Participation instruments in persons with spinal cord injury: A narrative review

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Abstract

Background: Spinal cord injury (SCI) has serious impacts on the patient's function. Therefore, their participation is important as one of the major indicators of the quality of life. This study reviews instruments that evaluate participation among people with spinal cord injury.

Methods: Four electronic databases (Web of Science, Scopus, MEDLINE/PubMed, SID) were searched for studies published in the English language between 2000 and 2019 in one or more peer-reviewed journals on the measurement properties (reliability, validity and/or responsiveness) in all populations including adults with SCI. Instruments assessed based on special criteria designed for disability outcome measures.

Results: Six instruments were included: Incontinence - Activity Participation Scale, Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P), World Health Organization's disability assessment tool-II (WHODAS-II), ICF Measure of Participation and ACTivities Screener (IMPACT-S), Impact on Participation and Autonomy (IPA), Participation measure for Post-Acute care (PM-PAC). Evidence related to the reliability and validity was reported for all of the instruments. Only WHODAS-II, USER-P, and IMPACT were compared with each other in recent publications. Responsiveness was not obtained for any of the instruments.

Conclusion: As the underlying structure of every instrument is different, the concept of the evaluated participation varies between instruments. The proper instrument for examining participation of the patients with SCI should be selected based on a thorough analysis of the individual's condition and context. Innovative models of disability should be the basis of emerging instruments for evaluation of participation, as well as empirical studies and modern measurement technologies that fill the gap between the perceived participation of the individual and the researcher's record.

Keywords: Rehabilitation, Participation, Spinal cord Injury, Outcome, Measurement

Introduction

Participation has emerged as a basic concept in most paradigms of disability, World Health Organization’s ICF (International Classification of Functioning, Disability and Health) included (1). ICF has defined Participation as

↓What is “already known” in this topic:

In accordance with ICF (International Classification of Functioning, Disability and Health), several studies have been conducted to define participation instruments for people with disabilities, but there's a lack of comprehensive review to generally conclude on the instruments and their findings in the field.

→What this article adds:

This paper intends to review related participation instruments that measure the performances of persons with spinal cord injury. It helps the reader to better digest the concept of rehabilitation medicine, as well as comprehensively review the participation instruments.
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“involvement in a life situation”, while participation restrictions, as its opposite, defined as “problems a human may experience in involvement in life circumstances” (2). Besides, the term “participation” remains an impartial concept to narrate social functioning and wellbeing. The latest revision of the ICF combines activities and participation into a single taxonomy and describes 9 scales of participation and activities, instead (3); learning and applying knowledge; general tasks of living; interpersonal communication; mobility; self-care; domestic life; interpersonal relationships, major life areas (education, work, economic); and community, civic, and social life (3). Additionally, ICF defines constraint in activities or restriction in participation as difficulties that an individual can face; It also offers a distinction between the efficiency of a person concerning with a health condition (loss, disease or disorder) with that of an individual without that condition in order to measure the limitation (4). The predecessors of ICF have inspired many researchers to design generic and disorder-specific participation instruments; Nevertheless, there is a lack of certainty in defining participation, as there are considerable diversities in item data, content, contexts, and response options (5). Spinal cord conditions have an important impact on the individual and the society as well. The consequential impairments relative to SCI interrelates with an upcoming risk of secondary health risks such as neuropathic and musculoskeletal pain, pressure ulcers, respiratory and cardiovascular diseases, diabetes, obesity and osteoporosis (6). Persons with SCI demonstrate psychological problems such as depression and anxiety after the occurrence of injury that leads to decreasing levels of life satisfaction and other aspects of quality of life (7). However, social participation is positively related to increased quality of life (8), stronger social connections and reduced psychological problems (9). The rates of occurrence for spinal cord injury are in the rise as the medical technologies improve properly and the survival from accidents and injuries, as well as surveillance of disability increases (10). Thus, participation which has emerged as a main rehabilitation outcome, has attracted extensive exerts for its operationalization and measurement (11) in the past recent years. The criteria which evaluate participation instruments most often are relied on the frequency of usage and their application to particular clinical populations (e.g. spinal cord injury, multiple sclerosis) (12,13). The overall interest in participation measurement has rooted in the prominence of the World Health Organization’s ICF, together with the increasing progression of technologies that measure participation. This paper is dedicated to provide a review of contemporary participation instruments that were developed for and/or assessed in a spinal cord injury population and to examine their measurement properties.

