Cross-cultural adaptation and psychometric evaluation of the Yoruba version of Oswestry disability index

Short title: Cross-cultural adaptation of the Yoruba version of the Oswestry disability index

Chidozie Emmanuel Mbada [1,2], Oluwabunmi Esther Oguntoyinbo [1], Francis Oluwafunso Fasuyi [3], Opeyemi Ayodiipo Idowu [4 *], Adesola Christiana Odole [2], Olusola Ayanniyi [2], Olubusola Esther Johnson [1], Elkanah Ayodele Orimolade[5], Ajibola Babatunde Oladiran [6], Francis Fatoye[7]

[1]Department of Medical Rehabilitation, College of Health Sciences, Obafemi Awolowo University, Ile – Ife, Nigeria

[2]Department of Physiotherapy, Faculty of Clinical Sciences, College of Medicine, University of Ibadan, Ibadan, Nigeria

[3]Department of Physiotherapy, Faculty of Allied Health Sciences, University of Medical Sciences, Ondo, Nigeria

[4]Department of Physiotherapy, School of Basic Medical Sciences, College of Medical Sciences, University of Benin, Nigeria.

[5]Department of Orthopaedic Surgery and Traumatology, College of Health Sciences, Obafemi Awolowo University, Ile – Ife, Nigeria

[6]Department of Orthopaedic Surgery and Traumatology, College of Medicine, Ibadan, Nigeria

[7] Department of Health Professions, Faculty of Health, Psychology and Social Care, Manchester Metropolitan University, Manchester, UK

*Corresponding author
Email:opeyemi.idowu@uniben.edu (O.A.I)

Abstract

Introduction: Low Back Pain is a common public health problem worsened by maladaptive beliefs and incongruent back pain behaviour. It is imperative to develop outcome measures to assess these beliefs among patients with chronic LBP. This study aimed to cross-culturally adapt and determine the psychometric properties of the Yoruba version of the ODI (ODI-Y).

Methods: The ODI-Y was cross-culturally adapted following the process involving forward translation, synthesis, backward translation, expert review, and pilot testing. One hundred and thirty-six patients with chronic LBP took part in the validation of the ODI-Y; 86 of these individuals took part in the test-retest reliability (within 1-week interval) of the translated instrument. Internal consistency and test-retest reliability of the ODI-Y were determined using the Cronbach's alpha and intra-class correlation. Other psychometric properties explored included the factor structure and fit, convergent validity, standard error of measurement and the minimal detectable change.

Results: The mean age of the respondents was 50.5±10.6years. The ODI-Y showed a high internal consistency, with a Cronbach's alpha (α) of 0.81. Test-retest of the Yoruba version of the ODI within 1-week interval yielded an Intra-Class Correlation coefficient of 0.89. The ODI-Y yielded a two-factor structure which accounted for 51.7% of the variance but showed poor fit. Convergent of ODI-Y with the visual analogue scale was moderate (r=0.30; p=0.00). The standard error of measurement and minimal detectable change of the ODI-Y were 2.0 and 5.5.

Conclusions: The ODI was adapted into the Yoruba language and proved to have a good factor structure and psychometric properties that replicated the results of other obtainable versions. We recommend it for use among Yoruba speaking patients with low-back pain.

61

62 **Keywords**: Low back pain, psychometrics, humans, translations, outcome assessment

63

Introduction

Low-Back Pain (LBP) is a major public health challenge with a high disability burden [1]. According to the 2010 Global Burden of Disease Study, LBP is among the top 10 diseases and injuries that account for the highest number of disability-adjusted life-years worldwide [2]. As a result of this, outcome tools that assess the disability resulting from LBP have become more abundant. Among the outcome tools, Roland-Morris Disability Questionnaire and Oswestry Disability Index (ODI) [3-5] are mostly recommended [6] owing to abundant reports literature on their clinimetric and psychometric properties [3,5,7,8].

Researchers and clinicians often use the Oswestry Disability Index (ODI) as a disease-specific questionnaire to assess pain and disability resulting from LBP [3,5,7]. Fairbank et al. developed the ODI as a self-administered 10-item questionnaire [8] [8]. The ODI assesses the consequences of pain on typical daily activities, including personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and travelling [8]. The anchors of the tool vary from no disability (0) to maximum disability (100) [8]. Based on psychometric properties and clinical usability, various languages translations including the Greek [9], Norwegian [10], Japanese [11], Turkish [12], Korean [13], Arabic [14], German [15], Danish [16], Iranian [17], Brazilian-Portuguese [18], Italian [19] and Tamil [20] exist. Most of these translations report excellent psychometric properties. The ODI has a Cronbach α ranging from 0.71 to 0.87, an intra-class correlation coefficient from 0.84 to 0.94 and a test-retest reliability value between 0.83 and 0.99 [7].

