

Krogsgaard, M. R., Brodersen, J., Christensen, K. B., Siersma, V. D., Jensen, J., Hansen, C. F., Engebretsen, L., Visnes, H., Forssblad, M., Comins, J. D. (2020). How to translate and locally adapt a PROM. Assessment of cross-cultural differential item functioning. *Scandinavian Journal of Medicine & Science in Sports*, 31(5), 999-1008.  
<http://dx.doi.org/10.1111/sms.13854>

---

Dette er siste tekst-versjon av artikkelen, og den kan inneholde små forskjeller fra forlagets pdf-versjon. Forlagets pdf-versjon finner du her:  
<http://dx.doi.org/10.1111/sms.13854>

---

This is the final text version of the article, and it may contain minor differences from the journal's pdf version. The original publication is available here:  
<http://dx.doi.org/10.1111/sms.13854>

---

1 **How to translate and locally adapt a PROM. Assessment of cross-cultural differential**  
2 **item functioning.**

3  
4 Michael R. Krogsgaard (1), John Brodersen (2, 3), Karl Bang Christensen (4), Volkert  
5 Siersma (2), Jonas Jensen (1), Christian Fugl Hansen (1), Lars Engebretsen (5), Håvard  
6 Visnes (6), Magnus Forssblad (7) and Jonathan D. Comins (1, 2).

7  
8 1. Section for Sports Traumatology M51, Bispebjerg and Frederiksberg Hospital,  
9 Copenhagen, Denmark

10 2. The Research Unit for General Practice and Section of General Practice, Department of  
11 Public Health, University of Copenhagen, Denmark

12 3. Primary Health Care Research Unit, Region Zealand, Denmark

13 4. Section of Biostatistics, Department of Public Health, University of Copenhagen,  
14 Denmark

15 5. Orthopedic Clinic, University of Oslo Medical School, and Oslo Sports Trauma Research  
16 Center, Oslo, Norway

17 6. Norwegian National Knee Ligament Registry, Department of Orthopedic Surgery,  
18 Haukeland University Hospital, Bergen Norway, and Oslo Sports Trauma Research  
19 Center, Norwegian School of Sports Sciences, Oslo, Norway

20 7. Department of Molecular Medicine and Surgery, Stockholm Sports Trauma Research  
21 Center, Karolinska Institute, Stockholm, Sweden.

22

23

24 Corresponding author: Michael Rindom Krogsgaard, Section for Sports Traumatology  
25 M51, Bispebjerg and Frederiksberg Hospital, Bispebjerg Bakke 23, DK-2400 Copenhagen  
26 NV, Denmark. Phone: +45-31226817. Mail: [Michael.Rindom.Krogsgaard@RegionH.dk](mailto:Michael.Rindom.Krogsgaard@RegionH.dk)

27

28 Running head: Translation and local adaption of PROMs

29

30

31 Abstract:

32 Translating patient reported outcome measures (PROMs) can alter the meaning of items  
33 and undermine the PROM's psychometric properties (quantified as cross-cultural  
34 differential item functioning (DIF)). The aim of this paper was to present the theoretical  
35 background for PROM translation, adaptation, and cross-cultural validation, and assess  
36 how PROMs used in sports medicine research have been translated and adapted. We also  
37 assessed DIF for the Knee Injury and Osteoarthritis Outcome Score (KOOS) across Danish,  
38 Norwegian, and Swedish versions.

39 We conducted a search in PubMed and SCOPUS to identify the method of translation,  
40 adaptation, and validation of PROMs relevant to musculoskeletal research. Additionally,  
41 150 preoperative KOOS questionnaires were obtained from the Scandinavian knee  
42 ligament reconstruction registries, and cross-cultural DIF was evaluated using  
43 confirmatory factor analysis and Rasch analysis.

44 There were 392 studies identified, describing the translation of 61 PROMs. Ninety-four  
45 percent were performed with forward-backwards technique. Forty-nine percent used  
46 cognitive interviews to ensure appropriate wording, understandability, and adaptation to  
47 the target culture. Only two percent were validated according to modern test theory. No  
48 study assessed cross-cultural DIF.

49 One KOOS subscale showed no cross-cultural DIF, two had DIF with respect to some (but  
50 not all) items, and thus conversion tables could be constructed, and two KOOS subscales  
51 could not be pooled.

52 Most PROM translations are of undocumented quality, despite the common conclusion  
53 that they are valid and reliable. Scores from three of five KOOS subscales can be pooled  
54 across the Danish, Norwegian, and Swedish versions, but two of these must be adjusted  
55 for DIF.

56

57 Key words: PROMs; translation; Cultural adaption; construct validity; Differential item  
58 functioning; Cognitive interview; data pooling; Knee Ligament Reconstruction Registry.

59

60 Case:

61 Three strategies (debridement, microfracture and no treatment) to handle full-thickness  
62 lesions of knee hyaline cartilage were evaluated by identifying patients with a knee  
63 ligament reconstruction and a cartilage lesion in the Norwegian and Swedish National  
64 Knee Ligament Registries. The outcome two years after surgery was the Knee Injury and  
65 Osteoarthritis Outcome Score (KOOS). Linear regression analyses were used to evaluate  
66 the effect of debridement and microfracture on the domain scores of KOOS<sup>1</sup>.

67 No significant effects of debridement were found on any of the KOOS subscales at two-  
68 year follow-up compared to no treatment. Microfracture treatment was associated to  
69 significantly worse scores compared to no treatment at two-year follow-up in the KOOS  
70 Sport and Recreation and Knee-Related Quality of Life subscales. For the remaining KOOS  
71 subscales of Pain, Symptoms and Activities of Daily Living, there were no significant  
72 effects of microfracture.

73 It was concluded that microfracture of concomitant full-thickness cartilage lesions showed  
74 adverse effects on patient-reported outcomes at two-year follow-up after ACL  
75 reconstruction. Debridement of concomitant full-thickness cartilage lesions showed  
76 neither positive nor negative effects on patient-reported outcomes at two-year follow-up  
77 after ACL reconstruction<sup>1</sup>.

78 Comment: The psychometric properties of the Norwegian and Swedish versions of KOOS  
79 have not been compared in a joint data set with individuals from both countries, so it is  
80 not known, if data from the two cohorts can be directly pooled. Whether KOOS functions  
81 differently across countries can be tested in a pooled dataset. If items or scales function  
82 differently between countries, this can often be adjusted for by using conversion tables  
83 derived from pooled data sets.

84

85 **Introduction.**

86 A common reason for translating and adapting patient related outcome measures  
87 (PROMs) from one language to another is that a specific PROM is needed for a study but  
88 does not exist in the local language. If a PROM has been developed with help from  
89 relevant patient groups, using valid methods, so it has content relevance and coverage for  
90 the patients in the planned study, then this is a good reason to translate and adapt the  
91 existing PROM instead of developing a new one. This is easier and less time consuming.

92 In other cases, there is a desire to conduct studies across countries, languages, or cultures,  
93 for instance in multi-centre trials involving different countries or trials in countries where  
94 there is more than one national language. Also, international clinical databases need the  
95 same outcome measures in all the participating countries, so data can be pooled or  
96 compared, and this includes relevant PROMs. There is an increasing need in relation to  
97 planning and financing in health policy to be able to compare clinical outcomes from  
98 different countries or cultural groups. PROMs are important in this context, which  
99 emphasizes that measurement must be independent of language and culture.

100 To adapt a PROM to a new language or culture is not trivial. Even for languages that are  
101 spoken by many people globally across different countries, such as Spanish, English and  
102 Arabic, the same basic language can have quite varied versions, as the habits and cultures  
103 of the different countries can diverge substantially. The same word or expression can carry  
104 different connotation and meaning across the different countries, or objects can be  
105 described by different words in the same language, dependent on culture or geography.  
106 For example, “braces” in the United Kingdom (UK) are called “suspenders” in the United  
107 States (US), where “braces” are used to straighten teeth.

108 Also, life conditions can be very different within language areas, dependent on  
109 socioeconomic, religious and cultural conditions and are often very different between  
110 countries. Therefore, the content of the items in a PROM may not have the same meaning  
111 or importance when it is translated to a new culture.

112 All these issues create methodological challenges when a PROM is translated and adapted  
113 to a new language and culture.

114 There are several ways to conduct translation and adaption, and there is evidence that a  
115 rigorous and multistep procedure leads to a better translation and adaption<sup>2</sup>.

116 Once a PROM has been translated and adapted it should be confirmed that it measures in  
117 the same way (invariantly) for all persons. Even within the same language and culture  
118 items can function differently dependent on for instance gender or age, and this is called  
119 differential item functioning (DIF)<sup>3,4</sup>. This is probably even more pronounced between

120 countries and cultures (cross-cultural DIF), for instance do Norwegians understand and  
121 respond to items in the same way as Americans? If results are compared between cultures  
122 or countries, or if data from several countries are pooled, items that have cross-cultural  
123 DIF introduce a systematic bias that will give respondents in different countries a different  
124 score, even though their condition is the same. For example, it was demonstrated by  
125 comparing results from the three Scandinavian knee ligament reconstruction registries  
126 that Danish patients have significantly lower scores in the KOOS domain “Symptoms”  
127 compared to their Norwegian and Swedish counterparts, both preoperatively and  
128 postoperatively<sup>5</sup>. Therefore, cross-cultural DIF can be suspected for items in this domain.

129 The presence of cross-cultural DIF is of course most important if data from different  
130 countries or cultures are pooled into one dataset. This is typically done in international  
131 databases or when national clinical databases are pooled, but also randomized multicentre  
132 studies and studies including cohorts in different countries can be affected by cross-  
133 cultural DIF, like the Delaware-Oslo cohort of ACL patients<sup>6,7</sup>.

134

### 135 **The theoretical background**

136 In most cases, PROMs are developed in one language and culture and then translated and  
137 adapted to other languages and settings. The most commonly used PROMs in sports  
138 science were all developed within the Western culture<sup>8</sup>. The main and most important  
139 objective of the translation and adaptation process of a PROM across settings is to transfer  
140 the meaning of each item and construct encompassed in the PROM from the original  
141 language and culture into another language and culture. This involves transfer of the  
142 wording as well as the relevance of each item.

143 There are four criteria, which must be considered for the translated PROM, as defined by  
144 Beaton<sup>9</sup>:

- 145 1. Semantic equivalence, meaning grammatical and vocabulary equivalence with  
146 the original PROM. Ambiguous wordings are avoided (i.e., the translated words  
147 must have one meaning and be understandable to everyone).
- 148 2. Idiomatic equivalence. Some expressions are idioms, meaning that the words  
149 themselves give no understanding of the expression. An example is “feeling  
150 downhearted and blue” (from Short Form 36 (SF-36)). Idioms must be reworked  
151 beyond translation, but for some idioms, there is no equivalent expression in  
152 target languages.
- 153 3. Experiential equivalence, meaning that some activities are not the same in the  
154 local setting and must be replaced by something equivalent. An example is that

155 skiing was replaced by surfing in the translation of a PROM from American  
156 English to Brazilian Portuguese<sup>10</sup>.

157 4. Conceptual equivalence, meaning that specific concepts (for instance “family”,  
158 “work”, and “leisure time”) may have very different meanings in different  
159 cultures, which can result in different answers.

160 It is generally recommended that questionnaires can be understood by the equivalent of a  
161 12-year-old (Grade 6 reading level)<sup>9</sup>, but the importance of this is of course dependent on  
162 the target population and its educational level. This can be a problem in countries, where a  
163 larger proportion of inhabitants do not have an educational level past Grade 6.

164

#### 165 *Translation and cultural adaption*

166 The first part of the process to translate a PROM into a local language is of course to  
167 translate the wording of the items and the instruction. The two most accepted methods are  
168 somewhat different: forward-backward translation and dual-panel translation. The steps  
169 are described in box 1 and 2 in the supplementary materials.

170 Of the two methods, the most frequently used is *forward-backward translation*, described  
171 in detail by Beaton<sup>9</sup>. With this method, the translation is sometimes performed by  
172 linguistic experts (e.g., professional translators) or healthcare professionals, and thus, there  
173 is a risk that the wording will not be in common lay language and thereby has suboptimal  
174 meaning or readability for the majority of the general population. This can only be  
175 addressed by conducting some kind of cognitive interviewing or field test of the  
176 understandability of the wording after the forward-backward translation has been  
177 conducted to ensure that meaning is not lost and that the translated version of the PROM  
178 is understandable for lay people<sup>9</sup>. As PROMs in most cases are completed by laypersons  
179 who are patients, cognitive interviewing regarding the wording should primarily be  
180 performed with laypersons. Healthcare professionals tend to use professional phrases, and  
181 patients tend to focus more on their disease(s) and thereby the subject matter in the PROM  
182 than on the actual language, meaning, and understandability, and neither of these groups  
183 are optimal for cognitive testing of the wording (the language).

184 However, patients with the condition that the PROM is meant to cover can participate in  
185 cognitive testing of the understandability of the translated PROM – does the wording  
186 make sense for the subjective understanding of the condition? This can be necessary, as a  
187 translation by professional translators can be linguistically correct, but not meaningful for  
188 the target group. This means that after the forward-backward translation has been carried

189 out, the PROM needs to be field-tested through cognitive interviews for understandability,  
190 and, if necessary, modified.

191 Conversely, the main purpose of the *dual-panel translation and adaptation* method is to  
192 ensure the quality of the translation during the translation process itself<sup>11</sup> (box 2). The  
193 primary translation is made in a group of bilingual persons and the wording is discussed  
194 (and possibly modified) until the group agrees that meaning of the wording in the original  
195 version is covered in the translated version. The second panel includes a lay panel of 3-5  
196 local persons, who in plenum can discuss the wording and modify the items that have  
197 been proposed by the first bi-lingual panel. So, if the dual-panel method is used, it is not  
198 necessary additionally to test the translated version for wording or understandability, as  
199 this is already part of the method.

200 Preferably, the researcher involved in developing the original PROM can be part of the  
201 entire translation and adaptation process and help ensure that the meaning of the items  
202 and constructs are kept in the translation process across the settings<sup>11</sup>.

### 203 *Assessing the psychometric properties of the translated PROM*

204 Regardless of which translation and adaptation method is used, an equally important  
205 aspect is to conduct psychometric analyses to confirm the construct validity of the PROM  
206 scales in the new setting and ideally whether there is DIF across the settings (i.e., across  
207 the two versions)<sup>4</sup>. Does the PROM measure the same single construct, or multiple  
208 constructs, in both settings, and do people in both settings interpret the items in the same  
209 way? Language DIF is in particular important to consider when comparing data and  
210 results from different countries, for instance in relation to publications of combined data  
211 from several countries (e.g., from National clinical databases such as knee-ligament  
212 reconstruction registries, arthroplasty registries, etc.). However, when psychometric  
213 properties are tested, it is usually only performed on data collected from one country, and  
214 thus cross-cultural analyses of the psychometric properties between the original and the  
215 translated measure are not addressed<sup>4</sup>. This is suboptimal if results are compared between  
216 countries. When PROM data is analysed in pooled data sets with data from more than one  
217 country, simple adjusting for the effect of country in a regression model is not sufficient.  
218 Consider the following analogy: A multi-centre study measures the primary outcome as  
219 changes in temperature. Some centres use Celsius while others use Fahrenheit. Adding an  
220 effect of country in your regression model will not yield a correct analysis. However,  
221 knowing how to translate from one temperature scale to the other will enable you to do a  
222 valid analysis. Therefore, conversion tables are required.

223 The optimal procedure of cross-cultural analysis is to evaluate validity in each language  
224 version separately and subsequently pool collected data and assess measurement



225 invariance and DIF relative to language for each domain score in the pooled data set. In  
226 this way, it is possible to reveal if persons with the same overall score on the remaining  
227 items systematically give different responses to the item being tested. If the difference in  
228 mean item scores for an item with DIF for the pooled scores (i.e., the combined data) is  
229 uniform along the scale (as measured by the total score), then this difference can be  
230 adjusted across the settings, so long as fit to a measurement model is maintained<sup>3</sup>. If this is  
231 the case, the item displays DIF across country, language, and culture. Once DIF has been  
232 identified, it can be compensated for using conversion tables, when data are reported.  
233 Measurement invariance can be tested using multiple groups confirmatory factor analysis  
234 (CFA)<sup>12</sup>, while DIF is most easily tested using item response theory (IRT). DIF can best be  
235 explained using the item location. For example, in a scale that measures the impact of knee  
236 function on quality of life, an item that assesses whether the respondent is able to go cross-  
237 country skiing would have a different location (i.e., level of difficulty on the scale) for  
238 Swedes and Norwegians (who have a long tradition for skiing regularly) compared to  
239 Danes (who mainly go skiing during vacations). It would be expected that a small  
240 proportion of Danish respondents, but a larger proportion of Swedes and Norwegians,  
241 would report this to have an impact on health-related quality of life. Since the ordering of  
242 all items in terms of level of difficulty included in a scale can be determined using IRT  
243 models, this provides a way to test items in scales for DIF in relation to country, language,  
244 and culture<sup>3</sup>. Such analyses for unidimensionality and DIF can provide robust evidence  
245 that the same constructs are actually measured in the same way across different borders,  
246 and that this is done invariantly<sup>3</sup>. Results of PROM scores that are pooled from several  
247 countries can be different, dependent on whether DIF has been compensated for or not.

248

## 249 **Hypotheses and aims**

250 It is stated in most articles reporting translation and adaption of a PROM that it was found  
251 to be a valid and reliable measurement tool in the translated version. However, it is not  
252 known to which extent translation, adaptation, and validation of versions in languages  
253 other than the original PROMs in sports in fact has been performed optimally. It was  
254 hypothesized that for a majority of PROMs used in sports research optimal methods had  
255 not been employed in the adaptation and validation of translated versions. Furthermore, it  
256 was hypothesized that calculation of local DIF and cross-cultural DIF was generally not  
257 performed.

258 In relation to the Scandinavian knee ligament reconstruction registries, it can be relevant  
259 to pool data from the three countries (Norway, Sweden, and Denmark). However, it has  
260 never been assessed whether there is cross-cultural DIF for the main outcome, KOOS. It

261 was hypothesized that there may be cross-cultural DIF between the local Scandinavian  
262 versions of KOOS, and that this can be compensated for, when pooled data are reported.

263 The aims were therefore twofold:

264 1. To study how translation, adaptation and validation was performed in the local versions  
265 of the most commonly used and relevant PROMs in Sports. These comprised 61 PROMs  
266 which had been identified from searches in PubMed 2011-20, being either commonly used  
267 (more than three times during this time period), used in randomized studies on  
268 musculoskeletal conditions or being the only PROM for a specific musculoskeletal  
269 condition of relevance. Translated versions of these 61 PROMs were searched for in  
270 PubMed and SCOPUS. This is described in detail elsewhere<sup>8</sup>.

271 2. To assess cross-cultural DIF in the questionnaire KOOS between Denmark, Sweden, and  
272 Norway.

273

## 274 **Methods.**

### 275 Aim 1:

276 All published translated versions of the 61 PROMs that were identified in<sup>8</sup> were analyzed.

277 The quality indicators for translation and adaptation of a PROM for use in another  
278 country, language, or culture were defined by three components:

- 279 1. *Translation and adaptation:* Has the meaning of the items and constructs in the PROM  
280 been adequately transferred from the original language and culture to the other  
281 language and culture?  
282
- 283 2. *Validation of the construct of the translated scale:* Has a test of unidimensionality and  
284 DIF of the scale(s), optimally using IRT models, been conducted?  
285
- 286 3. *Functioning of the translated PROM compared to the original version:* Has a test of  
287 item ordering in scale(s), using IRT models, been conducted, both separately for the  
288 countries and with the data from the different countries combined (i.e., are the  
289 ordering and locations consistent across countries)? Has a cross-cultural DIF analysis  
290 been conducted with data from the different countries combined?

291 Validation of the construct(s) was not included in the analyses for this study, as this has  
292 been assessed elsewhere<sup>8</sup>. Also, assessment of development of the original version has  
293 been covered in<sup>8</sup>.

294 Details of the analyses are supplied in the supplementary materials (“Details of recorded  
295 information”).

#### 296 Aim 2:

297 To assess cross-cultural DIF for KOOS in Denmark, Norway, and Sweden, data from  
298 questionnaires completed preoperatively were obtained from National knee ligament  
299 reconstruction registries in each country. From each registry responses from 75 women  
300 and 75 men, aged 18-37 years, between 2016 and 2018 were included. Validity was  
301 evaluated using CFA and Rasch models and the hypothesis of measurement invariance,  
302 that the latent variables are understood and measured in the same way across countries<sup>13</sup>,  
303 and absence of cross-cultural DIF was tested using multiple groups CFA by the latest  
304 available guidelines<sup>14</sup> and graphical Rasch models<sup>15</sup>. The R package lavaan<sup>16</sup> and the  
305 software package DIGRAM<sup>17</sup> were used.

306 For all subscales the following analyses were considered: First, validity in each country  
307 was assessed using CFA and Rasch analysis, controlling the type I error rate using the  
308 false discovery rate<sup>18</sup>. Second, the fit of a multiple groups CFA models with configural  
309 invariance and of graphical Rasch models were evaluated.

310 For subscales where these basic validity requirements were met multiple groups CFA  
311 models and graphical Rasch models with invariance were fitted. Sub scales where these  
312 restricted models fitted were categorized as having measurement invariance and no DIF.  
313 For subscales where this was not the case models with partial invariance were applied to  
314 identify items with DIF. Model fit is evaluated using chi-square test for CFA models and  
315 Andersens conditional likelihood ratio test for Rasch models<sup>19</sup>.

316 For subscales where models with partial invariance could be fitted to the data conversion  
317 tables are reported.

#### 318 **Results:**

319 Aim 1 (table 1-9 in the supplementary materials):

320 *Translation:*

321 Of the analyzed 392 PROM studies, direct translation by the researcher, with no formal  
322 procedure to secure quality, had been performed in 16. In 368 PROM studies (94%) the  
323 forward-backward method was used, and one study used the dual-panel method (tables  
324 1-9). In 6 cases the method of translation had not been described.