Methods

Search strategy: Articles were obtained using a systematic search strategy conducted in popular scientific databases (WebotScience, Scopus, MEDLINE/PubMed, SID) in order to identify studies that assessed and/or developed participation instruments in a population consisting of individuals with spinal cord injury; Therefore, the search phrase ‘spinal cord injury’ and ‘participation’ from 2000 to March 2019, were used in each database, as well as following terms which were tailored for each database: validation, assessment, instrument, internal validity, concurrent validity, discriminant validity, content validity, face validity, predictive validity, reliability, inter-rater reliability, intra-rater reliability, test-retest, reproducibility, responsiveness, evidence-based medicine, outcome measures, clinical assessment tools, scales and measures.

Inclusion criteria: Instruments selected for the review if there was sufficient information available regarding their focus on validation and/or reliability on their measurement properties (validity, reliability, and/or responsiveness) in adult participants with SCI and published in one or more peer-reviewed journals. Papers included only if the focus of the article was to evaluate/assess the psychometric properties of a participation instrument and if the papers were published in English and free full texts were available. A full illustration of the inclusion process has shown in Figure 1. Instruments considered to assess participation if their scales covered two or more of the following ICF domains: domestic life (chapter 6); interpersonal interactions and relationships (chapter 7); major life areas (chapter 8); and community, social and civic life (chapter 9).

Fig. 1. Diagram of inclusion criteria for evaluated articles

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**Data abstraction**

Andresen has proposed an 11-item criteria for reviewing the tools of disability outcomes research (14). Six criteria (validity, reliability, responsiveness, item/instrument bias and measurement model) have been selected for the purpose of this review (details: Table 1). Each criterion assessed and graded based on the evidence available for persons with SCI. Data related to the measurement model, reliability, validity, and responsiveness of the instruments were summarized by authors. Original papers examined by authors in order to determine if studies have included persons with SCI in the development or examination of the instrument content, as well as study-specific sample characteristics.

**Results**

Finally, 6 instruments (including 18 related articles) met the inclusion criteria: Incontinence-Activity Participation Scale, Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P), World Health Organization’s disability assessment tool-II (WHODAS-II), ICF Measure of Participation and ACTivities Screener (IMPACT-S), Impact on Participation and Autonomy (IPA), and Participation Measure for Post-Acute care (PM-PAC). The reviewed articles were aimed to assess or describe the process that led to the validity and/or psychometric properties of the instruments. Table 2 presents a summary of each instrument included in the systematic search. Each of the instruments has been designed based on a unique model of disability. In terms of the content, Table 2 demonstrates an overview of the domains mentioned in instruments. All of the instruments assess aspects of mobility (ICF chapter 4), daily activities (related to ICF chapters 5/6), recreation/leisure (related to ICF chapter 9) and work/education (related to ICF chapter 8). Differences have been found in the types of information asked in the instruments. For example, the I-APS information used to measure activities of daily living and occupation; meanwhile, The USER-P quantifies data for measuring objective and subjective participation (15). All instruments assess aspects of mobility (ICF chapter 4), daily activities (related to ICF chapters 5/6), recreation/leisure (related to ICF chapter 9) and work/education (related to ICF chapter 8). There are differences in the types of information asked in the six instruments. The I-APS includes questions measuring objective or quantifiable data, for example, "number of times engaged in an activity". In USER-P quantifiable data was analyzed to determine the frequency, perceived satisfaction and perceived restriction. Questions in these instruments require judgment from the respondent, for example asking about restrictions perceived in conducting activities (USER-P). All instruments follow a self-report rule. USER-P also consists of additional questions about perceived satisfaction and restriction in every activity. There was a significant difference in the number of items, ranging from 16 in I-APS to 53 in the PM-PAC, requiring anywhere from 10 to 120min to complete.

