the measure.^{14, 27} Finally, format compatibility examines the match between the target population characteristics and the assessment format to avoid age, gender, cultural or disability biases.^{12, 32} For respondent burden, tools were graded as “A” if they took 15 minutes or less and had high acceptability to respondents, a “B” grade if they were either longer (but appropriately so) or had some reported problems with acceptability, or a “C” grade if both length and acceptability were problematic.¹² For the administrative burden and format compatibility aspects, a description was provided for each tool.

RESULTS

Fifty-eight measures were identified for consideration, and 11 measures were included in the final review. Two wheelchair-specific measures were excluded because they focused on

physical activity as exercise. The Physical Activity Scale for Individuals with Physical Disabilities³³ was excluded because it was designed to identify metabolic equivalence for physical activity. The Wheelchair Physical Functional Performance test³⁴ was excluded because it includes a number of functional activities that intend to measure the domains of upper-body strength, upper body-flexibility, lower body strength, endurance and balance and coordination, which are more closely related to body structure and function than to activity and participation in the ICF. The other measures (n=45) were excluded because they were not wheelchair user specific. For example, the Participation Survey/Mobility (PARTS/M)³⁵ was not included in the review because it was developed for people with mobility impairments living in the community rather than for individuals who use wheelchairs exclusively. Similarly, the FIM was excluded, because it is not exclusively for individuals who use wheelchairs and, in fact, penalizes subjects for wheelchair use.³⁶

Table 1 lists the 11 tools included in the review and includes a description of their intended population(s), number of items, response scales and conceptual appropriateness.

Conceptual Appropriateness

The fourth column of table 1 indicates how items from each measure were classified into ICF chapters using Cieza et al.'s criteria.²⁰ All but three measures cover the domain of mobility exclusively. The Wheelchair Users Functional Assessment (WUFA)³⁷ includes two items from the self-care domain (dressing, bathing). The Wheelchair Outcome Measure (WhOM)³⁸ is the only instrument that uses items nominated and weighted by the client. As such, it could potentially, but not necessarily, include items from all participation domains, because the rater solicits information that is participation focused. The Functional Evaluation in a Wheelchair Questionnaire version (FEW-Q)³⁹ includes a mix of body function, activity and participation, and environmental elements. The FEW-Q was the most difficult measure to classify, because all items are multi-barrelled. For instance, question 5 asks respondents to rate their agreement with the following statement (with ICF codes included): "The size, fit, postural support and functional features of my wheelchair/scooter (e1201-Assistive products and technology for personal indoor and outdoor mobility and transportation) allow me to operate it (d465 –Mobility chapter-moving around using equipment) as independently (not classified in the ICF), safely (not classified in the ICF) and efficiently (not classified in the ICF) as possible." In this case, as in most FEW-Q items, the respondent needs to consider the impact of four features of the assistive technology on three characteristics of the quality of one facet of activity or participation by providing only one response on a seven point scale.

Looking more closely at the mobility item codes assigned to each measure, a majority of items were classified as d465 (moving around using equipment). For some measures, this code covers up to 30 different items. Other measures reflect a wider spectrum of mobility tasks, including transfers, reaching, manipulating wheelchair accessories and using transportation.

The fifth column of table 1 indicates whether measures were deemed capacity or performance assessments. Most measures involve standardized tasks in a standardized environment, suggesting a capacity assessment. Other measures are based on what the

person can do in his/her natural environment. Two involve the observation of customized tasks, selected based on the individual needs of the client, which are accomplished in his/her natural environment Powered Indoor Driving Assessment (PIDA) and Powered Community Driving Assessment (PCDA). As such, these are considered to be capacity assessments in the natural environment. As a self-report measure, the FEW-Q also involves a capacity assessment in the natural environment, because the questions focus on what the person can do with his/her wheelchair. The WhOM belongs to a unique category, because it captures the satisfaction with performance of activities or participation when using a wheelchair.