### 325 *Language adaption*

326 Among the 391 PROMs that had not been translated by the dual-panel method, wording  
327 had been discussed through individual interviews in 192 (49%) (tables 1-9 in the  
328 supplementary materials). In 120 cases (31%) the understandability was tested by analyses  
329 of filled out questionnaires but without interviews. In 61 the wording had not been  
330 discussed and in 16 it was not described if wording had been discussed.

### 331 *Content adaption*

332 In 291 (74%) of the translated PROMs, patients had been involved in testing relevance and  
333 understandability, while this was not the case in 80 and not described in 19 cases (tables 1-  
334 9). In 194 cases (49%) the pre-version of the PROM had been modified after testing, while  
335 no changes had been applied in 168 cases.

### 336 *Unidimensionality*

337 In 11 cases (3%), unidimensionality had been assessed for the translated version, in no  
338 cases for the original and the translated versions individually, and in no cases for the  
339 pooled data set (tables 1-9 in the supplementary materials).

### 340 *Cross-cultural DIF*

341 DIF had not been assessed for the local PROM in any case. Cross-cultural DIF had been  
342 assessed in one case (for The Western Ontario and McMaster Universities Osteoarthritis  
343 Index (WOMAC)) but not in relation to translation (tables 1-9 in the supplementary  
344 materials).

### 345 Aim 2:

346 Fit indices for models where no items were restricted to be equal across countries  
347 (sometimes called 'configural invariance' models) showed poor fit for all subscales except  
348 Quality of Life (QoL) (results not shown). Adjustment for multiple testing (five subscales  
349 in three countries using two different methods yielding 30 statistical tests) was used.  
350 Additional analyses using models with correlated error terms/local response dependence  
351 showed adequate fit for all subscales except Activities of Daily Living (ADL). No model  
352 with correlated error terms/local response dependence fitted this subscale.

353 Since there is no point in evaluating cross-cultural validity when there is no evidence of  
354 validity in any of the three countries, the question of cross-cultural validity was addressed  
355 for the four other subscales only. Fit indices for multiple group analyses for these are  
356 reported in Table 11. For the ADL subscale, that did not meet validity requirements in any  
357 of the countries. evaluation of cross-cultural validity was meaningless.

358 Fit indices for models where no items were restricted to be equal across countries  
359 (sometimes called 'configural invariance' models) showed adequate fit for the QoL  
360 subscale only (results not shown). Including local dependence (correlated error terms)  
361 yielded models with adequate fit (results not shown).

362 Fit indices for models where all items were restricted to be equal across countries  
363 (sometimes called 'scalar invariance' models) showed adequate fit for the QoL subscale  
364 only (results not shown). For the three subscales Pain, Symptoms and Sport we used  
365 multiple groups CFA and graphical Rasch models in an attempt to identify models where  
366 some, but not all items were restricted to be equal across countries (sometimes called  
367 'partial invariance' models). The items, that are not restricted, are the items that have  
368 cross-country DIF. For the Pain subscale the items P2 and P7 showed DIF, for the  
369 Symptoms subscale all items showed DIF, and for the Sport subscale the item Sp4 showed  
370 DIF (Table 10). This means that for the Pain subscale and the Sport subscale conversion  
371 tables can be constructed (Table 11).

372 In summary, the assessment of cross-cultural DIF across Denmark, Norway and Sweden  
373 for the KOOS subscales yielded different results for the five subscales. The ADL subscale  
374 did not show construct validity in any of the three countries, making evaluation of cross-  
375 cultural validity meaningless. The Symptoms subscale was valid in all countries, but all  
376 items displayed evidence of DIF. As no items are on the same metric for this domain,  
377 translation from the metric of one country to the metric of another country is not possible.  
378 The Pain and Sport subscales were valid in all countries, but they had DIF with respect to  
379 some (but not all) items. As the items in these two domains without DIF are on the same  
380 metric, translation from the metric of one country to the metric of another country can be  
381 based on these, and conversion tables could be constructed. The QoL subscale was valid in  
382 all countries with no evidence of DIF, and therefore scores from this sub-scale for the  
383 different countries can be pooled with no conversion.

384 The conversion table (Table 11) can be used to translate KOOS scores of the Pain and Sport  
385 sub-scales from one country to the metric of the corresponding KOOS sub-scales score in  
386 the other two of the three Scandinavian countries. For example, a Danish patient scoring  
387 (2,3,3,1,2) on the five items in the Sport sub-scale have a score of 50 for the sub-scale (the  
388 mean item score is divided by four and the result is transformed linearly to a zero to 100

389 scale, 100 indicating no problems and 0 indicates extreme problems, according to the  
390 instructions for KOOS). If the score from this patient is compared to or pooled with scores  
391 from Norwegians or Swedes, the score must be translated to 48.2 and 48.3, respectively. In  
392 a pooled dataset from all the three Scandinavian countries, one country is chosen as  
393 reference, and scores from the two other countries are transformed according to table 11  
394 before they are pooled.

395

## 396 **Discussion:**

### 397 Aim 1:

398 This study showed that almost all of PROMs had been translated by the forward-  
399 backward method based on the instructions described by Beaton et al. in 2000<sup>9</sup>, to which  
400 almost all authors referred. About half of the translations had followed the instructions  
401 regarding translation and cultural adaption in detail, which is better than hypothesized.  
402 However, for the vast majority construct validity had not been assessed by the most  
403 adequate methods (modern test theory models), which reduces confidence in the  
404 measurement properties.

405 This shows that the conclusion in most of the 392 manuscripts: “The translated PROM is a  
406 valid and reliable measurement tool” would not necessarily be correct, if thorough  
407 translation, adaptation and validation had actually been performed by optimal methods.  
408 The better methods, the higher risk there is to find that the PROM is not reliable and valid.  
409 Therefore, instead of referring to the conclusion in the translation-manuscript when the  
410 choice of PROM for a study is argued for, authors should describe the methods that had  
411 been used for translation, adaption and validation and search literature for additional  
412 assessments. There are several examples of translations, which have been assessed as  
413 reliable and valid using classical test theory methods only, that have been shown not to be  
414 valid when tested using modern test theory- and this should of course be accounted for in  
415 the study article.

416 A surprising but potentially serious problem that this study has identified is that for  
417 several PROMs that had been developed in patient populations with a mother tongue  
418 which was not English, an English version of the questionnaire was published with the  
419 development article, but with no documentation that it had been translated through any  
420 controlled process or been adapted in an English speaking country. As these English  
421 versions have been basis for the majority of other translations of these PROMs, the validity  
422 of the translated versions can, in principle, be questioned. This is the case for the  
423 Copenhagen Hip and Groin Outcome Score (HAGOS), the Foot and Ankle Outcome Score

424 (FAOS) and The Achilles Tendon Total Rupture Score. The 5 domains in KOOS and the  
425 Hip dysfunction and Osteoarthritis Outcome Score (HOOS) consist of 3 domains from the  
426 WOMAC, which were developed in a community of Canadian-English speaking patients,  
427 and 2 domains that were developed in a Swedish speaking population, but there is no  
428 documentation that WOMAC had been thoroughly translated to Swedish or the two other  
429 domains had been thoroughly translated into English. KOOS and HOOS were originally  
430 validated in a community of Swedish speaking patients. This means, that there is no  
431 documented validity of the English versions of KOOS and HOOS, and the Swedish  
432 version is questionable, as the process of translation to Swedish of 3 of 5 domains has not  
433 been documented. KOOS-Child was developed in a Swedish speaking community, and  
434 there is no documentation that the English version is based on a thorough translational  
435 and cultural adaptation process. The Achilles Tendon Total Rupture Score was also  
436 developed in Swedish, but how translation into the English version that was published in  
437 the development article had been performed, is not documented. Nine of the 12  
438 translations of this PROM have been made from the English version. The Forgotten Joint  
439 Score was developed and validated in a German speaking community, but the English  
440 version (from which 5 of 7 translations have been made) has not been documented. The  
441 Kujala Score (Anterior Knee Pain Scale) was developed in a Finnish setting, but there is no  
442 documentation of the translation to English (from which 9 of 10 translations were made).  
443 The Lysholm score was developed in Swedish and it is not documented how it was  
444 translated into English (from which 4 of 6 published translations were made).

445 In addition to the translations that were identified for this study through academic search  
446 strings, there is a large number of translated versions, which have either not been  
447 documented or have only been published in grey literature. As an example there are 51  
448 versions of KOOS, 14 versions of HAGOS, 25 versions of HOOS, 17 of FAOS and 7  
449 versions of KOOS-Child available (as of January 1, 2020) from [www.koos.nu](http://www.koos.nu), whereas the  
450 respective numbers of identified, published translations are 19, 4, 13, 11 and 2. This shows,  
451 that it is essential that reports on translation and adaption are actually peer reviewed and  
452 published.

453 It is rare that a PROM is developed simultaneously in different languages and settings.  
454 This has been described for KOOS, KOOS-Child and the Functional Assessment Scale for  
455 Acute Hamstring Injuries (FASH). The latter was developed in a Greek community and  
456 translated into German and French by the forward-backward method<sup>20</sup>. Even though the  
457 process is not described in all details, this has resulted in three valid PROMs. However, it  
458 is not a simultaneous development as only Greek patients participated in the development  
459 of items. KOOS is a mixture of subscales, that were developed in Canada (3 domains) and  
460 in Sweden (2 domains) but not simultaneously. So, there are no examples related to  
461 musculoskeletal conditions of PROMs developed simultaneously in difference countries or

462 cultures. This would be an optimal method to develop PROMs for patients with rare  
463 diseases, for instance children with ACL-rupture, as it is difficult to involve enough  
464 patients for development in one country.

465 A very thorough guide to forward-backward translation and cultural adaption is available  
466 in Wild D et al<sup>21</sup>.

467 Aim 2:

468 When data combined from several countries are published, it is a general measure of  
469 quality to know, if there is cross-cultural DIF, and if there is, that this DIF is corrected for,  
470 before data are pooled. This was first suggested in 2004<sup>22</sup>, but it has not been assessed for  
471 PROMs that are relevant for musculoskeletal research.

472 For KOOS, this study showed that data can be pooled from 1 of the 5 sub-scales without  
473 conversion and for 2 sub-scales if scores are corrected for cross-country DIF by conversion.  
474 For 2 sub-scales, pooling of data is not meaningful. This is relevant when data from  
475 National clinical databases from several countries are published, or when data from  
476 studies in different countries are pooled. There are no examples within sports research  
477 where cross-country DIF has been considered in studies where results from several  
478 language areas are represented. For observational studies comparing different conditions  
479 or treatments (like the study in the opening case of this article) the error that cross-country  
480 DIF can introduce depends on the distribution of the conditions/treatments between  
481 countries. If for instance one treatment is tradition in one country and another treatment in  
482 the second country, comparison of the treatment results is affected by cross-country DIF.  
483 For randomized, controlled studies, where allocation to treatment arms is made separately  
484 in each country, the means of outcome in the two treatment arm are affected equally by a  
485 cross-country DIF, but the variation in the pooled data might increase, if cross-country DIF  
486 is not compensated for. If, however, allocation is made for the complete cohort, treatments  
487 may not be distributed evenly in each country, and a cross-country DIF may affect the  
488 mean of the outcomes and thereby the assessment of a possible difference in outcome of  
489 the two treatments. This could be the case for an international multicentre study with a  
490 central computer for allocation.

491

492 Conclusion:

493 About half of the PROMs were translated and adapted by accepted methods. However,  
494 the vast majority of translated PROMs have not been validated optimally and are therefore  
495 of questionable quality, despite the common individual conclusion of the actual PROM  
496 being a valid and reliable measurement tool. There is differential item functioning (DIF)



497 between Denmark, Norway and Sweden in relation to many items of KOOS, meaning that  
498 if data are pooled or compared between countries, this should be corrected for. For two  
499 sub-scales of KOOS, pooled data are not meaningful.

500

501 Perspectives:

502 Ideally, all translated and adapted PROMs should be produced according to standard  
503 principles, and in cases where this has not been done, it can be considered to re-translate  
504 the PROM. It can be considered for PROMs that have not been validated by modern test  
505 theory model methods to re-validate, for instance by use of already existing data. The  
506 methods for translation, adaption and validation should always be described in detail,  
507 when results obtained by translated PROMs are published, and if optimal methods have  
508 not been used, the implications for the results should be discussed. If PROM scores from  
509 different countries are compared or pooled, it should be known if there is cross-country  
510 DIF, and this can be assessed during the process of translation and cultural adaption. Data  
511 should be converted before pooling, if there is cross-country DIF.

512

513 Conflicts of interest.

514 All authors declare that they have no conflicts of interest in relation to this manuscript.

515

516

517 Reference list (references for the tables are listed in relation to each table)

- 518 1. Røtterud JH, Sivertsen EA, Forssblad M, et al. Effect on patient-reported outcomes of  
519 debridement or microfracture of concomitant full-thickness cartilage lesions in anterior  
520 cruciate ligament-reconstructed knees: a nationwide cohort study from Norway and  
521 Sweden of 357 Patients With 2-Year Follow-up. *Am J Sports Med* 2016;44:337-44.
- 522 2. Acquadro C, Conway K, Hareendran A, Aaronson N. Literature Review of Methods to  
523 Translate Health-Related Quality of Life Questionnaires for Use in Multinational Clinical  
524 Trials. *Value Health* 2008;11(3):509-21.
- 525 3. Brodersen J, Meads DM, Kreiner S, Thorsen H, Doward L, McKenna SP. Methodological  
526 Aspects of Differential Item Functioning in the Rasch Model. *J Med Econ* 2007;10(3):309-24.
- 527 4. Holland PW, Wainer H (Eds). *Differential Item Functioning*. Laurence Erlbaum  
528 Associates, New York, 1993.
- 529 5. Granan LP, Forssblad M, Lind M, Engebretsen L. The Scandinavian ACL registries 2004-  
530 2007: baseline epidemiology. *Acta Orthop* 2009;80:563-7.6. Grindem H, Wellsandt E, Failla  
531 M, Snyder-Mackler L, Risberg MA. Anterior cruciate ligament injury – who succeeds  
532 without reconstructive surgery? The Delaware-Oslo ACL Cohort Study. *Orthop J Sports*  
533 *Med* 2018;6:2325967118774255.
- 534 7. Capin JJ, Failla M, Zarzycki R, et al. Superior 2-year functional outcomes among young  
535 female athletes after ACL reconstruction in 10 return-to-sport training sessions:  
536 comparison of ACL-SPORTS randomized controlled trial with Delaware-Oslo and MOON  
537 Cohorts. *Orthop J Sports Med* 2019;7:2325967119861311.
- 538 8. Hansen CD, Jensen J, Siersma V, Brodersen J, Comins JD, Krogsgaard MR. A catalogue  
539 of PROMs in sports science - quality assessment of PROM development and validation.  
540 *Scand J Med Sci Sports* 2020;xx:xx-xx-
- 541 9. Beaton DE, Bombardier C, Guillemin F, Ferraz MB: Guidelines for the process of cross-  
542 cultural adaptation of self-report measures. *Spine* 2000;25:3186-3191.
- 543 10. Metsavacht L, Leporace G, Riberto M, Sposito MMdM, Batista LA. Translation and  
544 cross-cultural adaption of the Brazilian version of the International Knee Documentation  
545 Committee subjective knee form. *Am J Sports Med* 2010;38:1894-9.
- 546 11. Swaine-Verdier A, Doward LC, Hagell P, Thorsen H, McKenna SP. Adapting Quality  
547 of Life instruments. *Value in Health* 2004;7:S27-S30.
- 548 12. Jöreskog KG. Simultaneous factor analysis in several populations. *Psychometrika* 1971;  
549 36:409-426.

- 550 13. Meredith W. Measurement invariance, factor analysis and factor-ial invariance.  
551 Psychometrika 1993;58:525–543.
- 552 14. Svetina D, Rutkowski L, Rutkowski D. Multiple-group invariance with categorical  
553 outcomes using updated guidelines: an illustration using *Mplus* and the lavaan/semTools  
554 packages. Structural Equation Modeling: A Multidisciplinary Journal, 2020;27:111–130.
- 555 15. Kreiner S, Christensen, KB. Graphical Rasch models. In Mesbah M, Cole FC, Lee MT  
556 (Eds.): Statistical methods for quality of life studies. Springer, Boston, MA, 2002:187–203.
- 557 16. Rosseel Y. lavaan: An R Package for structural equation modeling. J Stat Softw 2012;48:  
558 1–36.
- 559 17. Kreiner S, Nielsen T. Item analysis in DIGRAM 3.04: Part I: Guided tours. University of  
560 Copenhagen, 2013
- 561 18. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful  
562 approach to multiple testing. J Royal Stat Soc. Series B (Methodological) 1995;57:289–300.
- 563 19. Andersen EB. A goodness of fit test for the rasch model. Psychometrika 1973;38:123–  
564 140.
- 565 20. Malliaropoulos N, Korakakis V, Christodoulou D, et al. Development and validation of  
566 a questionnaire (FASH--Functional Assessment Scale for Acute Hamstring Injuries): to  
567 measure the severity and impact of symptoms on function and sports ability in patients  
568 with acute hamstring injuries. Br J Sports Med 2014;48:1607-12.
- 569 21. Wild D, Grove A, Martin M, et al. Principles of Good Practice for the Translation and  
570 Cultural Adaptation Process for Patient-Reported Outcomes (PRO) Measures: Report of  
571 the ISPOR Task Force for Translation and Cultural Adaptation. Value in Health 2005;8:94-  
572 104.
- 573 22. Tennant A, Penta M, Tesio L, et al. Assessing and adjusting for cross cultural validity  
574 of impairment and activity limitation scales through Differential Item Functioning within  
575 the framework of the Rasch model: the Pro-ESOR project. Medical Care 2004;42:37-48.

576

577

578

KOOS subscale	DIF items	CFA Validation			Rasch validation		
		Chi-square	DF	P	Chi-square	DF	P
Pain	P2, P7	109.468	89	0.070	129.5	106	0.0602
Symptoms	all						
Sport	Sp4	31.8	31	0.425	91.3	71	0.0529
QoL	none	19.975	20	0.459	28.0	20	0.1098

579

580 Table 10: Evaluation of models with partial invariance. All models include local  
581 dependence/correlated error terms. For the Symptoms subscale no differential item functioning  
582 (DIF) equating was possible because all items showed DIF. KOOS = the Knee injury and  
583 Osteoarthritis Outcome Score. CFA = Confirmatory factor analysis.

584

KOOS Pain subscale			KOOS Sport subscale		
Denmark	Norway	Sweden	Denmark	Norway	Sweden
0,0	0,0	0,0	0	0,0	0,0
3,7	3,8	2,3	5	5,0	5,3
7,4	7,6	5,2	10	9,8	10,4
11,1	11,2	8,8	15	14,5	15,4
14,8	14,8	12,8	20	19,2	20,3
18,5	18,3	16,9	25	24,0	25,1
22,2	21,7	21,1	30	28,8	29,9
25,9	25,2	25,3	35	33,6	34,6
29,6	28,6	29,5	40	38,5	39,2
33,3	32,1	33,8	45	43,4	43,8
37,0	35,7	38,0	50	48,2	48,3
40,7	39,3	42,1	55	53,1	52,8
44,4	42,9	46,1	60	57,8	57,3
48,1	46,6	49,9	65	62,6	62,0
51,9	50,3	53,6	70	67,5	66,9
55,6	54,0	57,2	75	72,5	72,3
59,3	57,7	60,8	80	77,7	77,8
63,0	61,4	64,3	85	82,9	83,4
66,7	65,0	67,7	90	88,1	88,8
70,4	68,6	71,1	95	93,2	94,1
74,1	72,2	74,4	100	100,0	100,0
77,8	75,7	77,7			
81,5	79,2	80,9			
85,2	82,7	84,2			
88,9	86,4	87,6			
92,6	90,4	91,2			
96,3	94,9	95,3			
100,0	100,0	100,0			

585

586 Table 11. Conversion tables for adjusting for cross-cultural differential item functioning (DIF).

587

Article ten in a series of ten.

How to translate and locally adapt a PROM. Assessment of cross-cultural differential item functioning.

Supplementary material.

#### Box 1: Forward-backward translation.

1. The PROM is forward translated separately from the original language by at least 2 translators, who have the local language as their mother tongue and are fluent in the language of the original version. It is recommended that one translator is informed about the purpose of the translation and has a professional healthcare background, while the other is uninformed and is not involved in healthcare.
2. The translated versions are compared, and differences, wordings, and possibly necessary adaptations of the items caused by differences in life conditions (for instance different metric systems, differences in housing traditions or type of popular sports) are discussed in a panel consisting of the translators and a moderator. The moderator can be one person but is often a group of various persons with expertise in health care, psychometrics, and language and sometimes patients. One conjoined version is produced.
3. The synthesized version is *translated back* to the original language by one, two or more bilingual, often professional translators, who are blinded to the original version of the questionnaire and to each other, and who are not informed about the purpose of the translation. The back translations are reconciled and any discrepancy between this version and the original version is discussed by the panel, into which the back-translators are now included. This can be a free discussion or based on a scoring system, according to which each member of the panel indicates for every item if there is full agreement between the back-translated version and the original version or not, and all discrepancies are discussed. If this results in changes in the translated questionnaire, a new back-translation is performed and the process is repeated, until there are no important differences.
4. Involvement of relevant patients and healthy persons for *pre-testing* of the accepted translated version is traditionally recommended at this stage, but it can be an advantage with inputs from a smaller group (typically 5-10 persons) before the translated PROM is back-translated (i.e., after step 2), so problems related to wording and local culture can be discussed with non-professionals early in the process. Ideally, pre-testing is performed by cognitive interviews with healthy persons and patients concerning understandability, meaning and relevance of each item in the PROM. However, in many cases the patients (ideally 30-40 persons) are just asked to fill the questionnaire out and state if it is understandable. If certain items are often left blank or commented on, they are discussed by the panel and eventually adapted further. This does not provide as much information as cognitive interviews.
5. The final back-translated and adapted version is sent to the PROM originator, who can accept it or suggest changes to the panel.