All of the instruments were designed for self-report. Three out of six instruments were available in languages other than English (USER-P, WHODAS-II, and IPA). All the instruments include point and percentage in terms of domain scores. Table 3 provides a specific overview of the participants. The I-APS determined to measure a unique aspect of restriction in participation. The scale was aimed to explore the impact of bladder problems on activity limitation and participation restriction in adults with SCI. This happened by identifying the related ICF chapters and gaining in-depth knowledge through a total of 35 one-to-one interviews. This population consisted of 20 subjects with SCI, 5 caregivers to SCI individuals, and 10 healthcare professionals dealing with SCI patients. Open-ended questions were presented in the form of a semi-structured interview, which probed into the respondent’s feelings and opinions regarding the activity limitation and...
participation restriction due to bladder problems without imposing any bias (16). Participants in the development study of IMPACT-S were survivors of road accidents which were selected from 10 acute care hospitals and rehabilitation facilities (17). USER-P (Utrecht scale for Evaluation of Rehabilitation—Participation) has been developed to fulfill a demand for a generic participation instrument that evaluates both objective and subjective participation in adults living in the community and is applicable in the rehabilitation practice. Therefore, it consists of 3 separate scales: Frequency, Restrictions, and Satisfaction. The study population included adults with SCI and permanent residency in Switzerland (15,18). WHODAS-II developed to enable medical practitioners to conduct cross-cultural comparisons. Therefore, the included items were obtained after identifying how health status is measured in different cultures. This procedure performed using linguistic analysis of every culture in terms of health-related terms, interviews with informants and discussions in the focus group (19). The IPA was developed initially for the Dutch language population. 100 individuals with different disabling conditions were asked from the outpatient facility of the department of rehabilitation of an academic hospital to participate. Items were

Table 2. Description of instruments

| Instrument | Conceptual Model | Year of Development | Questions | Domains | Mode of Administration | Translated versions | Scoring |
|------------|------------------|---------------------|-----------|---------|------------------------|---------------------|---------|
| I-APS      | ICF              | 2017                | 16        | Activities of daily living; Occupation/education | Self-report | None | Maximum score – 80
| IMPACT-S   | ICF              | 2008                | 32        | 9 domains according to ICF activities and participation chapters | Self-report | NR² | Response categories are scored from 0 (cannot do that at all) to 3 (no limitations whatsoever). All summary scores are converted to a score on a 0 to 100 scale, in which a high score indicates a high level of participation. Response categories are 0 (no difficulty) to 4 (extreme difficulty/cannot do). Six domain scores and a total disability index can be calculated by converting scores into a score ranging from 0 to 100, in which a lower score demonstrates better participation. |
| WHODASII   | ICF              | 2010                | 36        | understanding and communication, getting around, self-care, getting along with others, life activities, and participation in society | Self-report | NR | The sum scores of the segregated frequency, restrictions, and satisfaction scales are calculated and converted to a score on a scale ranging from 0 to 100, in which higher scores indicate better levels of participation (higher frequency, fewer restrictions, higher satisfaction). |
| USER-P     | ICF              | 2009                | 32 items in 3 scales; frequency (4*7**), restrictions (7), satisfaction (10) | chapters 6 through 9 of the ICF | Self-report | Korean | The items of perceived participation and perceived problems were recorded in 2 different sets of scores, with a range per item of zero to 4 and zero to 2, respectively. A higher score demonstrated greater restriction in participation or greater perceptions of problems in participation. |
| IPA        | ICIDH-2          | 1999                | 39        | autonomy indoors, autonomy outdoors, family role, social relationships and work and education | Self-report | English, Swedish and German | The items of perceived participation and perceived problems were recorded in 2 different sets of scores, with a range per item of zero to 4 and zero to 2, respectively. A higher score demonstrated greater restriction in participation or greater perceptions of problems in participation. |
| PM-PAC     | ICIDH-2; reconciled with the ICF | 2007 | 53 | major life areas/economic life; community, social, and civic participation; mobility | Self-report | NR | The items of perceived participation and perceived problems were recorded in 2 different sets of scores, with a range per item of zero to 4 and zero to 2, respectively. A higher score demonstrated greater restriction in participation or greater perceptions of problems in participation. |

1. International Classification of Diseases, Functioning, and Disability
2. Not reported
3. International Classification of Impairments, Disabilities and Handicaps
*Frequency of behaviors on vocational activities in the last 4 weeks
**Frequency of leisure and social activities in the last 4 weeks

