Psychometric Properties of the 12-Item World Health Organization Disability Assessment Schedule (WHODAS 2.0) in Adult Patients with Motor Disabilities

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ORIGINAL ARTICLE

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Abstract

To explore the psychometric properties of the Greek version of the World Health Organization Disability Assessment Schedule (WHODAS 2.0–12 item) in adult patients suffering from motor disabilities. The questionnaire of WHODAS 2.0–12 item was officially translated and cross-culturally adapted into Greek (WHODAS 2.0–12Gr).136 adult patients with motor disabilities included in the present observational study. A reliability study was carried out to explore WHODAS 2.0–12Gr's internal consistency (Cronbach's *a*), repeatability (Pearson's *r*) and test retest test-retest reliability between the WHODAS 2.0–12Gr outcomes of day-1 and day-8 [intra-class correlation coefficients with 95% confidence intervals (ICC 95%CI)], and the convergent validity (item-total correlation) of the questionnaire. Exploratory factor analysis (EFA) was used to explore the construct validity of the WHODAS 2.0–12Gr, while the concurrent validity of the questionnaire was testing against the Greek Medical Outcomes Study 36-item Short Form Health Survey version 1.0 (SF-36v1.0-Gr). *Reliability properties:* WHODAS 2.0–12Gr Cronbach's *a* was 0.814 ($p < 0.001$), Pearson's *r* value was 0.980 ($p < 0.001$) and ICC (95%CI) was 0.990 (0.985–0.993) ($p < 0.001$). *Validity properties:* Pearson's *r* values of item-total correlation were ranged from 0.376 to 0.736. EFA extracted a 3-factor model. Regarding concurrent validity, the significant correlations between the WHODAS 2.0–12Gr and the SF36v1.0-Gr ranged from −0.169 to −0.720. WHODAS 2.0–12Gr showed significant high to excellent reliability and significant weak to strong validity properties. Overall, it can be suggested that WHODAS 2.0–12Gr could be a reliable and valid tool for assessing patients with motor disabilities.

Keywords Motor disability · 12 item-WHODAS 2.0 · Psychometric properties · International classification of functioning · Disability and health

Introduction

Disability is a general term to include all persons presenting with limitations in activities and restrictions in participations. Disability occurs when a person with a health condition interacts with his environment. It is important to invent tools to assess disability in order to better meet the needs of those people, finance targeted social and

health services and finally evaluate the results of the abovementioned interventions (World Health Organization 2015).

It has been struggled through the last decades to change the way disability has been appreciated. The World Health Organization (WHO) responding to the new demands, to view disability through the frame of biopsychosocial aspect abandoning the medical model, has introduced an international classification scheme known as the International Classification of Functioning, Disability and Health (ICF) (WHO 2001).The ICF observes disability from the 'biopsychosocial' perspective but it is very detailed, comprising of more than 1400 codes, rending it impractical for use in clinical practice.

WHO has developed the self-rated health questionnaire WHO Disability Assessment Schedule 2.0 (WHODAS 2.0), that corresponds directly with ICF codes and is applicable to any health condition (Ustün et al. 2010). The WHODAS 2.0 was developed in order to assess behavioral limitations and restrictions to participation experienced by an individual, independently from a medical diagnosis. The WHODAS 2.0 distinguishes itself from other health-related quality of life (HRQOL) instruments in that it is based on an international classification system, it is applicable across cultures, and it treats all disorders independently when determining the level of functioning (Baron et al. 2008). An international increasing interest in WHODAS is evident by the fact that 1071 studies from more than 90 countries have been published between 1999 and 2019. WHODAS 2.0 has been translated into 47 languages and dialects and used in 27 areas of research (Federici et al. 2017).

People with motor disabilities account for a great percent of those receiving disability pensions, but nevertheless limitations and restrictions in everyday life of those people have not been thoroughly assessed. In Greece, WHODAS is not systematically used, mainly because no official validate Greek translation existed. In 2016, a validation study of WHODAS 2.0–12 item was published, in people with and without disabilities, but without discriminating between disability categories (motor, mental, blindness, deafness) (Xenouli et al. 2016). A more recent study (Koumpouros et al. 2018) evaluated psychometric properties in Greek elderly population without making any distinction among healthy and disabled people. Therefore, information about functionality in motor disability group is lacking.

The purpose of the present study was to conduct an intercultural adaptation and examine the psychometric properties of the Greek version of WHODAS 2.0–12 item (WHODAS 2.0–12Gr). In addition, our aim was to search the reliability, internal consistency and validity, of the instrument in a group of patients suffering from motor disabilities. Our aim was not to restrict our study to a specific disease, as previous studies had done before, but rather to broaden our sample in this disability category in order to be in line with the general concept of the biosocial model served by ICF.

Methods

Study Population

One hundred and sixty-five patients, men and women, aged ≥18, being treated for motor disabilities were invited to participate in the study. Participants were randomly selected from two rehabilitation centers in Athens and one outpatient clinic and invited

to participate in this observational cross-sectional study. Data collection took place between January and December 2016. Finally, 136 patients fulfilled the inclusion criteria and completed all tests. The rest (18%) were either excluded or did not show up. The main inclusion criteria were the existence of motor disabilities and the ability to provide informed consent. In order to be eligible, patients had to report restriction in movement of upper or lower limbs resulting in difficulty in standing, sitting or walking, lifting, carrying and handling objects, and difficulty in fine hand use for at least the previous month, irrespectively of the underlying disease (orthopedic, neurologic, rheumatologic). Those who had dementia or mental illness were excluded. Written informed consent was obtained from all participants. The study protocol was approved by the University of West Attica (former Technological Educational Institution of Athens) research committee and followed the principles of the Helsinki Declaration and its later amendments (World Medical Association, 2013).

Study Design

After asking approval from WHO, authorization was received by email on 2 May 2017 to culturally adapt the WHODAS 2.0–12 item in Greek. WHODAS 2.0–12 was translated from English to Greek according to internationally established guidelines. Forward translation of the original English WHODAS 2.0–12 into Greek was done independently by two researchers whose mother language is Greek. The two independent translations were compared and a final version was produced. The final version was back translated into English by another translator, whose mother language is English. The final Greek version (WHODAS 2.0–12Gr) of the WHODAS 2.0 questionnaire underwent pilot testing in three groups of ten individuals each, (healthy and patients) to assess comprehensibility.

Participants were interviewed twice at the rehabilitation clinics or the outpatient clinic where they had been admitted. At initial assessment (Day 1), information on the medical diagnosis, health status and demographic data were collected. Subsequently, the WHODAS 2.0–12Gr and the Greek Medical Outcomes Study 36-item Short Form Health Survey version 1.0 (SF-36v1.0-Gr) (Pappa et al. 2005) were administered by interviewing the participants. Seven days after the initial assessment (Day 8), WHODAS 2.0–12Gr was re-administered to all participants, so that the reliability properties of the instrument could be evaluated. Subject guidance and questionnaire completion were carried out under the supervision of the same member of the research team. Setting the interval in one week time between the two applications aimed to avoid a learning effect on one hand (Thomas et al. 2018) and minimize the possibility of changes in the profile of the patient's disability on the other (Baron et al. 2008).