Reliability

The reliability coefficients for each measure are presented in table 2. Reliability evidence for wheelchair user specific measures is limited. One measure has been subjected to no reliability study (PCDA); and, for most other studies, reliability estimates are established based on only one study. The published reliability coefficients are generally good (above 0.75), except for the intra-rater reliability coefficient of the PIDA which was 0.67,⁴⁰ however, only 4 measures have coefficients recommended for individual comparisons: Four Functional Tasks (FFT),⁴¹ Wheelchair Skills Test (WST) 2.4,⁴² WhOM⁴³ and Wheelchair Circuit (WC).⁴⁴ The type of ICC is not reported for three tools (WST 2.4,⁴² WUFA³⁷ and PIDA⁴⁰), and the confidence intervals are missing for three of them (WUFA, WST 2.4, and WST 1.0⁴⁵). For the WST 1.0, a Spearman's correlational coefficient for intra-rater reliability is reported, but this is corrected in the following version (WST 2.4). For the FEW-Q data for the FEW 2.0 are presented.⁴⁶

Validity

Content and face validity, construct validity and wheelchair contribution are described in table 3. With the exception of the WST, Obstacle Course Assessment of Wheelchair user performance (OCAWUP),^{47, 48} WC and WhOM, validity information is very limited. External comparisons using multitrait multimethod techniques were a common approach to evaluating the construct validity of measures. For example, the FIM³⁶ was used to establish the construct validity for the WST 2.4, Wheelchair Circuit and OCAWUP, with correlations of 0.38 to 0.31, 0.52 and 0.84 respectively. Often, however, the direction and magnitude of the *a priori* hypotheses was not reported, which makes the results equivocal.

Only the Wheelchair, AML⁴⁹ and WST (1.0) have reported responsiveness. Significant improvement in wheelchair skills post rehabilitation were found with the Wheelchair Circuit. SRMs were 0.6 for ability, 0.9 performance time and 0.8 physical strain.⁴⁴ In contrast, correlation between WST 1.0 change scores between time 1 and time 2 and therapist rated change scores were not statistically significant.⁴⁵ Research on the AML (5-item version) found significant changes in scores over time post spinal cord injury (SCI).⁵⁰

Extreme group validity was reported for four measures: the WST (2.4) OCAWUP, AML and Wheelchair Circuit. For the WST (2.4), people who used wheelchair longer than 21 days scored significantly better; and scores varied significantly between diagnostic groups.⁴² For the OCAWUP, there was a significant difference in Global Score of Ease between groups using different propulsion methods.⁴⁸ For the Wheelchair Circuit ability score differed

significantly based on level of lesion.⁴⁴ For the AML (five item version), scores on the tool differed significantly between individuals with tetraplegia and those with paraplegia.⁵⁰

Wheelchair Contribution

The wheelchair contribution for each measure is included in the last column of table 3. The FEW-Q, FFT, WC and AML did not document or otherwise consider the type of wheelchair system used by the person.

Applicability

The applicability of each measure is described in table 4. The respondent burden is high for most measures, especially for those based on task observation. The administration time exceeds 15 minutes for all measures except the four functional tasks and FEW-Q. Despite its brevity, however, the respondent burden of the FEW-Q is considered adequate, because of the double-barreled nature of its questions. The PCDA is the most demanding measure, because three sessions may be needed to complete the assessment. All of the measures are available for free and the scoring is done by hand. None require raters to attend special training sessions, and free manuals are available for the WST, FEW-Q, WhOM, PCDA, PIDA and OCAWUP (in French). Most measures are only applicable to one category of wheelchair, specifically to manual wheelchairs (n=6) or to powered wheelchairs (n=2). Three measures in the review are intended for individuals who use manual and power wheelchairs: the FEW-Q, OCAWUP and WhOM. A power mobility version of the WST is available, but no validity or reliability results are available to date.

With respect to format compatibility, the populations studied were generally heterogeneous in terms of diagnostic categories and sex. However, four measures were tested exclusively with people with a diagnosis of SCI (4 functional tasks, AML, WhOM and Wheelchair Circuit); and two were only tested with men (4 functional tasks, PIDA). The age span covers adults and older adults, except for the PCDA, which was validated for older adults only (66–93 years) and for the Wheelchair Circuit, WhOM, OCAWUP that included adults under the age of 65 years of age. Only the Wheelchair Circuit, WhOM, OCAWUP, and WST have alternative forms available. A Dutch version of the WC is available. French versions of the WhOM, OCAWUP and WST are available, and a questionnaire version was validated for a telephone or face-to-face interview.⁵¹

Many of the capacity measures require substantial space and equipment (i.e., WST (1.0, 2.4), WC and OCAWUP). For example, the OCAWUP requires a 20-foot ramp that can be adjusted to three different slope angles.