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derived based on the descriptions of the ‘participation’ of the ICIDH-2, clinical expertise of the research team, and qualitative pilot research with adults attending the rehabilitation facility of the Academic Medical Center (AMC) (20). The PM-PAC was designed to measure participation outcomes of rehabilitation practices provided in outpatient or home-care settings. Therefore, PM-PAC developers recruited 395 outpatient rehabilitation patients for psychometric analyses of the instrument (21). Table 4 exhibits the evidence related to the reliability of the participation instruments. All of the instruments were eligible of internal consistency in terms of domains score. Internal consistency for both the IMPACT-S and WHODAS-II were obtained from the person separation index that is similar to internal consistency and were 0.96 and 0.95, respectively. The WHODAS-II had the most evidence with above seven studies assessing test–retest reliability in different populations with disability. The test–retest reliability was higher in the IMPACT-S (ICC=0.94) in comparing with other instruments. Information regarding validity was available for all of the instruments (Table 5). All of the instruments (except I-APS) used Rasch analysis in testing the instruments, providing evidence for the factorial structure. Table 6 demonstrates measurement models and item bias for each instrument.

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### Table 3. Description of subjects assessed in studies

| Instrument | Country   | Number of Subjects (% male) | Age, years (mean, range, SD (if available)) | Type of SCI | Time since injury, years (mean, range, SD (if available)) |
|------------|-----------|----------------------------|---------------------------------------------|-------------|------------------------------------------------------------|
| 1-APS      | India     | 42 (74)                    | 29.5                                         | NR          | 3.5                                                         |
| IMPACT-S   | Netherlands | 197 (65.9)                | Range: 25-46                                | NR          | 2.2 (0.9)                                                  |
| WHODASII   | Australia | 63 (81)                    | 34.7 (SD:14.6)                              | Paraplegia (21) | NR                                                          |
|           |           |                            |                                             | Tetraplegia (42) | NR                                                          |
| USER-P     | Switzerland | 1549 (71.5)               | 52.4 (14.8)                                | Paraplegia (1063) | 16.9 (12.7)                                               |
|            |           |                            |                                             | Tetraplegia (474) |                                                             |
| IPA        | Netherlands | 100                      | 47.9 (14.6, Range: 23-79)                      | NR          | 2 years (range: 2 months-lifetime)                         |
| PM-PAC     | United States | 395 (41)               | 59.9 (18.2)                                | NR          |                                                             |

Abbreviations: NR, Not reported

### Table 4. Reliability of instruments

| Instrument | Internal consistency | Test–retest time period | Coefficients | Inter-rater time period |
|------------|----------------------|-------------------------|--------------|-------------------------|
| 1-APS      | 0.86                 | NR¹                     |              | NR                      |
|            | ADL domain= 0.85     |                         |              |                         |
|            | Occupation/education= 0.75 |                     |              |                         |
| IMPACT-S   | 0.96                 | 4 weeks                 |              |                         |
|            | Total ICC= 0.94       |                         |              |                         |
|            | Knowledge ICC= 0.87   |                         |              |                         |
|            | General tasks ICC= 0.72 |                        |              |                         |
|            | Communication ICC= 0.75 |                       |              |                         |
|            | Mobility ICC= 0.92    |                         |              |                         |
|            | Self-care ICC= 0.81   |                         |              |                         |
|            | Domestic life ICC= 0.86 |                        |              |                         |
|            | Interpersonal ICC= 0.86 |                       |              |                         |
|            | Major life areas ICC= 0.81 |                     |              |                         |
|            | Community life ICC= 0.78 |                       |              |                         |
|            | Activities ICC= 0.93  |                         |              |                         |
|            | Participation ICC= 0.90 |                        |              |                         |
| WHODASII   | 0.95                 | NR                      |              |                         |
| USER-P     | Frequency: 0.65       | NR                      |              |                         |
|            | Restrictions: 0.90    |                         |              |                         |
|            | Satisfaction: 0.90    |                         |              |                         |
| IPA        | Perceived participation measure= 0.94 | NR                     |              |                         |
|            | Perceived problems= 0.82 |                      |              |                         |
| PM-PAC     | Mobility= 0.85        | 1–15 days (mean = 4 days, 94% in 1–8 days) |              |                         |
|            | Role functioning = 0.83 (29) |                     |              |                         |
|            | Community, Social, and Civic Life= 0.89 |                  |              |                         |
|            | Domestic Life = 0.76  |                         |              |                         |
|            | Economic Life = 0.82  |                         |              |                         |
|            | Interpersonal Relationships= 0.72  |                    |              |                         |
|            | Communication= 0.79   |                         |              |                         |

