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ORIGINAL ARTICLE

Assessing self-reported disability in a low-literate population with chronic low back pain: cross-cultural adaptation and psychometric testing of Igbo Roland Morris disability questionnaire

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ABSTRACT

Purpose: Cross-culturally adapt and validate the Igbo Roland Morris Disability Questionnaire.

Method: Cross-cultural adaptation, test–retest, and cross-sectional psychometric testing. Roland Morris Disability Questionnaire was forward and back translated by clinical/non-clinical translators. An expert committee appraised the translations. Twelve participants with chronic low back pain pre-tested the measure in a rural Nigerian community. Internal consistency using Cronbach's alpha; test–retest reliability using intra-class correlation coefficient and Bland–Altman plot; and minimal detectable change were investigated in a convenient sample of 50 people with chronic low back pain in rural and urban Nigeria. Pearson's correlation analyses using the eleven-point box scale and back performance scale, and exploratory factor analysis were used to examine construct validity in a random sample of 200 adults with chronic low back pain in rural Nigeria. Ceiling and floor effects were investigated in the two samples.

Results: Modifications gave the option of interviewer-administration and reflected Nigerian social context. The measure had excellent internal consistency ($\alpha = 0.91$) and intraclass correlation coefficient (ICC $=0.84$), moderately high correlations ($r > 0.6$) with performance-based disability and pain intensity, and a predominant uni-dimensional structure, with no ceiling or floor effects.

Conclusions: Igbo Roland Morris Disability Questionnaire is a valid and reliable measure of pain-related disability.

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KEYWORDS
Cross-cultural research; low back pain; self-reported disability; interviewer-administration; cross-cultural adaptation; psychometric testing

➤ IMPLICATIONS FOR REHABILITATION

- Low back pain is the leading cause of years lived with disability worldwide, and is particularly prevalent in rural Nigeria, but there are no self-report measures to assess its impact due to low literacy rates. This study describes the cross-cultural adaptation and validation of a core self-report back pain specific disability measure in a low-literate Nigerian population.
- The Igbo Roland Morris Disability Questionnaire is a reliable and valid measure of self-reported disability in Igbo populations as indicated by excellent internal consistency ($\alpha = 0.91$) and intra-class correlation coefficient (ICC $=0.84$), moderately high correlations ($r > 0.6$) with performance-based disability and pain intensity that supports a pain-related disability construct, a predominant one factor structure with no ceiling or floor effects.
- The measure will be useful for researchers and clinicians examining the factors associated with low back pain disability or the effects of interventions on low back pain disability in this culture. This measure will support global health initiatives concurrently involving people from several cultures or countries, and may inform cross-cultural disability research in other populations.

Introduction

Low back pain (LBP) is the leading cause of years lived with disability in high- and low-income countries according to global burden of disease studies [1]. The impact is likely to be more devastating in low-income countries [2]. This is more so in rural African contexts where beliefs, culture, and common activities such as fetching water, farming, and carrying heavy objects, combined with high levels of poverty and lack of health information may increase the risk and impact of LBP.

The burden of LBP is disproportionately greater in rural Nigeria. The prevalence rate ranging between 70 and 85% in rural Nigeria is twice the prevalence rates in urban Nigeria [3]. A qualitative study in rural Nigeria suggested that LBP hindered the ability of individuals to perform their activities of daily living [4].

Despite the significant burden of LBP in rural Nigeria, there are no self-report disability measures to assess its impact in this context. Self-report disability measures such as the Roland Morris Disability Questionnaire (RMDQ) [5] appear to reflect the more

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Supplemental data for this article can be accessed here.

comprehensive biopsychosocial disability model defined in the World Health Organisation's International Classification of Functioning, Disability and Health (ICF). Disability constructs such as participation restriction, may be better measured subjectively through self-reports. In contrast, performance-based disability measures such as the back performance scale [6] appear to be impairment focused.

In contrast to the back performance scale that is objectively measured [6], self-report disability measures would require adaptation in a new language or culture [7]. Guidelines, developed from reviewing the cross-cultural adaptation of medical, sociological, and psychological literature, justify the use of self-report measures in countries, cultures, and/or languages that differ from those where they were initially developed [7]. This requires unique methods of translation and cultural adaptation to ensure semantic, idiomatic, experiential, and conceptual equivalence between the source and target questionnaires [7]. The source questionnaire refers to the original measure, while the target questionnaire refers to the new questionnaire after it has been adapted into the new language/culture [7].

Adaptation of self-report measures into interviewer-administered versions may be an additional requirement for low-literate populations, and may be more labor intensive and complex [8]. This may explain why studies in most countries including Nigeria have often used original English disability measures such as the RMDQ among urban English speaking participants, precluding the low-literate rural populations with the worst health outcomes. However, previous studies suggest that interviewer-administration of self-report measures is valid when interviewers are adequately trained to minimize bias to patient responses [9,10]. Moreover, interviewer-administration has been shown to reduce missing data [10], and may be the only way to administer self-report measures to illiterate people in low resource settings. Therefore, this study aimed to cross-culturally adapt the RMDQ into Igbo and investigate its psychometric properties in a low-literate Nigerian population.

Methods

Designs

Cross-cultural adaptation, test–retest measurements, and cross-sectional study of psychometric properties.

Ethical considerations

Ethical approvals were obtained from King's College London (Ref: BDM/13/14-99) and University of Nigeria Teaching Hospital (Ref: UNTH/CSA/329/Vol.5). Written permission was obtained from the original developers of the RMDQ.

