A Study of the Psychometric Properties of 12-item WHODAS 2.0 in a Large Population of People with Chronic Musculoskeletal Pain

Clinical messages

- This cross-sectional cohort study of 501 patients with chronic musculoskeletal pain demonstrated that the Finnish translation of the 12-item WHODAS 2.0 is a test with good psychometric abilities
- WHODAS 2.0 is a unidimensional test measuring a single latent 'general disability'
- The discrimination abilities of all the items in all possible response alternatives was high or perfect suggesting that the test was able to distinguish well the respondents with an elevated disability level from those with lesser disability
- Respondents should be experiencing slightly worse disability (compared with the average population rate) to achieve 50/50 probability of giving an answer that would be interpreted by the WHODAS 2.0 as a 'worse disability'

ABSTRACT

Objective

To assess the validity of the Finnish translation of the 12-item WHO Disability Assessment Schedule (WHODAS 2.0).

Design

Cross-sectional cohort survey study.

Setting

Physical and Rehabilitation Medicine outpatient university clinic.

Subjects

The 501 consecutive patients with chronic musculoskeletal pain.

Main measures

Exploratory factor analysis and a graded response model using item response theory analysis were used to assess the constructs and discrimination ability of WHODAS 2.0.

Results

The exploratory factor analysis revealed two retained factors with eigenvalues 5.15 and 1.04. Discrimination ability of all items was high or perfect varying from 1.2 to 2.5. The difficulty levels of seven out of 12 items were shifted towards the elevated disability level. As a result, the entire test characteristic curve showed a shift towards higher levels of disability placing at the point of disability level of +1 (where 0 indicates the average level of disability within the sample).

Conclusions

The present data indicate that the Finnish translation of the 12-item WHODAS 2.0 is a valid instrument for measuring restrictions of activity and participation among patients with chronic musculoskeletal pain.

INTRODUCTION

The accurate assessment of changes in functioning and disability are vital in measuring the success of a therapeutic intervention in rehabilitation medicine. Functioning and disability are complex concepts that can only be measured indirectly using aggregates of numerous variables. Comparing rehabilitation results between patients with different health conditions requires generic assessment tools capable of discriminating functional levels regardless of the particular disease. The World Health Organization (WHO) has developed a generic assessment tool – WHO Disability Assessment Schedule (WHODAS 2.0)[1] – which is easy to administer across all diseases in all cultures according by WHO. WHODAS 2.0 is based on the International Classification of Functioning, Disability and Health (ICF). Restrictions to participation experienced by a person can be assessed using one of the seven WHODAS 2.0 versions. The 12-item version has become popular for the purposes of clinical screening and research due to its universality, standardized character, and ease of use. It has subsequently been translated into several languages for broader application[2-5].

The WHODAS 2.0 has been admired for its one-dimensional structure, strong discrimination ability, and high internal consistency [6]. The one-dimensionality of a test means that the test describes only one underlying factor. [7 8] In the case of WHODAS 2.0, the underlying factor is a 'general disability factor', and this is related to, in theory, six major areas of functioning: cognitive functions, mobility, self-care, getting along, life activities, and participation [9]. The discrimination ability refers to how well the test distinguishes those with an elevated level of disability (more dependent) from those who are less disabled [10 11].

The psychometric characteristics of WHODAS 2.0 have been extensively studied[12] among various populations with different specific health disorders such as inflammatory diseases, stroke, and psychiatric, musculoskeletal, cardiac, and neurological disorders[4 10 13-21]. Some inconsistencies in the results have been demonstrated, likely due to the heterogeneity between study populations and the differences between both the settings and the outcome assessment tools used [12]. Additional research applied in different scenarios has repeatedly been suggested to validate WHODAS 2.0. The Finnish version of WHODAS 2.0 has not been previously studied.