Instruments

WHO Disability Assessment Schedule 2.0

WHODAS 2.0 assesses perceived disability associated with the health condition in the 30 days preceding its application. This instrument is divided into six domains: i) cognition; ii) mobility; iii) self-care; iv) inter-personal relationships; v) activities of daily living; and vi) participation. Three versions of the WHODAS 2.0 have been

developed, differing in length and method of administration: there is a version with 36 items (WHODAS 2.0–36), one with 12 items (WHODAS 2.0–12) and one with 12 + 24 items. The first two can be self-administered, administered in an interview and to a substitute respondent. The 12 + 24 item version can be administered in an interview or by computer. WHODAS 2.0 has excellent psychometric properties, (Downing et al. 2014; Garin et al. 2010; Guilera et al. 2012; Guilera et al. 2015) is easy to use and score, and is available on the public domain in self-report, proxy, and telephone-based versions that can be administered in around 5–10 min the 12-item, and around 20 min the 36-item (WHO | WHO Disability Assessment Schedule 2.0 (WHODAS 2.0) [WWW Document] (n.d.)). WHODAS 2.0–12 comprises of 2 questions for each domain from the longer version (36 items). The WHODAS 2.0–12 has proven to exhibit high correlation and agreement with WHODAS 2.0–36 (Silveira et al. 2018). Both the full and short versions of WHODAS 2.0 generate an overall score ranging from 0 to 100 (0 = no disability; 100 = full disability). Missing data were handled according to guidelines in the WHODAS manual (Ustün et al. 2010) whereby if a single item was missed, the mean value of the remaining items was assigned to the missed item. The scores assigned to each item are recoded and summed. A disability score of equal or greater to 25% was considered to indicate disability (0–4% no disability, 5–24% mild, 25–49% moderate, 50–95% severe and 96–100% complete disability) (WHO 2013).

Medical Outcomes Study 36-Item Short-Form Health Survey

In the present study, the reliable and valid Greek version (Anagnostopoulos et al. 2005; Pappa et al. 2005) of the SF-36®Health Survey (IQOLA SF-36 Standard Version 1.0) (Ware and Sherbourne 1992; Ware et al. 1993) was used.(SF36v1.0-Gr). The SF-36Health Survey is widely acknowledged as the gold standard instrument for assessing the health status in general and specific population groups. It is a 36-item self-reported questionnaire that measures eight dimensions of health status (eight subscales). Depending on the dimension of health status examined, the subscales are entitled as: physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems, mental health, energy/vitality, bodily pain and general health perception. The subscale item scores are coded, summed, and transformed on to a scale range from 0 to 100. A score of 0 represents the worst health status, whereas a score of 100 represents the best health status. Two standardized summary scores can also be calculated from the SF-36; the *Physical Component Summary* (PCS) and the *Mental Health Component Summary* (MCS) (Ware et al. 1993; Ware and Sherbourne 1992). In the present study, the reliable and valid Greek version of the SF-36®Health Survey (IQOLA SF-36 Standard Greek Version 1.0) was used (Anagnostopoulos et al. 2005; Pappa et al. 2005).

Statistical Analyses

Considering the exploration of psychometric properties of health-related questionnaires, there is a widely-cited rule of thumb that suggests ten respondents per item (Cappelleri et al. 2014; Nunnally 1978); thus for the WHODAS 2.0–12 a sample size of 120 participants would be adequate.

All analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 24.0 (SPSS Inc., Chicago, IL). The critical level for significance was set at $p < 0.05$.

The reliability of WHODAS 2.0–12Gr was evaluated by assessing the instrument's internal consistency, repeatability, test-retest reliability, and its convergent validity. Internal consistency evaluated how well different questions (items) that test the latent structure of the instrument gave consistent results (Trochim 2007). The internal consistency of WHODAS II-12Gr was assessed with Cronbach's alpha coefficient (Cronbach's *a*) (Cronbach 2004) using the data obtained from the initial WHODAS 2.0-Gr assessment. A threshold value of 0.70 was chosen, which indicates sufficient reliability for research purposes (Nunnally 1978). In the present study, the Cronbach's *a* "if item deleted" was used as an additional evaluation test of the WHODAS 2.0–12Gr internal consistency (Gliem and Gliem 2003).

Repeatability was defined as the stability of participants' responses over time, that is, the ability of the instrument to give consistent results whenever it is used (Berg and Latin 2004). The WHODAS 2.0–12Gr repeatability was determined by calculating Pearson's product moment correlation coefficient (Pearson's *r*) between the initial and re-assessment total scores of the WHODAS 2.0–12Gr questionnaire.

The test-retest reliability of the instrument was defined as the degree to which the participants maintained their opinion in the repeated measurements of the WHODAS 2.0–12Gr questionnaire, taking into account the error in measurements as a proportion of the total variance. Test-retest reliability was evaluated using the intra-class correlation coefficient (ICC) with 95% confidence interval (CI). The ICC, which is the most suitable statistical test for the assessment of reliability (Dunn and Everit 1995; Shrout and Fleiss 1979) ranges from 0 to 1, with 1 indicating perfect reliability.

Finally, the convergent validity of WHODAS 2.0–12Gr was evaluated by examining the correlations (Pearson's *r*) between the total score of the scale and the item scores, at initial assessment. This would provide evidence that all twelve items of WHODAS 2.0–12Gr are related to the same construct.

The Pearson correlation coefficient values were specified as follows: 0.00–0.19 = very weak correlation; 0.20–0.39 = weak correlation; 0.40–0.69 = moderate correlation; 0.70–0.89 = strong correlation; and 0.90–1.00 = very strong correlation (Fowler et al. 2002). The Cronbach's *a* and ICC correlations were characterized as follows: 0.00–0.25 = little, if any, correlation; 0.26–0.49 = low; 0.50–0.69 = moderate; 0.70–0.89 = high; and 0.90–1.00 = excellent (Portney and Watkins 2000).

In order to explore the construct validity of WHODAS 2.0–12Gr, the latent factor structure of the questionnaire was investigated with an exploratory factor analysis (EFA) using the principal component analysis (PCA) method of extraction and *varimax rotation* with Kaiser Normalization, with eigenvalues greater than 1.0, estimation of scree plot test and factor loading>0.30, converged in 5 iterations. Specifically, EFA was used to explore whether the 12 items (observed variables) could be explained largely or entirely in terms of a smaller set of unobserved variables, termed "factors". The factor structure was selected by examining the magnitude and rate of change in eigenvalues. The concurrent validity of WHODAS 2.0-Grwas tested against the SF36v1.0-Gr. Specifically, the correlations between the six domains and the total score of WHODAS 2.0–12Gragainst the subscales and the total score of the SF36v1.0-Gr were explored.

Results

Descriptives

One hundred and thirty-six adult patients participated in our study. Table 1 shows demographic and clinical characteristics of the participants. At initial assessment (Day-1), the mean of WHODAS 2.0–12Gr total score was 23.25 (SD ±8.14), ranging from 12 to 45. At the second administration (day 8); the mean WHODAS 2.0–12Gr total score was 22.91 (SD ±8.25), ranging from 12 to 45. There were no missing items for WHODAS 2.0–12Gr total score. There were no floor or ceiling effects, since none of the participants scored the worst (100) or the best (0) possible total score.