As cultural groups vary in disease perception and expressions and their use of various health care systems, local languages enhance the comprehensibility of outcome tools. [21]. Thus, increasing the comprehensibility and usability of outcome tools,

especially among non-English speakers necessitated the translation of outcome tools or questionnaires into local languages. Further, patients find outcomes translated into their local languages as easily accessible, user-friendly, and comprehensible [22]. Till date, only one translation (Hausa version) of the ODI with requisite data on validity and reliability exist [23], thus the need for translations of the ODI in other Nigeria languages [23], thus the need for translations of the ODI in other Nigeria languages.

Although English is the official language in Nigeria, a sizeable number of Nigerian patients are not literate in English [22]. Nigeria, as the most populous black African nation, is a multi-ethnic and multi-lingual country but with three major ethnic groups (Hausa, Igbo, and Yoruba) and with different languages. The Yoruba tribe makes up close to 40 million people [24], this should be among the largest ethnic groups of sub-Saharan Africa. Besides, other countries including the Benin Republic, Togo and Brazil speak the Yoruba language. [25,26]. Therefore, the availability of ODI in the Yoruba language will improve the uptake of the tool among Yoruba speaking patients with LBP. This study aimed to cross-culturally adapt, test the convergent validity, small detectable change, factor structure, ceiling and floor effects and test-retest reliability of the ODI among patients with LBP.

Materials and methods

Ethical approval and informed consent

The Health Research and Ethics Committee of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Nigeria gave ethical approval for this study. The respondents also gave their informed consents prior to participation in the study. Further, the respective heads of departments of the selected hospitals gave

113 administrative permission to conduct the study.

114 Study design

115 Cultural adaptation, test-retest and cross-sectional psychometric analyses.

116 Instruments

117 **The Oswestry disability questionnaire:** The ODI questionnaire is a ten 6-point
118 questionnaire. The first segment of the tool assesses the intensity of pain, while the
119 remaining sections assess the disabling effect of pain on typical daily activities such as
120 personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and
121 traveling. Each item has scores ranging from 0 to 5, with the sum of scores of the 10
122 items expressed as a percentage of the maximum scores, varying from 0 (no disability)
123 to 100 (maximum disability). Typically, it takes about five minutes to complete the
124 questionnaire and less than one minute to compute scores [3].

125 **The Yoruba version of the Visual Analogue Scale (VAS):** The VAS represents the
126 intensity dimension of pain by a 10cm line with two anchors of “no pain” and “worst
127 pain I ever felt” [27]. The VAS assesses pain intensity, has excellent psychometric
128 properties, and has wide applicability in clinical and research settings [27-30].
129 Odole and Akinpelu [29] reported a moderate correlation between the English version
130 and the translated Yoruba version of the VAS.

131 Cultural adaptation of the ODI to the Yoruba Language

132 Using a five-step guideline proposed by Guillemin, Bombardier, and Beaton [21],
133 we translated the English version of the ODI questionnaire into the Yoruba
134 language. The translation process in sequential order comprises:

135 i. Forward translation of the items and response choices of the English version of
136 the ODI to the Yoruba language by two professionally qualified translators who

are both native speakers of Yoruba language and bilingual in Yoruba and English languages. One translator had information about the concepts being examined in the questionnaire. This stage involved two forward translations referred to as T1 and T2.

ii. Synthesis: Synthesis: The two translators and the researcher (CEM) produced a synthesized version (T3) following a reconciliation meeting.

iii. Back translation: Back translation: Two independent qualified English translators translated the synthesized version (T3) back into the English language (BT1 and BT2). They individually identified inconsistencies in the words and concepts of the synthesized version.

iv. Expert committee review: An expert committee comprising three of the researchers (CEM, OEO, and, OEJ, physiotherapists by profession) and all four translators met to discuss issues of cultural adaptations and linguistic equivalence with the original English version of ODI. The meeting produced the final version of the YORUBA ODI (T4). The expert committee made some adaptations to the ODI while translating it from the original English version. Some adaptations were made to the ODI-Y while translating it from the original English version. Specifically, in section one (items 2 and 3), the Yoruba word *àfaradà* was used instead '*dédé*' (which means moderate) which should have been the most suitable transliteration equivalent. However, using '*dédé*' in the context will not make a meaningful sentence. In section three (Abala kéta), the word '*Gbígbé* had to be qualified in the ODI-Y, with '*Nnkan*' to become '*Nnkan gbígbé*' which means lifting. Also, item 5 in section three, was translated in the passive form, as a direct translation in the active cast may convey a different meaning, apart from that intended in the original translation. In section five

(Abala Karùn-ún), item 1, the term 'favourite chair' was changed to 'comfortable chair' because the term favourite chair is not commonly used in this study context. In section seven (Abala Kéje), items 2, 3 and 4, the element of time translated as àsìkò was included to trade the sense of sleep duration missing in the literal equivalent of the translation in the Yoruba language.

v. Pilot testing: Fifteen Yoruba speaking patients with LBP filled the pre-final version of the ODI (T4). The patients also undertook individualized cognitive debriefing. The cognitive debriefing was to explore the respondents' perception, understanding, interpretation of various terminologies used, and the formatting of the translated items of the T4. Analysis of the participants' interpretation of items evaluated whether or not the adapted version retained equivalence of the items in the English version. Reports were prepared at each stage to cover issues that were faced and how they were resolved.