Outcome measures

Roland Morris disability questionnaire (RMDQ)

RMDQ is the most commonly used valid measure of LBP disability [11]. It is recommended as a core outcome measure for the standardization of outcome measurement in LBP clinical trials, meta-analyses, cost-effectiveness analyses, and multicenter studies [12]. RMDQ is simple to administer, easily understood, and is the best measure for population or primary care based studies [12,13].

RMDQ is a 24-item back-specific self-report measure with each item having possible scores of 0 or 1 [5]. A total maximum score of 24 signifies the highest possible disability level and 0 means that there is no disability. It has good face and content validity, construct validity, internal consistency, test-retest reliability and responsiveness [13]. It has Cronbach's alpha ranging between 0.84 and 0.93; test–retest reliability ranging between 0.72 and 0.91; and a 2–5 point change from baseline is considered clinically important [13–15].

Back performance scale

This is an objective back-specific performance-based measure of mobility-related limitation that is scored by an assessor [6]. The measure involves instructing participants to perform five physical performance tests (sock test, pick-up test, roll-up test, finger-tip-to-floor test, and lift test) involving mobility of the trunk [6].

Sock test involves participants simulating putting on a sock from sitting. Pick-up test involves picking up a piece of paper from the floor. Roll-up test entails rolling up slowly from supine lying to a long sitting position with the arms relaxed. In finger-tip-to-floor test, participant stands on the floor with feet 10 cm apart, then bends forward with straight knees and tries to touch the floor with the fingertips. The distance between the floor and the fingertips is then measured in centimeters. For the lift test, a participant repeats lifting a 5-kg box from the floor to a 76 cm table and back to the floor for 1 min. The number of lifts is then recorded. Each of the five tests has scores ranging from 0 to 3 depending on the difficulty or ease with which they are performed. A total possible score of 15 signifies maximum disability while 0 means no disability [6]. The measure has good validity and reliability: internal consistency of 0.73, moderate correlations with RMDQ, and test–retest reliability of 0.91 [6,16,17].

Eleven-point box scale

The measure is a single eleven-point numeric scale for pain intensity [18,19] that consists of 11 numbers (0 through 10) surrounded by boxes [20]. Zero represents "no pain" and 10 represents "pain as bad as you can imagine" or "worst pain imaginable". It is easy to comprehend and administer [19], and may be the measure of choice for population-based studies involving illiterate people such as rural Nigeria.

Cross-cultural adaptation of Roland Morris disability questionnaire

Translation involves linguistic paraphrasing of a questionnaire. In contrast, cross-cultural adaptation comprises both translation and cultural adaptation in order to maintain the content validity of the instrument at a similar conceptual level in a different context [7]. This involves adaptation of individual items, instructions for the questionnaire, and the response options.

Participants for cross-cultural adaptation

Participants included clinical and non-clinical translators, and an expert review committee. Translators were one clinical physiotherapist with 20 years of clinical experience practicing in Nigeria, and three non-clinical translators including two Igbo linguistic experts who are professional translators experienced in patient reported outcome measures. Expert review committee members included two English experts (academic physiotherapist and health psychologist) working in the United Kingdom, and two Igbo experts (clinical physiotherapist and clinical psychologist) working in Nigeria.

Verbal pre-testing/piloting of the Igbo-RMDQ was done on 29 August 2014 with a convenience sample who participated in a previous study in rural Nigeria [4], and who were willing to give

informed consent and participate in this study. Their pain was not due to malignancy, spinal fracture, infection, inflammation, or cauda equina syndrome [21].

Procedure for cross-cultural adaptation

The original RMDQ [5] was cross-culturally adapted following evidence-based guidelines for cross-cultural adaptation of patient-reported outcome measures [7,22] (Figure 1).

First, the questionnaire was forward translated from English to Igbo by one bilingual clinical physiotherapist and one bilingual non-clinical professional translator. Item definitions were provided for the clinical translator to ensure familiarity with the assessed construct and provide greater psychometric equivalence with the original RMDQ. Item definitions were not provided for the non-clinical translator to ensure that the translation reflected the language used by lay people in Igbo culture. This stage produced two Igbo RMDQ versions: T1 and T2.

Second, T1 and T2 were synthesized via discussion between the two forward translators, mediated by the first author who is bilingual in English and Igbo. This produced one Igbo version: T-12. Translations were compared and discrepancies were noted.

Third, the Igbo (T-12) version of the RMDQ was back translated from Igbo to English by two back translators, blind to the original version, who were from non-clinical backgrounds, including one Igbo linguistic expert/professional translator. This produced two back-translated English versions: BT1 and BT2. This is a validation process ensuring that translation was consistent, and that the translated version (T-12) was reflecting the meaning in the original measure.

Fourth, T1, T2, T-12, BT1, and BT2 were discussed by the expert review committee to produce the pre-final Igbo-RMDQ. The main purpose of this committee was to achieve cross-cultural equivalence in terms of semantic, idiomatic, experiential and conceptual equivalence [7]. For semantic equivalence, the committee explored Igbo and English words to assess if they meant the same thing, if there were multiple meanings to an item, and if there were any grammatical difficulties in the translations. Idiomatic equivalence was assured by the committee formulating alternative Igbo idioms and colloquialisms, where the English versions were difficult to translate. Experiential equivalence was achieved by the committee ensuring that questionnaire items were experienced similarly in English and Igbo cultures. For conceptual equivalence, the committee determined that words in the items, instructions, and response options had similar conceptual meanings in Igbo and English cultures. The expert committee also ensured that Igbo wordings were simple and could be easily understood regardless of age and educational levels.