¹. Not Reported
². Intraclass correlation coefficient
In terms of convergent validity, three out of six instruments (with the exception of the IPA, PM-PAC, and I-APS) were evaluated. Four out of six instruments were assessed in terms of discriminant validity. Various differences detected among the four mentioned. When one scale contributed to the participation in an instrument (e.g., IPA), ceiling effects became apparent as an issue since a low percentage of participants obtained the best score possible (22). Information regarding responsiveness was available for none of the instruments. Thus, Responsiveness did not mention in the article. The WHODAS-II obtained the most number of supporting

| Instrument | Validity--Factorial structure | Validity--convergent correlations | Validity--discriminant groups | Content Validity Index (CVR*) |
|------------|------------------------------|----------------------------------|-------------------------------|------------------------------|
| I-APS      | NR                           | 0.61–0.88. tested by computing Spearman correlations between IMPACT-S and WHODAS-II scales | NR                           | 0.84                         |
| IMPACT-S   | The principal components analysis of the 9 scale scores resulted in 2 components with an eigenvalue above 1.0. A strong first component had an eigenvalue of 5.6 and explained 63.0% of the variance. A weak second component had an eigenvalue of 1.1 and explained 12.9% of the variance. | NR                           | NR | |
| WHODAS-II  | Unidimensionality. Analysis of the 36 items shows that overall items were found to fit the model producing item mean in fit statistics of 0.99 (SD' 0.39) and mean outfit statistics of 1.00 (SD 0.51) and thus performed satisfactorily. Overall, 86% of the items fit the Rasch measurement model (4) | 1 out of 7 hypothesized convergent associations between WHODAS-II and CHART was confirmed (WHODAS II ‘self-care’ with CHART ‘physical’) and none of the 6 hypothesized divergent associations were weak enough to present ‘no relationship’ (r<0.20) (4) | NR | NR | |
| USER-P     | NR, the SCI sample was too small to perform factor analysis (37) | Spearman correlation coefficients between the USER-Participation scales were below 0.60 (range 0.39–0.46), showing that they cover different aspects of participation. Concurrent validity of the USER-Participation was more than 75% (83.3%) of the 24 hypotheses (Spearman correlation coefficients above or below 0.60) with the other measurement instruments were confirmed (24) | Significant differences demonstrated in levels of participation between persons with different health conditions and different levels of functional limitations. Overall, the Restrictions score was sensitive to variations (37) | NR | |
| IPA        | Factor analysis with a four-factor solution demonstrated that the structure of subscales would be best interpreted according to the following dimensions of perceived handicap: social relationships, autonomy in self-care, mobility and leisure, and family role (the former subscales family role and financial independence) | NR | The distribution of participants ranged from 2.45 to −6.35 logits. When the whole range of the items is considered in relation to the participant distribution, it shows that persons’ perceived participation is not completely covered by the range of the item values, and items that might show differentiation of persons perceiving most participation are missing | NR | |
| PM-PAC     | Confirmatory factor analysis (after excluding 3 items) showed that the data fit a model consisted of seven participation domains as follows: mobility; role functioning; community, social, and civic life; domestic life; economic life; interpersonal relationships; and communication | NR | Pilot tests of known-groups validity indicated that PM-PAC subscales generally varied on the concept of condition severity and underlying ability for mobility | NR | |

*CVR= Content validity ratio

a One component consisted of Knowledge, General tasks, Communication, Relationships and Major life areas and the other factor included Mobility, Self-care, domestic life and community life.

b tested by computing Spearman correlations between IMPACT-S and WHODAS-II scales
evidence in terms of measurement properties. Seven out of eight measurement evaluations obtained a good-to-moderate scale for all categories. Thus, grades were assigned for the mentioned evidence (4,19,23–28). The I-APS and PM-PAC possessed the minimum amount of supportive evidence, with only one and three measurement properties, respectively (16,23,29).