## Box 2: Dual-panel translation.

1. Bilingual Panel: The actual translation is produced by a panel of typically 3-5 persons, fluent in both the target and the source language. The panel works together in consensus to produce the most appropriate translation. Emphasis is on a conceptually equivalent translation (i.e., the goal is to translate the meaning of the items where linguistic equivalence is of secondary importance). Panel members should represent the population the PROM is targeting in terms of age, gender, and sociodemographic characteristics. Professional translators and clinical research persons should generally be excluded, although one of the PROM developers can participate in order to explain possible contextual questions regarding the generation of items.
2. Lay Panel: The translated PROM produced by the bilingual panel is then assessed by a panel of 'lay persons' who are locals in the target setting. These persons are not proficient in the original source language and they have no relationship to the disease or disorder covered by the PROM. The Lay Panel discusses the items as a group, rewording items if deemed necessary. They may suggest testing out alternative wordings of items with actual patients in cognitive debriefing interviews, which is the next step in the translation process.
3. Cognitive debriefing interviews: Individual face-to-face interviews are conducted with a series of relevant patients in the target setting by a qualified interviewer. The interviewee is asked to complete the translated PROM in a "talk-out-loud" manner in the presence of the interviewer, but as though he or she were alone. Any problems are noted by the interviewer who probes the 'understandability' and relevance of the questions.



Details of recorded information:

For this study, the following information was recorded for each translated version of these 61 PROMs:

First, the method of translation was identified (e.g., forward-backward translation, dual-panel translation, or other methods).

If the dual-panel translation method had not been used, the articles were scrutinized for whether the researchers had tested ease of completion, understandability, and transfer of the meaning of the items using laypersons and patients in groups and single interviews. Moreover, if problems were identified in the groups or single person interviews, were the necessary modifications conducted, so the wording and meaning of the items functioned well in the new language context? In addition, it was recorded if the final version of the translated PROM had been discussed with relevant patients for functionality and relevance.

Second, it was assessed whether test of unidimensionality and DIF had been performed in a dataset in the new language setting by an IRT method or by confirmatory factor analysis (CFA).

Finally, it was assessed if tests of cross-cultural construct validity had been conducted (i.e., test of DIF across the different language versions of the PROM with datasets from the original version and the translated version). This means that validity should be tested in each dataset and the combined (pooled) dataset using modern test theory.

Supplementary: Tabel 1-9:

Neck PROMs translation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
<b>NDI</b>									
Neck Disability Index									
Arabic (Shaheen et al. 2013) (1)	No	Yes	No	Yes	Yes	Yes	No	No	
Brazilian-Portuguese (Cook et al. 2006) (2)	No	Yes	No	No	No	No	No	No	
Chinese (Wu et al. 2010) (3)	No	Yes	No	Test	Yes	Unclear	No	No	
Danish (Lauridsen et al. 2017) (4)	No	Yes, but undocumented.	No	No, not documented	No	No	Yes	No	Apparently compared to a translation by the Mapigroup ( <a href="http://www.mapigroup.com/Services/Linguistic-validation">www.mapigroup.com/Services/Linguistic-validation</a> ), no longer available from the indicated homepage
Dutch (Jorritsma et al. 2010) (5)	No	Yes, see comment	No	Yes	Yes	Yes	No	No	Back translator was a spine researcher who must know the English version
Dutch (Ailliet et al. 2013) (6)	No	No	Yes, see note	Yes	Yes	Yes	Yes	No	Backtranslation of an unpublished Dutch version
Finnish (Salo et al. 2010) (7)	No	Yes, see comment	No	No	No	No	No	No	Translated version was compared to an unauthorized existing Finnish translation and a consensus was made
French (Wlodyka-Demaille et al. 2002) (8)	No	Yes	No	Yes	Unclear	Yes	No	No	
German (Swanenburg et al. 2014a) (9)	No	Yes	No	Test	Yes	No	No	No	
Greek (Trouli et al. 2008) (10)	No	Yes	No	Yes	Yes	Yes	No	No	
Hebrew	No	Yes	No	Test	Yes	No	No	No	

(Shashua et al. 2016) (11)									
Iranian (Mousavi et al. 2007) (12)	No	Yes	No	Yes	Yes	Yes	No	No	
Italian (Monticone et al. 2012a) (13)	No	Yes	No	Yes	Yes	No	No	No	
Japanese (Nakamaru et al. 2012) (14)	No	Yes	No	Yes	Yes	Yes	No	No	
Japanese (Takeshita et al. 2012) (15)	No	Yes, but numbers of translators not specified	No	Yes, but unclear	Yes	Yes	No	No	
Korean (Song et al. 2010) (16)	No	Yes	No	Yes	Yes	Yes	No	No	
Marathi (Joseph et al. 2015) (17)	No	Yes	No	Yes	Yes	Yes	No	No	
Polish (Misterska et al. 2011) (18)	No	Yes	No	No	No	No	No	No	
Polish (Guzy et al. 2013) (19)	No	Yes	No	Yes	Yes	Unclear	Yes	No	
Portuguese (Cruz et al. 2015) (20)	No	No	Yes, an expert group reviewed the earlier version and found it OK	Yes	Yes	No	No	No	The original translation is unpublished but was available from <a href="http://www.mapigroup.com/Services/Linguistic-validation">www.mapigroup.com/Services/Linguistic-validation</a> (no more available)
Russian (Bakhtadze et al. 2015) (21)	No	Yes	No	No	No	No	No	No	
Serbian (Jovicic et al. 2018) (22)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish (Ortega et al. 2008) (23)	No	Yes	No	Unclear	Unclear	Unclear	No	No	
Taiwanese (Lue et al. 2018) (24)	No	Yes	No	Yes	Yes	Yes	No	No	
Thai (Uthaikhup et al. 2011) (25)	No	Yes	No	Test	Yes	No	No	No	

Turkish (Aslan et al. 2009) (26)	No	Yes	No	Yes	Yes	Yes	No	No	
Turkish (Kesiktas et al. 2012) (27)	No	Yes	No	Yes	Yes	Yes	No	No	
Urdu (Farooq et al. 2017) (28)	No	Yes	No	Yes	Yes	Yes	No	No	

1. Shaheen AA, Omar MT, Vernon H. Cross-cultural adaptation, reliability, and validity of the Arabic version of neck disability index in patients with neck pain. *Spine (Phila Pa 1976)*. 2013;38(10):E609-15.
2. Cook C, Richardson JK, Braga L, Menezes A, Soler X, Kume P, et al. Cross-cultural adaptation and validation of the Brazilian Portuguese version of the Neck Disability Index and Neck Pain and Disability Scale. *Spine (Phila Pa 1976)*. 2006;31(14):1621-7.
3. Wu S, Ma C, Mai M, Li G. Translation and validation study of Chinese versions of the neck disability index and the neck pain and disability scale. *Spine (Phila Pa 1976)*. 2010;35(16):1575-9.
4. Lauridsen HH, O'Neill L, Kongsted A, Hartvigsen J. The Danish Neck Disability Index: New Insights into Factor Structure, Generalizability, and Responsiveness. *Pain Pract*. 2017;17(4):480-93.
5. Jorritsma W, de Vries GE, Geertzen JH, Dijkstra PU, Reneman MF. Neck Pain and Disability Scale and the Neck Disability Index: reproducibility of the Dutch Language Versions. *Eur Spine J*. 2010;19(10):1695-701.
6. Ailliet L, Knol DL, Rubinstein SM, de Vet HC, van Tulder MW, Terwee CB. Definition of the construct to be measured is a prerequisite for the assessment of validity. The Neck Disability Index as an example. *J Clin Epidemiol*. 2013;66(7):775-82; quiz 82 e1-2.
7. Salo P, Ylinen J, Kautiainen H, Arkela-Kautiainen M, Hakkinen A. Reliability and validity of the finnish version of the neck disability index and the modified neck pain and disability scale. *Spine (Phila Pa 1976)*. 2010;35(5):552-6.
8. Wlodyka-Demaille S, Poiraudou S, Catanzariti JF, Rannou F, Fermanian J, Revel M. French translation and validation of 3 functional disability scales for neck pain. *Arch Phys Med Rehabil*. 2002;83(3):376-82.
9. Swanenburg J, Humphreys K, Langenfeld A, Brunner F, Wirth B. Validity and reliability of a German version of the Neck Disability Index (NDI-G). *Man Ther*. 2014;19(1):52-8.
10. Trouli MN, Vernon HT, Kakavelakis KN, Antonopoulou MD, Paganas AN, Lionis CD. Translation of the Neck Disability Index and validation of the Greek version in a sample of neck pain patients. *BMC Musculoskelet Disord*. 2008;9:106.
11. Shashua A, Geva Y, Levran I. Translation, Validation, and Crosscultural Adaptation of the Hebrew Version of the Neck Disability Index. *Spine (Phila Pa 1976)*. 2016;41(12):1036-40.
12. Mousavi SJ, Parnianpour M, Montazeri A, Mehdian H, Karimi A, Abedi M, et al. Translation and validation study of the Iranian versions of the Neck Disability Index and the Neck Pain and Disability Scale. *Spine (Phila Pa 1976)*. 2007;32(26):E825-31.
13. Monticone M, Ferrante S, Vernon H, Rocca B, Dal Farra F, Foti C. Development of the Italian Version of the Neck Disability Index: cross-cultural adaptation, factor analysis, reliability, validity, and sensitivity to change. *Spine (Phila Pa 1976)*. 2012;37(17):E1038-44.
14. Nakamaru K, Vernon H, Aizawa J, Koyama T, Nitta O. Crosscultural adaptation, reliability, and validity of the Japanese version of the neck disability index. *Spine (Phila Pa 1976)*. 2012;37(21):E1343-7.
15. Takeshita K, Hosono N, Kawaguchi Y, Hasegawa K, Isomura T, Oshima Y, et al. Validity, reliability and responsiveness of the Japanese version of the Neck Disability Index. *J Orthop Sci*. 2013;18(1):14-21.
16. Song KJ, Choi BW, Choi BR, Seo GB. Cross-cultural adaptation and validation of the Korean version of the neck disability index. *Spine (Phila Pa 1976)*. 2010;35(20):E1045-9.
17. Joseph SD, Bellare B, Vernon H. Cultural adaptation, reliability, and validity of neck disability index in Indian rural population: a Marathi version study. *Spine (Phila Pa 1976)*. 2015;40(2):E68-76.
18. Misturska E, Jankowski R, Glowacki M. Cross-cultural adaptation of the Neck Disability Index and Copenhagen Neck Functional Disability Scale for patients with neck pain due to degenerative and discopathic disorders. Psychometric properties of the Polish versions. *BMC Musculoskelet Disord*. 2011;12:84.
19. Guzy G, Vernon H, Polczyk R, Szpitalak M. Psychometric validation of the authorized Polish version of the Neck Disability Index. *Disabil Rehabil*. 2013;35(25):2132-7.
20. Cruz EB, Fernandes R, Carnide F, Domingues L, Pereira M, Duarte S. Cross-cultural adaptation and validation of the neck disability index to European Portuguese language. *Spine (Phila Pa 1976)*. 2015;40(2):E77-82.
21. Bakhtadze MA, Vernon H, Zakharova OB, Kuzminov KO, Bolotov DA. The Neck Disability Index-Russian Language Version (NDI-RU): A Study of Validity and Reliability. *Spine (Phila Pa 1976)*. 2015;40(14):1115-21.
22. Jovicic MD, Konstantinovic LM, Grgurevic AD, Milovanovic ND, Trajkovic G, Jovicic VZ, et al. Validation of the Neck Disability Index in Serbian Patients With Cervical Radiculopathy. *J Manipulative Physiol Ther*. 2018;41(6):496-502.
23. Andrade Ortega JA, Delgado Martinez AD, Almecija Ruiz R. Validation of the Spanish version of the Neck Disability Index. *Med Clin (Barc)* 2008;130(3):85-9.

24. Lue YJ, Chen CH, Chou SH, Lin CL, Cheng KI, Lu YM. Development and Validation of Taiwanese Version of the Neck Disability Index. *Spine (Phila Pa 1976)*. 2018;43(11):E656-E63.

25. Uthairakul S, Paungmalai A, Pirunsan U. Validation of Thai versions of the Neck Disability Index and Neck Pain and Disability Scale in patients with neck pain. *Spine (Phila Pa 1976)*. 2011;36(21):E1415-21.

26. Telci EA, Karaduman A, Yakut Y, Aras B, Simsek IE, Yagli N. The cultural adaptation, reliability, and validity of neck disability index in patients with neck pain: a Turkish version study. *Spine (Phila Pa 1976)*. 2009;34(16):1732-5.

27. Kesiktas N, Ozcan E, Vernon H. Clinimetric properties of the Turkish translation of a modified neck disability index. *BMC Musculoskelet Disord*. 2012;13:25.

28. Farooq MN, Mohseni-Bandpei MA, Gilani SA, Hafeez A. Urdu version of the neck disability index: a reliability and validity study. *BMC Musculoskelet Disord*. 2017;18(1):149.

Tabel 1: Translation, adaption and validation of neck-PROMs.

Shoulder PROMs translation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
<b>ASES</b>									
<i>American Shoulder and Elbow Surgeons for shoulder patients</i>									
Arabic (Yahia et al. 2011) (29)	No	Yes	No	Test	No	No	No	No	
Brazilian-Portuguese (Knaut et al. 2010) (30)	No	Yes	No	Yes	Yes	Yes	No	No	
Dutch (Felsch et al. 2019) (31)	No	Yes	No	Test	Yes	Yes	No	No	
Finnish (Piiitulainen et al. 2014) (32)	No	Yes	No	No	No	No	No	No	
Italian (Padua et al. 2010) (33)	No	Yes	No	No	No	No	No	No	
Spanish (Vrotsou et al. 2016) (34)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Spanish	No	Yes	No	Yes	Yes	Yes	No	No	

(Policastro et al. 2019) (35)									
<b>Constant Murley Score</b>									
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Brazilian Portuguese (Barreto et al. 2015) (36)	No	Yes	No	Test	Yes	Yes	No	No	
Chinese (Yao et al. 2017) (37)	No	Yes	No	Test	Yes	Yes	No	No	
Danish (Moeller et al. 2014) (38)	No	Yes	No	Yes	Yes	Yes	No	No	
<b>DASH</b> <i>Disabilities of the arm, shoulder and hand</i>									
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Chinese (Lee et al 2004, and Lee et al. 2005) (39)	No	No	Yes, direct	No	No	No	No	No	
Chinese (Chen et al. 2015) (40)	No	Yes	No	No	No	No	No	No	
Chinese (Chan et al. 2019) (41)	No	Yes	No	Yes	Yes	Yes	No	No	
Danish (Schönnemann et al. 2011) (42)	?	?	?	?	?	?	?	?	No published translation article
German	No	Yes	No	No	No	No	No	No	

(Offenbacher et al. 2002) (43)									
Greek (Themistocleous et al. 2006) (44)	No	Yes	No	No	No	No	No	No	
Igbo (Ibikunle et al. 2017) (45)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Italian (Padua R et al 2003, and Franchignoni et al. 2010) (46)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Korean (Lee et al. 2008) (47)	No	Yes	No	Yes	Yes	Yes	No	No	
Nepali (Sudarshan et al. 2019) (48)	No	Yes	No	Yes	Yes	Yes	No	No	
Norwegian (Finsen V et al 2008, and Haldorsen et al. 2014) (49)	No	No	Yes	No	No	No	No	No	
Persian (Mousavi et al. 2008) (50)	No	Yes	No	Yes	Yes	Yes	No	No	
Portuguese (Orfale AG et al 2005, and Cheng et al. 2009) (51)	No	Yes	No	Yes	Yes	Yes	No	No	
Swedish (Atroshi et al. 2000) (52)	No	Yes	No	Yes	Yes	Yes	No	No	
Swedish (Atroshi I et al 2000, and Gummeson et al. 2003) (53)	No	Yes	No	Yes	Yes	Yes	No	No	
Tamil (Srikesavan et al. 2019) (54)	No	Yes	No	Test	Yes	No	No validation	No validation	
Thai (Tongprasert et al. 2014) (55)	No	Yes	No	Test	Yes	Yes	No	No	
Thai	No	Yes	No	Yes	Yes	Yes	No	No	

(Jianmongkol S et al 2011) (56)									
Turkish (Kitis et al. 2009) (57)	?	?	?	?	?	?	?	?	No translation articles published in English, German or Nordic languages
Yoruba (Odole AC et al 2016) (58)	No	Yes	No	Yes	Yes	Yes	No	No	

**OISS**  
Oxford Instability Shoulder Score

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Dutch (van der Linde et al. 2015) (59)	No	Yes	No	Yes	Yes	Yes	No	No	
Italian (Mazzoni et al. 2018) (60)	No	Yes	No	Yes	Yes	Yes	No	No	
Norwegian (Skare et al. 2013) (61)	No	Yes	No	No	No	No	No	No	
Turkish (Sonmezer et al. 2018) (62)	No	Yes	No	Yes	Yes	Yes	Yes	No	

**OSS**  
Oxford Shoulder Score

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Brazilian-Portuguese	No	Yes	No	Test	Yes	Yes	No	No	



(Lima et al. 2016) (63)									
Chinese (Xu et al. 2015) (64)	No	Yes	No	Yes	Yes	Yes	No	No	
Danish (Frich et al. 2011) (65)	No	Yes	No	No	No	No	No	No	
Dutch (Berendes et al. 2010) (66)	No	Yes	No	Yes	Yes	Yes	No	No	
French (Tuton et al. 2016) (67)	No	Yes	No	Yes	Yes	Yes	No	No	
German (Huber et al. 2004) (68)	No	Yes	No	Test	Yes	No	No	No	
Italian (Murena et al. 2010) (69)	No	Yes	No	Yes	Yes	Yes	No	No	
Korean (Roh et al. 2012) (70)	No	Yes	No	Test	Yes	No	No	No	
Persian (Ebrahimzadeh et al. 2015a) (71)	No	Yes	No	No	No	No	No	No	
Persian (Naghdi et al. 2015) (72)	No	Yes	No	Yes	Yes	Yes	No	No	
Portuguese (Goncalves et al. 2018) (73)	No	Yes	No	Yes	Yes	Yes	No	No	
Romanian (Haragus et al. 2018a) (74)	Not described	Not described	Not described	Not described	Not described	Not described	No	No	
Spanish (Torres-Lacomba et al. 2015) (75)	No	Yes	No	Yes	Yes	Yes	No	No	
Turkish (Tugay et al. 2010) (76)	No	Yes	No	Test	Yes	No	No	No	

**PROMIS UE**

Patient-Reported Outcomes Measurement Information System Upper Extremity

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Dutch (Voshaar et al 2012, and Bruggen et al. 2019) (77) <i>v2.0 46 items</i>	No	Yes	No	Yes	Yes	Yes	No test, but yes in linked reference	No test, no cross-cultural DIF in linked reference	
German (Liegl et al. 2018) (78) <i>v1.2 16 items</i>	No	Yes	No	Yes	Yes	Yes	Yes	No	
Spanish (Hays et al. 2013) (79)	Not described	Not described	Not described	Not described	Not described	-Not described	Not described	Not described	-

**Q-DASH**  
*Quick-DASH*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Chinese (Cao et al. 2019) (80)	No	Yes	No	Yes	Yes	Yes	No	No	
Danish (Schönnemann, Eggers, 2016) (81)	?	?	?	?	?	?	No	No	No information about translation
Dutch (Iordens et al. 2017) (82)	?	?	?	?	?	?	?	?	No information about translation
French (Fayad et al. 2009) (83)	No	No	No	No	Yes	No	No	No	Not translated but the French full version was used
Italian (Franchignoni et al. 2011) (84)	?	?	?	?	?	?	Yes	No	No information about translation

Japanese (Imaeda et al. 2006) (85)	?	?	?	?	?	?	No	No	No information about translation
Swedish (Gummesson et al. 2006) (86)	?	?	?	?	?	?	No	No	No information about translation

### Rowe Score

The Rowe Score for Instability

	Dual panel translation	Forward- backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Brazilian- Portuguese (Marcondes et al. 2012a) (87)	No	Yes	No	Yes	Yes	Yes	Not tested	Not tested	

### Rowe score, modified PROMs

Brazilian- Portuguese (Marcondes et al. 2012b) (88) <i>For overhead athletes</i>	No	Yes	No	Yes	Yes	Yes	Not tested	Not tested	
--	----	-----	----	-----	-----	-----	---------------	------------	--

### SANE

*Single Assessment Numeric Evaluation score, shoulder*

	Conditions validated (n)	Different phases	Normals validated (n)	IRT method	Comparison with other PROMs	Other factor analyses	Domain aggregation	Test-retest reliability	Cronbach' s $\alpha$
Dutch (Theeuwes et al. 2019) (89)	No	Yes	No	Yes	Yes	Yes	No	No	