Finally, the pre-final Igbo-RMDQ was field tested in rural Nigeria, among the twelve participants who had participated in a previous qualitative study [4]. The first author interviewer-administered the RMDQ using the "think-aloud" cognitive interviewing procedure to assess comprehensibility, acceptability of items and cultural equivalence. Each item was read out, and participants were requested to actively verbalize their thoughts as they attempted to answer each question. Participants were asked if

Stage 1: Two forward translations of original RMDQ to Igbo

i. T1 (Igbo) version: bilingual Physiotherapist
ii. T2 (Igbo) version: bilingual non-clinical translator

Stage 2: Synthesis of the two forward translations (T1 & T2) by the two translators, with CNI-C mediating discussion, to produce T-12 (Igbo) version.

Stage 3: Two back translations of T-12 (Igbo) version to English

i. BT1 (English) version: non-clinical translator
ii. BT2 (English) version: non-clinical translator
iii. CNI-C: reviewed and summarised differences in BT1 and BT2 versions

Stage 4: Expert committee review produced pre-final Igbo RMDQ

CNI-C mediated discussion of translations and discrepancies in T1, T2, T-12, BT1 and BT2 versions with experts in UK and Nigeria.

Stage 5: Pretesting of pre-final Igbo RMDQ with patients by CNI-C to produce the final Igbo RMDQ.

CNI-C: The first author

Figure 1. Cross-cultural adaptation stages adapted from Beaton et al. [7].

they encountered difficulty comprehending the questionnaire, what was understood by each item, the meaning of the chosen response, and if they found any item offensive. They were encouraged to keep talking while the first author recorded their responses. This stage ensured that equivalence was maintained in the target setting to produce the final Igbo-RMDQ, confirming face and content validity. Technical equivalence (methods of data collection) was assured through data collection using the same format (interviewer-administration) with all participants.

Clarifications were sought from the original developers of the RMDQ and all linguistic changes made to the measure were discussed with them.

Psychometric testing of Igbo Roland Morris disability questionnaire

Sample size estimation

Test–retest reliability assessments

Based on a previous reliability study in South Africa, a minimum sample size of 27 was required per language group to detect an intra-class correlation coefficient of 0.9 and a maximum width of 0.23 for the 95% confidence interval [23]. A study was conducted for test-retest reliability assessment, and involved a convenient sample of 50 participants with chronic LBP, between the ages of 18 and 69 years, recruited from rural and urban communities in Enugu State, South-eastern Nigeria.

Construct validity assessments

A sample size of 194 would give an 80% power to detect a very small correlation coefficient of 0.2 at α level of 0.05. To ensure an adequate sample size, construct validity assessment was done as part of another study [24] – a population-based cross-sectional survey of a representative sample of 200 participants recruited from rural communities in Enugu State, South-eastern Nigeria.

Multistage cluster sampling was used to select 10 rural communities, representative of rural populations in Enugu State. A sub-sample of twenty participants was selected in each of the ten communities via village announcements facilitated by the traditional head in each community. Stratified sampling of individuals by gender was done to ensure an equal representation of male and female participants.

Training community health workers for data collection

Community health workers were required for data collection through interviewer-administration as a significant proportion of rural dwellers in Nigeria are not literate. Ten community health workers were recruited from the University of Nigeria Teaching Hospital, Enugu. They were trained for 2 weeks, for interviewer-administration of the self-report measures, and objective disability assessment with the back-performance scale. The training was daily, face-to-face, group-based, and done by the first author at the University of Nigeria Teaching Hospital Enugu, Nigeria. Training was done to minimize common survey errors: coverage, sampling, measurement, and non-response errors.

Coverage error was avoided by obtaining a representative sample of the population through multistage cluster sampling. Sampling error was prevented through adequate sample size and gender stratification ensuring the study was not conducted among only one of the many possible samples. Measurement error was reduced by using validated measures and tailoring community health workers' training to avoid asking questions in ways that could bias participants' responses or inaccurate objective disability measurements such as guessing measurements rather than using a tape measure. Training the workers to assess all recruited participants whilst ensuring that no items or scales were unanswered prevented non-response errors.

Training ended with question and answer sessions and a classroom clinical examination. Examination questions assessed survey rationale, purpose and protocol, and practical administration of outcome measures.

Participants and data collection procedure

Community health workers met with potential participants, provided information about the study and screened participants, by asking simple questions to rule out back pain due to malignancy, spinal fracture, infection, inflammation or cauda equina syndrome, in line with evidence-based guidelines for diagnosing non-specific LBP [21]. Participants were requested to describe their pain location with a body chart to confirm pain in the lower back. Informed consent was subsequently obtained.

The Igbo-RMDQ was then interviewer-administered. The eleven-point box scale was interviewer-administered to measure pain intensity, and was presented to participants as a "flash card" as the item was read out. The back performance scale was used to objectively assess performance-based disability.

To assess test–retest reliability, measures were completed at baseline on 11 August 2014 among the convenient sample of urban and rural Nigerian dwellers. Measurements were repeated seven days after the first measurement among 45 participants. The remaining five participants were reassessed after 10 d when they were available. The same community health worker collected data from each participant on the two occasions.

For validity assessment, measures were completed at one time-point in a cross-sectional design on 22 August 2014 among the 200 rural dwellers.