In Finland, chronic musculoskeletal pain is the most common reason for visiting a Physical and Rehabilitation Medicine (PRM) specialist. Thus, the purpose of the present study was to validate the Finnish translation of the WHODAS 2.0 in people with musculoskeletal pain with regard to its ability to identify the single underlying latent trait – the 'general disability factor' – and its capacity for discrimination of patients by level of function and disability. These results will provide insight into the accurate measurement of functioning and disability in musculoskeletal pain populations.

METHODS

This was a cohort study of consecutive patients with a musculoskeletal pain condition. All the patients were seen in an outpatient PRM clinic at a university hospital between April 22, 2014 and January 31, 2015. The patients were selected by their physicians for further consultation with a PRM specialist due to persistent symptoms or due to suspicion of a malignant or complex pain etiology. A questionnaire was sent to the patients a few weeks prior to their clinic visit. It was filled out either at home or in the clinic lobby, before the physician visit. This questionnaire included a Finnish translation of the 12-item WHODAS 2.0, patient demographics, symptoms, pain intensity, quality of life, perceived work ability, and educational level. The ethics committee of the university hospital approved the study.

12-item self-administered WHODAS 2.0

The self-administered 12-item WHODAS 2.0 is a questionnaire containing 12 items covering six individual domains of functioning according to the ICF[1]. The questionnaire assesses disability during the preceding 30 days (Table 4). Each item is assessed on a five-level ordinal scale with zero denoting 'no limitation' and four denoting 'extreme limitation or an inability to function'. The total score is a percentage calculated by the sum of all answers divided by 48 and multiplied by 100 as follows:

Total score = ($\sum$item scores/48) x 100

A score of 0% represents the highest possible level of functioning and independence while a score of 100% represents the lowest level of functioning with total dependence.

Construct validity of WHODAS 2.0 (Exploratory Factor Analysis)

This study employed exploratory factor analysis to approximate the construct structure of WHODAS 2.0 as a preparatory step for the item response theory analysis. The goal was to determine if 12-item WHODAS 2.0 measures only one latent trait or if there are other possible significant latent variables affecting the results.

Difficulty and discrimination of WHODAS 2.0 items (Item Response Theory)

By using item response theory, the 'difficulty' and the 'discrimination' of all items were evaluated. In the case of WHODAS 2.0, 'difficulty' refers to the level of experienced disability that is needed to achieve a 0.5 probability of getting a particular score. For any given item, 'difficulty estimates' show how likely it will be that a patient with a certain disability level will choose a corresponding value that accurately represents this disability level. The 'difficulty estimates' of each item collectively define the overall difficulty of the entire test. In an ideal situation, patients who experience an average disability level (in this particular population) should have a 0.5 probability of getting the WHODAS 2.0 average total score of 50% (24 out of 48 points). Thus, in this "best possible" example, the responses of '0', '1', or '2' points

in WHODAS items would produce ‘difficulty estimates’ with a minus sign, indicating that the respondent perceived a lower level of disability than the average within the population. Respectively, estimates for responses with ‘3’ and ‘4’ points would carry a positive sign, indicating that the respondent perceived higher levels of disability than the average within this population. First, the average level of a trait in the whole study population was estimated. Then, the level of disability experienced by each participant was compared to the average level of experienced disability observed in the entire sample.

In turn, ‘discrimination’ defines how well WHODAS 2.0 distinguishes those who are disabled more from those who are disabled less. In this study, discrimination of 0.01 to 0.24 was considered 'none' (a totally level regression curve), 0.25 to 0.64 was considered 'low', 0.65 to 1.34 was considered 'moderate', 1.35 to 1.69 was considered 'high', and a discrimination $\geq$1.7 was considered 'perfect' (a regression curve approaching a vertical line) [23]. Ideally, the steepest interval should correspond to the patients who obtained an average disability total score of 50% (24 out of 48 points).