### SPADI

*Shoulder Pain and Disability Index*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Arabic (Alsanawi et al. 2015) (90)	No	Yes	No	Yes	Yes	Yes	No	No	
Brazilian-Portuguese (Martins et al. 2010) (91)	No	Yes	No	Yes	Yes	Yes	No	No	
Chinese (Yao et al. 2017) (92)	No	Yes	No	Yes	Yes	Yes	No	No	
Chinese (Wang et al. 2018) (93)	No	Yes	No	Yes	Yes	Yes	No	No	
Danish (Christiansen et al. 2013) (94)	No	Yes	No	No	No	No	No	No	
Dutch (Graaf et al. 2015) (95)	?	?	?	?	?	?	No	No	No translation article accessible
German (Angst et al. 2007) (96)	No	Yes	No	Yes	Yes	Yes	No	No	
Greek (Vrouva et al. 2016) (97)	No	Yes	No	Yes	Yes	Yes	No	No	
Italian (Marchese et al. 2012) (98)	No	Yes	No	No	No	No	No	No	
Nepali (Sudarshan et al. 2019) (99)	No	Yes	No	Yes	Yes	Yes	No	No	
Persian (Ebrahimzadeh et al. 2015b) (100)	No	Yes	No	Yes	Yes	Yes	No	No	
Slovene (Jamnik, Spevak, 2008) (101)	No	Yes	No	No	No	No	No	No	
Spanish (Torres-Lacomba et al. 2015) (75)	No	Yes	No	Yes	Yes	Yes	No	No	

Spanish (Membrilla-Mesa et al. 2015) (102)	No	Yes	No	Yes	Yes	Yes	No	No	
Tamil (Jeldi et al. 2012) (103)	No	Yes	No	Test	Yes	No	No	No	
Thai (Phongamwong, Choosakde, 2015) (104)	No	Yes	No	Test	Yes	No	No	No	

**SST**  
The Simple Shoulder Test

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Neto et al. 2013) (105)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Dutch (Kampen et al. 2012) (106)	No	Yes	No	?	?	?	Yes	No	
Italian (Marchese et al. 2012) (98)	No	Yes	No	No	No	No	No	No	
Persian (Naghdi et al. 2015) (72)	No	Yes	No	Yes	Yes	Yes	No	No	
Persian (Ebrahimzadeh et al. 2016) (107)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish (Membrilla-Mesa et al. 2015) (108)	No	Yes	No	No	No	No	No	No	

**WORC**  
The Western Ontario Rotator Cuff Index

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Lopes et al 2006, and Lopes et al. 2008) (109)	No	Yes	No	Yes	Yes	Yes	No		
Canadian-French (St-Pierre et al. 2015) (110)	No	Yes	No	Yes	Yes	Yes	No	No	
Chinese (Wang et al. 2017) (111)	No	Yes	No	Yes	Yes	Yes	No	No	
Dutch (Wiertsema et al. 2013) (112)	No	Yes	No	No	No	No	No	No	
Dutch (Wessel et al. 2013) (113)	No	Yes	No	Yes	Yes	Yes	No	No	
English (Kirkley et al. 2003) (114)									
English (Wessel et al. 2005) (115)									
Japanese (Kawabata et al. 2013) (116)	No	Yes	No	No	No	No	No	No	
Persian (Mousavi et al. 2009) (117)	No	Yes	No	Yes	Yes	Yes	No	No	
Polish (Bejer et al. 2018) (118)	No	Yes	No	Yes	Yes	Yes	No	No	
Swedish (Zhaentan et al. 2016) (119)	?	?	?	?	?	?	No	No	No accessible translation article
Turkish (El et al. 2006) (120)	No	Yes	No	Yes	Yes	No	No	No	

WOSI

*The Western Ontario Shoulder Instability Index*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaptation)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Barbosa et al. 2012) (121)	No	Yes	No	Yes	Yes	Yes	No	No	
Canadian- and Swiss-French (Gaudelli et al. 2015) (122)	No	Yes	No	No	No	No	No	No	
Danish (Eshoj et al. 2017) (123)	No	Yes	No	Yes	Yes	Yes	No	No	Danish version translated from Swedish version, merged with an unpublished Danish translation from English and back-translated into Swedish AND English !
French (Perrin et al. 2017) (124)	No	Yes	No	Yes	Yes	Yes	No	No	
German (Hofstaetter et al. 2010) (125)	No	Yes	No	Yes	Yes	Yes	No	No	
Hebrew (Gottlieb, Springer, 2019) (126)	No	Yes, but only one translator	No	Yes	Yes	Yes	No	No	
Italian (Cacchio et al. 2012a) (127)	No	Yes	No	Yes	Yes	Yes	No	No	
Japanese (Hatta et al. 2011) (128)	No	Yes, but only one translator	No	No	No	No	No	No	
Norwegian	No	Yes	No	No	No	No	No	No	

(Skare et al. 2013) (61)									
Spanish (Yuguero et al. 2016) (129)	No	Yes	No	Yes	Yes	Yes	No	No	
Swedish (Salomonsson et al. 2009) (130)	No	Yes	No	Yes	Yes	Yes	No	No	
Turkish (Basar et al. 2017) (131)	No	Yes	No	Test	Yes	No	No	No	

29. Yahia A, Guermazi M, Khmekhem M, Ghroubi S, Ayedi K, Elleuch MH. Translation into Arabic and validation of the ASES index in assessment of shoulder disabilities. *Ann Phys Rehabil Med.* 2011;54(2):59-72.

30. Knaut LA, Moser AD, Melo Sde A, Richards RR. Translation and cultural adaptation to the portuguese language of the American Shoulder and Elbow Surgeons Standardized Shoulder assessment form (ASES) for evaluation of shoulder function. *Rev Bras Reumatol.* 2010;50(2):176-89.

31. Felsch QTM, Sievert P, Schotanus MGM, Jansen EJP. The Dutch version of the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form is a reliable and valid questionnaire for shoulder problems. *JSES Open Access.* 2019;3(3):213-8

32. Piitulainen K, Paloneva J, Ylinen J, Kautiainen H, Hakkinen A. Reliability and validity of the Finnish version of the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, patient self-report section. *BMC Musculoskelet Disord.* 2014;15:272.

33. Padua R, Padua L, Ceccarelli E, Bondi R, Alvitto F, Castagna A. Italian version of ASES questionnaire for shoulder assessment: cross-cultural adaptation and validation. *Musculoskelet Surg.* 2010;94 Suppl 1:S85-90.

34. Vrotsou K, Cuellar R, Silio F, Rodriguez MA, Garay D, Busto G, et al. Patient self-report section of the ASES questionnaire: a Spanish validation study using classical test theory and the Rasch model. *Health Qual Life Outcomes.* 2016;14(1):147.

35. Policastro PO, Pierobon A, Perez J, Novoa GA, Calvo Delfino M, Sajfar ME, et al. Cross-cultural adaptation and validation of the Argentine "American Shoulder and elbow surgeons, patient self-report section" questionnaire. *Musculoskelet Sci Pract.* 2019;43:37-44

36. Barreto RP, Barbosa ML, Balbinotti MA, Mothes FC, da Rosa LH, Silva MF. The Brazilian version of the Constant-Murley Score (CMS-BR): convergent and construct validity, internal consistency, and unidimensionality. *Rev Bras Ortop.* 2016;51(5):515-20.

37. Yao M, Yang L, Cao ZY, Cheng SD, Tian SL, Sun YL, et al. Chinese version of the Constant-Murley questionnaire for shoulder pain and disability: a reliability and validation study. *Health Qual Life Outcomes.* 2017;15(1):178.

38. Ban I, Troelsen A, Christiansen DH, Svendsen SW, Kristensen MT. Standardised Test Protocol (Constant Score) for Evaluation of Functionality in Patients With Shoulder Disorders. *Dan Med J* 2013; 60(4):A4608, and Moeller AD, Thorsen RR, Torabi TP, Bjoerkman AS, Christensen EH, Maribo T, et al. The Danish version of the modified Constant-Murley shoulder score: reliability, agreement, and construct validity. *J Orthop Sports Phys Ther.* 2014;44(5):336-40.

39. Lee EWC, Lau JSY, Chung MMH, Li APS, Lo SK. Evaluation of the Chinese Version of the Disability of the Arm, Shoulder and Hand (DASH-HKPWH): Cross-Cultural Adaptation Process, Internal Consistency and Reliability Study. *J Hand Ther* 2004;17(4):417-23, and Lee EW, Chung MM, Li AP, Lo SK. Construct validity of the Chinese version of the disabilities of the arm, shoulder and hand questionnaire (DASH-HKPWH). *J Hand Surg Br.* 2005;30(1):29-34.

40. Chen H, Ji X, Zhang W, Zhang Y, Zhang L, Tang P. Validation of the simplified Chinese (Mainland) version of the Disability of the Arm, Shoulder, and Hand questionnaire (DASH-CHNPLAGH). *J Orthop Surg Res.* 2015;10:76.

41. R KYC, Leung YC, F KLL, C XSF, A KPC, T KCL, et al. Reliability and validity of the Chinese (Queen Mary Hospital, Hong Kong version) of the Disabilities of the Arm, Shoulder and Hand on patients with upper extremity musculoskeletal disorders in Hong Kong. *Hong Kong J Occup Ther.* 2019;32(1):62-8

42. Schonemann JO, Larsen K, Hansen TB, Soballe K. Reliability and validity of the Danish version of the disabilities of arm, shoulder, and hand questionnaire in patients with fractured wrists. *J Plast Surg Hand Surg.* 2011;45(1):35-9.

43. Offenbacher M, Ewert T, Sangha O, Stucki G. Validation of a German version of the 'Disabilities of Arm, Shoulder and Hand' questionnaire (DASH-G). *Z Rheumatol.* 2003;62(2):168-77.

44. Themistocleous GS, Goudelis G, Kyrou I, Chloros GD, Krokos A, Galanos A, et al. Translation into Greek, cross-cultural adaptation and validation of the Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH). *J Hand Ther.* 2006;19(3):350-7.

45. PO Ibikunle AO, CO Akosile, AC Ezeakunne. Cross-cultural adaptation and psychometric properties of the Nigerian (IGBO) version of the Disabilities of the Arm, Shoulder and Hand questionnaire (I-DASH). *Hand Therapy.* 2017;22(3):101-9.



46. Padua R, Padua L, Ceccarelli E, et al. Italian Version of the Disability of the Arm, Shoulder and Hand (DASH) Questionnaire. Cross-cultural Adaptation and Validation. *J Hand Surg Br* 2003;28 (2):179-86, and Franchignoni F, Giordano A, Sartorio F, Vercelli S, Pascariello B, Ferriero G. Suggestions for refinement of the Disabilities of the Arm, Shoulder and Hand Outcome Measure (DASH): a factor analysis and Rasch validation study. *Arch Phys Med Rehabil*. 2010;91(9):1370-7.
47. Lee JY, Lim JY, Oh JH, Ko YM. Cross-cultural adaptation and clinical evaluation of a Korean version of the disabilities of arm, shoulder, and hand outcome questionnaire (K-DASH). *J Shoulder Elbow Surg*. 2008;17(4):570-4.
48. Kc S, Sharma S, Ginn K, Almadi T, Subedi H, Reed D. Cross-cultural adaptation and measurement properties of the Nepali version of the DASH (disability of arm, shoulder and hand) in patients with shoulder pain. *Health Qual Life Outcomes*. 2019;17(1):51.
49. Finsen V. Norwegian Version of the DASH Questionnaire for Examination of the Arm Shoulders and Hand. *Tidsskr Nor Laegeforen* 2008;128 (9):1070, and Haldorsen B, Svege I, Roe Y, Bergland A. Reliability and validity of the Norwegian version of the Disabilities of the Arm, Shoulder and Hand questionnaire in patients with shoulder impingement syndrome. *BMC Musculoskelet Disord*. 2014;15:78.
50. Mousavi SJ, Parnianpour M, Abedi M, Askary-Ashtiani A, Karimi A, Khorsandi A, et al. Cultural adaptation and validation of the Persian version of the Disabilities of the Arm, Shoulder and Hand (DASH) outcome measure. *Clin Rehabil*. 2008;22(8):749-57.
51. Orfale AG, Araújo PMP, Ferraz MB, Natour J. Translation into Brazilian Portuguese, cultural adaptation and evaluation of the reliability of the Disabilities of the Arm, Shoulder and Hand Questionnaire. *Br J Med Biol Res* 2005;38:293-302, and Cheng HM, Sampaio RF, Mancini MC, Fonseca ST, Cotta RM. Disabilities of the arm, shoulder and hand (DASH): factor analysis of the version adapted to Portuguese/Brazil. *Disabil Rehabil*. 2008;30(25):1901-9.
52. Atroshi I, Gummesson C, Andersson B, Dahlgren E, Johansson A. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: reliability and validity of the Swedish version evaluated in 176 patients. *Acta Orthop Scand*. 2000;71(6):613-8.
53. Atroshi I, Gummesson C, Andersson B, Dahlgren E, Johansson A. The Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Questionnaire: Reliability and Validity of the Swedish Version Evaluated in 176 Patients. *Acta Orthop Scand* 2000; 71(6):613-8, and Gummesson C, Atroshi I, Ekdahl C. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. *BMC Musculoskelet Disord*. 2003;4:11.
54. Srikesavan C, Bhardwaj P, Gobinath K, Ramalingam AT, Sabapathy S. Tamil Translation, Cross-Cultural Adaptation, and Pilot Testing of the Disabilities of Arm, Shoulder, and Hand Questionnaire. *Indian J Orthop*. 2019;53(5):602-6.
55. Tongprasert S, Rapipong J, Buntragulpoontawe M. The cross-cultural adaptation of the DASH questionnaire in Thai (DASH-TH). *J Hand Ther*. 2014;27(1):49-54.
56. Jianmongkol S, Kosuwon W, Thammaroj T, Boonard M. Validity of the Thai Version of Disability of the Arm, Shoulder and Hand Questionnaire (KKU-DASH) in Patients With Brachial Plexus Injury. *J Med Assoc Thai* 2011;94(1):71-7.
57. Kitis A, Celik E, Aslan UB, Zencir M. DASH questionnaire for the analysis of musculoskeletal symptoms in industry workers: a validity and reliability study. *Appl Ergon*. 2009;40(2):251-5.
58. Odole AC, Odunaiya NA, Mbaïke CF, Ibikunle PO, Akinseloyin AA, Olaseinde OR. Nigerian (Yoruba) version of Disabilities of the Arm, Shoulder and Hand questionnaire (DASH-Y): Cross-cultural adaptation and initial validation. *Hand Therapy* 2016;21:140-150.
59. van der Linde JA, van Kampen DA, van Beers LW, van Deurzen DF, Terwee CB, Willems WJ. The Oxford Shoulder Instability Score; validation in Dutch and first-time assessment of its smallest detectable change. *J Orthop Surg Res*. 2015;10:146.
60. Mazzoni B, Cucchi D, Giovannelli T, Paci M, Arrigoni P, Nicoletti S. Translation, cross-cultural adaptation, and validation of the Italian version of the Oxford Shoulder Instability Score. *Int Orthop*. 2019;43(9):2125-9.
61. Skare O, Liavaag S, Reikeras O, Mowinckel P, Brox JI. Evaluation of Oxford instability shoulder score, Western Ontario shoulder instability index and Euroqol in patients with SLAP (superior labral anterior posterior) lesions or recurrent anterior dislocations of the shoulder. *BMC Res Notes*. 2013;6:273.
62. Sonmezer E, Yosmaoglu HB, Dogan CD. The reliability and validity of the Turkish version of the oxford shoulder instability score. *Disabil Rehabil*. 2018:1-6.
63. Lima Eda S, Natour J, Moreira E, Jones A. Translation, cultural adaptation and reproducibility of the Oxford Shoulder Score questionnaire for Brazil, among patients with rheumatoid arthritis. *Sao Paulo Med J*. 2016;134(1):40-6.
64. Xu X, Wang F, Wang X, Wei X, Wang Z. Chinese cross-cultural adaptation and validation of the Oxford shoulder score. *Health Qual Life Outcomes*. 2015;13:193.
65. Frich LH, Noergaard PM, Brorson S. Validation of the Danish version of Oxford Shoulder Score. *Dan Med Bull*. 2011;58(11):A4335.
66. Berendes T, Pilot P, Willems J, Verburg H, te Slaa R. Validation of the Dutch version of the Oxford Shoulder Score. *J Shoulder Elbow Surg*. 2010;19(6):829-36.
67. Tuton D, Barbe C, Salmon JH, Drame M, Nerot C, Ohl X. Transcultural validation of the Oxford Shoulder Score for the French-speaking population. *Orthop Traumatol Surg Res*. 2016;102(5):555-8.
68. Huber W, Hofstaetter JG, Hanslik-Schnabel B, Posch M, Wurnig C. The German version of the Oxford Shoulder Score--cross-cultural adaptation and validation. *Arch Orthop Trauma Surg*. 2004;124(8):531-6.
69. Murena L, Vulcano E, D'Angelo F, Monti M, Cherubino P. Italian cross-cultural adaptation and validation of the Oxford Shoulder Score. *J Shoulder Elbow Surg*. 2010;19(3):335-41.
70. Roh YH, Noh JH, Kim W, Oh JH, Gong HS, Baek GH. Cross-cultural adaptation and validation of the Korean version of the Oxford shoulder score. *Arch Orthop Trauma Surg*. 2012;132(1):93-9.
71. Ebrahimzadeh MHM, Birjandinejad AM, Razi SM, Mardani-Kivi MM, Reza Kachooei AM. Oxford Shoulder Score: A Cross-Cultural Adaptation and Validation Study of the Persian Version in Iran. *Iran J Med Sci*. 2015;40(5):404-10.

72. Naghdi S, Nakhostin Ansari N, Rustaie N, Akbari M, Ebadi S, Senobari M, et al. Simple shoulder test and Oxford Shoulder Score: Persian translation and cross-cultural validation. *Arch Orthop Trauma Surg.* 2015;135(12):1707-18.
73. Goncalves RS, Caldeira CQ, Rodrigues MV, Felicia SC, Cavalheiro LM, Ferreira PL. Cross-cultural adaptation and validation of the Portuguese version of the Oxford Shoulder Score (OSS). *Acta Reumatol Port.* 2018;43(2):102-8.
74. Haragus H, Prejbeanu R, Patrascu J, Faur C, Roman M, Melinte R, et al. Cross-cultural adaptation and validation of the Romanian Oxford Shoulder Score. *Medicine (Baltimore).* 2018;97(23):e10926.
75. Torres-Lacomba M, Sanchez-Sanchez B, Prieto-Gomez V, Pacheco-da-Costa S, Yuste-Sanchez MJ, Navarro-Brazalez B, et al. Spanish cultural adaptation and validation of the shoulder pain and disability index, and the oxford shoulder score after breast cancer surgery. *Health Qual Life Outcomes.* 2015;13:63.
76. Tugay U, Tugay N, Gelecek N, Ozkan M. Oxford Shoulder Score: cross-cultural adaptation and validation of the Turkish version. *Arch Orthop Trauma Surg.* 2011;131(5):687-94.
77. Voshaar MAO, Klooster PMT, Taal E, Krishnan E, van de Laar MA. Dutch Translation and Cross-Cultural Adaptation of the PROMIS® Physical Function Item Bank and Cognitive Pre-Test in Dutch Arthritis Patients. *Arthritis Res Ther* 2012;14(2):R47, and van Bruggen SGJ, Lameijer CM, Terwee CB. Structural validity and construct validity of the Dutch-Flemish PROMIS((R)) physical function-upper extremity version 2.0 item bank in Dutch patients with upper extremity injuries. *Disabil Rehabil.* 2019;1-9.
78. Liegl G, Rose M, Correia H, Fischer HF, Kanlidere S, Mierke A, et al. An initial psychometric evaluation of the German PROMIS v1.2 Physical Function item bank in patients with a wide range of health conditions. *Clin Rehabil.* 2018;32(1):84-93.
79. Hays RD, Spritzer KL, Amtmann D, Lai JS, Dewitt EM, Rothrock N, et al. Upper-extremity and mobility subdomains from the Patient-Reported Outcomes Measurement Information System (PROMIS) adult physical functioning item bank. *Arch Phys Med Rehabil.* 2013;94(11):2291-6.
80. Cao S, Zhou R, Zhou H, Chen Y, Cui H, Lu Z, et al. Reliability and validity of Simplified Chinese version of Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) questionnaire: cross-cultural adaptation and validation. *Clin Rheumatol.* 2019;38(11):3281-7.
81. Schonnemann JO, Eggers J. Validation of the Danish version of the Quick-Disabilities of Arm, Shoulder and Hand Questionnaire. *Dan Med J.* 2016;63(12).
82. Iordens GIT, Den Hartog D, Tuinebreijer WE, Eygendaal D, Schep NWL, Verhofstad MHJ, et al. Minimal important change and other measurement properties of the Oxford Elbow Score and the Quick Disabilities of the Arm, Shoulder, and Hand in patients with a simple elbow dislocation; validation study alongside the multicenter FuncSiE trial. *PLoS One.* 2017;12(9):e0182557.
83. Fayad F, Lefevre-Colau MM, Gautheron V, Mace Y, Fermanian J, Mayoux-Benhamou A, et al. Reliability, validity and responsiveness of the French version of the questionnaire Quick Disability of the Arm, Shoulder and Hand in shoulder disorders. *Man Ther.* 2009;14(2):206-12.
84. Franchignoni F, Ferriero G, Giordano A, Sartorio F, Vercelli S, Brigatti E. Psychometric properties of QuickDASH - a classical test theory and Rasch analysis study. *Man Ther.* 2011;16(2):177-82.
85. Imaeda T, Toh S, Wada T, Uchiyama S, Okinaga S, Kusunose K, et al. Validation of the Japanese Society for Surgery of the Hand Version of the Quick Disability of the Arm, Shoulder, and Hand (QuickDASH-JSSH) questionnaire. *J Orthop Sci.* 2006;11(3):248-53.
86. Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (QuickDASH): validity and reliability based on responses within the full-length DASH. *BMC Musculoskelet Disord.* 2006;7:44.
87. Marcondes FB, de Vasconcelos RA, Marchetto A, de Andrade AL, Zoppi A, Etchebehere M. Translation and cross-cultural adaptation of the rowe score for portuguese. *Acta Ortop Bras.* 2012;20(6):346-50.
88. Marcondes FB, de Vasconcelos RA, Marchetto A, de Andrade AL, Filho AZ, Etchebehere M. Translation to Portuguese Language and Cross-Cultural Adaptation of the Modified Rowe Score for Overhead Athletes. *Rev Bras Ortop.* 2012;47(6):788-92.
89. Theeuwes DMJ, van der Steen MC, Bonneux IFM, Giesberts AME, Koot HWJ, Reijman M. Translation and evaluation of psychometric properties of the Dutch version of the Single Assessment and Numeric Evaluation Method (SANEM) in shoulder patients. *J Orthop Surg Res.* 2019;14(1):303.
90. Alsanawi HA, Alghadir A, Anwer S, Roach KE, Alawaji A. Cross-cultural adaptation and psychometric properties of an Arabic version of the Shoulder Pain and Disability Index. *Int J Rehabil Res.* 2015;38(3):270-5.
91. Martins J, Napoles BV, Hoffman CB, Oliveira AS. The Brazilian version of Shoulder Pain and Disability Index: translation, cultural adaptation and reliability. *Rev Bras Fisioter.* 2010;14(6):527-36.
92. Yao M, Yang L, Cao ZY, Cheng SD, Tian SL, Sun YL, et al. Translation and cross-cultural adaptation of the Shoulder Pain and Disability Index (SPADI) into Chinese. *Clin Rheumatol.* 2017;36(6):1419-26.
93. Wang W, Jia ZY, Liu J, Xie QY, Cui J, Zheng W, et al. Cross-cultural adaptation and validation of the Chinese version of the shoulder pain and disability index in patients with symptomatic shoulder pain: A prospective case series. *Medicine (Baltimore).* 2018;97(26):e11227.
94. Christiansen DH, Andersen JH, Haahr JP. Cross-cultural adaptation and measurement properties of the Danish version of the Shoulder Pain and Disability Index. *Clin Rehabil.* 2013;27(4):355-60.
95. Thoomes-de Graaf M, Scholten-Peeters GG, Duijn E, Karel Y, Koes BW, Verhagen AP. The Dutch Shoulder Pain and Disability Index (SPADI): a reliability and validation study. *Qual Life Res.* 2015;24(6):1515-9.
96. Angst F, Goldhahn J, Pap G, Mannion AF, Roach KE, Siebertz D, et al. Cross-cultural adaptation, reliability and validity of the German Shoulder Pain and Disability Index (SPADI). *Rheumatology (Oxford).* 2007;46(1):87-92.
97. Vrouva S, Batistaki C, Koutsoumpa E, Kostopoulos D, Stamoulis E, Kostopanagioutou G. The Greek version of Shoulder Pain and Disability Index (SPADI): translation, cultural adaptation, and validation in patients with rotator cuff tear. *J Orthop Traumatol.* 2016;17(4):315-26.