Summary Appraisal

Table 5 summarizes the properties of all of the measures included in the review. Good reliability evidence is reported for most of the measures, but validity information is only available for six of the 11 measures and responsiveness for three. In this regard, The Wheelchair Circuit, AML and WST 2.4 have the most extensive psychometric information. The respondent burden is adequate for most measures, except the 4 functional tasks, which has the least respondent burden and is considered excellent.

The relationship between the measures and the ICF taxonomy is illustrated in figure 1. Position along the x-axis indicates the degree to which the instrument measures activity or participation. Position on the y-axis indicates whether the instrument measures performance or capacity. Position on the z-axis indicates how well the tool isolates the contribution of the wheelchair to activity and participation. For example, the WUFA measures capacity (y-axis) to perform activities (x-axis), but does not indicate that the type of wheelchair and wheelchair seating should be recorded (z-axis). Alternatively, with the PCDA,⁵² the type of power chair is recorded (z-axis) and the activity of power mobility (x-axis) is evaluated in the natural environment of the user, so it is neither a capacity test in a standardized environment nor a performance assessment of what the user normally does. For this reason, it is positioned halfway between capacity and performance (y-axis). Measures like the FEW-Q and WUFA are indicated using slightly wider boxes, as they incorporate a small number of non-mobility related self-care activities.

DISCUSSION

Most of the items of the measures included in this review, with the exception of the WhOM, FEW-Q and WUFA, focus exclusively on the construct of mobility. The FEW-Q and WUFA include only a few self-care items, whereas the WhOM is the only measure to potentially include all ICF participation chapters (domains). The pre-assessment interviews of the OCAWUP and PCDA refer to participation in areas such as work and family roles, but the scoring does not take those aspects into consideration. Moreover, most of the measures tend to measure capacity in standardized environments, rather than performance or capacity in real-life settings. Some measures, such as the PIDA, PCDA and FEW-Q, assess the capacity of the wheelchair user in his or her natural environment; but this approach does not capture what the individual actually does on a daily basis. The WhOM and FEW-Q are the only measures that look at performance subjectively. It has been suggested that both the objective and subjective measurement of capacity and performance represent complementary rather than competing perspectives.⁵³ Therefore, Figure 1 can assist researchers and clinicians in the selection of complementary tools.

There are a number of issues with the reliability coefficients of the measures in this review. Two of these problems include a lack of confidence intervals and use of Spearman's correlations for inter and intra-rater reliability. These are of particular concern, because they fail to account for within subject and between subject levels of error, which undermines confidence in the accuracy of the reliability coefficients. As well, although most measures have reliability coefficients above 0.75, only four measures (FFT, WST 2.4, WhOM & WC) demonstrate reliability coefficients at the level recommended for individual comparisons.²²

Validity is an issue for all of the measures in this review. Many measures only have content validity evidence (WUFA, FEW-Q, PIDA & PCDA). Construct validity testing and responsiveness estimates are needed to give credibility to these measures. As indicated by generalizability theory,⁵⁴ it cannot be assumed that reliability and validity evidence from one population or setting can be applied to another. Many of the measures require validation in various populations of individuals who use wheelchairs and their applicability to the clinical setting deserves some attention, because the administrative burden is quite demanding. For

example, because the Wheelchair Circuit was validated only with individuals with SCI who used manual wheelchairs, additional research with other populations is warranted. The environment is another aspect that plays an important role in shaping activity and participation outcomes of people who use wheelchairs. Future measures should document more extensively either how those variables interact in real life situations or how they can be used in conjunction with environmental measures such as the Craig Hospital Inventory of Environmental Factors⁵⁵ or the Measure of the Quality of the Environment,⁵⁶ which could capture the impact of physical and social environmental factors on performance.