Statistical analysis

Exploratory factor analysis (principal factors) was applied with a minimum eigenvalue for retention set at $\geq$1.0 (Kaiser’s rule) [24]. Retained and excluded factors were also explored visually on a scree plot. The graded response model (GRM) of item response theory was used for further calculations. After fitting the model with the maximum amount of iterations set at 16,000, both parameters – difficulty and discrimination – were calculated for each of the 12 items and for the entire test. Results were reported along with their 95% confidence intervals (95%CI). The test characteristic curve and the test information function were presented graphically. Sensitivity test was conducted excluding items mostly loaded on the others than the main factor from the analysis. The item characteristic curves of all 12 items are available from the corresponding author on request. All analyses were performed using Stata/IC Statistical Software: Release 14. College Station (StataCorp LP, TX, USA).

RESULTS

A total of 501 patients (67%) from the eligible study population completed the supplied questionnaire. Patients had a variety of musculoskeletal pain conditions with associated disability as the main reason for visiting the clinic (Table 1). The median time from survey response to clinic visit was one day (IQR 0 to 3, range 0 to 141). Of the patients studied, 176 (35.1%) were men and 325 (64.9%) were women. The average age of the patients (n=496) was 47.1 (SD 13.9, range 16 to 84) years. The median body mass index (n=493) was 26.5 (IQR 23.5 to 29.8, range 15.6 to 49.0) kg/m^2. The median total score of WHODAS 2.0 was 11 (IQR 6 to 18, range 0 to 43) points.

The exploratory factor analysis resulted in two retained factors with eigenvalues >1.0: one with an eigenvalue of 5.15 and another with an eigenvalue of 1.04 (Table 2 and Figure 1). The factor analysis showed that the test construct might not be one- but two-dimensional, related to two latent traits. The smaller factor, however, was only marginally above the Kaiser's cut-off level for retaining of 1.0. The main factor was predominantly responsible for over 81% of the variation. In total, these two factors accounted for 97% of the variation (Table 3). Factor loadings (pattern matrix) and unique variances of two retained factors showed that factor #2 – one with a smaller eigenvalue – was related particularly to WHODAS 2.0 items 8, 9 and 10 (loadings >0.4). The presence of this second small factor did not significantly affect the results. Sensitivity analysis (item response theory), excluding these three items, showed the same shift of the discrimination curve towards higher disability levels.

Item response theory analysis achieved a good fit after five iterations (n=489). Such a small number of iterations needed for analysis testifies to a sufficient sample size. The figures of discrimination and difficulty abilities of the WHODAS 2.0 items are presented in Table 4 and Table 5, respectively. Discrimination ability of all items was high or perfect with overall statistical significance and narrow 95%CIs. Figure 2 summarizes the results for the discrimination ability of the entire WHODAS 2.0. As shown in Table 5, the difficulty level of seven out of 12 items in WHODAS 2.0 – S3, S4, S6, S7, S8, S10, S11 – were shifted towards the elevated disability level (compared to the average disability level in the studied population). As a result, the entire test characteristic curve also showed a shift towards higher levels of disability. This was confirmed by the test information function curve (Figure 3) with function peak located on the right side of the point indicating an average level of disability in the studied population (point of zero on the X-axis).

DISCUSSION

This cross-sectional cohort study of 501 patients with chronic musculoskeletal pain demonstrated that the Finnish translation of the 12-item WHODAS 2.0 is a test with good psychometric abilities. According to exploratory factor analysis, WHODAS 2.0 measured, with some uncertainty, what it is supposed to measure – a single latent 'general disability' variable. The discrimination abilities of all the items in all possible response alternatives was high or perfect suggesting that the test was able to distinguish well the respondents with an elevated disability level from those with lesser disability. The evaluation of the difficulty of items detected a slight shift towards elevated disability rates. This implicates that a respondent should be experiencing slightly worse disability (compared with the average population rate) to achieve 50/50 probability of giving an answer that would be interpreted by the WHODAS 2.0 as a 'worse disability'.