Psychometric Testing

There is no internationally accepted consensus about the minimum required sample size for validation studies. However, no less 50 participants be considered adequate for construct validity, reliability, and ceiling/floor effects analyses [31]. Based on sample size ranges in previous studies on translation of the ODI, a sample range of between 30 and 126 [19, 20] was observed. Thus, a sample size estimate of 150 participants was considered adequate in this study. All the respondents in this study were recruited from three hospitals in the South-west zone of Nigeria namely: Obafemi Awolowo University Teaching Hospital complex Ile-Ife (OAUTHC), Wesley Guild Hospital, Ilesha, and University College Hospital, Ibadan. Eligibility for inclusion in the study was having a history of non-specific LBP of three months and longer, being literate in Yoruba

187 languages, and having no cognitive impairment. The diagnostic criteria for non-specific
188 LBP included the absence of serious pathology (red flags conditions such as fracture,
189 malignancies or infection) and radicular syndrome. Volunteers with non-specific
190 chronic LBP but with a systemic illness, rheumatologic diseases or other co-morbidity
191 were excluded from the study. The ODI-Y and the VAS were administered on the
192 participants on the same day. In addition to this, socio-demographic information and
193 anthropometric measurements were also taken. Out of the 150 consenting patients with
194 chronic LBP consulted for the cross-sectional study, only 136 (70 males and 66
195 females) returned their ODI-Y questionnaires validly completed. Eighty-six of the
196 respondents completed the ODI-Y again after seven days of the first administration.
197

198 ## Data Analysis

199 Data were assessed for normality using visual (normal distribution curve and Q-Q plot)
200 and statistical methods (Shapiro-Wilk's test and Skeweness/Kurtosis scores). Data were
201 summarized using descriptive statistics of mean, standard deviation, percentages and
202 median.

203 The reliability of the ODI-Y (an indication of how the instrument measures
204 consistently over time) was determined using the Intra-Class Correlation (ICC). The
205 absolute agreement, 2-way random-effects approach which assumes that errors in
206 measurement could arise from either raters or participants) was used for the test-retest
207 reliability of the ODI-Y. An ICC in the range of 0.4 - 0.75 was regarded as moderate,
208 while values below and above this range were considered low and high respectively
209 [32]. Reliability was also evaluated using the standard error of measurement (SEM) and
210 minimal detectable change (MDC). Minimal detectable change is defined as the amount
211 of change in a score that is required to distinguish a true performance change from a

212 change due to chance [33]. The MDC was calculated using the standard error of
213 measurement (which is based on the standard deviation of observed test scores for a
214 given true test score). The standard error of measurement of the ODI-Y was calculated
215 using the formula: $SEM = SD\sqrt{1-R}$ [33]. Further, the MDC of the ODI-Y was
216 calculated with the formula: $MDC = 1.96 \times \sqrt{2} \times SEM$ [33]. Bland-Altman analysis
217 [34] was also used to visually assess heterodascity between test-retest measurements by
218 plotting mean scores against difference in total scores. Cronbach alpha was used to test
219 for the internal consistency of the ODI-Y respectively. A Cronbach's alpha not less 0.7
220 is recommended for outcome measures [35]. The validity of the ODI-Y was determined
221 by correlating the ODI-Y scores with each of the VAS (convergent validity) and age of
222 respondents (divergent validity) respectively. Spearman ranks correlation was used to
223 assess the validity of the instrument.

224 Principal Factor analysis was used to determine the factor structure of the ODI-
225 Y. Kaiser-Meyer- Olkin value, Bartlett's test of sphericity and correlation matrix table
226 was used to check the suitability of the ODI-Y data prior to the conduction of principal
227 component analysis (PCA). Confirmatory factor analysis (CFA) was performed using
228 the one factor, two-factor theory-driven model (static activities: pain, sleep, standing,
229 driving and sleeping; dynamic activities: personal care, lifting, walking, sex and social
230 life) as suggested in the literature as well as the model obtained from the PCA. The
231 CFA was performed using maximum likelihood estimates. To evaluate the goodness of
232 fit of each the three models, the following indicators were used: the goodness-of-fit-
233 index (GFI) $\geq$ 0.95, the root mean square error of approximation (RMSEA) $<$ 0.08;
234 adjustment of goodness of fit index (AGFI) $\geq$ 0.90 and the comparative fit index (CFI)
235 $\geq$ 0.95 [36]. AMOS software, version 22.0 (SPSS Inc.) was used for the SEM. Potential
236 ceiling and floor effects were considered present if >15% of respondents achieved the

lowest (10%) or highest possible total scores (100%) [31]. Data were analysed using SPSS (Statistical Package for Social Sciences) for Windows (Version 16.0. Chicago, SPSS Inc.) Alpha level was set as 0.05.

Results

Shapiro-Wilk's normality test ($P < 0.05$), as well as the Q-Q plots observation, showed that the ODI-Y was not normally distributed. The mean age, weight, height and BMI of the respondents (51.5% females) was 50.7±10.6years, 75.0±11.2Kg, 1.67±0.04m, and 26.71±4.23Kg/m^2 respectively. The general characteristics of the respondents by gender are presented in Table 1.