By not documenting the type of wheelchair system used, the FEW-Q, 4 functional tasks, Wheelchair Circuit, WUFA and AML omit a potentially confounding variable. For example, residents in nursing facilities might have limited participation, not because of a lack of desire or capacity but because of their inappropriate wheelchair systems.⁵⁷ As well, FEW-Q, 4 functional tasks, Wheelchair Circuit, WUFA and AML do not provide guidelines about the subject's use of more than one wheelchair during testing. For example, a client may use a power wheelchair to facilitate grocery shopping in the community and a manual chair to maximize participation inside the home; but this variable would potentially be unidentified with these measures. This lack of attention to assistive technology is a problem common to many outcome measures.¹⁹

Measures that ignore the impact of wheeled mobility on activity and participation are limited in their ability to evaluate the effectiveness of wheelchair interventions. To correct this deficiency to some extent, the instructions for administration of these measures could easily be altered by insisting that wheelchair attributes including model, seating and configuration and set up, be recorded prior to administering the measure. As well, the use of multiple wheelchairs during testing needs to be documented.⁵⁸ As suggested by our definition of wheelchair contribution, ideally the measure would use a dual rating to differentiate clearly the effects of different models of wheelchairs on activity and participation outcomes. None of the measures satisfied this criterion.

Overall, none of the measures were scored as excellent on all of the ratings, which suggests all could be improved or evolved in some way. Obviously, most measures would benefit from additional psychometric testing, especially in terms of validity and responsiveness testing. If these tools are to be used clinically, measures like the WUFA, FEW-Q and PIDA may require modification or additional testing to ensure that their reliability coefficients are sufficient to make individual comparisons.

In terms of using the ICF to classify wheelchair activity and participation measures, two primary issues were identified. First, a majority of items were coded as d465 (moving around with equipment), which suggests that this code does not provide adequate descriptive detail. For example, this code, which does not even specify the type of equipment being used, was used to encapsulate a diverse assortment of activities including propelling on different surfaces (eg, carpet, gravel, pavement, grass etc.), negotiating various curbs, inclines and thresholds and navigating in a variety of settings. Unlike the code for walking (d 450), which has additional fourth level codes that allow specification of walking short distances (d4500), walking long distances (d4502), walking on different surfaces (d4502)

and walking around obstacles (d4503), the absence of fourth level codes for d465 seriously limit the granularity of this category. Second, elements of items, in the FEW-Q for example, were coded as “not covered,” because the ICF does not include subjective elements of activity and participation, which has previously been noted as a limitation.^{59, 60}

There are a number of strengths and limitations that are evident when wheelchair-specific measures are compared with generic measures of activity and participation. A strength of wheelchair-specific measures is that they encourage consideration of factors that are particularly relevant to wheelchair users, such as wheelchair propulsion, terrain and issues of working at different surface heights. One drawback to the use of wheelchair-specific measures is that they prevent comparisons between wheelchair users and other populations. It should be noted, however, that such head to head comparisons may not be feasible with more generic measures, which may either lack face or content validity for individuals who use wheelchairs or be unacceptable to them. This would include measures such as the Barthel Index(BI),⁶¹ FIM³⁶ and Assessment of Life Habits⁶² that reduce scores for people who use assistive technology. As well, the inclusion of ambulation items in instruments such as the BI, FIM instrument, Late Life Function and Disability Instrument⁶³ and WHO Disability Assessment II⁶⁴ may limit acceptability and thus negatively impact the completion rates of individuals who use wheelchairs as their primary means of mobility.⁶⁵

Strengths and Limitations

This review was limited to wheelchair-specific measures that were described in at least one published peer-reviewed article. For example, the Wheelchair Skills Tests 3.2 and 4.1 were excluded from the review because they have not been published in a peer-reviewed journal. Measures described only in grey literature, such as conference proceedings or academic theses, were also not included. As the review focused on measures developed exclusively for individuals who use wheelchairs, it did not include measures developed for other populations that may have applicability for these individuals such as 1) the PARTS/M³⁵ that was developed for people with mobility impairments living in the community, 2) diagnosis-specific instruments, like those intended for individuals with spinal cord injuries, many of whom use wheelchairs, or 3) more generic measures of participation that do not penalize individuals who use wheelchairs including the Impact on Participation and Autonomy Questionnaire⁶⁶ or Keele Assessment of Participation.⁶⁷ A number of wheelchair-specific measures were excluded because of their focus on body function and structure, and others were excluded because they were diagnosis rather than wheelchair-specific. The evaluation of the conceptual issues associated with these measures is a particular strength of the study, as many reviews of outcome measures focus exclusively on issues of reliability, validity and applicability.