The present investigation represents the first validation study of the Finnish translation of the 12-item WHODAS 2.0. Two possible sources of bias might be considered when making inferences based on our results. First, this was a cohort study involving patients selected by their physicians for further consultation with a PRM specialist due to persistent symptoms or due to suspicion of a malignant or complex pain etiology. Thus, it is unclear how well the sample represents the entire population of patients with musculoskeletal pain. Second, this was a cross-sectional study and, therefore, it does not provide insight on the longitudinal performance of WHODAS 2.0. It is unknown do the psychometric abilities of the test remain unchanged in repeated measures settings. Additionally, this study does not focus on the capability of WHODAS 2.0 to measure the change in disability level, like what might occur during a rehabilitation program. On the other hand, this research was conducted on a sample big enough to achieve statistically significant results. Even taking into account the aforementioned conditions, this particular PRM clinic provides consultations to a population of approximately one million people, thus the studied cohort probably represents the diversity of people experiencing chronic musculoskeletal pain within the general population.

In theory, an assessment scale for measuring an unobserved variable should be designed to measure only one latent variable, e.g. disability or pain level. Most of the previous studies on WHODAS 2.0 did not question its one-dimensionality[7 25]. The present results were slightly different. The exploratory factor analysis resulted in two retained factors responsible for almost 100% of the variation. When more than one factor exists in a test, it may distort the outcomes by suggesting that another variable other than the one intended to be tested is affecting the results. Of the two factors detected in our analysis, the second one had a five-time smaller eigenvalue than the first one, and this value exceeded the cut-off point for retaining only marginally by 0.04. The clinical importance of such a smaller factor seems to be irrelevant and WHODAS 2.0 may be considered, with some uncertainty, as a one-dimensional tool.

In line with previous reports on the ability of WHODAS 2.0 to discriminate respondents with different levels of disability, the present findings were positive [7 8 10 11]. In our study, discrimination ability, however, had a shift towards higher disability grades. More than half of the twelve WHODAS 2.0 items demonstrated 'difficulty estimates' that were positioned on the 'more severe' side of the axis, to the right of the zero-point corresponding to an average level of disability in this population. This indicates that WHODAS 2.0 is more sensitive at distinguishing 'much more' disabled from 'more' disabled rather than 'more' disabled' from 'less' disabled. This finding has not been previously reported. It may be explained by the fact that few studies have used item response theory to test WHODAS[25 26]. The research approaches used previously more often (e.g. like Rasch analysis) focused primarily on evaluating the 'difficulty' of items, leaving their 'discrimination' abilities unrevealed. In turn, item response theory can measure the inherent discriminatory ability of a test to distinguish accurately different levels of a given trait, and this statistical model was used to test the WHODAS 2.0. Results showed that this particular test is generally good at accurately measuring disability levels, but is particularly good at distinguishing higher levels of disability.

The difficulty level of seven out of 12 items in WHODAS 2.0 – S3, S4, S6, S7, S8, S10, S11 – were shifted towards the elevated disability level. This implies that these seven items favor those who experienced greater disability compared to the average level. It is unclear what is special about these seven items, as opposed to the other five, that require a higher level of functional disability in order for a patient to experience a problem in these areas. The reason for that finding may be a subject for further research. Put another way, a respondent should experience more severe disability than the average in order to get a higher score on these seven items.

Translation and cross-cultural adaptation of standardized tools to assess functioning is important for understanding health behavior in different cultures and for contributing to worldwide public health policies[27-30]. The 12-item WHODAS 2.0 seems to be a promising, generic instrument for measuring functioning among patients with chronic musculoskeletal pain. The potential usefulness of WHODAS 2.0 in that population is very wide. For example, it can be used for determining the need for rehabilitation or the assistance required at home or during the rehabilitation course. It is vital to measure functioning and disability in the musculoskeletal pain population given the highly subjective and problematic nature of measuring changes in pain. Particularly in patients with chronic pain, improvement in function should be prioritized as the most important goal of a rehabilitation program or other therapeutic interventions. The 12-item WHODAS 2.0 may be a valid, easy to use, and standardized test for that goal.