Table 1: General characteristics of the participants by gender (N=136)

Variables	Male Mean ± SD	Female Mean ± SD	t-cal	p-value
Age (years)	48.5 ± 10.7	52.7 ± 10.2	-2.328	0.021
Weight (kg)	74.9 ± 10.9	75.1 ± 11.5	-0.083	0.834
Height (m)	1.68 ± 0.04	1.68 ± 0.04	0.706	0.482
BMI (Kg/m^2)	26.6 ± 4.21	26.8 ± 4.28	-0.255	0.799

SD: Standard deviation; BMI: body mass index

The 1-week test-retest reliability of the ODI-Y using ICC was 0.80 (95% CI 0.74-0.84). Further, the internal consistency of the ODI-Y was 0.81. The Item by Item Correlation between the Test-Retest of the ODI-Y and the Cronbach's Alpha if an item of the ODI-Y is deleted are presented in Tables 2 and 3 respectively. The SEM and MDC of the ODI-Y were 2.0 and 5.5. The mean difference between the test and retest scores as shown by Bland-Altman analysis was -0.26. Further, only 2 outliers affected the 95% limits of agreements. The Spearman's rank correlation coefficient for the convergent validity of the ODI-Y with the VAS was r=0.30; p=0.00.

Table 2: Reliability of the Yoruba version of the ODI

Global score of the ODI (α) 0.81

Item	Cronbach's alpha if Item Deleted
1	0.814
2	0.783
3	0.806
4	0.781
5	0.798
6	0.775
7	0.80
8	0.775
9	0.775
10	0.784

ODI: Oswestry disability index; α; Cronbach's alpha.

Table 3: Test-retest of the Yoruba version of the ODI

	ICC	95% CI
Global score	0.80	0.74 – 0.84
Item by item		
1	0.876	0.80-0.92
2	0.917	0.872 – 0.946
3	0.971	0.955 – 0.981
4	0.939	0.906 – 0.96
5	0.969	0.952 – 0.98
6	0.94	0.911 – 0.962
7	0.893	0.833 – 0.931
8	0.929	0.891 – 0.954
9	0.900	0.846 – 0.935
10	0.945	0.915 – 0.964

ODI: Oswestry disability index; ICC: intra-class correlation; CI: confidence interval

Principal component analysis (PCA) with Oblimin rotation was used to evaluate the factor structure of the ODI-Y. To determine that the data was suitable for factor analysis, indicators including the correlation matrix table (presence of many coefficients > 0.3), Kaiser-Meyer- Olkin measure of sampling adequacy (0.74) and Bartlett's test of sphericity (X^2=432.34, P<0.001) were considered; all of them indicated that PCA could proceed. Only factors with eigen value >1 were considered to contribute significantly to explaining variance. Factors loading >0.3 were included in the model. Initial principal components extraction yielded a total of three factors which accounted for 61.56% of the total variance of the 10 factors. The first factor, with an eigenvalue of 3.9, consisted

of items 2, 4, 6, 8, 9 and 10 accounting for 39.5% of the variance. The second factor, with an eigenvalue of 1.2, consisted of items 1 and 3 accounting for 12% of the variance. The third factor with an eigenvalue of 1.0 consisted of items 5 and 7 accounting for 10.1% of the variance. However, scree plot analysis as well as results from a parallel analysis suggested retaining the two-factor solution. A second principal components analysis with forced two factors extraction using the same rotation method yielded two factors (Factor 1: items 2, 4-10; Factor 2: items 1, 3). The total variance explained by the two factors was 51.47%. This is presented in Table 4.

Table 4: Principal component analysis of the Yoruba version of the ODI

Item	Principal component coefficient ≥ 0.4		
	Factor 1	Factor 2	Communality
1. Pain		0.835	0.699
2. Personal care	0.662		0.463
3. Lifting		0.686	0.512
4. Walking	0.714		0.512
5. Sitting	0.527		0.277
6. Standing	0.756		0.585
7. Sleeping	0.557		0.386
8. Sex	0.687		0.551
9. Social life	0.714		0.543
10. Travelling	0.763		0.618
Eigenvalue	3.95	1.20	
% of the variance explained	39.47	12.0	

ODI: Oswestry disability index

The results of the goodness of fit derived from the confirmatory factor analysis of the ODI-Y showed that none of the indicators in the three models were within ranges of acceptable fit (Table 5). Further, the factor loadings of the model derived from the PCA (Fig 1) ranged from 0.4-0.74. The ODI-Y had no ceiling or floor effect as no respondent had the maximum possible score and only 2.2% of respondents had the minimum possible score.

Table 5: Confirmatory factor analysis of the Yoruba version of the ODI

Model	$\chi 2$	d.f.	*P*	GFI	RMSEA	AGFI	CFI
One factor	116.7	35	0.000	0.879	0.131	0.810	0.796
Theory driven Two-factor	114.6	34	0.000	0.881	0.132	0.808	0.799
Two-factor derived from PCA	109.12	34	0.000	0.885	0.128	0.814	0.813

PCA: Principal component analysis; GFI: goodness-of-fit-index; RMSEA: root mean square error of approximation; AGFI: adjustment of goodness of fit index; CFI: comparative fit index.