CONCLUSION

The field of outcome measurement for wheelchair outcomes is still in its infancy. A comprehensive review of activity and participation outcome measures for individuals who use wheelchairs identified 11 wheelchair-specific measures. Most of the measures were focused on the measurement of wheeled mobility capacity; and only three tools, the FEW-Q,

WUFA and WhOM, looked at activity and participation more broadly. The WhOM was the only tool that could potentially measure activity and participation across ICF domains. The review found that the psychometric testing of most of these measures was limited. This study suggests the need for further testing and development of wheelchair-specific outcome measures that will allow clinicians to justify their equipment recommendations and to show the effectiveness of their interventions to their clients, colleagues and health care administrators.

Acknowledgments

We thank Jacek Kopec, MD, PhD for his suggestions on an early draft of the review. (#76731). Supported by a Quality of Life Strategic Training Fellowship in Rehabilitation Research, Canadian Institute of Health Research Musculoskeletal and Arthritis Institute; the Canadian Occupational Therapy Foundation (doctoral grant); Michael Smith Foundation for Health Research (doctoral grant); the Canadian Institute of Health Research (graduate fellowship); the Canadian Institutes of Health Institute of Aging; and l'Ordre des Ergothérapeutes du Québec (doctoral grant); CIHR New Investigator Award (MSH-76731).

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Figure 1.
Instruments and the ICF

Table 1**Instrument Characteristics of Wheelchair-Specific Activity and Participation Measures**

Instrument	Population	Items	ICF Constructs (items per ICF chapter)	Performance or Capacity	Response scale (range)
Wheelchair Users Functional Assessment (WUFA)	MW	13	Mobility (9) Self-Care (2) Not classified (2)	C	7 point (1–7)
Functional Evaluation in a Wheelchair Questionnaire (FEW-Q)	PM/MW	10	Mobility (6) Self-care (3) General tasks and demands (1)	C/P	6 point (1–6)
Reliability of four functional tasks (FFT)	MW	4	Mobility (4)	C	Time Distance
Wheelchair skills test (1.0) (WST 1.0)	MW	33	Mobility (33)	C	3 point scale (0–2)
Wheelchair skills test (2.4) (WST 2.4)	MW	50	Mobility (50)	C	Pass/fail
Additional Motor and Locomotor Items assessment	MW [*]	6 [∞]	Mobility (6)	C	6 point (1–6)
Obstacle course assessment of wheelchair user performance (OCWUP)	PM/MW	10	Mobility (10)	C	Time 4 point (0–3)
Wheelchair Outcome Measure (WhOM)	PM/MW	varies	Client identified participation issues	P [#]	11 point (0–10)
Wheelchair Circuit (WC)	MW ^ξ	8	Mobility (8) and Exercise capacity (body function)	C	2–3 point (0–(.5)–1) Time Maximal heart rate
Power-mobility Indoor Driving Assessment (PIDA)	PM	30	Mobility (30)	C/P	4 point (1–4)
Power-mobility Community Driving Assessment (PCDA)	PM	Varies	Mobility (14–36)	C/P	4 point (0–3)

Notes:

MP=Power Mobility

MW= Manual Wheelchair

C= Capacity in standardized environment

C/P =Capacity in natural environment

P= Performance

^{*} Individuals with paraplegia^ξ Individuals with spinal cord injury[#] Measures satisfaction with performance[∞] A 5 item version of this tool (5-AML) has been suggested to augment the FIM⁴⁹