Reliability Measures

The internal consistency of WHODAS 2.0–12Grwas excellent, with an overall Cronbach's *a* at 0.814, ranging between 0.782 (item 12) and 0.817 (item 6) (Table 2). All values were higher than the chosen threshold value of 0.7, suggesting that all WHODAS 2.0–12Gr items are interdependent and homogeneous in terms of the construct they measure. Pearson's *r* value of 0.980 ($p < 0.001$) showed excellent repeatability and the ICC coefficient value of 0.990 ($p < 0.001$) revealed excellent test-retest reliability between the two assessments (Table 3). Our results indicated that the total score of WHODAS 2.0–12Grwas remarkably consistent between the two measurements.

Convergent Validity

Table 4 summarizes the correlations between the WHODAS 2.0–12Gr total score and the item scores of the questionnaire at initial assessment (items - total score correlations). Most items showed moderate or strong correlation coefficients, with the exception of item S6 (=0.376) ranging from 0.400 (item S11) to 0.736 (item S7), indicating that WHODAS 2.0–12Gr items were acceptably related to the same construct (Dancey and Reidy 2007; Dancey and Reidy 2008).

Validity Measures

Exploratory Factor Analysis/Construct Validity

The structural properties of WHODAS 2.0–12Gr were examined using exploratory factor analysis (EFA). The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted prior to EFA in order to evaluate the factorability. The KMO measure of sampling adequacy was 0.745 and the significance of Bartlett's test of sphericity was equal to 0.00, meaning that EFA can be applied to the obtained dataset (Kaiser 1974). EFA was conducted with the obtained data to extract the factor structure of the instrument and to examine its construct validity. Factors were extracted by the maximum likelihood method and rotated by varimax rotation. The number of factors was determined by the screeplot, cumulative variance explained, interpretability,

Table 1 Demographic and clinical characteristics of the study's sample

Characteristics	Total Sample ($n = 136$)
Age (yr)[a]	56.42 ± 16.28
Sex (n / %)	
Men	44 / 32.4
Women	92 / 67.6
Work status (n / %)	
Paid work	40 / 29
Student	11 / 8
Household activities	16 / 12
Unemployed	23 / 17
Retired	46 / 34
Marital status (n / %)	
Never married	25 / 18
Currently married	50 / 37
Divorced	22 / 16
Widowed	39 / 29
Educational level (n / %)	
Low (Elementary)	39 / 29
Medium (High school)	68 / 50
High (University)	29 / 21
Medical Conditions (n / %)	
Fractures	54 / 39
Spondylosis	43 / 31
Tendonitis	21 / 15
Arthritis	11 / 8
Parkinson disease	2 / 1.5
Multiple sclerosis	3 / 2
Neuropathy	2 / 1.5

[a] The values are expressed as mean ± SD; SD = standard deviation

and Kaiser's criterion. Three factors were extracted and rotated, and the cumulative variance explained was 56.762% (Table 5, Fig. 1).

Concurrent Validity

The concurrent validity of WHODAS 2.0–12Gr was evaluated in relation to SF-36v1.0-Gr. Pearson's correlations between the parametric outcomes of WHODAS 2.0–12Gr against SF-36v1.0-Gr are presented in Table 6. The results indicated acceptable validity by very weak to strong correlations between the two self-reported instruments. The weaker significant correlation [−0.169 ($p < 0.05$)] was observed between the Domain 3 "Self-care" of WHODAS 2.0–12Grand the subscale "Mental Health/Emotional Well-being" of SF-36v1.0-Gr, while the strongest significant

Table 2 Internal consistency of the Greek version of WHO Disability Assessment Schedule 2.0–12 items questionnaire

Internal consistency of the WHODAS 2.0-12Gr questionnaire	
Items	Cronbach's *a*
S1. Standing for long periods such as 30 minutes?	0.793
S2. Taking care of your household responsibilities?	0.798
S3. Learning a new task, for example, learning how to get to a new place?	0.799
S4. How much of a problem did you have joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	0.792
S5. How much have you been emotionally affected by your health problems?	0.802
S6. Concentrating on doing something for ten minutes?	0.817
S7. Walking a long distance such as a kilometer [or equivalent]	0.783
S8. Washing your Whole body?	0.804
S9. Getting dressed?	0.805
S10. Dealing with people you do not know?	0.809
S11. Maintaining a friendship?	0.811
S12. Your day-to-day work?	0.782
	Overall *a*=0.814*

WHODAS 2.0-12Gr: the Greek version of the World Health organization Disability Assessment Schedule-2.0-12 items questionnaire

*when computing Cronbach's , "if item deleted" was selected

correlation [−0.720($p < 0.01$)] was observed between the total score of WHODAS 2.0–12Gr and the subscale "Physical Functioning" of SF-36v1.0-Gr. The negative sign of the correlation between WHODAS II-12Gr and SF-36v1.0-Gr can be explained by the fact that higher scoring in WHODAS 2.0–12Gr implies poorer functional status, whereas higher scoring in SF-36v1.0-Gr is equivalent to better functional status.

Discussion

The present study aimed to examine the psychometric properties of the WHODAS 2.0–12Gr in a group of patients with motor disabilities. The instrument was found to be a

Table 3 Reliability properties of the WHODAS 2.0–12Gr questionnaire($n = 136$)

Property	Measure	Value	Significance *p*
Internal consistency	Cronbach's *a*	0.814	<0.001
Repeatability	Pearson's *r*	0.980	<0.001
Test-retest reliability	ICC (95%CI)	0.990(0.985, 0.993)	<0.001

WHODAS 2.0–12Gr: the Greek version of the World Health Organization Disability Assessment Schedule-2.0-12 items questionnaire; ICC: intraclass correlation coefficient; CI: confidence interval;

Table 4 Convergent validity: Item-total correlations of the WHODAS 2.0–12Gr questionnaire at initial assessment

Item	Pearson's *r*
S1. Standing for long periods such as 30 min?	0.653
S2.Taking care of your household responsibilities?	0.607
S3. Learning a new task, for example, learning how to get to a new place?	0.573
S4. How much of a problem did you have joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	0.655
S5. How much have you been emotionally affected by your health problems?	0.598
S6. Concentrating on doing something for ten minutes?	0.376
S7. Walking a long distance such as a kilometer [or equivalent]?	0.736
S8.Washing your Whole body?	0.518
S9.Getting dressed?	0.512
S10. Dealing with people you do not know?	0.440
S11. Maintaining a friendship?	0.400
S12. Your day-to-day work?	0.733

WHODAS 2.0–12Gr: the Greek version of the World Health Organization Disability Assessment Schedule-2.0-12 items questionnaire

reliable and valid assessment tool to evaluate those patients. This is among the few studies that evaluate the WHODAS 2.0–12 questionnaire and the first to address this specific patient group.