Discussion

The test-retest of the ODI-Y within 1-week interval showed a high correlation based on ICC. The high ICC coefficient got for the ODI-Y conforms to the recommendation of an ICC of 0.75 or more, considered in many studies as reliable [8]. The narrow 95% CI obtained for the ICCs in this study shows that the ODI-Y can yield reliable results when administered on multiple occasions. The test-retest reliability

306 results obtained in this study was like that reported in the Norwegian [10], Korean [13],
307 and Brazilian-Portuguese [18] versions. From previous studies, the ICC of the
308 ODI ranged between 0.7 and 0.99 with test-retest interval ranging from 2 days to 4
309 weeks [37]. That only 2 outliers affected the 95% limits of agreements during the
310 Bland-Altman analysis indicates a very strong agreement between the test and retest
311 scores and minimal within-subject variations. The Bland-Altman analysis accounts for
312 the shortcoming of the ICC which might indicate strong correlations between two
313 measurements with minimal agreement [38]. The findings of this study show that the
314 ODI-Y had a high internal consistency. A higher internal consistency > 0.95 would
315 have indicated a redundancy in the questionnaire items. The internal consistencies of
316 most of the ODI translations [37, 39, 40] fall within this band.

317 The estimated SEM (2.0) of the ODI-Y resulted in a $MCD_{95\%}$ of 5.5. The
318 $MDC_{95\%}$ found in our study was like that reported in the Croatian version of the ODI
319 (6.0) [37]. The MDC of the ODI-Y was lower than that of the Polish (MDC=10) [41];
320 German (9.0) [15]; Hungarian (MDC=11) [42] and Chinese (12.8) [43] translations of
321 the ODI. An MDC of 5.5 found in our study implies that below 5.5, the measurement
322 error of the ODI-Y is indistinguishable.

323 The ODI-Y correlated with pain intensity. This finding on the convergent
324 validity of the ODI-Y is like previous ODI translations, where the instrument often
325 correlated with pain. For example, Norwegian (0.52) [10], Korean (0.42) [13], Swiss-
326 German (0.78) [15], Iranian (0.54) [17] and Brazilian-Portuguese (0.66) [18] versions of
327 the ODI, all correlated moderately with pain intensity. The positive correlation between
328 ODI-Y and pain intensity supports the concept of the former as a measure of physical
329 disability.

Principal component analysis of the ODI-Y revealed a two-factor structure accounting for 51.47% of the variance. The first factor (everyday activities) includes personal care, walking, sitting, standing, sleeping, sex life, social life, and travelling while the second factor (pain/lifting) includes pain and lifting. Most factor analyses of the language translations of the ODI yielded one factor [5, 15, 40, 44, 45] or two-factor structures [40, 37, 46, 47, 48]. The two-factor model in this study differs from the two-factor models reported by previous studies on the ODI. Such factors reported include social/ recreational activities and non-recreational activities [37], dynamic and static activities [46, 49], pain-related activity, and pain intensity and pain-related participation [39]. Further, the item loadings of the various two-factor models are dissimilar. While the theory-driven two-factor model had a better fit than each of the PCA-derived and one-factor models in this study, none had acceptable fit following CFA.

Gabel and colleagues [49] conducted a PCA of the ODI in a large sample of 32,263 patients with LBP derived from the international Spine Tango registry of EUROSPINE. Their analysis yielded a single-factor model which was confirmed by the CFA. They further conducted a CFA on the literature-recommended two-factor model of the ODI; this yielded indicators which were not within the ranges of acceptable fit. Based on the evidence from the study by Gabel et al [49], that none of the previous two-factor models have similar factor loading, and the results from our study, it is recommended that a global score of the ODI be used in research and the clinical settings. The unidimensionality of the ODI, however, remains debatable. Larger sample size studies are thus needed to provide answers to the dimensionality of the ODI. The ODI-Y had no floor or ceiling effects. Floor and ceiling effect refers to the percentage of patients scoring maximal or minimal scores. It is recommended that questionnaires with more than 15% of the respondents scoring either the maximal or minimal scores

should not be used. Our study is without limitations. This study focussed only on individuals with chronic low back pain; generalizability of results may be difficult. Secondly, a Rasch analysis of the ODI-Y was not conducted. In sum, the ODI-Y showed acceptable internal consistency, test-retest reliability, convergent validity, a two-factor structure with a poor fit, and no floor or ceiling effects. The ODI-Y is recommended for assessing patients with LBP among the Yoruba population.

Conclusion

The Yoruba version of the ODI questionnaire is valid and reliable, with adequate psychometric properties, and it can be used in Yoruba speaking patients with low-back pain. The psychometric properties of the ODI-Y are comparable with the original English and other translations of the ODI.

Acknowledgement

The authors thank all the people who volunteered to participate in the study.