98. Marchese C, Cristalli G, Pichi B, Manciocco V, Mercante G, Pellini R, et al. Italian cross-cultural adaptation and validation of three different scales for the evaluation of shoulder pain and dysfunction after neck dissection: University of California - Los Angeles (UCLA) Shoulder Scale, Shoulder Pain and Disability Index (SPADI) and Simple Shoulder Test (SST). *Acta Otorhinolaryngol Ital.* 2012;32(1):12-7.
99. Kc S, Sharma S, Ginn K, Almadi T, Reed D. Nepali translation, cross-cultural adaptation and measurement properties of the Shoulder Pain and Disability Index (SPADI). *J Orthop Surg Res.* 2019;14(1):284.
100. Ebrahimzadeh MH, Birjandinejad A, Golhasani F, Moradi A, Vahedi E, Kachooei AR. Cross-cultural adaptation, validation, and reliability testing of the Shoulder Pain and Disability Index in the Persian population with shoulder problems. *Int J Rehabil Res.* 2015;38(1):84-7.
101. Jamnik H, Spevak MK. Shoulder Pain and Disability Index: validation of Slovene version. *Int J Rehabil Res.* 2008;31(4):337-41.
102. Membrilla-Mesa MD, Cuesta-Vargas AI, Pozuelo-Calvo R, Tejero-Fernandez V, Martin-Martin L, Arroyo-Morales M. Shoulder pain and disability index: cross cultural validation and evaluation of psychometric properties of the Spanish version. *Health Qual Life Outcomes.* 2015;13:200.
103. Artaban Johnson Jeldi ALA, Appaswami Gurunatha Dhandapani, Kathryn Elizabeth Roach. Cross-cultural adaptation, reliability and validity of an Indian (Tamil) version for the Shoulder Pain and Disability Index. *Hong Kong Physiotherapy Journal.* 2012;30(2):99-104.
104. Phongamwong C, Choosakde A. Reliability and validity of the Thai version of the Shoulder Pain and Disability Index (Thai SPADI). *Health Qual Life Outcomes.* 2015;13:136.
105. Neto JO, Gesser RL, Steglich V, Bonilauri Ferreira AP, Gandhi M, Vissoci JR, et al. Validation of the Simple Shoulder Test in a Portuguese-Brazilian population. Is the latent variable structure and validation of the Simple Shoulder Test Stable across cultures? *PLoS One.* 2013;8(5):e62890.
106. van Kampen DA, van Beers LW, Scholtes VA, Terwee CB, Willems WJ. Validation of the Dutch version of the Simple Shoulder Test. *J Shoulder Elbow Surg.* 2012;21(6):808-14.
107. Ebrahimzadeh MH, Vahedi E, Baradaran A, Birjandinejad A, Seyyed-Hoseinian SH, Bagheri F, et al. Psychometric Properties of the Persian Version of the Simple Shoulder Test (SST) Questionnaire. *Arch Bone Jt Surg.* 2016;4(4):387-92.
108. Membrilla-Mesa MD, Tejero-Fernandez V, Cuesta-Vargas AI, Arroyo-Morales M. Validation and reliability of a Spanish version of Simple Shoulder Test (SST-Sp). *Qual Life Res.* 2015;24(2):411-6.
109. Lopes AD, Stadniky SP, Masiero D et al. Traducaao e adaptacao cultural do WORC: um questionario de qualidade de vida para alteracoes do manguito rotator. *Rev Bras Fisioter* 2006;10:309-315, and Lopes AD, Ciconelli RM, Carrera EF, Griffin S, Faloppa F, Dos Reis FB. Validity and reliability of the Western Ontario Rotator Cuff Index (WORC) for use in Brazil. *Clin J Sport Med.* 2008;18(3):266-72.
110. St-Pierre C, Dionne CE, Desmeules F, Roy JS. Reliability, validity, and responsiveness of a Canadian French adaptation of the Western Ontario Rotator Cuff (WORC) index. *J Hand Ther.* 2015;28(3):292-8; quiz 9.
111. Wang W, Xie QY, Jia ZY, Cui L, Liu D, Wang CR, et al. Cross-cultural translation of the Western Ontario Cuff Index in Chinese and its validation in patients with rotator cuff disorders. *BMC Musculoskelet Disord.* 2017;18(1):178.
112. Wiertsema SH, Rietberg MB, Hekman KM, Schothorst M, Steultjens MP, Dekker J. Reproducibility of the Dutch version of the Western Ontario rotator cuff Index. *J Shoulder Elbow Surg.* 2013;22(2):165-70.
113. Wessel RN, Wolterbeek N, Fermont AJ, van Mameren H, Sonneveld H, Griffin S, et al. The conceptually equivalent Dutch version of the Western Ontario Rotator Cuff Index (WORC)(c). *BMC Musculoskelet Disord.* 2013;14:362.
114. Kirkley A, Alvarez C, Griffin S. The development and evaluation of a disease-specific quality-of-life questionnaire for disorders of the rotator cuff: The Western Ontario Rotator Cuff Index. *Clin J Sport Med.* 2003;13(2):84-92.
115. Wessel J, Razmjou H, Mewa Y, Holtby R. The factor validity of the Western Ontario Rotator Cuff Index. *BMC Musculoskelet Disord.* 2005;6:22.
116. Kawabata M, Miyata T, Nakai D, Sato M, Tatsuki H, Kashiwazaki Y, et al. Reproducibility and validity of the Japanese version of the Western Ontario Rotator Cuff Index. *J Orthop Sci.* 2013;18(5):705-11.
117. Mousavi SJ, Hadian MR, Abedi M, Montazeri A. Translation and validation study of the Persian version of the Western Ontario Rotator Cuff Index. *Clin Rheumatol.* 2009;28(3):293-9.
118. Bejer A., Probachta M., Kulczyk M., Griffin S. The western ontario rotator cuff index (worc) -the polish language versio. The polish language version of the WORC. *Issue Rehabil. Orthop. Neurophysiol. Sport Promot.* 2017; 20: 20-29, and Bejer A, Probachta M, Kulczyk M, Griffin S, Domka-Jopek E, Plocki J. Validation of the Polish version of the Western Ontario Rotator Cuff Index in patients following arthroscopic rotator cuff repair. *BMC Musculoskelet Disord.* 2018;19(1):333.
119. Zhaeentan S, Legeby M, Ahlstrom S, Stark A, Salomonsson B. A validation of the Swedish version of the WORC index in the assessment of patients treated by surgery for subacromial disease including rotator cuff syndrome. *BMC Musculoskelet Disord.* 2016;17:165.
120. El O, Bircan C, Gulbahar S, Demiral Y, Sahin E, Baydar M, et al. The reliability and validity of the Turkish version of the Western Ontario Rotator Cuff Index. *Rheumatol Int.* 2006;26(12):1101-8.
121. Gisele Barbosa LL, Michele F. Saccol, Alberto Pocchini, Benno Ejnisman, Sharon Griffin. TRANSLATION AND CULTURAL ADAPTATION TO BRAZILIAN PORTUGUESE OF THE WESTERN ONTARIO SHOULDER INSTABILITY INDEX (WOSI). *Revista Brasileira de Medicina do Esporte.* 2012;18(1): .
122. Gaudelli C, Balg F, Godbout V, Pelet S, Djahangiri A, Griffin S, et al. Validity, reliability and responsiveness of the French language translation of the Western Ontario Shoulder Instability Index (WOSI). *Orthop Traumatol Surg Res.* 2014;100(1):99-103.

123. Eshoj H, Bak K, Blond L, Juul-Kristensen B. Translation, adaptation and measurement properties of an electronic version of the Danish Western Ontario Shoulder Instability Index (WOSI). *BMJ Open*. 2017;7(7):e014053.

124. Perrin C, Khiami F, Beguin L, Calmels P, Gresta G, Edouard P. Translation and validation of the French version of the Western Ontario Shoulder Instability Index (WOSI): WOSI-Fr. *Orthop Traumatol Surg Res*. 2017;103(2):141-9.

125. Hofstaetter JG, Hanslik-Schnabel B, Hofstaetter SG, Wurnig C, Huber W. Cross-cultural adaptation and validation of the German version of the Western Ontario Shoulder Instability index. *Arch Orthop Trauma Surg*. 2010;130(6):787-96.

126. Gottlieb U, Springer S. Translation and validation of a Hebrew version of the Western Ontario Shoulder Instability index. *J Orthop Surg Res*. 2019;14(1):245.

127. Cacchio A, Paoloni M, Griffin SH, Rosa F, Properzi G, Padua L, et al. Cross-cultural adaptation and measurement properties of an Italian version of the Western Ontario Shoulder Instability Index (WOSI). *J Orthop Sports Phys Ther*. 2012;42(6):559-67.

128. Hatta T, Shinozaki N, Omi R, Sano H, Yamamoto N, Ando A, et al. Reliability and validity of the Western Ontario Shoulder Instability Index (WOSI) in the Japanese population. *J Orthop Sci*. 2011;16(6):732-6.

129. Yuguero M, Huguet J, Griffin S, Sirvent E, Marcano F, Balaguer M, et al. Transcultural adaptation, validation and assessment of the psychometric properties of the spanish version of the Western Ontario Shoulder Instability Index questionnaire. *Rev Esp Cir Ortop Traumatol*. 2016;60(6):335-45.

130. Salomonsson B, Ahlstrom S, Dalen N, Lillkrona U. The Western Ontario Shoulder Instability Index (WOSI): validity, reliability, and responsiveness retested with a Swedish translation. *Acta Orthop*. 2009;80(2):233-8.

131. Basar S, Gunaydin G, Hazar Kanik Z, Sozlu U, Alkan ZB, Pala OO, et al. Western Ontario Shoulder Instability Index: cross-cultural adaptation and validation of the Turkish version. *Rheumatol Int*. 2017;37(9):1559-65.

Table 2: Translation, adaption and validation of shoulder PROMs.

Elbow PROMs translation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated	Cross-cultural DIF tested	Comments
<b>pASES-e</b> <i>American Shoulder and Elbow Surgeons Elbow Questionnaire</i>									
German (John et al. 2010) (132)	No	Yes	No	Yes	Yes	Yes	No	No	
<b>PRTEE</b> <i>Patient-rated Tennis Elbow Evaluation</i>									
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated	Cross-cultural DIF tested	Comments
Canadian-French	No	Yes	No	Yes	Yes	Yes	No	No	



*Patient-Rated Wrist Evaluation*

Brazilian-Portuguese (Rodrigues et al. 2015) (139)	No	Yes	No	Yes	Yes	No	No	No	
Czech, French, Hungarian, Italian, Brazilian-Portuguese, Russian, Ukrainian Goldhahn et al. 2013) (140)	No	Yes	No	Yes	Unclear	Yes	Not performed	Not performed	
Chinese, English (Weixin, Seow, 2004) (141)	No	Yes	No	Yes	Yes	Undocumented	No	No	
Chinese (Wah et al. 2005) (142)	No	No	Yes, one forward translator and a panel. No Backwards translation	Test	Yes	No	No	No	
Danish (Schønneman et al. 2013) (143)	Yes	No	No	Yes	Yes	Yes	No	No	
Finnish (Sandelin et al. 2016) (144)	No	Yes	No	Test	Yes	No	No	No	
German (John et al 2008) (145)	No	Yes	No	Yes	Uncertain	Yes	No	No	
Hindi (Mehta et al. 2012) (146)	No	Yes	No	Yes	No	Yes	No	No	
Japanese (Imaeda et al. 2010) (147)	No	Yes	No	Unclear	Unclear	Unclear	No	No	
Korean	No	Yes	No	Test	Yes	Unclear	No	No	

(Kim, Kang, 2013) (148)									
Persian (Hassankhani et al 2017) (149)	No	Yes	No	Test	Yes	No	No	No	
Polish (Czarnecki et al. 2015) (150)	No	Yes	No	Yes, but unclear	Yes	Unclear	No	No	
Spanish (Alfie et al. 2017) (151)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish, 2017 (Rosales et al. 2017) (152)	No	Yes	No	No	No	No	No	No	
Swedish (Navarro et al. 2011) (153)	No	Yes	No	Yes	Yes	Yes	No	No	
Swedish (Lövgren, Hellström, 2012) (154)	No	Yes, but only one forward translator	No	No	No	No	No	No	
Turkish (Öztürk et al. 2015) (155)	No	Yes	No	Test	Yes	Unclear	No	No	

**PRWE modified PROMs**

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural adaption)	Dimensionality tested in translated version	Cross-cultural DIF tested	Comments
Arabic <i>PRWHE-form</i> (Hasani et al. 2015) (156)	No	Yes	No	Yes	Yes	Yes	No	No	
Italian <i>PRWHE-form</i> (Fairplay et al. 2012) (157)	No	Yes	No	No	No	No	No	No	
Turkish <i>PRWHE-form</i> (Topcu, Afsar, 2019) (158)	No	Yes	No	Test	Yes	Unclear	No	No	

139. da Silva Rodrigues EK, de Cassia Registro Fonseca M, MacDermid JC. Brazilian version of the Patient Rated Wrist Evaluation (PRWE-BR): Cross-cultural adaptation, internal consistency, test-retest reliability and construct validity. J Hand Ther. 2015;28(1):69-75; quiz 6





<b>HAGOS</b> Copenhagen Hip and Groin Outcome Score									
Chinese (Cao et al. 2018) (159)	No	Yes	No	Test	Yes	No	No	No	From English
English (Thorborg et al. 2011) (160)	?	?	?	?	?	?	?	?	No description of translation from Swedish to English
Dutch (Brans et al. 2016) (161)	No	Yes	No	Yes	Yes	Yes	Yes	No	From English
Dutch (Tak et al. 2018) (162)	No	Yes	No	Yes	Yes	Yes	No	No	From Danish
Swedish (Thomeé et al. 2013) (163)	No	Yes	No	Yes	No	Yes	No	No	
<b>HOOS</b> Hip Disability and Osteoarthritis Outcome Score									
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Machado et al. 2019) (164)	No	Yes	No	Test	Yes	No	No	No	From English
Chinese (Wei et al. 2012) (165)	No	Yes	No	Undocumented	Undocumented	Undocumented	No	No	Probably from English
Dutch (de Groot et al. 2006) (166)	No	Yes	No	Test	Yes	No	No	No	From Swedish
French (Ornetti et al. 2010) (167)	No	Yes	No	Test	Yes	No	No	No	From English
German (Blasimann et al. 2014) (168)	No	Yes, but only described in art	No	Yes	No	Yes	No	No	From English

German (Arbab et al. 2017) (169)	No	Yes	No	Test	Yes	No	No	No	From English, no difference compared to Swiss-German translation
Italian (Torre et al. 2018) (170)	No	Yes	No	Test	Yes	No	No	No	From English
Japanese (Sato et al. 2013) (171)	No	Yes	No	Test	No	No	No	No	From English
Korean (Lee et al. 2011) (172)	No	Yes	No	Test	Yes	No	No	No	From English
Persian (Mousavian et al. 2018) (173)	No	Yes	No	Test	Yes	No	No	No	From English
Polish (Glinkowski et al. 2019) (174)	No	Yes	No	Test	Yes	No	No	No	From English
Romanian (Haragus et al. 2018a) (175)	No documented	Not documented	Not documented	Not documented	Not documented	Not documented	No	No	From English
Swedish (Nilsdotter et al. 2003) (176)									English version undocumented
Thai (Trathitiphan et al. 2016) (177)	No	Yes	No	Test	Yes	No	No	No	From English

**HOOS modified PROMs**

Austria, Canada, Finland, France, Germany, Hungary, Iceland, Italy, Poland, Spain, Sweden, Switzerland, United Kingdom (Davis et al. 2008) (178) <i>5-item physical function</i>	?	?	?	?	?	?	Yes	Cross-country DIF	English translation undocumented
--	---	---	---	---	---	---	-----	-------------------	----------------------------------

<i>subscale short form</i>										
Danish (Paulsen et al. 2012a) (179) <i>Physical function-, pain- and QoL-subcales</i>	?	?	?	?	?	?	No	No	Danish translation undocumented	
Danish (Paulsen et al. 2013) (180) <i>Physical function-, pain- and QoL-subcales</i>	?	?	?	?	?	?	No	No	Danish translation undocumented	
Turkish (Yilmaz et al. 2014) (181) <i>5-item physical function subscale short form</i>	No	Yes	No	Test	Yes	No	No	No	From English	

THR: Total Hip Replacement

HOS

Hip Outcome Score

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (de Oliveira et al. 2014) (182)	No	Yes	No	Yes	Yes	Yes	Not performed	Not performed	
German (Naal et al. 2011) (183)	No	Yes, but not documented	No	Test	Yes	No	No	No	
Korean (Lee et al. 2014a) (184)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish (Seijas et al. 2014) (185)	No	Yes	No	Test	Yes	No	No	No	

Turkish (Polat et al. 2017) (186)	No	Yes	No	Yes	Yes	Yes	No	No	
---	----	-----	----	-----	-----	-----	----	----	--

**iHOT-12**

*International Hip Outcome Tool 12 items*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Polesello et al. 2012) (187)	No	Yes	No	Yes	Yes	Yes	Not performed	Not performed	
Dutch (Stevens et al. 2015) (188)	No	Yes	No	No	No	No	No	No	
German (Baumann et al. 2016a) (189)	No	Yes	No	Test	Yes	No	No	No	
Japanese (Watanabe et al. 2018) (190)	No	Yes	No	Yes	Yes	Yes	No	No	
Swedish (Jónasson et al. 2014) (191)	No	Yes	No	Yes	No	Yes	No	No	

**iHOT-33**

*International Hip Outcome Tool 33 items*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Polesello et al. 2012) (187)	No	Yes	No	Yes	Yes	Yes	Not performed	Not performed	
Dutch (Tijssen et al. 2018) (192)	No	Yes	No	Yes	Yes	Yes	No	No	
German	No	Yes	No	Test	Yes	No	No	No	

(Baumann et al. 2016b) (193)									
Spanish (Ruiz-Iban et al. 2015) (194)	No	Yes	No	Test	Yes	No	No	No	

**LEFS**  
Lower Extremity Functional Scale

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Arabic (Alnahdi et al. 2016) (195)	No	Yes	No	Test	Yes	No	No	No	
Arabic (Korakakis et al. 2019) (196)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Brazilian-Portuguese (Metsavaht et al. 2012) (197)	No	Yes	No	Test	Yes	No	No	No	
Brazilian-Portuguese (Pereira et al. 2013) (198)	No	Yes	No	Yes	Yes	Yes	No	No	
Dutch (Hoogeboom et al. 2012) (199)	No	Yes	No	Yes	Yes	Yes	No	No	
Finnish (Repo et al. 2017) (200)	No	Yes	No	Yes	Yes	Yes	No	No	
German (Naal et al. 2015) (201)	No	Yes, but not documented	No	Not documented	Not documented	Not documented	No	No	
Gujarati (Brahmbhatt, Sheth, 2018) (202)	No	Yes	No	Test	Yes	No	No	No	
Italian	No	Yes	No	Yes	Yes	Yes	No	No	

(Cacchio et al. 2010) (203)									
Malaysian (Yunus et al. 2017) (204)	No	Yes	No	No	No	No	No	No	
Persian (Negahban et al. 2014) (205)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish (Cruz-Diaz et al. 2014) (206)	No	Yes	No	No	No	No	No	No	
Taiwan-Chinese (Hou et al. 2014) (207)	No	Yes	No	No	No	No	No	No	
Turkish (Citaker et al. 2016) (208)	No	Yes	No	Test	Yes	No	No	No	