Table 5 Rotated Component Matrix[a]

Items	Factors (Variance %)		
	Factor 1 (33.663%)	Factor 2 (12.542%)	Factor 3 (10.357%)
S1	0.756		
S2	0.638		0.401
S3	0.399	0.351	
S4	0.642		
S5	0.722		
S6		0.556	
S7	0.682		
S8			0.820
S9			0.878
S10		0.862	
S11		0.682	
S12	0.607	0.422	

Extraction Method: Principal Component Analysis

Rotation Method: Varimax with Kaiser Normalization[a]

[a] Rotation converged in 5 iterations

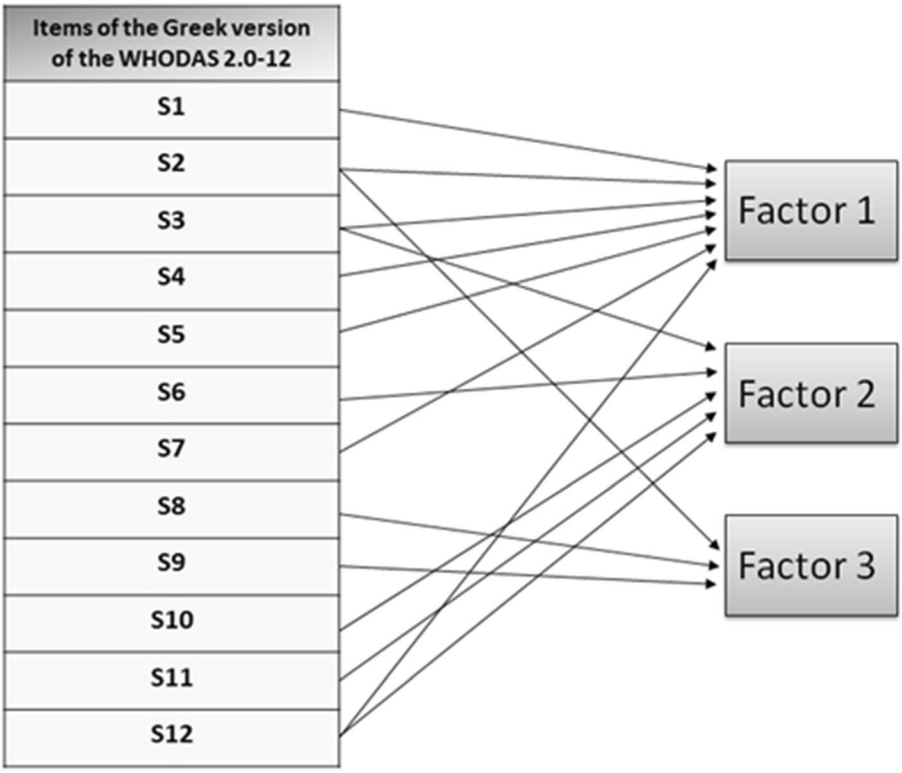

Fig. 1 Factor loading diagram of the Greek version of WHO Disability Assessment Schedule 2.0–12 items questionnaire

WHODAS 2.0 is based on an international classification system (ICF), thus it treats all cultures, nationalities and disorders equally when determining the level of functioning. It measures overall disability but also, determines specific domains in each disability category. Applying WHODAS 2.0 in a disability category, in our case "motor disability", rather than to specific diseases is much closer to the ICF philosophy.

While the 36-item version has been examined in several different populations, the-12-item version has only been validated in a handful of studies (Abedzadeh-Kalahroudi et al. 2016; Andrews et al. 2009; Carlozzi et al. 2015; Gaskin et al. 2017; Habtamu et al. 2017; Luciano et al. 2010; Marom et al. 2017; Mayrink et al. 2018; Saltychev et al. 2017; Schiavolin et al. 2014; Silveira et al. 2018; Smedema et al. 2016; Snell et al. 2017; Tazaki et al. 2014; Xenouli et al. 2016; Younus et al. 2017). Previous studies have evaluated the psychometric properties of the WHODAS 2.0 in specific disease samples, such as arthritis (Baron et al. 2008), systemic sclerosis (Hudson et al. 2008), psychotic disorders (Chopra et al. 2004), hearing loss (Chisolm et al. 2005), stroke (Schlote et al. 2008), ankylosing spondylitis (van Tubergen et al. 2003), depression and low back pain (Chwastiak and Von Korff 2003), schizophrenia (McKibbin et al. 2004), patients in rehabilitation (Pösl et al. 2007). Studies conducted in Greece (Xenouli et al. 2016) had tested reliability on a more general population, people receiving disability pensions, without distinguishing between several disability categories (blindness, deafness, mental disorders, motor disabilities or any other). A more recent study

Table 6 Concurrent validity between WHODAS 2.0–12Gr and the SF-36 v.1.0-Gr (n = 136)

	WHODAS 2.0–12Gr total score	Do 1 Understanding and Communicating	Do 2 Mobility	Do 3 Self-care	Do 4 Getting along with others	Do 5 Life activities	Do 6 Participation in Society
SF-36v1.0-Gr total score	−0.649**	−0.413**	−0.457**	−0.453**	−0.234**	−0.504**	−0.515**
Physical Functioning	−0.720**	−0.394**	−0.668**	−0.535**	−0.192*	−0.596**	−0.448**
Role Physical	−0.577**	−0.426**	−0.332**	−0.430**	−0.210*	−0.552**	−0.403**
Role Emotional	−0.406**	−0.273**	−0.229**	−0.198*	−0.292**	−0.247**	−0.392**
Social Functioning	−0.083	−0.175*	−0.041	−0.061	−0.023	−0.078	−0.135
Mental Health	−0.274**	−0.197*	−0.131	−0.169*	−0.044	−0.205*	−0.312**
Bodily Pain	−0.521**	−0.425**	−0.256**	−0.365**	−0.100	−0.479**	−0.460**
Vitality	−0.262**	−0.163	−0.308**	−0.006	−0.022	−0.141	−0.325**
General Health	−0.250**	−0.067	−0.366**	−0246**	−0.002	−0.154	−0.126

WHODAS 2.0–12Gr: the Greek version of WHO Disability Assessment Schedule 2.0–12 items questionnaire, SF-36 v.1.0-Gr: the Greek version of the Medical Outcomes Study 36-Item Short-Form Health Survey version 1.0questionnaire, Do: Domain

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

(Koumpouros et al. 2018) examined reliability on a general population sample and not in a patient sample. To the best of our knowledge this study is the first to explore the psychometric properties of WHODAS 2.0–12Gr on an adult motor disability population in outpatient basis.

Reliability Properties

The WHODAS 2.0–12Gr appears to have high internal consistency; the overall Cronbach's α value was 0.814. The Alpha coefficient is found to be high in all the items. Items related to mobility, such as S1, S2, S3, S4 and S7, show better consistency and this is what was expected, since our sample consisted of people with motor disabilities. On the contrary, items measuring learning and applying knowledge are less descriptive of our sample. The reliability properties of the WHODAS 2.0–12Gr are similar with those of other studies in patients suffering from diseases that also lead to motor disabilities, such as inflammatory arthritis a = 0,93 (Baron et al. 2008), rheumatoid arthritis a = 0,89 (Meesters et al. 2010), disability in general (motor, mental, sensory) (a ranging from 0.69 to 0.84) (Federici et al. 2009), and a = 0.85 in another study with a similar sample (Xenouli et al. 2016), Huntington disease (a = 0.94) (Carlozzi et al. 2015), patients accepted for physical rehabilitation in Norway a = 0.92 (Moen et al. 2017), osteoarthritis (Kutlay et al. 2011), multiple sclerosis (Magistrale et al. 2015), stroke (a = 0.88) (Tarvonen-Schröder et al. 2019a), musculoskeletal pain (Silva et al. 2013) spinal cord injury a = 0.86 (Tarvonen-Schröder et al. 2019b; Tarvonen-Schröder et al. 2019c; Wolf et al. 2012). Thus, our study further supports the results from previous studies of WHODAS 2.0–12 and the reliability of the tool in this specific population.