There is still a need for its additional validation in different settings, translations, and populations. In order to specify the psychometric properties of WHODAS 2.0 with better precision, further research is needed both longitudinally and cross-sectionally. These data suggest that WHODAS warrants comparative validity studies with historically utilized functional and disability outcome measures, such

as the Oswestry Disability Index[31] and the Short Form-36 Questionnaire[32]. Because the assessment of disability is particularly challenging in the musculoskeletal pain population, defining sub-populations who may be better assessed by the WHODAS 2.0 as opposed to the Oswestry Disability Index or Short Form-36 could be useful. The dimensionality of 12-item WHODAS 2.0 should be investigated in more detail. In this study, the test was considered being unidimensional even though there was a second latent factor slightly exceeding the Kaiser's cut-off point of retaining. It is unclear if the factor structure of the 'original' comprehensive 36-item version of WHODAS 2.0 remains unchanged when simplifying the test from 36 down to 12 items.

The Finnish translation of the 12-item WHODAS 2.0 seems to be a valid instrument for measuring the functional level among patients with chronic musculoskeletal pain, particularly in those with greater levels of disability.

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Table 1. Main reasons for visiting a PRM clinic.

ICD-10 diagnosis	**n**	**%**
M54 Back pain	179	36.0
M51 Intervertebral disc disorder	55	11.0
M79 Soft tissue disorder	40	8.1
M75 Shoulder lesion	35	7.0
M50 Cervical disc disorder	23	4.6
M25 Joint disorder	20	4.0
M70 Soft tissue disorder related to use, overuse and pressure	13	2.6
M43 Deforming dorsopathy	12	2.4
M53 Dorsopathy	11	2.2
G54 Nerve root and plexus disorder	7	1.4
M48 Spondylopathy	7	1.4
M47 Spondylosis	6	1.2
Other	89	17.9
Total	497	100

Table 2. Exploratory factor analysis of WHODAS 2.0

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.15	4.11	0.81	0.81
Factor2	1.04	0.42	0.16	0.97
Factor3	0.63	0.34	0.10	1.07
Factor4	0.29	0.21	0.05	1.11
Factor5	0.07	0.11	0.01	1.12
Factor6	-0.04	0.01	-0.01	1.12
Factor7	-0.05	0.01	-0.01	1.11
Factor8	-0.06	0.05	-0.01	1.10
Factor9	-0.11	0.03	-0.02	1.08
Factor10	-0.13	0.06	-0.02	1.06
Factor11	-0.19	0.03	-0.03	1.03
Factor12	-0.21	0.00	-0.03	1.00

Table 3. Factor loadings (pattern matrix) and unique variances of two retained factors

WHODAS 2.0 item	Retained factor 1	Retained factor 2	Uniqueness variance
S1 Standing for long periods	0.63	0.10	0.60
S2 Household responsibilities	0.75	0.28	0.36
S3 Learning a new task	0.55	-0.32	0.59
S4 Joining in community activities	0.77	-0.12	0.39
S5 Emotionally affected by health problems	0.66	-0.14	0.54
S6 Concentrating	0.64	-0.23	0.54
S7 Walking a long distance	0.65	0.12	0.56
S8 Washing	0.64	0.44	0.40
S9 Dressing	0.55	0.49	0.46
S10 Dealing with strangers	0.59	-0.44	0.46
S11 Maintaining a friendship	0.70	0.32	0.40
S12 Day-to-day work	0.66	-0.13	0.55

Table 4. Discrimination ability of WHODAS 2.0 questionnaire items

WHODAS 2.0 item	Discrimination	Lower 95%CI	Upper 95%CI
S1 Standing for long periods	1.47*	1.20	1.73
S2 Household responsibilities	2.28*	1.92	2.65
S3 Learning a new task	1.79*	1.37	2.21
S4 Joining in community activities	2.82*	2.32	3.32
S5 Emotionally affected by health problems	1.85*	1.55	2.16
S6 Concentrating	2.02*	1.65	2.40
S7 Walking a long distance	1.51*	1.24	1.79
S8 Washing	1.59*	1.28	1.90
S9 Dressing	1.22*	0.97	1.47
S10 Dealing with strangers	2.26*	1.72	2.80
S11 Maintaining a friendship	2.45*	1.98	2.93
S12 Day-to-day work	1.81*	1.51	2.11