**NAHS**

*Non-arthritic Hip Score*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (del Castillo et al. 2013) (209)	No	Yes	No	Yes	Yes	Yes	No	No	

**OHS**

*Oxford Hip Score*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Chinese (Zheng et al. 2014) (210)	No	Yes, but only one forward translator	No	Test	Yes	No	No	No	

Danish (Paulsen et al. 2012b) (211)	No	Yes, but only one forward translator	No	Yes	Yes	Yes	No	No	
German (Naal et al. 2008a) (212)	No	Yes	No	Test	Yes	No	No	No	
Iranian (Nourbakhsh et al. 2013) (213)	No	Yes	No	Yes	Yes	Yes	No	No	
Italian (Martinelli et al. 2011) (214)	No	Yes	No	Yes	Yes	Yes	No	No	
Korean (Lee et al. 2014b) (215)	No	Yes	No	Yes	Yes	Yes	No	No	
Romania (Haragus et al. 2018b) (216)	No	Yes	No	Yes	Yes	Undocumented	No	No	
Spanish (Martín-Fernández et al. 2017) (217)	?	?	?	?	?	?	?	?	The Spanish translation is undocumented
Turkish (Tugay et al. 2015) (218)	No	Yes	No	Test	Yes	No	No	No	

**OHS modified PROMs**

Dutch (Gosens et al. 2009) (219)	No	Yes	No	Yes	Yes	Yes	No	No	From the English 2002 translation
Japanese (Uesugi et al. 2006, and Uesugi et al. 2009) (220)	No	Yes	No	? Article in Japanese	? Article in Japanese	? Article in Japanese	No	No	

**WOMAC**

*Western Ontario and McMaster Universities Osteoarthritis Index*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Dutch (Roorda et al. 2003) (221)	?	?	?	?	?	?	?	?	The Dutch translation has apparently never been published.
Finnish (Soininen et al. 2008) (222)	No	Yes, see comment	No	No	No	No	No	No	Translation by a professional company, and it was "checked for linguistic clearness and compared to a validated Swedish version of the questionnaire"
German (Ryser et al. 1999) (223)	?	?	?	?	?	?	?	?	The German translation is from 1996 and published in German
Persian (Nadrian et al. 2012) (224)	No	Yes	No	Yes	Yes	No	No	No	
Spanish (Escobar et al. 2002) (225)	?	?	?	?	?	?	?	?	The Spanish translation is from 1999 and published in Spanish
<b>WOMAC modified PROMs</b>									
Canadian-French (Tubach et al. 2005) (226) <i>8-item short form</i>	?	?	?	?	?	?	?	?	The French-Canadian translation was apparently published in Arthritis Rheum in 1994 but it is not available
<p>159. Cao S, Cao J, Li S, Wang W, Qian Q, Ding Y. Cross-cultural adaptation and validation of the Simplified Chinese version of Copenhagen Hip and Groin Outcome Score (HAGOS) for total hip arthroplasty. <i>J Orthop Surg Res.</i> 2018;13(1):278.</p> <p>160. Thorborg K, Holmich P, Christensen R, Petersen J, Roos EM. The Copenhagen Hip and Groin Outcome Score (HAGOS): development and validation according to the COSMIN checklist. <i>Br J Sports Med.</i> 2011;45(6):478-91.</p> <p>161. Brans E, de Graaf JS, Munzebrock AV, Bessem B, Reininga IH. Cross-Cultural Adaptation and Validation of the Dutch Version of the Hip and Groin Outcome Score (HAGOS-NL). <i>PLoS One.</i> 2016;11(1):e0148119.</p> <p>162. Tak I, Tijssen M, Schamp T, Sierevelt I, Thorborg K, Kerkhoffs G, et al. The Dutch Hip and Groin Outcome Score: Cross-cultural Adaptation and Validation According to the COSMIN Checklist. <i>J Orthop Sports Phys Ther.</i> 2018;48(4):299-306.</p> <p>163. Thomee R, Jonasson P, Thorborg K, Sansone M, Ahlden M, Thomee C, et al. Cross-cultural adaptation to Swedish and validation of the Copenhagen Hip and Groin Outcome Score (HAGOS) for pain, symptoms and physical function in patients with hip and groin disability due to femoro-acetabular impingement. <i>Knee Surg Sports Traumatol Arthrosc.</i> 2014;22(4):835-42.</p> <p>164. Machado RK, Casagrande AA, Pereira GR, Vissoci JRN, Pietrobon R, Ferreira APB. Hip Disability and Osteoarthritis Outcome Score (HOOS): A Cross-Cultural Validation of the Brazilian Portuguese Version Study. <i>Rev Bras Ortop (Sao Paulo).</i> 2019;54(3):282-7.</p> <p>165. Wei X, Wang Z, Yang C, Wu B, Liu X, Yi H, et al. Development of a simplified Chinese version of the Hip Disability and Osteoarthritis Outcome Score (HOOS): cross-cultural adaptation and psychometric evaluation. <i>Osteoarthritis Cartilage.</i> 2012;20(12):1563-7.</p> <p>166. de Groot IB, Reijman M, Terwee CB, Bierma-Zeinstra SM, Favejee M, Roos EM, et al. Validation of the Dutch version of the Hip disability and Osteoarthritis Outcome Score. <i>Osteoarthritis Cartilage.</i> 2007;15(1):104-9.</p>									



167. Ornetti P, Parratte S, Gossec L, Tavernier C, Argenson JN, Roos EM, et al. Cross-cultural adaptation and validation of the French version of the Hip disability and Osteoarthritis Outcome Score (HOOS) in hip osteoarthritis patients. *Osteoarthritis Cartilage*. 2010;18(4):522-9.
168. Blasimann A, Dauphinee SW, Staal JB. Translation, cross-cultural adaptation, and psychometric properties of the German version of the hip disability and osteoarthritis outcome score. *J Orthop Sports Phys Ther*. 2014;44(12):989-97.
169. Arbab D, van Ochten JHM, Schnurr C, Bouillon B, Konig D. Assessment of reliability, validity, responsiveness and minimally important change of the German Hip dysfunction and osteoarthritis outcome score (HOOS) in patients with osteoarthritis of the hip. *Rheumatol Int*. 2017;37(12):2005-11.
170. Torre M, Luzi I, Mirabella F, Del Manso M, Zanoli G, Tucci G, et al. Cross-cultural adaptation and validation of the Italian version of the Hip disability and Osteoarthritis Outcome Score (HOOS). *Health Qual Life Outcomes*. 2018;16(1):115.
171. Satoh M, Masuhara K, Goldhahn S, Kawaguchi T. Cross-cultural adaptation and validation reliability, validity of the Japanese version of the Hip disability and Osteoarthritis Outcome Score (HOOS) in patients with hip osteoarthritis. *Osteoarthritis Cartilage*. 2013;21(4):570-3.
172. Lee YK, Chung CY, Koo KH, Lee KM, Lee DJ, Lee SC, et al. Transcultural adaptation and testing of psychometric properties of the Korean version of the Hip Disability and Osteoarthritis Outcome Score (HOOS). *Osteoarthritis Cartilage*. 2011;19(7):853-7.
173. Mousavian A, Kachooie AR, Birjandinejad A, Khoshsaligheh M, Ebrahimzadeh MH. Translation and Cross-cultural Adaptation of the Hip Disability and Osteoarthritis Score into Persian Language: Reassessment of Validity and Reliability. *Int J Prev Med*. 2018;9:23.
174. Glinkowski W, Zukowska A, Dymitrowicz M, Wolyniec E, Glinkowska B, Koziol-Kaczorek D. Translation, Cross-Cultural Adaptation, and Psychometric Properties of the Polish Version of the Hip Disability and Osteoarthritis Outcome Score (HOOS). *Medicina (Kaunas)*. 2019;55(10).
175. Haragus H, Deleanu B, Prejbeanu R, Timar B, Levai C, Vermesan D. Cross-cultural adaptation and validation of the Romanian Hip disability and Osteoarthritis Outcome Score for Joint Replacement. *Int J Qual Health Care*. 2019;31(4):307-11.
176. Nilsson AK, Lohmander LS, Klassbo M, Roos EM. Hip disability and osteoarthritis outcome score (HOOS)--validity and responsiveness in total hip replacement. *BMC Musculoskelet Disord*. 2003;4:10.
177. Trathitiphan W, Paholpak P, Sirichativapee W, Wisanuyotin T, Laupattarakasem P, Sukhonthamarn K, et al. Cross-cultural adaptation and validation of the reliability of the Thai version of the Hip disability and Osteoarthritis Outcome Score (HOOS). *Rheumatol Int*. 2016;36(10):1455-8.
178. Davis AM, Perruccio AV, Canizares M, Tennant A, Hawker GA, Conaghan PG, et al. The development of a short measure of physical function for hip OA HOOS-Physical Function Shortform (HOOS-PS): an OARSI/OMERACT initiative. *Osteoarthritis Cartilage*. 2008;16(5):551-9.
179. Paulsen A, Pedersen AB, Overgaard S, Roos EM. Feasibility of 4 patient-reported outcome measures in a registry setting. *Acta Orthop*. 2012;83(4):321-7.
180. Paulsen A, Roos EM, Pedersen AB, Overgaard S. Minimal clinically important improvement (MCII) and patient-acceptable symptom state (PASS) in total hip arthroplasty (THA) patients 1 year postoperatively. *Acta Orthop*. 2014;85(1):39-48.
181. Yilmaz O, Gul ED, Bodur H. Cross-cultural adaptation and validation of the Turkish version of the Hip disability and Osteoarthritis Outcome Score-Physical function Short-form (HOOS-PS). *Rheumatol Int*. 2014;34(1):43-9.
182. de Oliveira LP, Moura Cardinot T, Nunes Carreras Del Castillo L, Cavalheiro Queiroz M, Cavalli Polesello G. Translation and cultural adaptation of the Hip Outcome Score to the Portuguese language. *Rev Bras Ortop*. 2014;49(3):297-304.
183. Naal FD, Impellizzeri FM, Miozzari HH, Mannion AF, Leunig M. The German Hip Outcome Score: validation in patients undergoing surgical treatment for femoroacetabular impingement. *Arthroscopy*. 2011;27(3):339-45.
184. Lee YK, Ha YC, Martin RL, Hwang DS, Koo KH. Transcultural adaptation of the Korean version of the Hip Outcome Score. *Knee Surg Sports Traumatol Arthrosc*. 2015;23(11):3426-31.
185. Seijas R, Sallent A, Ruiz-Iban MA, Ares O, Marin-Pena O, Cuellar R, et al. Validation of the Spanish version of the Hip Outcome Score: a multicenter study. *Health Qual Life Outcomes*. 2014;12:70.
186. Polat G, Celik D, Cil H, Erdil M, Asik M. Evidence for reliability, validity and responsiveness of Turkish version of Hip Outcome Score. *Acta Orthop Traumatol Turc*. 2017;51(4):319-24.
187. Polesello GC, Godoy GF, Trindade CA, de Queiroz MC, Honda E, Ono NK. Translation and cross-cultural adaptation of the International Hip Outcome Tool (iHOT) into Portuguese. *Acta Ortop Bras*. 2012;20(2):88-92B.
188. Stevens M, van den Akker-Scheek I, ten Have B, Adema M, Giezen H, Reininga IH. Validity and Reliability of the Dutch Version of the International Hip Outcome Tool (iHOT-12NL) in Patients With Disorders of the Hip. *J Orthop Sports Phys Ther*. 2015;45(12):1026-34, A1-2.
189. Baumann F, Popp D, Muller K, Muller M, Schmitz P, Nerlich M, et al. Validation of a German version of the International Hip Outcome Tool 12 (iHOT12) according to the COSMIN checklist. *Health Qual Life Outcomes*. 2016;14:3.
190. Watanabe N, Murakami S, Uchida S, Tateishi S, Ohara H, Yamamoto Y, et al. Exploring the validation of a Japanese version of the International Hip Outcome Tool 12: Reliability, validity, and responsiveness. *J Orthop Sci*. 2019;24(4):652-7.
191. Jonasson P, Baranto A, Karlsson J, Sward L, Sansone M, Thomee C, et al. A standardised outcome measure of pain, symptoms and physical function in patients with hip and groin disability due to femoro-acetabular impingement: cross-cultural adaptation and validation of the international Hip Outcome Tool (iHOT12) in Swedish. *Knee Surg Sports Traumatol Arthrosc*. 2014;22(4):826-34.
192. Tijssen M, Tak I, Stubbe J, Haverkamp D, de Visser E, Nijhuis-van der Sanden M, et al. Translation, Cross-cultural Adaptation, and Validation of the Dutch International Hip Outcome Tool-33 (iHOT-33 NL) in Young, Physically Active Individuals With Symptomatic Hip Joint Pathology. *J Orthop Sports Phys Ther*. 2018;48(4):289-98.

193. Baumann F, Weber J, Zeman F, Muller M, Lahner M, Nerlich M, et al. Validation of a German version of the International Hip Outcome Tool (G-iHOT33) according to the COSMIN checklist: how much improvement is clinically relevant? *Arch Orthop Trauma Surg.* 2016;136(1):83-91.
194. Ruiz-Iban MA, Seijas R, Sallent A, Ares O, Marin-Pena O, Muriel A, et al. The international Hip Outcome Tool-33 (iHOT-33): multicenter validation and translation to Spanish. *Health Qual Life Outcomes.* 2015;13:62
195. Alnahdi AH, Alrashid GI, Alkhalidi HA, Aldali AZ. Cross-cultural adaptation, validity and reliability of the Arabic version of the Lower Extremity Functional Scale. *Disabil Rehabil.* 2016;38(9):897-904.
196. Korakakis V, Saretsky M, Whiteley R, Azzopardi MC, Klauznicer J, Itani A, et al. Translation into modern standard Arabic, cross-cultural adaptation and psychometric properties' evaluation of the Lower Extremity Functional Scale (LEFS) in Arabic-speaking athletes with Anterior Cruciate Ligament (ACL) injury. *PLoS One.* 2019;14(6):e0217791.
197. Metsavaht L, Leporace G, Riberto M, Sposito MM, Del Castillo LN, Oliveira LP, et al. Translation and cross-cultural adaptation of the lower extremity functional scale into a Brazilian Portuguese version and validation on patients with knee injuries. *J Orthop Sports Phys Ther.* 2012;42(11):932-9.
198. Pereira LM, Dias JM, Mazuquin BF, Castanhas LG, Menacho MO, Cardoso JR. Translation, cross-cultural adaptation and analysis of the psychometric properties of the lower extremity functional scale (LEFS): LEFS- BRAZIL. *Braz J Phys Ther.* 2013;17(3):272-80.
199. Hoozeboom TJ, de Bie RA, den Broeder AA, van den Ende CH. The Dutch Lower Extremity Functional Scale was highly reliable, valid and responsive in individuals with hip/knee osteoarthritis: a validation study. *BMC Musculoskelet Disord.* 2012;13:117.
200. Repo JP, Tukiainen EJ, Roine RP, Ilves O, Jarvenpaa S, Hakkinen A. Reliability and validity of the Finnish version of the Lower Extremity Functional Scale (LEFS). *Disabil Rehabil.* 2017;39(12):1228-34.
201. Naal FD, Impellizzeri FM, Torka S, Wellauer V, Leunig M, von Eisenhart-Rothe R. The German Lower Extremity Functional Scale (LEFS) is reliable, valid and responsive in patients undergoing hip or knee replacement. *Qual Life Res.* 2015;24(2):405-10.
202. Bhoomika Gunvantbhai Brahmbhatt MSS. Translation, Cross-Cultural Adaptation and Reliability of the Lower Extremity Functional Scale into a Gujarati Version and Validation. *Journal of Clinical and Diagnostic Research.* 2018;12(08).
203. Cacchio A, De Blasis E, Necozone S, Rosa F, Riddle DL, di Orio F, et al. The Italian version of the lower extremity functional scale was reliable, valid, and responsive. *J Clin Epidemiol.* 2010;63(5):550-7.
204. Mohd Yunus MA, Musa R, Nazri MY. Construct and criterion validity of the Malaysia version of Lower Extremity Functional Scale (LEFS). *Asia Pac J Sports Med Arthrosc Rehabil Technol.* 2017;10:8-11.
205. Negahban H, Hessam M, Tabatabaei S, Salehi R, Sohani SM, Mehravar M. Reliability and validity of the Persian lower extremity functional scale (LEFS) in a heterogeneous sample of outpatients with lower limb musculoskeletal disorders. *Disabil Rehabil.* 2014;36(1):10-5.
206. Cruz-Diaz D, Lomas-Vega R, Osuna-Perez MC, Hita-Contreras F, Fernandez AD, Martinez-Amat A. The Spanish lower extremity functional scale: a reliable, valid and responsive questionnaire to assess musculoskeletal disorders in the lower extremity. *Disabil Rehabil.* 2014;36(23):2005-11.
207. Hou WH, Yeh TS, Liang HW. Reliability and validity of the Taiwan Chinese version of the Lower Extremity Functional Scale. *J Formos Med Assoc.* 2014;113(5):313-20.
208. Citaker S, Kafa N, Hazar Kanik Z, Ugurlu M, Kafa B, Tuna Z. Translation, cross-cultural adaptation and validation of the Turkish version of the Lower Extremity Functional Scale on patients with knee injuries. *Arch Orthop Trauma Surg.* 2016;136(3):389-95
209. Del Castillo LN, Leporace G, Cardinot TM, Levy RA, Oliveira LP. Translation, cross-cultural adaptation and validation of the Brazilian version of the Nonarthritic Hip Score. *Sao Paulo Med J.* 2013;131(4):244-51.
210. Zheng W, Li J, Zhao J, Liu D, Xu W. Development of a valid simplified Chinese version of the Oxford Hip Score in patients with hip osteoarthritis. *Clin Orthop Relat Res.* 2014;472(5):1545-51.
211. Paulsen A, Odgaard A, Overgaard S. Translation, cross-cultural adaptation and validation of the Danish version of the Oxford hip score: Assessed against generic and disease-specific questionnaires. *Bone Joint Res.* 2012;1(9):225-33.
212. Naal FD, Sieverding M, Impellizzeri FM, von Knoch F, Mannion AF, Leunig M. Reliability and validity of the cross-culturally adapted German Oxford hip score. *Clin Orthop Relat Res.* 2009;467(4):952-7.
213. Nourbakhsh M, Zarezadeh A, Shemshaki H, Etemadifar MR, Moezi M, Mazoochian F. Translation and cultural adaptation of the oxford hip score for Iranian population. *Int J Prev Med.* 2013;4(2):141-5.
214. Martinelli N, Longo UG, Marinozzi A, Franceschetti E, Costa V, Denaro V. Cross-cultural adaptation and validation with reliability, validity, and responsiveness of the Italian version of the Oxford Hip Score in patients with hip osteoarthritis. *Qual Life Res.* 2011;20(6):923-9.
215. Lee YK, Chung CY, Park MS, Lee KM, Lee DJ, Lee SC, et al. Transcultural adaptation and testing of psychometric properties of the Korean version of the Oxford hip score. *J Orthop Sci.* 2012;17(4):377-81.
216. Haragus H, Prejbeanu R, Poenaru DV, Deleanu B, Timar B, Vermesan D. Cross-cultural adaptation and validation of a patient-reported hip outcome score. *Int Orthop.* 2018;42(5):1001-6.
217. Martin-Fernandez J, Gray-Laymon P, Molina-Siguero A, Martinez-Martin J, Garcia-Maroto R, Garcia-Sanchez I, et al. Cross-cultural adaptation and validation of the Spanish version of the Oxford Hip Score in patients with hip osteoarthritis. *BMC Musculoskelet Disord.* 2017;18(1):205.
218. Tugay BU, Tugay N, Guney H, Hazar Z, Yuksel I, Atilla B. Cross-cultural adaptation and validation of the Turkish version of Oxford hip score. *Arch Orthop Trauma Surg.* 2015;135(6):879-89.

219. Gosens T, Hoefnagels NH, de Vet RC, Dhert WJ, van Langelaan EJ, Bulstra SK, et al. The "Oxford Heup Score": the translation and validation of a questionnaire into Dutch to evaluate the results of total hip arthroplasty. *Acta Orthop.* 2005;76(2):204-11.

220. Uesugi Y, Fujita K, Okumiya A. Quality of Life (QOL) of Total Hip Arthroplasty Patients, and Reliability and Validity of the Oxford Hip Score (OHS) Japanese Version. 2006; 29:81-7, and Uesugi Y, Makimoto K, Fujita K, Nishii T, Sakai T, Sugano N. Validity and responsiveness of the Oxford hip score in a prospective study with Japanese total hip arthroplasty patients. *J Orthop Sci.* 2009;14(1):35-9

221. Roorda LD, Jones CA, Waltz M, Lankhorst GJ, Bouter LM, van der Eijken JW, et al. Satisfactory cross cultural equivalence of the Dutch WOMAC in patients with hip osteoarthritis waiting for arthroplasty. *Ann Rheum Dis.* 2004;63(1):36-42.

222. Soininen JV, Paavolainen PO, Gronblad MA, Kaapa EH. Validation study of a Finnish version of the Western Ontario and McMaster University osteoarthritis index. *Hip Int.* 2008;18(2):108-11.

223. Ryser L, Wright BD, Aeschlimann A, Mariacher-Gehler S, Stucki G. A new look at the Western Ontario and McMaster Universities Osteoarthritis Index using Rasch analysis. *Arthritis Care Res.* 1999;12(5):331-5.

224. Nadrian H, Moghimi N, Nadrian E, Moradzadeh R, Bahmanpour K, Iranpour A, et al. Validity and reliability of the Persian versions of WOMAC Osteoarthritis Index and Lequesne Algofunctional Index. *Clin Rheumatol.* 2012;31(7):1097-102.