Convergent Validity

In the present study, the items-total score correlations is used to check if any item is inconsistent with the averaged behavior of the other items of the WHODAS 2.0–12Gr questionnaire. Our results indicated that all twelve items converge on the same construct. However, the item S6 - which investigates the individual's capability of concentrating on doing something for ten minutes-, exhibited weak correlation coefficients (0.376), while all other items had moderate or strong values. Moreover, the same item was the only one to have a value higher than the overall Cronbach's *a*, though only by three thousandth (Table 1). These findings could be related to the fact that our sample consisted of patients with solely motor disabilities who normally do not exhibit cognitive difficulties. Furthermore, patients who had dementia or mental illness were excluded.

Validity Properties

Exploratory factor analysis extracts a 3-factor model; it seems that, concerning our study's sample, the WHODAS 2.0–12Gr is tridimensional. The Factor 1 reflects motor ability, Factor 2 reflects participation and cognition and Factor 3 reflects self-care (Table 5, Fig. 1). Specifically, all items, except item S5, that explained by theFactor1, reflect aspects of motor ability. ItemS5, in which patient is asked how much have been emotionally affectedin respect to his/her motor disability, doesn't describe motor

ability, although it is loading only in Factor 1. We interpret its presence in this factor by the fact that people with severe motor disability face severe restrictions in activities and participation and therefore are expected to be emotionally affected. The exact same loading of these 6 items in the same factor has been reported by Gaskin et al. (2017).

Item S3 (learning a new task) loads equally in both Factor1 and Factor 2 (0.399 & 0.351, respectively); however, it fits better in Factor 2 which reflects participation and cognition. Tabachnick and Fidell (2007) say that a loading of more than 0.32 is a minimum level that can explain approximately 10% of variance. In our case, item S3 loads more than 0.32 in both factors, and this is probably due to the fact that our sample didn't consist of people suffering from mental diseases (exclusion criterion). Item S12 loads in both Factor1 and Factor 2 almost equally, since the day-to-day work reflects both motor ability (one's ability to reach the place of his work), as well as participation and cognition (to cope with job's requirements). ItemS2 (taking care of household) partly belongs in Factor 3 as well as in Factor 1, where it loads more heavily, but rationally reflects both aspects of activities and it is expected to appear in both sites.

There is a great discrepancy regarding the factors of the WHODAS 2.0–12. In some studies, WHODAS 2.0–12 appears to be unidimensional (Luciano et al. 2010; Schiavolin et al. 2014) which can be interpreted by the fact that defines overall disability as a whole. In other studies it is reported that it consists of 6 domains, following the structure of its "parent questionnaire", WHODAS 2.0–36 (Andrews et al. 2009; Carlozzi et al. 2015; Habtamu et al. 2017; Silveira et al. 2018; Ustün et al. 2010; Xenouli et al. 2016; Younus et al. 2017). Although WHODAS 2.0–12 was built from the 36 items, borrowing 2 items from each of the 6 domains, it is questionable whether 2 items suffice to describe each factor separately. The WHODAS 2.0–12has been proved to be reliable, explaining up to 81% of the variance of the WHODAS 2.0–36 (Ustün et al. 2010), but it remains unclear if WHODAS 2.0–12can adequately measures equally the 6 domains with only12 items. It was reported that confirmatory factor analysis requires at least 3 items for each domain (Brown 2015). Guyatt et al. (1986) also support the idea that 3 or 4 items should be included in each domain. Costello and Osborne (2005), state that a factor with fewer than 3 items is weak and unstable and that 5 or more strongly (more than 0.5) loading items better indicate a solid factor. So, it is expected that in questionnaires with 12 items, 3 or 4 factors should be expected. One can conclude that a short questionnaire may discriminate between patient groups, but will not be always able to capture subtle changes in individual patients (Griffin et al. 2012; Tarvonen-Schröder et al. 2018a; Tarvonen-Schröder et al. 2018b; Tarvonen-Schröder et al. 2019a; Tarvonen-Schröder et al. 2019b; Tarvonen-Schröder et al. 2019c).

The above discrepancy of factor analysis in WHODAS 2.0–12 has been thoroughly investigated by Gaskin et al. (2017). Their main point is that sample selection influences the factor analysis. They report that previous research that supported unidimensional factor analysis is a consequence of sample selection. That is, the sample that includes people with multiple degrees of disability will produce more factors than samples with people with slight or without disability (floor effect). In their study, the 3-factor solution, as in our study, (mobility, life activities, and participation in society) was proved to be more interpretable. The 3-dimensional pattern has also been reported by Snell et al. (2017), each factor describing participation, physical activity and self-care, accounting for 72,61% of the total variance. The three factors described are similar to ours, as well as the items belonging in each one.

In the present study, the concurrent validity of the WHODAS 2.0–12Gr was tested by exploring the correlation between the instrument and the SF-36-Gr. The strongest correlation is achieved between WHODAS 2.0–12Gr total score and physical functioning of SF 36-Gr (−0.720), as well as between WHODAS 2.0–12Gr "mobility domain" and physical functioning of SF 36-Gr (−0.668). Moderate and strong correlations, between the domains of WHODAS 2.0 and SF-36 have been reported previously in patients with inflammatory arthritis, systemic sclerosis, depression and back pain, chronic diseases and rehabilitation patients (Baron et al. 2008; Chwastiak and Von Korff 2003; Garin et al. 2010; Pösl et al. 2007; Von Korff et al. 2003).

As a general comment, one can say that even though the data sample was very specific, restricted to people with motor disabilities, these patients also displayed restrictions in participation in social events, limitations in activities such as self-care and probably have difficulties in cognitive tasks. Thus, WHODAS, a derivative of ICF, is an excellent tool to draw the whole picture of a person with disability and not just quantify his difficulty.

Strengths and Limitations

The present research was designed to study patients suffering from a spectrum of diseases that all led to motor disability. The WHODAS II-12Gr was applied to people with motor disabilities, irrespectively of the underlying disease (neurologic, orthopedic or rheumatologic). The data selection reflects better the ICF philosophy from where WHODAS was derived and adds important strength to this study. In that way, this study differentiates itself from previous studies that focus on specific diseases and not on basic disability categories. In addition, the extensive reliability and validity study present one of the strengths of the study. Furthermore, the sample size of 136 patients was more than adequate~~,~~ based on the "rule of ten".

On the other hand, some potential limitations should be noted. The WHODAS 2.0-Gr validated only in specific patient population groups and that may influence the extent to which our results can be generalized. Furthermore, patients included in the study were selected only from rehabilitation centers and one outpatient clinic. Thus, no inpatients, who are expected to be more severely affected from diseases, were evaluated. Therefore, WHODAS 2.0–12 validation in other patients' populations is needed.