*p-value <0.0001

Table 5. Difficulty of WHODAS 2.0 questionnaire items

Item	Response	Disability	95%CI	
S1	>=1	-0.69	-0.89	-0.49
	>=2	-0.06	-0.22	0.11
	>=3	0.74	0.54	0.93
	4	1.78	1.46	2.1
S2	>=1	-0.98	-1.15	-0.8
	>=2	0.05	-0.08	0.19
	>=3	1.01	0.83	1.18
	4	2.03	1.74	2.32
S3	>=1	1.02	0.81	1.23
	>=2	1.59	1.3	1.88
	>=3	2.18	1.77	2.59
	4	3.41	2.63	4.19
S4	>=1	0.01	-0.11	0.14
	>=2	0.66	0.52	0.8
	>=3	1.13	0.96	1.3
	4	1.76	1.52	1.99
S5	>=1	-1.3	-1.53	-1.08
	>=2	-0.21	-0.36	-0.06
	>=3	0.75	0.57	0.92
	4	2.63	2.2	3.05
S6	>=1	0.3	0.16	0.45
	>=2	1.02	0.83	1.21
	>=3	1.87	1.58	2.15
	4	2.8	2.32	3.28
S7	>=1	-0.31	-0.48	-0.13
	>=2	0.52	0.34	0.69
	>=3	1.02	0.81	1.24
	4	1.8	1.49	2.12
S8	>=1	0.18	0.02	0.34
	>=2	1.11	0.89	1.33
	>=3	2.1	1.74	2.46
	4	3.06	2.48	3.63
S9	>=1	-0.24	-0.43	-0.04
	>=2	1.24	0.97	1.52
	>=3	2.4	1.93	2.87
	4	4.32	3.29	5.35
S10	>=1	1.1	0.91	1.29
	>=2	1.59	1.33	1.85
	>=3	1.92	1.61	2.24
	4	2.77	2.26	3.28
S11	>=1	0.42	0.29	0.56
	>=2	1.07	0.89	1.25
	>=3	1.66	1.41	1.9
	4	2.51	2.12	2.91
S12	>=1	-1.3	-1.53	-1.07
	>=2	-0.3	-0.46	-0.14
	>=3	0.57	0.4	0.73
	4	1.26	1.04	1.48

Figure 1. Scree plot of exploratory factor analysis of WHODAS 2.0.