225. Escobar A, Quintana JM, Bilbao A, Azkarate J, Guenaga JI. Validation of the Spanish version of the WOMAC questionnaire for patients with hip or knee osteoarthritis. Western Ontario and McMaster Universities Osteoarthritis Index. *Clin Rheumatol.* 2002;21(6):466-71.

226. Tubach F, Baron G, Falissard B, Logeart I, Dougados M, Bellamy N, et al. Using patients' and rheumatologists' opinions to specify a short form of the WOMAC function subscale. *Ann Rheum Dis.* 2005;64(1):75-9.

i

Tabel 5: Translation, adaption and validation of hip PROMs.

Thigh PROMs translation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
<b>FASH</b> <i>Functional Assessment Scale for Acute Hamstring Injuries</i>									
English (Malliaropoulos et al. 2014) (227)	?	?	?	Yes	No	Yes	No	No	Translated from Greek
French (Locquet et al. 2019) (228)	No	Yes	No	Test	Yes	No	No	No	Translated from the English version
German (Malliaropoulos et al. 2014) (227)	?	?	?	Yes	No	Yes	No	No	Translated from Greek

Spanish (Hernández-Sánchez et al. 2019) (229)	No	Yes	No	Undocumented	Undocumented	Undocumented	No	No	
<p>227. Malliaropoulos N, Korakakis V, Christodoulou D, Padhiar N, Pyne D, Giakas G, et al. Development and validation of a questionnaire (FASH--Functional Assessment Scale for Acute Hamstring Injuries): to measure the severity and impact of symptoms on function and sports ability in patients with acute hamstring injuries. Br J Sports Med. 2014;48(22):1607-12.</p> <p>228. Locquet M, Willems T, Specque C, Beaudart C, Bruyere O, Van Beveren J, et al. Cross-cultural adaptation, translation, and validation of the functional assessment scale for acute hamstring injuries (FASH) questionnaire for French-speaking patients. Disabil Rehabil. 2019:1-7.</p> <p>229. Hernandez-Sanchez S, Korakakis V, Malliaropoulos N, Moreno-Perez V. Validation study of the Functional Assessment Scale for Acute Hamstring injuries in Spanish professional soccer players. Clin Rehabil. 2019;33(4):711-23</p>									

Tabel 6: Translation, adaption and validation of thigh PROMs.

Knee PROMs validation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
<b>AIMS2</b>									
Arthritis Impact Measurement Scales 2									
Brazilian-Portuguese (Brandão et al. 1998) (230)	No	Yes	No	No	No	No	No	No	Process not described in detail
French (Pouchot et al. 1996a) (231)	No	Yes	No	Yes	Yes	Yes	No	No	Process not described in detail
French (Pouchot et al. 1996b) (232)	No	Yes	No	Yes	Yes	Yes	No	No	
German (Rosemann, Szecsenyi, 2007) (233)	No	Yes	No	Test	Yes	No	No	No	

Italian (Salaffi et al. 2000) (234)	No	No	Yes	No	No	No	No	No	
Persian (Mousavi et al. 2009) (235)	No	Yes	No	No	No	No	No	No	
Slovak (Soosova, Macejova, 2013) (236)	No	No	Yes dire ct tran slati on	No	No	No	No	No	
Turkish (Atamaz et al. 2005) (237)	No	Yes	No	Yes	Yes	Yes	No	No	Process not described in detail
Chinese (Chu et al. 2004) (238) Added 2 items	No	Yes, but only one translator each way	No	No	No	No	No	No	
German (Rosemann et al. 2005) (239) 26-item short form	No	Yes	No	Yes	Yes	Yes	No	No	Process not described in detail
Norwegian (Haugen et al. 2011) (240) Hand and finger subscale only	?	?	?	?	?	?	?	?	Translation undocumented
Persian (Askary- Ashtiani et al. 2009a) (241) 26-item short form	No	Yes	No	Yes	Yes	Yes	No	No	
Persian (Askary- Ashtiani et al. 2009b) (242) 26-item short form	No	Yes	No	Test	Yes	Yes	No	No	

**Cincinnati**

*Modified Cincinnati Knee Rating score*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Ramos Marinho et al. 2019) (243)	No	Yes	No	Ytst	Yes	No	No	No	

### FJS-12

#### *Forgotten Joint Score*

FJS was developed by help from patients in Austria in German. There is no information about how the English version was produced.

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Ferreira et al. 2018) (244)	No	Yes	No	Yes	Yes	Yes	No validation	No validation	From English
Chinese (Cao et al. 2017) (245)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Dutch (Shadid et al. 2016) (246)	No	Yes	No	Yes	Yes	Yes	No	No	From German
German (Baumann et al. 2016c) (247)	No	Yes, but unclear	No	Test	Yes	No	No	No	From English
Swedish (Heijbel et al. 2019) (248)	Unknown	Unknown	Unknown	Yes	Yes	Yes	No	No	"Swedish translation provided by developers"
Japanese (Matsumoso et al 2015) (249)	No	Yes, but unclear	No	No	No	No	No	No	From English
French (Kloushea et al 2018) (250)	No	Yes	No	Test	Yes	No	No	No	From English



German (Kümmel et al. 2018) (259)	?	?	?	?	?	?	?	?	The translation process of the German version is undocumented
Greek (Koumantakis et al. 2016) (260)	No	Yes	No	Test	Yes	No	No	No	
Italian (Padua et al. 2004) (261)	No	Yes	No	No	No	No	No	No	An undocumented translation already existed, and after forward-backward translation the resulting Italian questionnaire was quite similar to the undocumented version, and this undocumented version was then chosen for validation.
Korean (Kim et al. 2013) (262)	No	Yes	No	Yes	Yes	Yes	No	No	
Persian (Ebrahimzadeh et al. 2015c) (263)	No	Yes	No	Test	Yes	No	No	No	
Swedish (Grevnerts et al. 2017) (264)	No	Yes	No	Yes	Yes	Yes	No	No	
Thai (Lertwanich et al. 2008) (265)	No	Yes	No	Test	Yes	No	No	No	
Turkish (Celik et al. 2014) (266)	No	Yes	No	Yes	Yes	Yes	No	No	

**K-SES**

*Knee Self-Efficacy Scale*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Dutch (van Lankveld et al. 2019) (267)	No	Yes, but not described in detail	No	Test	Yes	No	No	No	Unclear if translated from Swedish or English
English (Thoméé et al. 2006) (268)	?	?	?	?	?	?	?	?	The PROM was developed in Sweden with Swedish patients. There is no indication how the English wording has been



										translated and how the English version has been validated.
<b>KOOS</b>										
<i>Knee Injury and Osteoarthritis Outcome Score</i>										
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality listed in	Cross-cultural DIF tested	Comments	
Arabic (Almangoush et al. 2013) (269)	No	Yes	No	Yes	Yes	Yes	No	No		
Chinese (Cheung et al. 2016) (270)	No	Yes	No	Test	Yes	No	No	No	From English	
Chinese (Huang et al. 2017) (256)	No	Yes	No	Test	Yes	No	No	No	From English	
Chinese (Cheng et al. 2019) (271)	Not relevant	Not relevant	Not relevant	No	No	No	No	No	The Singapore-Chinese version was adapted to Hong Kong-Chinese by professional translators.	
Danish (Comins et al. 2008) (272)	?	?	?	?	?	?	No	No?	The Danish translation is undocumented.	
Dutch (de Groot et al. 2008) (273)	No	Yes	No	Test	Yes	No	No	No	From Swedish	
English (Roos et al. 1998a) (274)	?	?	?	?	?	?	No	No	English translation undocumented.	
French (Ornetti et al. 2008) (275)	No	Yes	No	Test	Yes	No	No	No	From English	
Greek (Moutzouri et al. 2015) (276)	No	Yes	No	Yes	Yes	Yes	No	No	From English	
Italian (Monticone et al. 2012b) (277)	No	Yes, see note	No	Test	Yes	No	No		From English. Backwards translation was apparently done so it would resemble the original	
Japanese (Nakamura et al. 2011) (278)	No	Yes	No	Test	Yes	No	No	No	From English	

Malaysian (Zulkifli et al. 2017) (279)	No	Yes	No	Yes	Yes	Yes	Yes	No	From English
Persian (Salavati et al. 2008) (280)	No	Yes	No	Test	Yes	No	No	No	From English
Polish (Paradowski et al. 2013) (281)	No	Yes	No	Yes	Yes	Yes	No	No	From English AND Swedish
Portuguese (Goncalves et al. 2009) (282)	No	Yes	No	Test	Yes	No	No	No	From US-English
Saudi Arabic (Alfadhel et al. 2018) (283)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Singapore-English, Singapore-Chinese (Xie et al. 2006) (284)	No	Yes, see note	No	Test	Yes	yes	No	No	Translated to Singapore-Chinese. The backtranslation to English was apparently different from the original English version and was termed Singapore-English
Spanish (Vaquero et al. 2014) (285)	No	Yes, see note	No	Test	Yes	No	No	No	Frem English
Swedish (Roos et al. 1998a) (274)	No	No	Yes, see note	No	No	No	No	No	The Original Swedish version was translated into English (developed simultaneously) and compared by a panel
Urdu, India (Ateef et al. 2017) (286)	No	No	Yes, see note	Test	Yes	No	No	No	From English, translated by a bureau, no backward translation

**KOOS modified PROMs**

Japanese (Lyman et al. 2018) (287) <i>8-item short form</i>	Not relevant	Not relevant	Not relevant	Yes	Yes	Yes	No	No	This was re-deelopment of the ADL domain to fit Japanese culture plus addition of a Flexion domain
Malaysian (Zulkifli et al. 2017) (279) <i>5 domains, 26 item short form</i>	No	Yes	No	Yes	Yes	Yes	Yes	No	From English
Turkish (Gul et al. 2013) (288)	No	Yes	No	Test	Yes	No	No	No	

<i>Physical Function short form</i>										
-------------------------------------	--	--	--	--	--	--	--	--	--	--

**KOOS-child**  
*Knee Injury and Osteoarthritis Outcome Score for Children*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Dutch (van der Velden et al. 2019) (289)	No	Yes	No	Test	Yes	No	No	No	
French (Trottier et al. 2018) (290)	No	Yes	No	No	No	No	No	No	From English

It is unclear how the English version of KOOS-Child was developed.

**KOOS4**  
*Knee Injury and Osteoarthritis Outcome Score*

No accessible studies found.

**KOS**  
*Knee Outcome Survey Activities of Daily Living Scale*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Arabic (Algarni et al. 2017) (291)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Arabic (Bouzubar et al. 2018) (292)	No	Yes	No	Yes	Yes	No	No	No	
Chinese (Jia et al. 2016) (293)	No	Yes	No	Test	Yes	No	No	No	
French (Roy et al. 2014) (294)	No	Yes	No	Test	Yes	No	No	No	

German (Bizzini, Gorelick, 2007) (295)	No	Yes	No	Yes	Yes	Yes	No	No	
Greek (Kapreli et al. 2011) (296)	No	Yes	No	Yes	Yes	No	No	No	
Polish (Szczepanik et al. 2018) (297)	No	Yes	No	Yes	Yes	Yes	No	No	
Portuguese (Goncalves et al. 2008) (298)	No	Yes	No	Test	Yes	No	No	No	
Turkish (Evcik et al. 2009) (299)	No	Yes	No	Yes	Yes	Yes	No	No	

**KSS**

*Knee Society Clinical Rating System*

	Dual panel translation	Forward- backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian- Portuguese (Silva et al. 2012) (300)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish (Ares et al. 2013) (301)	No	Yes	No	Yes	Yes	Yes	No	No	
NEW VERSION OF KSS BELOW									
Brazilian- Portuguese (e Silvaa et al 2017) (302)	No	Yes	No	Test	Yes	No	No	No	
Dutch (van der Straeten 2013) (303)	No	Yes	No	Test	Yes	No	No	No	

Dutch (Dinjens et al 2014) (304)	No	No	Yes, see note	No	No	No	No	No	Adaption of KSS to the new generations, meaning extra activities were added. Translation is not described, but was probably made by the authors
French (Debettea et al 2014) (305)	Not documented	Not documented	Not documented	No	No	No	No	No	Apparently, authors did the translations but in no structured way
German (Kayaalp et al 2019) (306)	No	Yes	No	Yes	Yes	Yes	No	No	
Japanese (Hamamito et al 2015) (307)	No	Yes	No	No	No	No	No	No	
Korean (Kim et al 2017) (308)	No	Yes	No	Test	Yes	No	No	No	
Turkish (Ozden et al 2019) (309)	No	Yes	No	No	No	No	No	No	

2011 KSS - New version of Knee Society Score (See note above)

**Kujala/AKPS**  
*Anterior Knee Pain Score*

The Questionnaire was developed with Finish patients. There is no description of how items were translated into English and how the translation was validated.

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Arabic (Hamdan et al. 2019) (310)	No	No	Yes, direct translation	No	No	No	No	No	?
Brazilian-Portuguese (da Cunha et al. 2013) (311)	No	Yes	No	Test	Yes	No	No	No	From English
Dutch (Kievit et al. 2013) (312)	No	Yes	No	Test	Yes	No	No	No	From English

Dutch (Ummels et al. 2017) (313)	No	Yes	No	No	No	No	No	No	From English
French (Buckinx et al. 2017) (314)	No	Yes	No	Test	Yes	No	No	No	From English
German (Dammerer et al. 2018) (315)	No	Yes	No	Test	Yes	No	No	No	From English
Greek (Papadopoulos et al. 2017) (316)	No	Yes	No	Test	Yes	No	No	No	From English
Italian (Cerciello et al. 2018) (317)	No	Yes	No	No	No	No	No	No	From English
Spanish (Gil-Gómez et al. 2016) (318)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Thai (Apivatgaroon et al. 2016) (319)	No	Yes	No	Test	Yes	No	No	No	From English

**Lysholm/LKS**

*Lysholm Knee Scoring Scale*

Lysholm was developed by Swedish patients but reported in English. It is unknown how translation was performed and validated.

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Arabic (Ahmed et al. 2019) (253)	No	Yes	No	No	No	No	No	No	From English
Brazilian-Portuguese (Peccin et al. 2006) (320)	Undocumented	Undocumented	Undocumented	Yes	Yes	Yes	No	No	Undocumented
Chinese (Wang et al. 2016) (321)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Dutch (Eshuis et al. 2016) (322)	No	Yes	No	Test	Yes	No	No	No	From English

German (Swanenburg et al. 2014b) (323)	?	?	?	?	?	?	No	No	Translation undocumented
Spanish (Arroyo-Morales et al. 2019) (324)	Undocumented	Undocumented	Undocumented	No	No	No	No	No	
Turkish (Celik et al. 2013) (325)	No	Yes	No	Test	Yes	No	No	No	From English

**PEDI-IKDC**

*Pediatric International Knee Documentation Committee*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Danish (Jacobsen et al. 2016) (326)	No	Yes	No	Yes	Yes	Yes	No	No	
Dutch (van der Velden et al. 2019) (289)	No	Yes	No	Test	Yes	No	No	No	

**VISA-P**

Victorian Institute of Sports Assessment - Patella

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Dutch (Zwerwer et al. 2009) (327)	No	Yes	No	Test	Yes	No	No	No	
French (Kaux et al. 2016b) (328)	No	Yes	No	Test	?	No	No	No	
German (Lohrer et al. 2011) (329)	No	Yes	No	Test	No	No	No	No	

Greek (Korakakis et al. 2014) (330)	No	Yes	No	Yes	No	Yes	No	No	
Italian (Maffulli et al. 2008a) (331)	No	Yes, but only one forward and one backward translator	No	No	No	No	No	No	
Kannada, Indian (Acharya et al. 2018) (332)	No	Yes	No	Test	Yes	No	No	No	
Spanish (Hernández-Sánchez et al. 2011) (333)	No	Yes	No	Test	Yes	No	No	No	
Swedish (Frohm et al. 2004) (334)	No	Yes	No	Test	Yes	No	No	No	

**WOMAC**

*Western Ontario and McMaster Universities Osteoarthritis Index*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Arabic (Guermazi et al. 2004) (335)	No	Yes	No	Yes	Yes	Yes	No	No	
Arabic (Faik et al. 2008) (336)	No	Yes	No	Test	Yes	No	No	No	
Bengali (Rabbani et al. 2015) (337)	No	Yes	No	Yes	Yes	Yes	No	No	
Chinese (Xie et al. 2008) (338)	No	Yes	No	Yes	Yes	Yes	No	No	
Chinese (Symonds et al. 2015) (339)	No	Yes	No	Yes	Yes	Yes	No	No	
Finnish	?	?	?	?	?	?	No	No	There is no reference to a documented Finnish translation



(Soininen et al. 2008) (222)									
Hebrew (Wigler et al. 1999) (340)	No	No	Yes, apparently one translator each way	No	No	No	No	No	
Korean (Bae et al. 2001) (341)	No	Yes	No	No	No	No	No	No	
Persian (Nadrian et al. 2012) (224)	No	Yes	No	Test	Yes	No	No	No	
Persian (Ebrahimzadeh et al. 2014) (342)	No	Yes	No	No	No	No	No	No	

**WOMAC modified PROMs**

Arabic (Alghadir et al. 2016) (343)	No	Yes	No	Test	Yes	No	No	No	
Nepalese (Nakarmi et al. 2019) (344)	No	Yes, but only one translator each way	No	Yes	Yes	Yes	No	No	
Thai (Kuptniratsaikul et al. 2017) (345)	No	Yes, but only one translator each way	No	Test	Yes	No	No	No	

230. Brandao L, Ferraz MB, Zerbini CA. Health status in rheumatoid arthritis: cross cultural evaluation of a Portuguese version of the Arthritis Impact Measurement Scales 2 (BRASIL-AIMS2). *J Rheumatol.* 1998;25(8):1499-501.
231. Pouchot J, Guillemin F, Coste J, Bregeon C, Sany J. Validation of the French version of the arthritis impact measurement scales 2 and comparison with the french version of the Nottingham Health Profile. "Quality of Life in Rheumatology" Task Force. *Rev Rhum Engl Ed.* 1996;63(6):389-404.
232. Pouchot J, Guillemin F, Coste J, Bregeon C, Sany J. Validity, reliability, and sensitivity to change of a French version of the arthritis impact measurement scales 2 (AIMS2) in patients with rheumatoid arthritis treated with methotrexate. *J Rheumatol.* 1996;23(1):52-60.
233. Rosemann T, Szecsenyi J. Cultural adaptation and validation of a German version of the Arthritis Impact Measurement Scales (AIMS2). *Osteoarthritis Cartilage.* 2007;15(10):1128-33.
234. Salaffi F, Piva S, Barreca C, Cacace E, Ciancio G, Leardini G, et al. Validation of an Italian version of the arthritis impact measurement scales 2 (ITALIAN-AIMS2) for patients with osteoarthritis of the knee. Gonarthrosis and Quality of Life Assessment (GOQOLA) Study Group. *Rheumatology (Oxford).* 2000;39(7):720-7.
235. Mousavi SJ, Parnianpour M, Askary-Ashtiani AR, Hadian MR, Rostamian A, Montazeri A. Translation and validation study of the Persian version of the Arthritis Impact Measurement Scales 2 (AIMS2) in patients with osteoarthritis of the knee. *BMC Musculoskelet Disord.* 2009;10:95.
236. Soosova MS, Macejova Z. Is the Arthritis Impact Measurement Scales 2 a good tool to assess quality of life in Slovak patients with rheumatoid arthritis? *Bratisl Lek Listy.* 2013;114(9):534-9.
237. Atamaz F, Heppguler S, Oncu J. Translation and validation of the Turkish version of the arthritis impact measurement scales 2 in patients with knee osteoarthritis. *J Rheumatol.* 2005;32(7):1331-6.