The two samples were similar in characteristics except that the test–retest sample also included urban dwellers who routinely have higher literacy levels in Nigeria. Importantly, recruiting different samples of rural and urban dwellers ensures wide applicability of the Igbo-RMDQ in rural and urban Nigeria, as well as across all levels of literacy or illiteracy.

Fidelity assessment

Fidelity checks were done to avoid systematic differences in data collection by the community health workers. Involving workers that passed the post-training examinations facilitated adherence to data collection protocols. Additionally, the first author visited each worker during data collection without prior arrangement, and assessed their interviewing styles, data recording and assessment of performance-based disability. Furthermore, a participant from each community health worker was randomly selected, and the performance-based disability which is expected to be stable over the short period, was re-assessed by the first author and compared with the worker's records.

Data analyses

Statistical Package for Social Sciences version 22 (SPSS, Chicago, IL) was used.

Reliability

Reliability assesses the ability of an instrument to measure consistently. Test–retest reliability evaluated how consistent the adapted

RMDQ consistently measured disability over time, and was investigated using intra-class correlation coefficient (ICC). ICC was calculated using a two-way random effects model (which assumes that measurement errors could arise from either raters or subjects), using an absolute agreement definition between test–retest scores: 0.7, 0.8, and 0.9 represented good, very good, and excellent ICCs, respectively. Internal consistency (Cronbach's alpha), which portrays the extent to which all items in a test measure the same construct, was calculated and rated as low/weak (0–0.2), moderate (0.3–0.6), and strong (0.7–1.0). Bland–Altman plots were used to visually assess the level of agreement between test-retest measurements by plotting mean Igbo-RMDQ scores against difference in Igbo-RMDQ total scores.

Reliability was also evaluated using the standard error of measurement (SEM) and minimal detectable change (MDC). MDC is a statistical estimate of the smallest change detected by a measure that corresponds to a noticeable change in ability which is not due to measurement error. MDC was calculated using the standard error of measurement (SEM) which is based on the distribution method, and the reliability of the measure which takes precision into account [25]. SEM was based on the standard deviation (SD) of the sample and the test-retest reliability (R) of the Igbo-RMDQ, and was calculated with the following equation [25]:

$$\mathrm{SEM} = \mathrm{SD}\ \sqrt{(1 - \mathrm{R})}$$

Equation (1): Standard Error of Measurement

MDC was subsequently calculated with the following equation [25]:

$$\mathrm{MDC} = 1.96 \times \sqrt{2} \times \mathrm{SEM}$$

Equation (2): Minimal detectable change

Validity

Construct validity evaluates the extent to which a measure assesses the construct it was intended to measure. As there are no "gold standard" Igbo self-reported disability measures, construct validity was investigated. Construct validity of the Igbo-RMDQ was assessed with Pearson's correlation coefficients (normally distributed data), and was rated as weak (0–0.2), moderate (0.3–0.6), and strong (0.7–1.0). As RMDQ assesses pain-related disability, the Igbo-RMDQ is expected to correlate at least moderately with pain intensity and performance-based disability. There was no Igbo quality of life measure with which to validate the Igbo-RMDQ.

There was no hypothesized factor structure, therefore exploratory factor analysis (EFA) was used to determine the number of factors influencing the Igbo-RMDQ, i.e., the items that go together (dimensionality). EFA was applied according to Kaiser Meyer Olkin (KMO) and the Bartlett's test with a minimum eigenvalue for retention set at 1.0 (Kaiser's rule) [26]. Retained and excluded factors were also explored visually on a scree plot. There was minimal correlation between items, therefore, varimax (orthogonal) rotation was done, and factor loadings less than 0.3 were suppressed as recommended [27]. Extraction was done using principal axis factoring. The number of factors and the underlying relationships between the items were then investigated. Pearson's correlation analyses (normally distributed data) were used to investigate the relationships between the underlying factors, and pain intensity, and performance-based disability.

Floor and ceiling effects

Ceiling or floor effect occurs when a high proportion of participants score the highest or the lowest score, respectively, implying that a measure is unable to discriminate between participants at either extreme of the scale. A ceiling or floor effect was defined as 15% or more of the total sample of 250 participants scoring 0 or 24 on the Igbo-RMDQ [28].

Table 1. Demographic characteristics of participants that pre-tested the measure.

$n = 12$	Frequency	%
Mean age= 45 years		
Gender		
Male	7	58.33
Female	5	41.67
Main occupation		
Manual workers	7	58.33
Non-manual workers	5	41.67
Religion (Christian denomination)		
Protestant Pentecostal	10	83.33
Catholic	2	16.67
Marital status		
Married	11	91.67
Single	1	8.33
Educational level completed		
Secondary	4	33.33
Primary	3	25.00
None	3	25.00
Tertiary	2	16.67
Literacy (ability to read and write)		
Illiterate (inability to read and write)	4	33.33
English	6	50.00
English and Igbo	2	16.67

Results

Participants for cross-cultural adaptation

Table 1 shows that slightly over half of the participants were males and manual workers, including farmers, panel beaters, and welders. Non-manual workers were civil servants and traders. Majority were from the Pentecostal Christian religion, married, with secondary education. Half of them were literate in English only.

Translation, comprehensibility, and cultural equivalence of the Igbo Roland Morris disability questionnaire

There were no major translation problems. The expert review committee introduced two extra clauses in the instruction: "or when someone reads them to you" and "or tell the person that read it to you to mark your response" to give the option of interviewer-administration (Supplemental materials).