Table 2

Instrument Reliability

Instrument	n	Test-retest coefficient	n	Intra-rater	n	Inter-rater
WUFA			5	ICC=0.78 ^{**} , ϕ	5	ICC=0.96 ^{**} , ϕ
FEW-Q θ	30	ICC=0.86				
FFT	10	$r=0.99$ ^{**}			10	ICC=0.99 ^{**} , $\mathcal{I}$
WST 1.0	21	$r=0.65$ ^{**}	21	$r=0.96$ ^{**}	24	$r=0.95$ ^{**}
WST 2.4	20	ICC=0.904 ^{**} , ϕ	20	ICC=0.959 ^{**} , ϕ	20	ICC=0.968 ^{**} , ϕ
AML					20	$\kappa=0.82$ to 0.98
OCAWUP	17	ICC=0.74–0.99 (t) $\kappa=0.09$ –1.00 (EU) ICC 0.96 (OS)			17	ICC=0.98 (t) $\kappa=0.29$ –1.00 (EU) ICC 0.97 (OS)
WhOM			50	ICC=0.93	50	ICC=0.91
WC			27	ICC=0.98	27	ICC=0.97
PIDA			15	ICC=0.67 ϕ	15	ICC=0.87 ϕ
PCDA						

Notes:

t=time

EU=ease of use

OS= Overall score

 θ reliability data from FEW 2.0^{**} confidence interval not reported ϕ type of ICC not reported $\mathcal{I}$ excluded 1 item

Table 3

Validity and Wheelchair Contribution

Instrument	Face/Content	Construct	Wheelchair contribution
WUFA	1,2	--	NI
FEW-Q	2	--	NI
FFT	--	--	NI
WST(1.0)	1	TGR $r=0.45$	WSR
WST 2.4	2	Age (all) $r=-.43$ Age (wheelchair users) $r=-.27$ TGR $r=.40$ Admission FIM $r=.38$	WSR
AML	1	--	NI
OCAWUP	1	FIM mobility and global score of ease $r=0.84$	NI
WhOM	1,2	QUEST (total score) $r= .58$ QUEST (Assistive Device Scale) $r= .66$ LIFE – H (Entering and exiting home) $r=.33$ LIFE –H (Moving around outside home) $r= .35$	WSR
WC	3	FIM mobility and WC ability $r=0.52$	NI
PIDA	1,2	--	WSR
PCDA	1,2	--	WSR

Notes:

1 = experts/ health professional involved in development

2 = wheelchair users involved in development

3= based on other related instruments

--= not reported

TGR = Therapist Global Rating

NI= No instruction about subject's use of wheel-chairs or other assistive technology

WSR= wheelchair specifications recorded

Applicability of Measures

Table 4

Instrument	Alternative Forms	Administration time (min)	Respondent demands	Rater training	Expense	Availability	Number of Studies
WUFA	N	45	TP	0	0 ^T	Authors	1
FEW-Q	Y ^ω	15	P&P	0	0	On-line	1
FFT	N	15	TP	0	0 ^T	Authors	1
WST 1.0	Y	45	TP ^β	*	0	On-line	1
WST 2.4	Y ^π	45	TP ^β	*	0 ^T	On-line	1
AML	N	30	TP	0	0 ^T	Authors	1
OCAWUP	Y ^ψ	45	TP	*	0 ^T	Authors	2
WhOM	Y ^ψ	30	P&P	*	0	Authors	1
WC	Y ^{‡*}	45	TP	0	0 ^T	Authors	1
PIDA	N	45	TP	*	0 ^T	On-line	2
PCDA	N	60	TP	*	0	On-line	1

Notes:

Y= Yes

N= No

TP= task performance

P&P = pencil and paper

^ω An observational capacity and performance based FEW-Q have been developed but no psychometric testing has been reported^π Questionnaire format available^ψ French and English forms available^{‡*} Dutch and English forms available^β Potential risk for injury requires use of spotter strap

* Raters are instructed to review the manual

^T 0\$ for measure, but other items may be need to be acquired

Table 5

Summary of Measures

Instrument	Measurement Properties				WC Contribution	Respondent burden
	Reliability	Validity	Responsiveness			
WUFA	A	--	--		C	B
FEW-Q	A	--	--		C	B
FFT	A+	--	--		C	A
WST 1.0	B	B	C		B	B
WST 2.4	A+	B	--		B	B
AML	A	B	B		C	B
OCAWUP	A	A	--		B	B
WhOM	A+	B	--		B	B
WC	A+	B	B		C	B
PIDA	B	--	--		B	B
PCDA	--	--	--		B	B

A+=Excellent (allows for individual comparisons)

A= Very Good

B= Fair

C= Poor