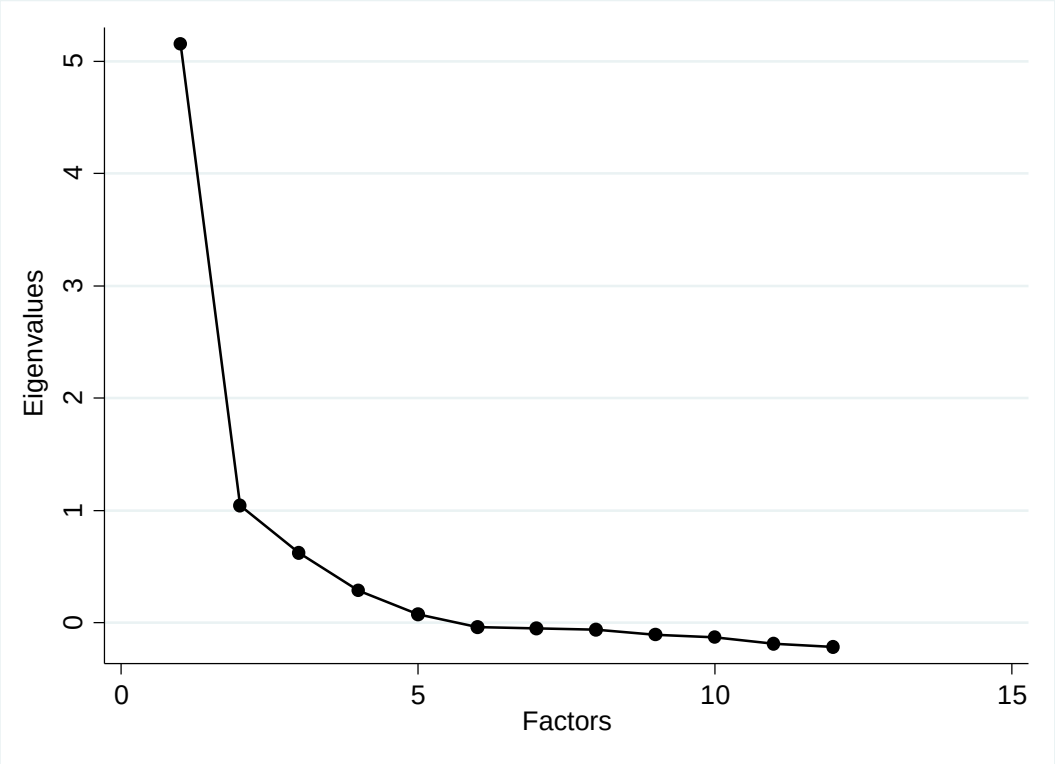

Figure 2. Test characteristics curve for 12-item WHODAS 2.0

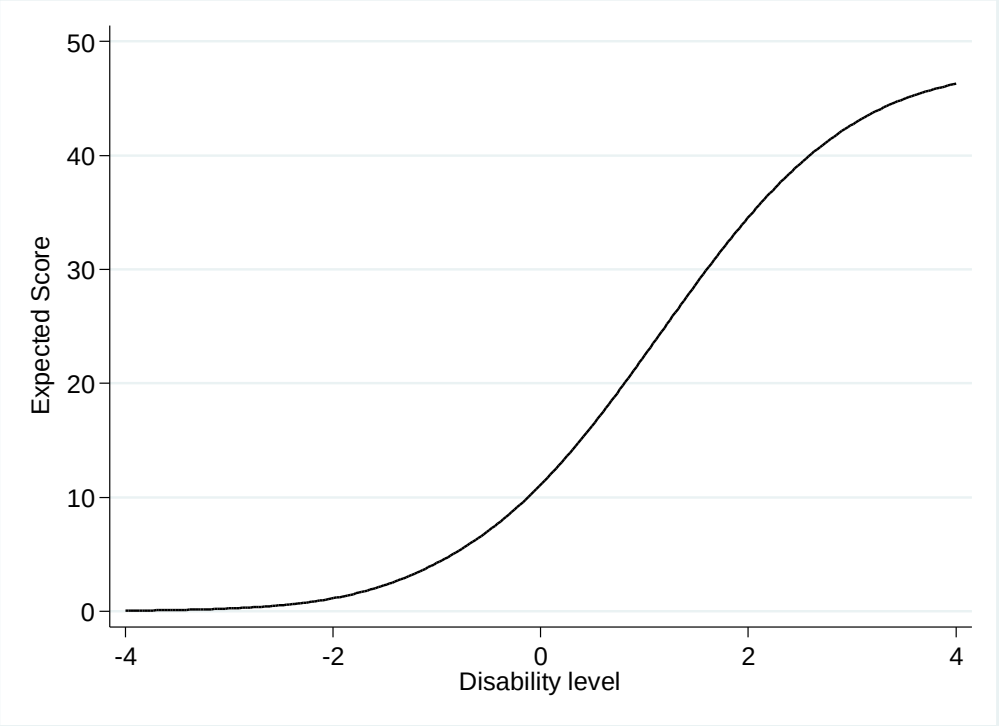

Figure 3. Test information function curve for 12-item WHODAS 2.0