T1 and T2 translators used different Igbo dialects and sentence structures for many items. These were resolved during syntheses, back translations, and expert committee review by using central/official Igbo dialect and sentence structures that retained meaning closest to the original item. In item 1, "nearly all the time" was used to better reflect the original item as the same Igbo phrase means "many times" or "most of the time". Item 5 was translated differently: "I hold onto something … " and "I hold onto a stick … " because there is no Igbo word for "handrail". Through consensus of all translators, "I hold onto the step hand … " was used as the Igbo equivalent means the same thing as the original item. For item 16, a new phrase "my foot wear" was used by the expert review team to better reflect the social context of rural Nigeria where many people do not wear socks. For item 23, a new phrase "or uphill" was added to the original item to reflect rural Nigeria where many dwellers lived in bungalows with hilly terrains. Through consensus of all translators and the review team, "I lie down" was used in place of "I stay in bed" in item 24, as some rural Nigerian dwellers do not lie on beds. During pre-testing of

Igbo-RMDQ, the Igbo word for "waist pain" was how participants understood pain in the lower back. Literal Igbo translation of back pain was understood as either upper back pain or pain of the entire back, which made some participants with pain only in the lower back to deselect items. Therefore "back pain or back" and "waist pain or waist" were used in the items (Supplemental materials), but "waist pain or waist" was read out for this specific lower back pain population. Supplemental materials were produced in consultation with Professor Martin Roland, the developer of the original RMDQ. Supplemental material 1 contains the Igbo-RMDQ. Supplemental material 2 contains the minor changes made to the measure and why, and instructions to researchers and clinicians using the Igbo-RMDQ.

Psychometric properties

Fidelity results

Community health workers (CHWs) adhered to the recommended interviewing styles emphasized during the training. Examples include maintaining neutrality during interview, not reacting by gesture or word, either positively or negatively to any responses; discouragement of digression, distraction and inappropriate enquiries, and not changing the wording and sequence of questions in the measures. Data recording was adequate as this was planned *a priori*. CHWs provided only one answer to each item, marked in the space provided for each item in each measure. The assessment of performance-based disability was adequate. For instance, CHWs used tape measures adequately to assess 10 cm between the feet, and measured the distance between the fingertips and the floor, for the finger-tip-to-floor test. The performance-based disability levels recorded by the first author and the CHWs were similar for the randomly selected subsample of participants (exact values or differences of not more than 2 in the back-performance scale were observed).

Participants for psychometric testing

The demographic characteristics of the two samples are presented in Tables 2 and 3. Table 2 presents the test–retest sample of 50 participants, and shows that a majority were females, married, in paid work or self-employed. Slightly less than half were rural dwellers in Enugu state. Participants were mostly middle aged with secondary level of education. Table 3 presents 200 participants in the cross-sectional validity testing. They were all rural dwellers in Enugu state. Nearly equal numbers were males. They were middle aged with primary level of education. A majority were married and self-employed.

Table 2: Demographic characteristics of participants for test-retest reliability testing.

$n = 50$	Frequency (%)	Mean (SD)
Gender		
Female	32 (64.0)	
Male	18 (36.0)	
Habitation		
Rural	20 (40.0)	
Urban	30 (60.0)	
Age (years)		45.2 (11.55)
Education (years)		13.3 (7.14)
Current marital status		
Currently married	37 (74.0)	
Never married	8 (16.0)	
Widowed	4 (8.0)	
Separated	1 (2.0)	
Work status		
Paid work	25 (50.0)	
Self-employed (own business or farming)	19 (38.0)	
Keeping house/homemaker	2 (4.0)	
Student	2 (4.0)	
Non-paid work (volunteer or charity)	1 (2.0)	
Unemployed (health reasons)	1 (2.0)	

Reliability

Table 4 shows that internal consistency was excellent ($\alpha = 0.91$), and intraclass correlation coefficient was very good (ICC = 0.84). Standard error of measurement and minimal detectable change were 2.53 and 7.01, respectively.

Figure 2 suggests acceptable agreement between test-retest values of the Igbo-RMDQ as the mean difference was close to zero and most points were within the 95% limits of agreement of the mean difference.

Construct validity

Table 5 shows that Igbo-RMDQ had moderately high correlations ($r > 0.6$) with performance-based disability and pain intensity. The scree plot in Figure 3 suggests a predominant one-factor structure and a secondary four-factor solution of the Igbo-RMDQ.

Table 6 also suggests one dominant factor structure of the Igbo-RMDQ with four underlying factors because the amount of explained variance drops sharply after the first factor (from 32.41% to 5.56%). However, all four factors had eigenvalues >1.

Factor 1 had six items (5, 23, 3, 16, 7, and 12) loading on it; and represents "mobility problems related to climbing stairs, walking, wearing socks, sit-to-stand transfer". Factor 2 had five items (24, 20, 2, 6, and 13) loading on it; and signifies sensory function of pain, and reduced activity and frequent change of position to alleviate pain. Factor 3 had eight times (15, 18, 8, 19, 9, 22, 1, and 14) loading on it; and corresponds to mental functions related to

Table 3. Demographic characteristics of participants for cross-sectional validity testing.

$n = 200$	n (%)	Mean (SD)
Sex		
Female	112 (56.0)	
Male	88 (44.0)	
Age (years)		48.6 (12.0)
Education (years)		7.0 (6.4)
Current marital status		
Currently married	143 (71.5)	
Widowed	31 (15.5)	
Never married	22 (11.0)	
Cohabiting	2 (1.0)	
Separated	2 (1.0)	
Work status		
Self-employed (own business or farming)	125 (62.5)	
Paid work	31 (15.5)	
Non-paid work (volunteer or charity)	16 (8.0)	
Keeping house/homemaker	13 (6.5)	
Student	7 (3.5)	
Unemployed (health reasons)	4 (2.0)	
Unemployed (other reasons)	3 (1.5)	
Retired	1 (0.5)	

Table 4. Reliability of Igbo-RMDQ.