### Discussion

While participation counts among the significant outcomes of the rehabilitation practice, it has, however, rarely been selected for measurement (30). This article reviewed six instruments that assess participation in persons with SCI; exploration of each instrument considered critical criteria for measuring participation as an outcome. Instruments counted as a measure tool for participation if their domains included two ICF chapters from 6 to 9, at least. This pragmatic description of participation may not absolutely distinguish the discrimination between activity and participation. With respect to novel guidelines, however, an inventory of activity and participation domains (Titles of ICF chapters) are presented that aid the user with complete, sectional or no overlap within either the domains or sub-domains within each of them. Some participation measurement tools (SCIM III (31), for example) were excluded from this article with regards to this explanation of participation, as they covered questions concerning ICF chapter 4 (Mobility) and chapter 5 (self-care). There were similar instruments such as the Oxford (32) that would comply with the matter of participation if a broader explanation were used. According to ICF, there must be a distinction between activity and participation as they are singular concepts that should be differentiated theoretically and functionally, but the coding structure for both terms is identical (33). Authors of IMPACT-S have defined a comprehensive term for the former parameters as "functioning", which contains physical functioning, body constructions, activity and participation. The latter form of aggregation in redefining concepts would be beneficial for future researches concerning a rehabilitation outcome measurement. “Activity” ascribes as the execution of any action by a person, which defines the individual’s tolerance of functioning. “Participation” indicates the contention of a person in any situation of life and exhibits the communal aspect of functioning. According to this manner, disability is supplemental to the functioning and embraces malfunctions or deformities in structure, limitations in activity and restrictions in participation. (17) In the PM-PAC, meanwhile, the team of researchers developing activity and participation measures concluded that activity items would demonstrate concrete task performance that could be seen as being a means to an end. However, participation items would reflect a person’s degree of perceived limitation in a particular situation of life, irrespective of the means by which participation takes place (34). Additionally, most instruments are heterogeneous in terms of scales and total scores, namely including items that relate to various ICF chapters; meanwhile, IMPACT (ICF Measure of Participation and ACTivities) was designed as a comprehensive measure to reflect ICF accurately and redefine performance and handicap separate from a health condition (17). However, in the time of designing IMPACT-S items, various sections and domains were classified as too incoherent to be contained in one title. The chapter “mobility”, for example, the domain “carrying, moving and handling objects” was counted as heterogeneous. In response, 4 items were constructed to envelop this domain. Then again, 2 do-

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mains, "education" and "work/occupation", were combined into one section because only a minor section of study participants are concerned with education (17). This coding structure was weighed for the USER-P, too (18). The World Health organization disability Assessment Scale II (WHODAS II) has developed to evaluate daily performance across 6 domains that correspond with the activities and participation concepts of the International Classification of Functioning, disability and Health (ICF) as a comprehensive model, appropriate for experimentation with different health conditions, in different cultures and nationalities around the world (4). Focusing on the SCI population, the WHODAS II utilized noteworthy features in comparison with other participation measures validated for SCI which employ no subscale structures relevant to components of the ICF (35, 36). IPA depicted as a generic self-reporting inventory, focusing on person-perceived handicaps and autonomy, considering subjective scales as to ascribe meaning to persons' situations (20).

Conclusion
This article explored an in-depth view of 6 participation instruments for people with spinal cord injury, a table describing each instrument in detail, a table providing psychometric properties for each instrument, a table describing participants assessed in the studies, and a table for reliability and validity, individually. The results of this review indicate that subjective participation is emerging as an indicator for determining participation among people with physical disabilities, especially spinal cord injuries. Meanwhile, it has an inconspicuous role in the determinants of existing instruments in the field. In order to determine participation as it relates to ICF, the impression of subjective participation should be elevated in the future studies that aim to evaluate participation or develop instruments for that purpose. Participation items included in the instruments represent different aspects of an ICF chapter; therefore, they should be prescribed based on a careful examination of the person’s type of injury, condition and context. Meanwhile, participation instruments must be constructed based on current definitions of disability, pragmatic comparisons with previously developed instruments, and modern measurement technologies that fill the gap between the perceived participation of the individual and examiner’s record. Rehabilitation clinician-scientists are encouraged to select the proper instrument based on their research focus and related evidence-based practice. Furthermore, the respected concept of subjective participation should get proper consideration in persons with severe conditions. Due to the low resources in the literature regarding subjective participation, various aspects of this concept, such as expectation, satisfaction and fulfillment should get addressed in any future effort trying to explore and deploy the conceptualization and evaluation of participation in persons with serious physical disabilities. Future studies should also look for cues that result in a more subtle and comprehensive explanation of participation.

In this review, the lack of knowledge and information about environmental factors in different countries and cultures was the most prominent blind spot that did not observed meanwhile in reviewed articles. Finally, the strong point of the reviewed instruments was allegiance to the ICF and their growing interest in dissecting the concepts in it, which leads to defining novel concepts that complement previous agreements.

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Conflict of Interests
The authors declare that they have no competing interests.

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