References

1. Koes BW, van Tulder MW, Thomas S. Diagnosis and treatment of low back pain. BMJ [Internet]. 2006 Jun 17 [cited 2018 Jul 2]; 332(7555):1430–4. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16777886

2. Murray CJL, Lopez AD. Measuring the Global Burden of Disease. N Engl J Med [Internet]. 2013 [cited 2018 Jun 29]; 369(5):448–57. Available from: http://www.ph.ucla.edu/epi/faculty/detels/PH150/GlobBurdDis_NEJM_2013.pdf

3. Fairbank J, Couper J, Davies J, O' Brien JP. The Oswestry low back pain disability questionnaire. Physiotherapy. 1980;66(8):271-273.

4. Davies CC, Nitz AJ. Psychometric properties of the Roland-Morris Disability Questionnaire compared to the Oswestry Disability Index: a systematic review. Phys Ther Rev. 2009;14(6):399-408.

5. Stevens ML, Lin CCW, Maher CG. The Roland Morris Disability Questionnaire [Internet]. Vol. 62, J Physiother. 2016 [cited 2018 Jun 29]. p. 116. Available from: https://www.journalofphysiotherapy.com/article/S1836-9553(15)00123-X/pdf

6. Roland M, Fairbank J. Roland-Morris Disability Questionnaire & Oswestry Disability Index Questionnaire. Spine, 2000;25:3115-3125.

7. Vianin M. Psychometric properties and clinical usefulness of the Oswestry Disability Index. J Chiropr Med [Internet]. 2008 Dec [cited 2018 Jun 29];7(4):161–3. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19646379

8. Fairbank J, Pynsent P. The Oswestry Disability Index. Spine, 2000;25(22):2940-2952.

9. Boscainos P, Sapkas G, Stillanessi E. Greek versions of the Oswestry Disability Index and Roland Morris Disability questionnaire. Clin Orthop, 2003;41:40-53.

10. Grotle M, Brox J, Volleatad N. Cross-culutural adaptation of the Norwegian version of Roland Morris Disability questionnaire and Oswestry Disability Index. J Rehabil Med. 2003;35:241-245.

11. Fujiwara A, Kobayashi N, Saiki K. Association of Japanese Orthopaedic Association score with the Oswestry Disability index, Roland Morris Disabilty questionnaire and short-form 36. Spine, 2003;28:1601-1607.

12. Yakut E, Duger T, Oksuz C. Validation of the turkish version of the Oswestry Disability Index for patients with LBP. Spine, 2004;29: 581-585.

13. Kim D, Lee S, Lee H. Validtion of the korean version of the Oswestry Disability Index. Spine, 2005;30:123-127.

14. Guermazi M, Mezghani M, Ghroubis. The Oswestry Disability Index for low back pain translated into arabic and validated in arab population. Ann Re-adapt Med Phys. 2005;2005:1-10.

15. Mannion A, Junge A Fairbank J. Development of German version of oswestry disability index part 1; cross cultual adaptation, reliability and validity. Eur Spine J. 2005;15:55-65.

16. Lauridsen H, Hartrigsen J, Manniche C. Danish version of Oswestry Disability Index for patients with LBP part 1; cross-cultural adaptation, reliability and validity in two different populations. Eur Spine J. 2006;15:1705-1716.

17. Mousavi SJ, Parnianpour M, Mehdian H, Montazeri A, Mobini B. The Oswestry Disability Index, the Roland-Morris Disability Questionnaire, and the Quebec Back Pain Disability Scale: translation and validation studies of the Iranian versions. Spine 2006;31(14): E454-9.

18. Viggatto R, Alexandre N, Correafilho H. Development of the Brazillian-Portuguese version of the Oswestry Disabiity Index. Spine, 2007;32:481-486.

19. Marco M, Paola B, Silvano F. Development of the Italian version of oswestry disability index (ODI-1). A cross-cultural adaptation, reliability and validated study. Spine, 2009;34(19):2090-2095.

20. Vincent JI, MacDermid JC, Grewal R, Sekar VP, Balachadran D. Translation of Oswestry Disability Index into Tamil with Cross Cultural Adaptation and Evaluation of Reliability and Validity (§). Open Orthop J [Internet]. 2014;8(1):11–9.

21. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol 1993; 46(12): 1417-32.

22. Akinpelu AO, Maruf F, Adegoke B. Validation of a yoruba translation of the World Health Organisation's quality of life scale short form among stroke survivors in south western Nigeria. Afr J Med Medi Sci, 2006;35:417-424.

23. Ayanniyi O, Ajayi A, Mbada CE, Auwa MA. Validity and reliability of hausa version of the oswestry disability index. Arch Physiother Glob Res [Internet]. 2016;20(3):7–11.