Conclusion

The WHODAS II-12Gr was found to be a reliable and valid assessment tool that can be used to evaluate patients with motor disabilities. The results are in accordance with previous published work conducted with various WHODAS II-12 translations and in various disease groups. This study is unique regarding the fact that it addresses a disability category rather than a specific disease, staying in line with the biopsychosocial model. A broader awareness of these findings in the Greek setting would facilitate objective comparisons between studies of different national origin and would contribute to the validity of future meta-analyses.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (include name of committee + reference number) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Abedzadeh-Kalahroudi, M., Razi, E., Sehat, M., & Asadi-Lari, M. (2016). Psychometric properties of the world health organization disability assessment schedule II -12 item (WHODAS II) in trauma patients. *Injury, 47*, 1104–1108. https://doi.org/10.1016/j.injury.2015.11.046.

Anagnostopoulos, F., Niakas, D., & Pappa, E. (2005). Construct validation of the Greek SF-36 health survey. *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 14*, 1959–1965. https://doi.org/10.1007/s11136-005-3866-8.

Andrews, G., Kemp, A., Sunderland, M., Von Korff, M., & Ustun, T. B. (2009). Normative data for the 12 item WHO disability assessment schedule 2.0. *PLoS One, 4*, e8343. https://doi.org/10.1371/journal.pone.0008343.

Baron, M., Schieir, O., Hudson, M., Steele, R., Kolahi, S., Berkson, L., Couture, F., Fitzcharles, M. A., Gagné, M., Garfield, B., Gutkowski, A., Kang, H., Kapusta, M., Ligier, S., Mathieu, J.-P., Ménard, H., Starr, M., Stein, M., & Zummer, M. (2008). The clinimetric properties of the World Health Organization disability assessment schedule II in early inflammatory arthritis. *Arthritis and Rheumatism, 59*, 382–390. https://doi.org/10.1002/art.23314.

Berg, K., & Latin, R. (2004). *Measurements and data collection concepts. Essentials of research methods in health, physical education, exercise science, and recreation* (2nd ed.). Baltimore-Philadelphia: Lippincott Williams & Wilkins.

Brown, T. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York: The Guilford Press.

Cappelleri, J. C., Jason Lundy, J., & Hays, R. D. (2014). Overview of classical test theory and item response theory for the quantitative assessment of items in developing patient-reported outcomes measures. *Clinical Therapeutics, 36*, 648–662. https://doi.org/10.1016/j.clinthera.2014.04.006.

Carlozzi, N. E., Kratz, A. L., Downing, N. R., Goodnight, S., Miner, J. A., Migliore, N., & Paulsen, J. S. (2015). Validity of the 12-item World Health Organization disability assessment schedule 2.0 (WHODAS 2.0) in individuals with Huntington disease (HD). *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 24*, 1963–1971. https://doi.org/10.1007/s11136-015-0930-x.

Chisolm, T. H., Abrams, H. B., McArdle, R., Wilson, R. H., & Doyle, P. J. (2005). The WHO-DAS II: Psychometric properties in the measurement of functional health status in adults with acquired hearing loss. *Trends in Amplification, 9*, 111–126. https://doi.org/10.1177/108471380500900303.

Chopra, P. K., Couper, J. W., & Herrman, H. (2004). The assessment of patients with long-term psychotic disorders: Application of the WHO disability assessment schedule II. *The Australian and New Zealand Journal of Psychiatry, 38*, 753–759. https://doi.org/10.1080/j.1440-1614.2004.01448.x.

Chwastiak, L. A., & Von Korff, M. (2003). Disability in depression and back pain: Evaluation of the World Health Organization disability assessment schedule (WHO DAS II) in a primary care setting. *Journal of Clinical Epidemiology, 56*, 507–514.

Costello, A., Osborne, J., (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Practical Assessment Research & Evaluation, 10(7).

Cronbach, L. J. (2004). My current thoughts on coefficient alpha and successor procedures. *Educational and Psychological Measurement, 64*, 391–418.

Dancey, C. P., & Reidy, J. (2007). *Statistics without maths for psychology*. Harlow: Pearson Education.

Dancey, C. P., & Reidy, J. (2008). *Statistics without Maths for psychology: Using SPSS for windows*. Harlow: Pearson Education.

Downing, N. R., Kim, J.-I., Williams, J. K., Long, J. D., Mills, J. A., Paulsen, J. S., & PREDICT-HD Investigators and Coordinators of the Huntington Study Group. (2014). WHODAS 2.0 in prodromal Huntington disease: Measures of functioning in neuropsychiatric disease. Eur. J. Hum. Genet. *EJHG, 22*, 958–963. https://doi.org/10.1038/ejhg.2013.275.

Dunn, G., & Everit, B. (1995). *Clinical biostatistics: An introduction to evidence-based medicine*. London: Edward Arnold.

Federici, S., Meloni, F., Mancini, A., Lauriola, M., & Olivetti Belardinelli, M. (2009). World Health Organisation disability assessment schedule II: Contribution to the Italian validation. *Disability and Rehabilitation, 31*, 553–564. https://doi.org/10.1080/09638280802240498.

Federici, S., Bracalenti, M., Meloni, F., & Luciano, J. V. (2017). World Health Organization disability assessment schedule 2.0: An international systematic review. *Disability and Rehabilitation, 39*, 2347–2380. https://doi.org/10.1080/09638288.2016.1223177.

Fowler, J., Jarvis, P., & Chevannes, M. (2002). *Practical statistics for nursing and health care*. Sussex: Wiley.

Garin, O., Ayuso-Mateos, J. L., Almansa, J., Nieto, M., Chatterji, S., Vilagut, G., Alonso, J., Cieza, A., Svetskova, O., Burger, H., Racca, V., Francescutti, C., Vieta, E., Kostanjsek, N., Raggi, A., Leonardi, M., Ferrer, M., & MHADIE consortium. (2010). Validation of the "World Health Organization disability assessment schedule, WHODAS-2" in patients with chronic diseases. *Health and Quality of Life Outcomes, 8*, 51. https://doi.org/10.1186/1477-7525-8-51.

Gaskin, C. J., Lambert, S. D., Bowe, S. J., & Orellana, L. (2017). Why sample selection matters in exploratory factor analysis: Implications for the 12-item World Health Organization disability assessment schedule 2.0. *BMC Medical Research Methodology, 17*, 40. https://doi.org/10.1186/s12874-017-0309-5.

Gliem, J.A., Gliem, R.R., 2003. Calculating, interpreting, and reporting cronbach's alpha reliability coefficient for likert-type scales.

Griffin, D. R., Parsons, N., Mohtadi, N. G. H., Safran, M. R., & Multicenter Arthroscopy of the Hip Outcomes Research Network. (2012). A short version of the international hip outcome tool (iHOT-12) for use in routine clinical practice. *Arthroscopy., 28*, 611–616; quiz 616–618. https://doi.org/10.1016/j.arthro.2012.02.027.

Guilera, G., Gómez-Benito, J., Pino, O., Rojo, J. E., Cuesta, M. J., Martínez-Arán, A., Safont, G., Tabarés-Seisdedos, R., Vieta, E., Bernardo, M., Crespo-Facorro, B., Franco, M., & Rejas, J. (2012). Utility of the World Health Organization disability assessment schedule II in schizophrenia. *Schizophrenia Research, 138*, 240–247. https://doi.org/10.1016/j.schres.2012.03.031.