Number of items: 24; Cronbach's alpha global score: 0.91; ICC (95% CI): 0.84 (0.71, 0.91)

Cronbach's alpha if item deleted							
1	2	3	4	5	6	7	8
0.89	0.89	0.90	0.90	0.90	0.89	0.89	0.90
9	10	11	12	13	14	15	16
0.90	0.89	0.89	0.89	0.89	0.89	0.90	0.89
17	18	19	20	21	22	23	24
0.90	0.90	0.90	0.90	0.89	0.90	0.89	0.89

SEM: 2.53; MDC: 7.01.

appetite, sleep, emotions and relationships; self-care related to dressing and getting people to help; and transfer-in-bed aspects of mobility. Factor 4 had five items (10, 21, 17, 11, and 4) loading on it. This factor represents problems with performing household tasks and avoidance behavior in relation to maintaining or sustaining a body position or movement, including bending/kneeling.

Table 7 shows the mobility factor had the strongest correlation ($r \simeq 0.6$) with back performance scale, a measure of mobility-related limitation. Similarly, the pain sensation factor had the strongest correlation ($r \simeq 0.6$) with eleven-point box scale, a measure of pain intensity. In contrast, the lowest correlations ($r \simeq 0.4$) with pain intensity and mobility-related limitation were with the mental functions/self-care factor and household tasks/avoidance behavior factor, respectively. All factors had at least a moderate correlation with pain intensity and mobility-related limitation and had high moderate correlations with each other.

Ceiling and floor effects

About 5.6% (14) and 0.8% (2) of participants scored 0 and 24, respectively, on the Igbo-RMDQ.

Discussion

Low literacy is a common exclusion criterion in clinical trials and epidemiological studies in both high income and low income countries due to the difficulty with completing self-report measures. This study enabled the cross-cultural adaptation of a self-report disability measure – the RMDQ into an interviewer-administered version for Igbo populations with low literacy rates.

The RMDQ was easy to translate, culturally adapt, comprehend, and was generally acceptable in this population, similar to other adaptations. Pain in the lower back was generally described with the Igbo word for "waist pain" in this population possibly due to limited Igbo adjectives, and the Igbo cultural connotation of the "waist" as a body part that does important human movements/activities, believed to be hampered by LBP [4]. LBP is commonly regarded as "waist pain" in other rural African contexts such as rural Botswana [29].

The internal consistency of the Igbo-RMDQ ($\alpha = 0.84$) corresponds with the 0.84–0.93 of the original English measure [13], similar to other adaptations. The Igbo-RMDQ is reliable, evidenced by high ICC (0.80); and Bland–Altman plots suggesting agreement which concurs with the original measure, and other adaptations.

The minimal detectable change (MDC: 7.00) and Bland–Altman limits of agreement (−8.58 to 9.54) are greater than 4–5 reported in Norwegian translation [30], five points minimal clinically important difference (MCID) [14,15], and the 30% reduction of baseline score MCID criteria [31] (Igbo-RMDQ mean score of 11.12 in this population). SEM and MDC of the original RMDQ have been reported as 1.79 and 5, respectively [32]. Inflated SEM and MDC of the Igbo-RMDQ observed in this study may be due to high sample variability (standard deviation), probably due to low literacy rates, interviewer-administration in place of self-administration, and data collection by several raters. Although stringent efforts via rigorous training and fidelity checks were made to avoid systematic differences in data collection, it is possible that different personalities of the community health workers may have influenced participants' responses in dissimilar ways. Future studies should compare interviewer-administration involving a single rater with administration by multiple raters to determine if there are differences in sample standard deviations. However, the SEM (2.53) of Igbo-RMDQ in this study is below the reported MCID of the RMDQ suggesting clinical utility.

MCID combines both anchor-based methods (patients' rating of improvement) and distribution-based method (dependent on

Table 5. Pearson's correlation between Igbo-RMDQ, performance-based disability and pain intensity.