24. Wikipedia Yoruba People [Internet] USA: Wikipedia; 2018 [Updated 2018 Jun 25; cited 2018 Jun 29]. Available from: https://en.wikipedia.org/wiki/Yoruba_people

25. Adeuyan JO. Contributions Of Yoruba People In The Economic & Political Developments Of Nigeria [Internet]. 1st ed. Bloomington: AuthorHouse; 2011 [cited 2018 Jun 29]. 300 p. Available from: https://read.barnesandnoble.com/book/contributions-of-yoruba-people-in-the-

447 economic-political-developments-of-nigeria/who-are-the-yoruba-people

448 26. Mbada CE, Idowu OA, Ogunjimi OR, Ayanniyi O, Orimolade EA, Oladiran
449 AB, et al. Cross-cultural Adaptation, Reliability, and Validity of the Yoruba
450 Version of the Roland-Morris Disability Questionnaire. Spine (Phila Pa 1976).
451 2017;42(7):497–503.

452 27. Gould D. Visual analog scale. J Clin Nurs. 2001;10:697-706.

453 28. Conn, D.A. 2005. Assessment of acute and chronic pain. Anaesth Intensive Care
454 Med 6:14-15.

455 29. Odole AC, Akinpelu AO. Translation and alternate forms reliability of the visual
456 analogue scale in the three major Nigerian languages. Int J Allied Health Sci
457 Pract 2009; 7:3

458 30. Le May S, Ballard A, Khadra C, Gouin S, Plint AC, Villeneuve E, et al. A
459 comparison of the psychometric properties of three pain scales used in the
460 pediatric emergency department. Pain [Internet]. 2018 Mar [cited 2018 Jun
461 29];1. Available from: http://insights.ovid.com/crossref?an=00006396-
462 900000000-98994.

463 31. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al.
464 Quality criteria were proposed for measurement properties of health status
465 questionnaires. J Clin Epidemiol, 2007; 60: 34–42.

466 32. Harley SM, Fragala-Pinkham MA. Interpreting change scores of tests and
467 measures used in physical therapy. Phys Ther 2006:86:735-743.

468 33. de Vet HC, Terwee CB, Ostelo RW, Beckerman H, Knol DL, Bouter LM.
469 Minimal changes in health status questionnaires: distinction between minimally
470 detectable change and minimally important change. Health Qual Life Out. 2006;
471 4(1):1.

34. Bland JM, Altman D. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet, 1986; 327:307–310.

35. Andresen EM. Criteria for assessing the tools of disability outcomes research. Arch Phys Med Rehabil 2000;81:s15-s20.

36. Hooper D, Coughlan J, Mullen M. Structural equation modelling: guidelines for determining model fit. Electron J Bus Res Methods 2008;6(1):53–60.

37. Domazet I, Nemir J, Barl P, Saša Đurić K, Pašalić I, Barić H, Stančić M. 2018. Validation of the Croatian version of the Oswestry Disability Index. Eur Spine J 27:2814–2822. https://doi.org/10.1007/s00586-018-5757-z

38. Igwesi-Chidobe CN, Amarachukwu C, Sorinola IO, Godfrey EL. Translation, cultural adaptation and psychometric testing of Igbo fear avoidance beliefs questionnaire in mixed rural and urban Nigerian populations with chronic low back pain. PLoS ONE 2019;14(5): e0216482. https://doi.org/10.1371/journal.pone.0216482

39. Adamu AS, Ibrahim AA, Ahmad, YA, Akindele MA, Kaka B, Mukhtar NB. Cross-Cultural Adaptation and Validation of the Hausa Version of the Oswestry Disability Index 2.1a for Patients with Low Back Pain. Spine 2019; doi: 10.1097/brs.0000000000003068

40. Yao M, Wang Li, Yang L, Huang P, Sun Y, Wang Y et al. A Systematic Review of Cross-cultural Adaptation of the Oswestry Disability Index. Spine 2016; 41: E1470–E1478.

41. Miekisiak M, Kollataj M, Dobrogowski J, Kloc W, Libionka W, Banach M, et al. Validation and cross-cultural adaptation of the Polish version of the Oswestry Disability Index. Spine 2013;38(4):E237–43.

42. Valasek T, Varga PP, Szövérfi Z, Kumin M, Fairbank J, Lazary A, et al.

Reliability and validity study on the Hungarian versions of the Oswestry Disability Index and the Quebec Back Pain Disability Scale. Eur Spine J 2013;22(5):1010–18.

43. Lue YJ, Hsieh CL, Huang MH, Lin GT, Lu YM. Development of a Chinese version of the Oswestry Disability Index version 2.1. Spine 2008;33(21):2354–60.

44. Shah S, Balaganapathy M. Reliability and validity study of the Gujarati version of the Oswestry Disability Index 2.1a. J Back Musculoskelet Rehabil2017;22;30(5):1103–1109.

45. Gamus D, Glasser S, Langner E, Beth-Hakimian A, Caspi I, Carmel N, et al. Psychometric properties of the Hebrew version of the Oswestry Disability Index. J Back Musculoskelet Rehabil 2016;1–9.

46. Algarni AS, Ghorbel S, Jones JG, Guerzmazi M. Validation of an Arabic version of the Oswestry index in Saudi Arabia. Ann Phys Rehabil Med 2014;57(9-10):653–63.

47. Payares K, Lugo LH, Morales V, Londono A. Validation in Colombia of the Oswestry disability questionnaire in patients with low back pain. Spine 2011;36(26):E1730–5.