Guilera, G., Gómez-Benito, J., Pino, Ó., Rojo, E., Vieta, E., Cuesta, M. J., Purdon, S. E., Bernardo, M., Crespo-Facorro, B., Franco, M., Martínez-Arán, A., Safont, G., Tabarés-Seisdedos, R., Rejas, J., & Spanish Working Group in Cognitive Function. (2015). Disability in bipolar I disorder: The 36-item World Health Organization disability assessment schedule 2.0. *Journal of Affective Disorders, 174*, 353–360. https://doi.org/10.1016/j.jad.2014.12.028.

Guyatt, G. H., Bombardier, C., & Tugwell, P. X. (1986). Measuring disease-specific quality of life in clinical trials. *CMAJ., 134*, 889–895.

Habtamu, K., Alem, A., Medhin, G., Fekadu, A., Dewey, M., Prince, M., & Hanlon, C. (2017). Validation of the World Health Organization disability assessment schedule in people with severe mental disorders in rural Ethiopia. *Health and Quality of Life Outcomes, 15*, 64. https://doi.org/10.1186/s12955-017-0647-3.

Hudson, M., Steele, R., Taillefer, S., Baron, M., & Research, C. S. (2008). Quality of life in systemic sclerosis: Psychometric properties of the World Health Organization disability assessment schedule II. *Arthritis and Rheumatism, 59*, 270–278. https://doi.org/10.1002/art.23343.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31–36. https://doi.org/10.1007/BF02291575.

Koumpouros, Y., Papageorgiou, E., Sakellari, E., Prapas, X., Perifanou, D., & Lagiou, A. (2018). Adaptation and psychometric properties evaluation of the Greek version of WHODAS 2.0. Pilot application in Greek elderly population. *Health Services & Outcomes Research Methodology*. https://doi.org/10.1007/s10742-017-0176-x.

Kutlay, S., Küçükdeveci, A. A., Elhan, A. H., Oztuna, D., Koç, N., & Tennant, A. (2011). Validation of the World Health Organization disability assessment schedule II (WHODAS-II) in patients with osteoarthritis. *Rheumatology International, 31*, 339–346. https://doi.org/10.1007/s00296-009-1306-8.

Luciano, J. V., Ayuso-Mateos, J. L., Fernández, A., Serrano-Blanco, A., Roca, M., & Haro, J. M. (2010). Psychometric properties of the twelve item World Health Organization disability assessment schedule II (WHO-DAS II) in Spanish primary care patients with a first major depressive episode. *Journal of Affective Disorders, 121*, 52–58. https://doi.org/10.1016/j.jad.2009.05.008.

Magistrale, G., Pisani, V., Argento, O., Incerti, C. C., Bozzali, M., Cadavid, D., Caltagirone, C., Medori, R., DeLuca, J., & Nocentini, U. (2015). Validation of the World Health Organization disability assessment schedule II (WHODAS-II) in patients with multiple sclerosis. *Mult Scler., 21*, 448–456. https://doi.org/10.1177/1352458514543732.

Marom, B. S., Carel, R. S., Sharabi, M., & Ratzon, N. Z. (2017). Cross-cultural adaptation of the World Health Organization disability assessment schedule 2.0 (WHODAS 2.0) for Hebrew-speaking subjects with and without hand injury. *Disability and Rehabilitation, 39*, 1155–1161. https://doi.org/10.1080/09638288.2016.1189606.

Mayrink, J., Souza, R. T., Silveira, C., Guida, J. P., Costa, M. L., Parpinelli, M. A., Pacagnella, R. C., Ferreira, E. C., Sousa, M. H., Say, L., Chou, D., Filippi, V., Barreix, M., Barbour, K., von Dadelszen, P., Cecatti, J. G., & Brazilian Cohort on Severe Maternal Morbidity (COMMAG) study group and the WHO Maternal Morbidity Working Group (MMWG). (2018). Reference ranges of the WHO Disability Assessment Schedule (WHODAS 2.0) score and diagnostic validity of its 12-item version in identifying altered functioning in healthy postpartum women. *Int J Gynaecol Obstet., 141*(Suppl 1), 48–54. https://doi.org/10.1002/ijgo.12466.

McKibbin, C., Patterson, T. L., & Jeste, D. V. (2004). Assessing disability in older patients with schizophrenia: Results from the WHODAS-II. *The Journal of Nervous and Mental Disease, 192*, 405–413.

Meesters, J. J. L., Verhoef, J., Liem, I. S. L., Putter, H., & Vliet Vlieland, T. P. M. (2010). Validity and responsiveness of the World Health Organization disability assessment schedule II to assess disability in rheumatoid arthritis patients. *Rheumatology (Oxford, England), 49*, 326–333. https://doi.org/10.1093/rheumatology/kep369.

Moen, V. P., Drageset, J., Eide, G. E., Klokkerud, M., & Gjesdal, S. (2017). Validation of World Health Organization assessment schedule 2.0 in specialized somatic rehabilitation services in Norway. *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 26*, 505–514. https://doi.org/10.1007/s11136-016-1384-5.

Nunnally, J. C. (1978). *Psychometric methods*. New York: McGraw-Hill.

Pappa, E., Kontodimopoulos, N., & Niakas, D. (2005). Validating and norming of the Greek SF-36 health survey. *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 14*, 1433–1438.

Portney, L. G., & Watkins, M. P. (2000). *Foundations of clinical Research: Applications to practice*. Upper Saddle River: Prentice Hall.

Pösl, M., Cieza, A., & Stucki, G. (2007). Psychometric properties of the WHODASII in rehabilitation patients. *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 16*, 1521–1531. https://doi.org/10.1007/s11136-007-9259-4.

Saltychev, M., Mattie, R., McCormick, Z., & Laimi, K. (2017). Confirmatory factor analysis of 12-item World Health Organization disability assessment schedule in patients with musculoskeletal pain conditions. *Clinical Rehabilitation, 31*, 702–709. https://doi.org/10.1177/0269215516652930.

Schiavolin, S., Ferroli, P., Acerbi, F., Brock, S., Broggi, M., Cusin, A., Schiariti, M., Visintini, S., Quintas, R., Leonardi, M., & Raggi, A. (2014). Disability in Italian neurosurgical patients: Validity of the 12-item World Health Organization disability assessment schedule. *Int J Rehabil Res., 37*, 267–270. https://doi.org/10.1097/MRR.0000000000000064.

Schlote, A., Richter, M., Wunderlich, M. T., Poppendick, U., Möller, C., & Wallesch, C. W. (2008). Use of the WHODAS II with stroke patients and their relatives: Reliability and inter-rater-reliability. *Rehabil., 47*, 31–38. https://doi.org/10.1055/s-2007-985168.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*, 420–428.

Silva, C., Coleta, I., Silva, A. G., Amaro, A., Alvarelhão, J., Queirós, A., & Rocha, N. (2013). Adaptation and validation of WHODAS 2.0 in patients with musculoskeletal pain. *Revista de Saúde Pública, 47*, 752–758. https://doi.org/10.1590/S0034-8910.2013047004374.