	Back performance scale	Eleven-point box scale
Igbo-RMDQ	646**	0.608**

**$p < 0.01$.

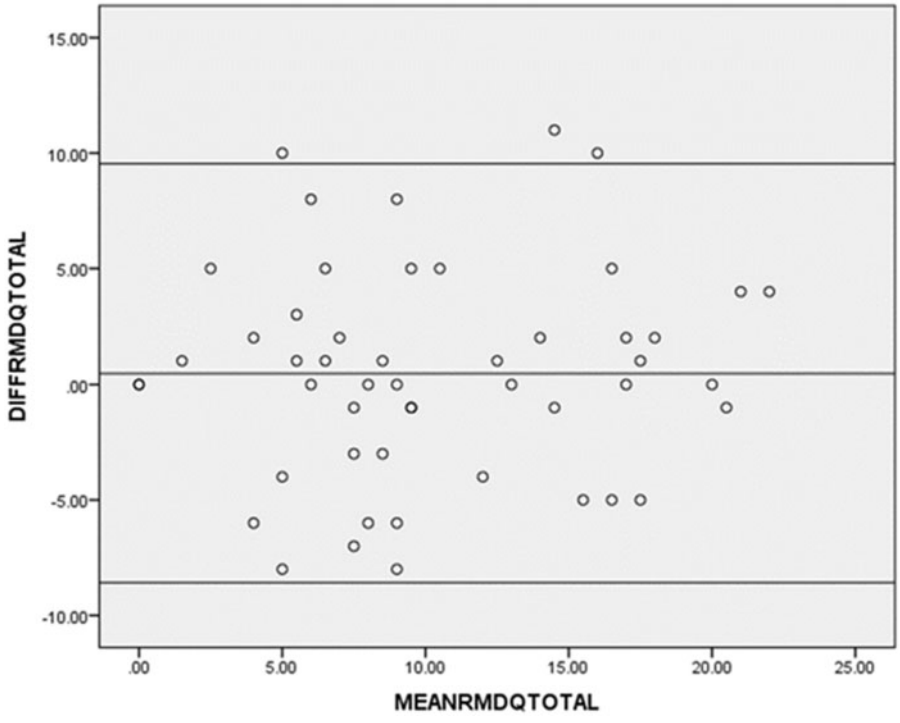

Figure 2. Bland–Altman plot for test-retest agreement of Igbo-RMDQ.

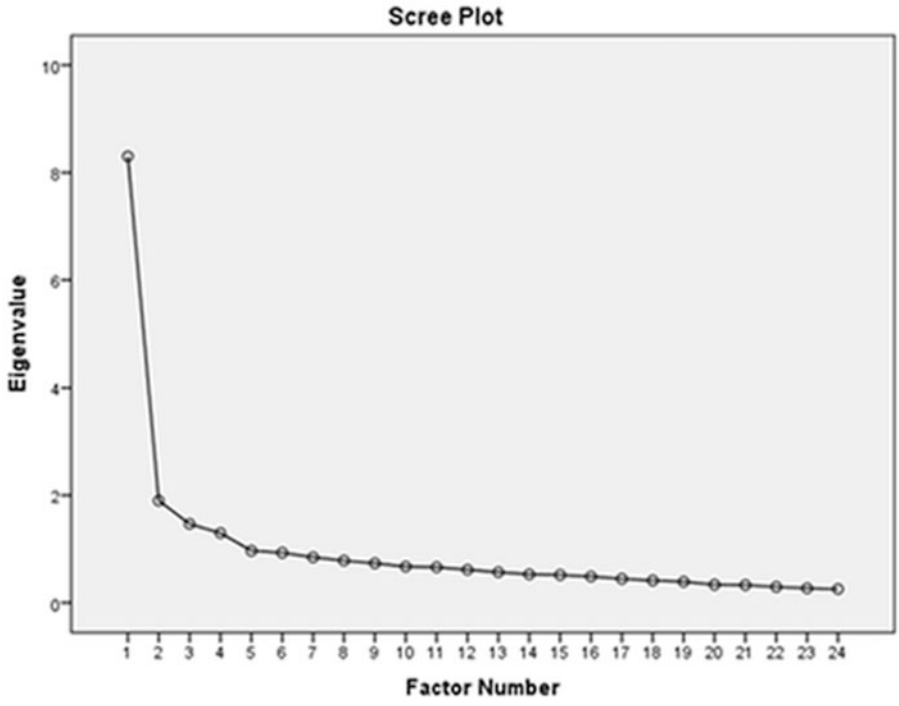

Figure 3. Scree plot of Igbo-RMDQ.

Table 6. Exploratory factor analysis of the Igbo-RMDQ.

	Factor			
	1	2	3	4
Igbo-RMDQ5	0.773			
Igbo-RMDQ23	0.644			
Igbo-RMDQ3	0.579			
Igbo-RMDQ16	0.515			
Igbo-RMDQ7	0.503			
Igbo-RMDQ12	0.450			
Igbo-RMDQ24		0.691		
Igbo-RMDQ20		0.613		
Igbo-RMDQ2		0.533		
Igbo-RMDQ6		0.519		
Igbo-RMDQ13		0.488		
Igbo-RMDQ15			0.567	
Igbo-RMDQ18			0.561	
Igbo-RMDQ8			0.469	
Igbo-RMDQ19			0.446	
Igbo-RMDQ9			0.437	
Igbo-RMDQ22			0.431	
Igbo-RMDQ1			0.396	
Igbo-RMDQ14			0.350	
Igbo-RMDQ10				0.634
Igbo-RMDQ21				0.615
Igbo-RMDQ17				0.551
Igbo-RMDQ11				0.504
Igbo-RMDQ4				0.405
KMO= 0.91 χ^2= 1913.583***				
Eigenvalue of each factor	8.301	1.901	1.467	1.296
% explained variance of factor	32.416	5.558	4.064	2.950

Only factor loadings above 0.3 are shown; KMO: Kaiser–Meyer–Olkin measure of sampling adequacy; χ^2= Bartlett's test of sphericity tested with Chi-square ***$p < 0.001$; extraction method: principal axis factoring; rotation method: varimax with Kaiser normalization; rotation converged in eight iterations.

the SEM), and has not been determined in this population. MDC should be sufficiently small to detect MCID [25]. However MDC solely determined using distribution-based methods may lead to patients with actual improvement being rated as not improved [31], as measurement error is not constant across scores and populations [32]. The Igbo-RMDQ has a SEM (2.53) that is smaller than its Bland and Altman agreement limits and MCID of the original RMDQ. Importantly, change within measurement error, believed to be real by patients, likely reflect true change [31].