48. Pekkanen L, Kautiainen H, Ylinen J, Petri S, Häkkinen A. Reliability and Validity Study of the Finnish Version 2.0 of the Oswestry Disability Index . Spine 2011; 36:332–338.

49. Gabel CP, Cuesta-Vargas A, Qian M, Vengust R, Berlemann U, Aghayev E, et al. The Oswestry Disability Index, confirmatory factor analysis in a sample of 35,263 verifies a one-factor structure but practicality issues remain. Eur Spine J 2017;26(8):2007–2013.

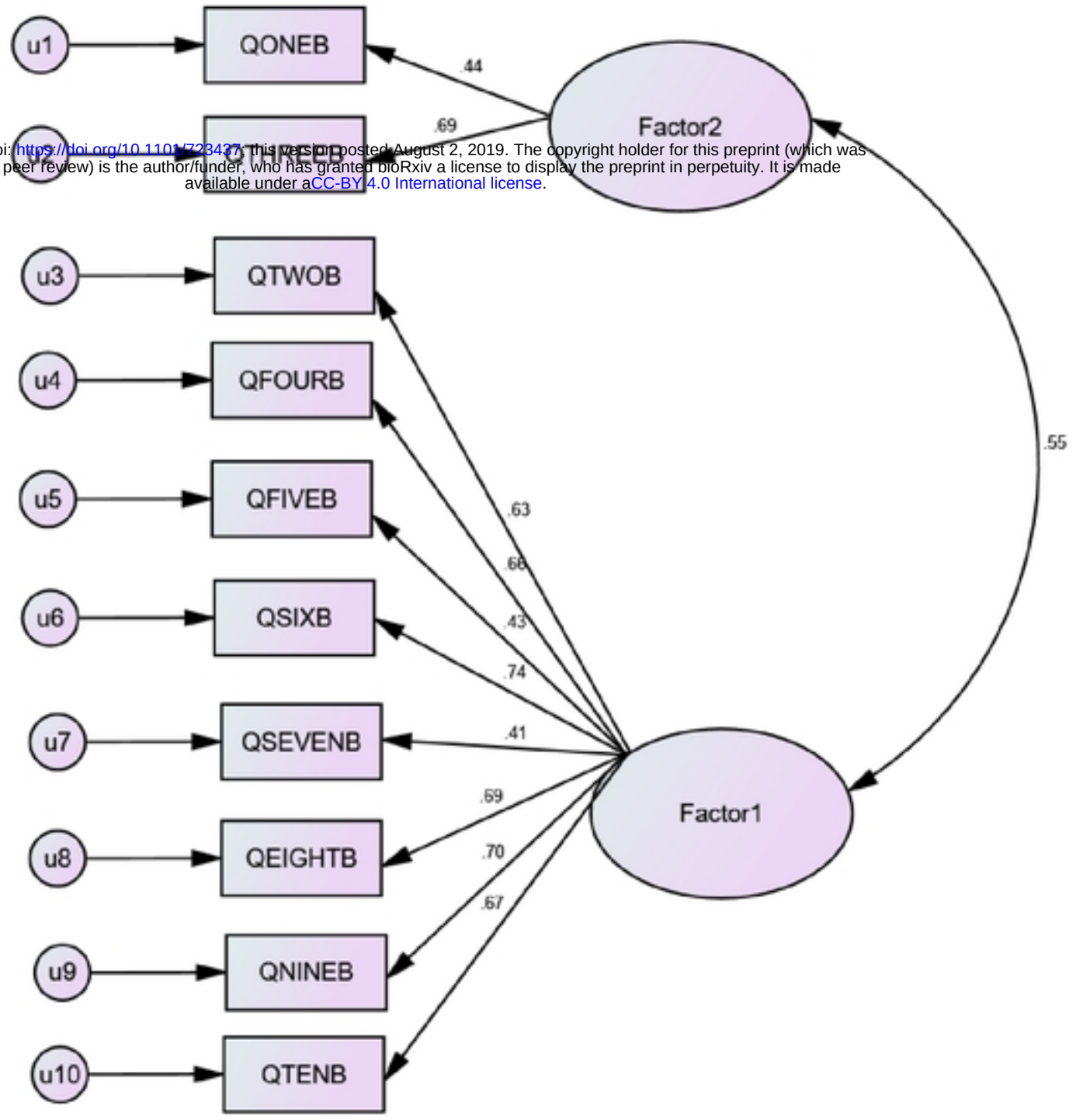
Supporting Information

S1Data. The ODI validity data (n=136)

S2 Data. The ODI-Yoruba test-retest reliability data

S3 Document. Ìgbéléwòn Bèbèré Èyìn Dídùn ti Oswestry (The Yoruba Oswestry Disability Index) (Word doc.).

Fig 1: The principal component analysis derived 2-factor model with correlated errors. Models 1 (with items: pain and lifting) and 2 (with items: personal care, walking, sitting, standing, sleeping, sex, social life and travelling) represents pain and pain-related activity, and common activities of daily living. Error terms are represented by u1-10.



Figure