Silveira, C., Souza, R. T., Costa, M. L., Parpinelli, M. A., Pacagnella, R. C., Ferreira, E. C., Mayrink, J., Guida, J. P., Sousa, M. H., Say, L., Chou, D., Filippi, V., Barreix, M., Barbour, K., Firoz, T., von Dadelszen, P., Cecatti, J. G., & Brazilian Cohort on Severe Maternal Morbidity (COMMAG) study group and the WHO Maternal Morbidity Working Group (MMWG). (2018). Validation of the WHO Disability Assessment Schedule (WHODAS 2.0) 12-item tool against the 36-item version for measuring functioning and disability associated with pregnancy and history of severe maternal morbidity. *Int J Gynaecol Obstet., 141*(Suppl 1), 39–47. https://doi.org/10.1002/ijgo.12465.

Smedema, S. M., Yaghmaian, R. A., Ruiz, D., Muller, V., Umucu, E., & Chan, F. (2016). Psychometric validation of the world health organization disability assessment schedule 2.0-12-item version in persons with fibromyalgia syndrome. *Journal of Rehabilitation, 82*, 28–35.

Snell, D. L., Iverson, G. L., Panenka, W. J., & Silverberg, N. D. (2017). Preliminary validation of the World Health Organization disability assessment schedule 2.0 for mild traumatic brain injury. *Journal of Neurotrauma, 34*, 3256–3261. https://doi.org/10.1089/neu.2017.5234.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics (5th edition)*. Needham Heights: Allyn & Bacon, Inc..

Tarvonen-Schröder, S., Kaljonen, A., & Laimi, K. (2018a). Disability in amyotrophic lateral sclerosis compared with traumatic brain injury using the World Health Organization disability assessment schedule 2.0 and the international classification of functioning minimal generic set. *Int J Rehabil Res., 41*, 224–229. https://doi.org/10.1097/MRR.0000000000000292.

Tarvonen-Schröder, S., Tenovuo, O., Kaljonen, A., & Laimi, K. (2018b). Comparing disability between traumatic brain injury and spinal cord injury using the 12-item WHODAS 2.0 and the WHO minimal generic data set covering functioning and health. *Clinical Rehabilitation, 32*, 1676–1683. https://doi.org/10.1177/0269215518785945.

Tarvonen-Schröder, S., Hurme, S., & Laimi, K. (2019a). The World Health Organization disability assessment schedule (WHODAS 2.0) and the WHO minimal generic set of domains of functioning and health versus conventional instruments in subacute stroke. *Journal of Rehabilitation Medicine, 51*, 675–682. https://doi.org/10.2340/16501977-2583.

Tarvonen-Schröder, S., Kaljonen, A., & Laimi, K. (2019b). Utility of the World Health Organization disability assessment schedule and the World Health Organization minimal generic set of domains of functioning and health in spinal cord injury. *Journal of Rehabilitation Medicine, 51*, 40–46. https://doi.org/10.2340/16501977-2501.

Tarvonen-Schröder, S., Kaljonen, A., & Laimi, K. (2019c). Comparing functioning in spinal cord injury and in chronic spinal pain with two ICF-based instruments: WHODAS 2.0 and the WHO minimal generic data set covering functioning and health. *Clinical Rehabilitation, 33*, 1241–1251. https://doi.org/10.1177/0269215519839104.

Tazaki, M., Yamaguchi, T., Yatsunami, M., & Nakane, Y. (2014). Measuring functional health among the elderly: Development of the Japanese version of the World Health Organization disability assessment schedule II. *Int J Rehabil Res., 37*, 48–53. https://doi.org/10.1097/MRR.0000000000000032.

Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2018). *Research methods in physical activity*. Champaign: Human kinetics.

Trochim, W., (2007). The Research Methods Knowledge Base. Retrieved December 26, 2019, from ResearchGate website: https://www.researchgate.net/publication/243783609_The_Research_Methods_Knowledge_Base

Ustün, T. B., Chatterji, S., Kostanjsek, N., Rehm, J., Kennedy, C., Epping-Jordan, J., Saxena, S., von Korff, M., Pull, C., & WHO/NIH Joint Project. (2010). Developing the World Health Organization disability assessment schedule 2.0. *Bulletin of the World Health Organization, 88*, 815–823. https://doi.org/10.2471/BLT.09.067231.

van Tubergen, A., Landewé, R., Heuft-Dorenbosch, L., Spoorenberg, A., van der Heijde, D., van der Tempel, H., & van der Linden, S. (2003). Assessment of disability with the World Health Organisation disability assessment schedule II in patients with ankylosing spondylitis. *Annals of the Rheumatic Diseases, 62*, 140–145.

Von Korff, M., Katon, W., Rutter, C., Ludman, E., Simon, G., Lin, E., & Bush, T. (2003). Effect on disability outcomes of a depression relapse prevention program. *Psychosomatic Medicine, 65*, 938–943.

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-ltem short-form health survey (SF-36): I. Conceptual Framework and Item Selection. *Medical Care, 30*, 473–483. https://doi.org/10.1097/00005650-199206000-00002.

Ware, J. E., Snow, K. K., Kosinski, M., Gandek, B., & New England Medical Center Hospital, Health Institute. (1993). *SF-36 health survey: Manual and interpretation guide*. Boston: Health Institute, New England Medical Center.

WHO | WHO Disability Assessment Schedule 2.0 (WHODAS 2.0) [WWW Document]. (n.d.). WHO. URL http://www.who.int/classifications/icf/more_whodas/en/. Accessed 26 April 2019.

WHO global disability action plan 2014-2021. GENEVA: WHO. [WWW Document]. (2015). WHO. URL http://www.who.int/disabilities/actionplan/en/. Accessed 26 April 2019.

Wolf, A. C., Tate, R. L., Lannin, N. A., Middleton, J., Lane-Brown, A., & Cameron, I. D. (2012). The World Health Organization disability assessment scale, WHODAS II: Reliability and validity in the measurement of activity and participation in a spinal cord injury population. *Journal of Rehabilitation Medicine, 44*, 747–755. https://doi.org/10.2340/16501977-1016.

World Health Organization (Ed.). (2001). *International classification of functioning, disability and health: ICF*. Geneva: World Health Organization.

World Health Organization. (2013). How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF). Exposure draft for comment. WHO, GENEVA.

World Medical Association. (2013). World medical association declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*, 2191–2194. https://doi.org/10.1001/jama.2013.281053.

Xenouli, G., Xenoulis, K., Sarafis, P., Niakas, D., & Alexopoulos, E. C. (2016). Validation of the World Health Organization disability assessment schedule (WHO-DAS II) in Greek and its added value to the short form 36 (SF-36) in a sample of people with or without disabilities. *Disability and Health Journal, 9*, 518–523. https://doi.org/10.1016/j.dhjo.2016.01.009.

Younus, M. I., Wang, D.-M., Yu, F.-F., Fang, H., & Guo, X. (2017). Reliability and validity of the 12-item WHODAS 2.0 in patients with Kashin-Beck disease. *Rheumatology International, 37*, 1567–1573. https://doi.org/10.1007/s00296-017-3723-4.

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