The construct validity of the Igbo-RMDQ was confirmed as it had moderately high positive correlations with performance-based disability and pain intensity suggesting that it is a measure of pain-related disability. The moderate correlation of Igbo-RMDQ with performance-based disability suggests that self-reported and performance-based disability are related but distinct constructs. However, the lack of any Igbo quality of life measure with which to validate the Igbo-RMDQ is a limitation as individuals' perception of their functional ability may reflect how chronic back pain impacts on quality of daily life. Moreover, performance-based disability and pain intensity measures assessed mobility and pain-related functional capacity, whereas Igbo-RMDQ included life activities that may be more affected by negative emotions, more in line with the construct of quality of life. Therefore, future studies should cross-culturally adapt Igbo quality of life measures which can then be compared with the Igbo-RMDQ.

The original RMDQ was developed and has been routinely scored as a unidimensional disability measure which is supported by this study. The dimensionality of the RMDQ has been a topic of debate among researchers. Whereas some authors support a unidimensional structure of the RMDQ [33], others support a three-factor structure [34]. In this study, one dominant factor structure of the Igbo-RMDQ with a secondary four-factor structure was suggested because the amount of explained variance dropped sharply after the first factor which explained nearly three times the variance of the other three factors combined although all four factors had eigenvalues >1. This implies that the Igbo-RMDQ measured an overall disability construct with several related underlying constructs. The four underlying factors within the overall disability construct were problems with mobility (factor 1), sensory function of pain (factor 2), mental functions and self-care (factor 3), and household tasks and avoidance behavior (factor 4). Problems with mobility, self-care, and household tasks are

Table 7. Pearson's correlation analyses between the underlying factors of Igbo-RMDQ, and pain intensity, and performance-based disability.

	Back performance scale	Eleven-point box scale
Factor 1: mobility	0.585**	0.523**
Factor 2: Pain sensation	0.542**	0.553**
Factor 3: mental functions and self-care	0.539**	0.397**
Factor 4: household tasks and avoidance behavior	0.352**	0.458**

	Correlation matrix of factors		
	Factor 2	Factor 3	Factor 4
Factor 1	0.639**	0.633**	0.577**
Factor 2		0.607**	0.572**
Factor 3			0.490**

**$p < 0.01$.

at the level of activity limitation and participation restriction, whereas sensory function of pain and mental functions are at the level of body functions. In the study by Magnussen, et al. [34] mental functions were split into "symptoms" including poor appetite and "functional limitations" including relationships/conflict handling; whereas self-care tasks were classified under activity limitations and participation restrictions.

The high moderate correlations of the four secondary factors with each other and the cross loading of items again corroborate one dominant factor structure of the Igbo-RMDQ. Mobility factor was not completely distinct as one mobility item (item 14) "I find it difficult to turn around when I am lying down because of my waist(back)" also loaded on factor 3. Factor 3 also had mental functions related to appetite, sleep, emotions and relationships; and self-care related to dressing and getting people to help. The interpretation of this construct is not straightforward as mental functions, self-care and mobility were represented as one factor. It is possible that the difficulty people in this population encountered in "turning around in bed" impacted on the quality of the mental function of sleep. The fact that mental functions of appetite, sleep, emotions and relationships; and self-care loaded on the same factor; and, therefore, represented related constructs could be because reduced ability to perform self-care activities such as dressing, and involving other people in performing such intimate activities may have stimulated feelings of dependence, low self-esteem, and helplessness in this population. This supports the literature suggesting that some forms of social support can paradoxically reinforce a sense of dependence and undermine self-esteem, leading to feelings of helplessness [35].

The strongest correlation of the mobility factor and pain sensation factor with the measures of mobility-related limitation and pain intensity, respectively; and the comparative weaker correlations of mental functions/self-care factor and household tasks/avoidance behavior factor with pain intensity and mobility-related limitation suggest that secondary constructs of pain sensation, mobility, self-care, household tasks, and avoidance behavior contribute to the one dominant factor structure of the Igbo-RMDQ. To some extent, these findings support the ICF multidimensional concept of disability [36–39], however, no item in the RMDQ explicitly represented occupational or community aspects of participation, body structure, and environmental components of the ICF.

In agreement with other studies, there were no floor and ceiling effects observed with the Igbo-RMDQ. However, the literature shows that the RMDQ may not discriminate among patients with different levels of severe disability suggesting that a ceiling effect may exist for people with severe disability [13]. In this study, the mean RMDQ score was 11.12 (SD =6.5), suggesting low to moderate disability levels, and, therefore, a low risk for ceiling effect.

This study has some limitations including the inability to compare self-administration with interviewer-administration of the Igbo-RMDQ due to the few number of people that were literate in Igbo. This should be the focus of future research to clarify whether interviewer-administration increased measurement error. Studies could also compare self-administration of the original RMDQ with interviewer-administration of the Igbo-RMDQ in populations that are literate in Igbo and English to further validate the Igbo-RMDQ. Sensitivity-to-change clinical studies of the Igbo-RMDQ may be needed with single raters, and using more rigorous analysis such as receiver operating characteristic (ROC) curves, which includes patients' own global impression of change to determine the MCID of the Igbo-RMDQ. Future studies are required to confirm the factor structure of the Igbo-RMDQ utilizing Rasch and confirmatory factor analysis.

Conclusions

The Igbo-RMDQ (Supplemental material 1) is a valid and reliable measure of disability that will be useful for clinical and global health research purposes. This study found support for one dominant factor that legitimize the use of a single sum score as in the original measure.

Disclosure statement

The authors report no declarations of interest.

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