238. Chu EM, Chiu KY, Wong RW, Tang WM, Lau CS. Translation and validation of Arthritis Impact Measurement Scales 2 into Chinese: CAIMS2. *Arthritis Rheum.* 2004;51(1):20-7.
239. Rosemann T, Korner T, Wensing M, Schneider A, Szecsenyi J. Evaluation and cultural adaptation of a German version of the AIMS2-SF questionnaire (German AIMS2-SF). *Rheumatology (Oxford).* 2005;44(9):1190-5.
240. Haugen IK, Moe RH, Slatkowsky-Christensen B, Kvien TK, van der Heijde D, Garratt A. The AUSCAN subscales, AIMS-2 hand/finger subscale, and FIOHA were not unidimensional scales. *J Clin Epidemiol.* 2011;64(9):1039-46.
241. Askary-Ashtiani AR, Mousavi SJ, Parnianpour M, Montazeri A. Translation and validation of the Persian version of the Arthritis Impact Measurement Scales 2-Short Form (AIMS2-SF) in patients with rheumatoid arthritis. *Clin Rheumatol.* 2009;28(5):521-7.
242. Askary-Ashtiani AR, Mousavi SJ, Montazeri A, Shamsollahi S, Parnianpour M. Cultural adaptation and validation of the Persian version of the Arthritis Impact Measurement Scales 2-Short Form in patients with osteoarthritis of the knee. *Disabil Rehabil.* 2009;31(25):2081-7.
243. Ramos Marinho AP, Nunes GS, Benetti M, de Noronha M. Cross-cultural adaptation and measurement properties of the Brazilian-Portuguese version of the Cincinnati Knee Rating System. *Disabil Rehabil.* 2019:1-7.
244. Ferreira MC, Silva G, Zidan FF, Franciozi CE, Luzo MVM, Abdalla RJ. Forgotten Joint Score - Portuguese translation and cultural adaptation of the instrument of evaluation for hip and knee arthroplasties. *Rev Bras Ortop.* 2018;53(2):221-5.
245. Cao S, Liu N, Han W, Zi Y, Peng F, Li L, et al. Simplified Chinese version of the Forgotten Joint Score (FJS) for patients who underwent joint arthroplasty: cross-cultural adaptation and validation. *J Orthop Surg Res.* 2017;12(1):6.
246. Shadid MB, Vinken NS, Marting LN, Wolterbeek N. The Dutch version of the Forgotten Joint Score: test-retesting reliability and validation. *Acta Orthop Belg.* 2016;82(1):112-8.
247. Baumann F, Ernstberger T, Loibl M, Zeman F, Nerlich M, Tibesku C. Validation of the German Forgotten Joint Score (G-FJS) according to the COSMIN checklist: does a reduction in joint awareness indicate clinical improvement after arthroplasty of the knee? *Arch Orthop Trauma Surg.* 2016;136(2):257-64.
248. Heijbel S, Naili JE, Hedin A, A WD, Nilsson KG, Hedstrom M. The Forgotten Joint Score-12 in Swedish patients undergoing knee arthroplasty: a validation study with the Knee Injury and Osteoarthritis Outcome Score (KOOS) as comparator. *Acta Orthop.* 2019:1-6.
249. Matsumoto M, Baba T, Homma Y et al. Validation study of the Forgotten Joint Score-12 as a universal patient-reported outcome measure. *Eur J Orthop Surg Traumatol* 2015;25:1141-1145.
250. Klouchea S, Giesinger JM, Sariali E-H. Translation, cross-cultural adaptation and validation of the French version of the Forgotten Joint Score in total hip arthroplasty. *Orthop Traumatol Surg Res* 2018;104:657-661.
251. Narin S, Unver B, Bakirhan S, Bozan O, Karatosun V. Cross-cultural adaptation, reliability and validity of the Turkish version of the Hospital for Special Surgery (HSS) Knee Score. *Acta Orthop Traumatol Turc.* 2014;48(3):241-8.
252. Neuprez A, Delcour JP, Fatemi F, Gillet P, Mawet M, Francois G, et al. Development and validation of the French version of a tool assessing patient's expectations in lower limb osteoarthritis. *J Orthop.* 2015;12(1):46-57.
253. Ahmed KM, Said HG, Ramadan EKA, Abd El-Radi M, El-Assal MA. Arabic translation and validation of three knee scores, Lysholm Knee Score (LKS), Oxford Knee Score (OKS), and International Knee Documentation Committee Subjective Knee Form (IKDC). *SICOT J.* 2019;5:6.
254. Metsavaht L, Leporace G, Riberto M, de Mello Sposito MM, Batista LA. Translation and cross-cultural adaptation of the Brazilian version of the International Knee Documentation Committee Subjective Knee Form: validity and reproducibility. *Am J Sports Med.* 2010;38(9):1894-9.
255. Fu SN, Chan YH. Translation and validation of Chinese version of International Knee Documentation Committee Subjective Knee Form. *Disabil Rehabil.* 2011;33(13-14):1186-9.
256. Huang CC, Chen WS, Tsai MW, Wang WT. Comparing the Chinese versions of two knee-specific questionnaires (IKDC and KOOS): reliability, validity, and responsiveness. *Health Qual Life Outcomes.* 2017;15(1):238.
257. Jia ZY, Zhang C, Zou Y, Huang X, Xu WD. Translation and validation of the Simplified Chinese version of International Knee Documentation Committee Subjective Knee Form. *Arch Orthop Trauma Surg.* 2018;138(10):1433-41.
258. Haverkamp D, Siersevelt IN, Breugem SJ, Lohuis K, Blankevoort L, van Dijk CN. Translation and validation of the Dutch version of the International Knee Documentation Committee Subjective Knee Form. *Am J Sports Med.* 2006;34(10):1680-4.
259. Kummel D, Preiss S, Harder LP, Leunig M, Impellizzeri FM. Measurement properties of the German version of the IKDC subjective knee form (IKDC-SKF). *J Patient Rep Outcomes.* 2018;2:31.
260. Koumantakis GA, Tsoligkas K, Papoutsidakis A, Ververidis A, Drosos GI. Cross-cultural adaptation and validation of the International Knee Documentation Committee Subjective Knee Form in Greek. *J Orthop Traumatol.* 2016;17(2):123-9.
261. Padua R, Bondi R, Ceccarelli E, Bondi L, Romanini E, Zanoli G, et al. Italian version of the International Knee Documentation Committee Subjective Knee Form: cross-cultural adaptation and validation. *Arthroscopy.* 2004;20(8):819-23.
262. Kim JG, Ha JK, Lee JY, Seo SS, Choi CH, Lee MC. Translation and validation of the Korean version of the international knee documentation committee subjective knee form. *Knee Surg Relat Res.* 2013;25(3):106-11.
263. Ebrahimzadeh MH, Makhmalbaf H, Golhasani-Keshtan F, Rabani S, Birjandinejad A. The International Knee Documentation Committee (IKDC) Subjective Short Form: a validity and reliability study. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(11):3163-7.
264. Tigerstrand Grevnerts H, Gravare Silbernagel K, Sonesson S, Ardern C, Osterberg A, Gauffin H, et al. Translation and testing of measurement properties of the Swedish version of the IKDC subjective knee form. *Scand J Med Sci Sports.* 2017;27(5):554-62.

265. Lertwanich P, Praphruetkit T, Keyurapan E, Lamsam C, Kulthanan T. Validity and reliability of Thai version of the International Knee Documentation Committee Subjective Knee Form. *J Med Assoc Thai.* 2008;91(8):1218-25.
266. Celik D, Coskunsu D, KiliCoglu O, Ergonul O, Irrgang JJ. Translation and cross-cultural adaptation of the international knee documentation committee subjective knee form into Turkish. *J Orthop Sports Phys Ther.* 2014;44(11):899-909.
267. van Lankveld W, van Melick N, Habets B, Pronk Y, Staal JB, van Cingel R. Cross-cultural adaptation and measurement properties of the Dutch knee self efficacy scale (K-SES). *BMC Sports Sci Med Rehabil.* 2019;11:3.
268. Thomee P, Wahrborg P, Borjesson M, Thomee R, Eriksson BI, Karlsson J. A new instrument for measuring self-efficacy in patients with an anterior cruciate ligament injury. *Scand J Med Sci Sports.* 2006;16(3):181-7.
269. Cheung RT, Ngai SP, Ho KK. Chinese adaptation and validation of the Knee Injury and Osteoarthritis Outcome Score (KOOS) in patients with knee osteoarthritis. *Rheumatol Int.* 2016;36(10):1449-54.
270. Almangoush A, Herrington L, Attia I, Jones R, Aldawoudy A, Abdul Aziz A, et al. Cross-cultural adaptation, reliability, internal consistency and validation of the Arabic version of the knee injury and osteoarthritis outcome score (KOOS) for Egyptian people with knee injuries. *Osteoarthritis Cartilage.* 2013;21(12):1855-64.
271. Cheng ASK, Chan KC, Chan SY, Fan MK, Fung MK, Lee OY, et al. Cross-Cultural Adaptation and Validation of the Hong Kong Version of the Knee Injury and Osteoarthritis Outcome Score (HK-KOOS) for Patients with Knee Osteoarthritis. *Occup Ther Int.* 2019;2019:8270637.
272. Comins J, Brodersen J, Krogsgaard M, Beyer N. Rasch analysis of the Knee injury and Osteoarthritis Outcome Score (KOOS): a statistical re-evaluation. *Scand J Med Sci Sports.* 2008;18(3):336-45.
273. de Groot IB, Favejee MM, Reijman M, Verhaar JA, Terwee CB. The Dutch version of the Knee Injury and Osteoarthritis Outcome Score: a validation study. *Health Qual Life Outcomes.* 2008;6:16.
274. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* 1998;28(2):88-96.
275. Ornetti P, Parratte S, Gossec L, Tavernier C, Argenson JN, Roos EM, et al. Cross-cultural adaptation and validation of the French version of the Knee injury and Osteoarthritis Outcome Score (KOOS) in knee osteoarthritis patients. *Osteoarthritis Cartilage.* 2008;16(4):423-8.
276. Moutzouri M, Tsoumpou P, Billis E, Papoutsidakis A, Gliatis J. Cross-cultural translation and validation of the Greek version of the Knee Injury and Osteoarthritis Outcome Score (KOOS) in patients with total knee replacement. *Disabil Rehabil.* 2015;37(16):1477-83.
277. Monticone M, Ferrante S, Salvaderi S, Rocca B, Totti V, Foti C, et al. Development of the Italian version of the knee injury and osteoarthritis outcome score for patients with knee injuries: cross-cultural adaptation, dimensionality, reliability, and validity. *Osteoarthritis Cartilage.* 2012;20(4):330-5.
278. Nakamura N, Takeuchi R, Sawaguchi T, Ishikawa H, Saito T, Goldhahn S. Cross-cultural adaptation and validation of the Japanese Knee Injury and Osteoarthritis Outcome Score (KOOS). *J Orthop Sci.* 2011;16(5):516-23.
279. Zulkifli MM, Kadir AA, Elias A, Bea KC, Sadagatullah AN. Psychometric Properties of the Malay Language Version of Knee Injury and Osteoarthritis Outcome Score (KOOS) Questionnaire among Knee Osteoarthritis Patients: A Confirmatory Factor Analysis. *Malays Orthop J.* 2017;11(2):7-14.
280. Salavati M, Mazaheri M, Negahban H, Sohani SM, Ebrahimian MR, Ebrahimi I, et al. Validation of a Persian-version of Knee injury and Osteoarthritis Outcome Score (KOOS) in Iranians with knee injuries. *Osteoarthritis Cartilage.* 2008;16(10):1178-82.
281. Paradowski PT, Witonski D, Keska R, Roos EM. Cross-cultural translation and measurement properties of the Polish version of the Knee injury and Osteoarthritis Outcome Score (KOOS) following anterior cruciate ligament reconstruction. *Health Qual Life Outcomes.* 2013;11:107.
282. Goncalves RS, Cabri J, Pinheiro JP, Ferreira PL. Cross-cultural adaptation and validation of the Portuguese version of the Knee injury and Osteoarthritis Outcome Score (KOOS). *Osteoarthritis Cartilage.* 2009;17(9):1156-62.
283. Alfidhel SA, Vennu V, Alnahdi AH, Omar MT, Alasmari SH, AlJafri Z, et al. Cross-cultural adaptation and validation of the Saudi Arabic version of the Knee Injury and Osteoarthritis Outcome Score (KOOS). *Rheumatol Int.* 2018;38(8):1547-55.
284. Xie F, Li SC, Roos EM, Fong KY, Lo NN, Yeo SJ, et al. Cross-cultural adaptation and validation of Singapore English and Chinese versions of the Knee injury and Osteoarthritis Outcome Score (KOOS) in Asians with knee osteoarthritis in Singapore. *Osteoarthritis Cartilage.* 2006;14(11):1098-103.
285. Vaquero J, Longo UG, Forriol F, Martinelli N, Vethencourt R, Denaro V. Reliability, validity and responsiveness of the Spanish version of the Knee Injury and Osteoarthritis Outcome Score (KOOS) in patients with chondral lesion of the knee. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(1):104-8.
286. Ateef M, Kulandaivelan S, Alqahtani M. Cross-Cultural Validation of Urdu Version KOOS in Indian Population with Primary Knee Osteoarthritis. *Int J Rheumatol.* 2017;2017:1206706.
287. Lyman S, Omori G, Nakamura N, Takahashi T, Tohyama H, Fukui N, et al. Development and validation of a culturally relevant Japanese KOOS. *J Orthop Sci.* 2019;24(3):514-20.
288. Gul ED, Yilmaz O, Bodur H. Reliability and validity of the Turkish version of the knee injury and osteoarthritis outcome score-physical function short-form (KOOS-PS). *J Back Musculoskelet Rehabil.* 2013;26(4):461-6.
289. van der Velden CA, van der Steen MC, Leenders J, van Douveren F, Janssen RPA, Reijman M. Pedi-IKDC or KOOS-child: which questionnaire should be used in children with knee disorders? *BMC Musculoskelet Disord.* 2019;20(1):240.
290. Rioux Trotter E, Beausejour M, Lamer S, Glavas P, Grimard G, Nault ML. Validation of the French version of the KOOS-child questionnaire. *Knee Surg Sports Traumatol Arthrosc.* 2019;27(7):2361-7.

291. Algarni AD, Alrabai HM, Al-Ahaideb A, Kachanathu SJ, AlShammari SA. Arabic translation, cultural adaptation, and validation study of Knee Outcome Survey: Activities of Daily Living Scale (KOS-ADLS). *Rheumatol Int.* 2017;37(9):1585-9.
292. Bouzubar FF, Aljadi SH, Alotaibi NM, Irrgang JJ. Cross-cultural adaptation and validation of the Arabic version of the knee outcome survey-activities for daily living scale. *Disabil Rehabil.* 2018;40(15):1817-28.
293. Jia ZY, Wang W, Nian XW, Zhang XX, Huang ZP, Cui J, et al. Cross-cultural Adaptation and Validation of the Simplified Chinese Version of the Knee Outcome Survey Activities of Daily Living Scale. *Arthroscopy.* 2016;32(10):2009-16.
294. Roy JS, Esculier JF, Maltais DB. Translation, cross-cultural adaptation and validation of the French version of the Knee Outcome Survey-Activities of Daily Living Scale. *Clin Rehabil.* 2014;28(6):614-23.
295. Bizzini M, Gorelick M. Development of a German version of the knee outcome survey for daily activities. *Arch Orthop Trauma Surg.* 2007;127(9):781-9.
296. Kapreli E, Panelli G, Strimpakos N, Billis E, Zacharopoulos A, Athanasopoulos S. Cross-cultural adaptation of the Greek version of the Knee Outcome Survey--activities of Daily Living Scale (KOS-ADLS). *Knee.* 2011;18(6):424-7.
297. Szczepanik M, Bejer A, Snela S, Szymczyk D, Jablonski J, Majewska J. Polish Cross-Cultural Adaptation and Validation of the Knee Outcome Survey Activities of Daily Living Scale (KOS-ADLS) in Patients Undergoing Total Knee Arthroplasty. *Med Sci Monit.* 2018;24:5309-19.
298. Goncalves RS, Cabri J, Pinheiro JP. Cross-cultural adaptation and validation of the Portuguese version of the Knee Outcome Survey-Activities of Daily Living Scale (KOS-ADLS). *Clin Rheumatol.* 2008;27(11):1445-9.
299. Evcik D, Ay S, Ege A, Turel A, Kavuncu V. Adaptation and validation of Turkish version of the Knee Outcome Survey-Activities for Daily Living Scale. *Clin Orthop Relat Res.* 2009;467(8):2077-82.
300. Silva AL, Demange MK, Gobbi RG, da Silva TF, Pecora JR, Croci AT. Translation and Validation of the Knee Society Score - KSS for Brazilian Portuguese. *Acta Ortop Bras.* 2012;20(1):25-30.
301. Ares O, Castellet E, Macule F, Leon V, Montanez E, Freire A, et al. Translation and validation of 'The Knee Society Clinical Rating System' into Spanish. *Knee Surg Sports Traumatol Arthrosc.* 2013;21(11):2618-24
302. Silvaa ALP, Croci AT, Gobbia RC et al. Translation and validation of the new version of the Knee Society Score - The 2011 KS Score - into Brazilian Portuguese. *Rev Bras Orthop* 2017; 52:506-10.
303. Van Der Straeten C, Witvrouw E, Willems T. Translation and Validation of the Dutch New Knee Society Scoring System. *Clin Orthop Relat Res* (2013) 471:3565–3571.
304. Dinjens RB, Senden R, Heyligers IC, Grimm B. Clinimetric quality of the new 2011 Knee Society Score: High validity, low completion rate. *The Knee* 2014;21:647–654.
305. Debettea C, Parratteb S, Boulchc M. French adaptation of the new Knee Society Scoring System for total knee arthroplasty. *Orthop Traumatol Surg Res* 2014;100:531–534.
306. Kayaalp ME, Keller T, Fitz W, Scuderi GR, Becker R. Translation and Validation of the German New Knee Society Scoring System. *Clin Orthop Relat Res* 2019;477:383-393.
307. Hamamoto Y, Ito H, Furu M et al. Cross-cultural adaptation and validation of the Japanese version. of the new Knee Society Scoring System for osteoarthritic knee with total knee arthroplasty. *Orthop Sci* 2015;20:849–853.
308. Kim SJ, Basur MS, Park CK et al. Crosscultural Adaptation and Validation of the Korean Version of the New Knee Society Knee Scoring System. *Clin Orthop Relat Res* 2017;475:1629–1639.
309. Ozden F, Tugay N, Tugay BU, Kılınc CY. Psychometrical properties of the Turkish translation of the new knee society scoring system. *Acta Orthop Traumatol Turc* 2019.
310. Hamdan M, Haddad B, Isleem U, Hamad A, Hussein L, Shawareb Y, et al. Validation of the Arabic version of the Kujala patellofemoral pain scoring system. *J Orthop Sci.* 2019;24(2):290-3.
311. da Cunha RA, Costa LO, Hespanhol Junior LC, Pires RS, Kujala UM, Lopes AD. Translation, cross-cultural adaptation, and clinimetric testing of instruments used to assess patients with patellofemoral pain syndrome in the Brazilian population. *J Orthop Sports Phys Ther.* 2013;43(5):332-9.
312. Kievit AJ, Breugem SJ, Sierveelt IN, Heesterbeek PJ, van de Groes SA, Kremers KC, et al. Dutch translation of the Kujala Anterior Knee Pain Scale and validation in patients after knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2013;21(11):2647-53.
313. Ummels PE, Lenssen AF, Barendrecht M, Beurskens AJ. Reliability of the Dutch translation of the Kujala Patellofemoral Score Questionnaire. *Physiother Res Int.* 2017;22(1).
314. Buckinx F, Bornheim S, Remy G, Van Beveren J, Reginster J, Bruyere O, et al. French translation and validation of the "Anterior Knee Pain Scale" (AKPS). *Disabil Rehabil.* 2019;41(9):1089-94.
315. Dammerer D, Liebensteiner MC, Kujala UM, Emmanuel K, Kopf S, Dirisamer F, et al. Validation of the German version of the Kujala score in patients with patellofemoral instability: a prospective multi-centre study. *Arch Orthop Trauma Surg.* 2018;138(4):527-35.
316. Papadopoulos C, Constantinou A, Cheimonidou AZ, Stasinopoulos D. Greek cultural adaption and validation of the Kujala anterior knee pain scale in patients with patellofemoral pain syndrome. *Disabil Rehabil.* 2017;39(7):704-8.
317. Cerciello S, Corona K, Morris BJ, Visona E, Maccauro G, Maffulli N, et al. Cross-cultural adaptation and validation of the Italian versions of the Kujala, Larsen, Lysholm and Fulkerson scores in patients with patellofemoral disorders. *J Orthop Traumatol.* 2018;19(1):18.
318. Gil-Gamez J, Pecos-Martin D, Kujala UM, Martinez-Merinerio P, Montanez-Aguilera FJ, Romero-Franco N, et al. Validation and cultural adaptation of "Kujala Score" in Spanish. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(9):2845-53.
319. Apivatgaroon A, Angthong C, Sanguanjit P, Chernchujit B. The validity and reliability of the Thai version of the Kujala score for patients with patellofemoral pain syndrome. *Disabil Rehabil.* 2016;38(21):2161-4
320. Peccin MS, Ciconelli R, Cohen M. Specific questionnaire for knee symptoms - the "Lysholm Knee Scoring Scale" –translation and validation into Portuguese. *Acta Orthop Bras.* 2006;14(5).

321. Wang W, Liu L, Chang X, Jia ZY, Zhao JZ, Xu WD. Cross-cultural translation of the Lysholm knee score in Chinese and its validation in patients with anterior cruciate ligament injury. *BMC Musculoskelet Disord.* 2016;17(1):436.
322. Eshuis R, Lentjes GW, Tegner Y, Wolterbeek N, Veen MR. Dutch Translation and Cross-cultural Adaptation of the Lysholm Score and Tegner Activity Scale for Patients With Anterior Cruciate Ligament Injuries. *J Orthop Sports Phys Ther.* 2016;46(11):976-83.
323. Swanenburg J, Koch PP, Meier N, Wirth B. Function and activity in patients with knee arthroplasty: validity and reliability of a German version of the Lysholm Score and the Tegner Activity Scale. *Swiss Med Wkly.* 2014;144:w13976.
324. Arroyo-Morales M, Martin-Alguacil J, Lozano-Lozano M, Cuesta-Vargas AI, Fernandez-Fernandez AJ, Gonzalez JA, et al. The Lysholm score: Cross cultural validation and evaluation of psychometric properties of the Spanish version. *PLoS One.* 2019;14(8):e0221376.
325. Celik D, Coskunsu D, Kilicoglu O. Translation and cultural adaptation of the Turkish Lysholm knee scale: ease of use, validity, and reliability. *Clin Orthop Relat Res.* 2013;471(8):2602-10
326. Jacobsen JS, Knudsen P, Fynbo C, Rolving N, Warming S. Reproducibility and responsiveness of a Danish Pedi-IKDC subjective knee form for children with knee disorders. *Scand J Med Sci Sports.* 2016;26(12):1408-14.
327. Zwerver J, Kramer T, van den Akker-Scheek I. Validity and reliability of the Dutch translation of the VISA-P questionnaire for patellar tendinopathy. *BMC Musculoskelet Disord.* 2009;10:102.
328. Kaux JF, Delvaux F, Oppong-Kyei J, Beudart C, Buckinx F, Croisier JL, et al. Cross-cultural Adaptation and Validation of the Victorian Institute of Sport Assessment-Patella Questionnaire for French-Speaking Patients With Patellar Tendinopathy. *J Orthop Sports Phys Ther.* 2016;46(5):384-90.
329. Lohrer H, Nauck T. Cross-cultural adaptation and validation of the VISA-P questionnaire for German-speaking patients with patellar tendinopathy. *J Orthop Sports Phys Ther.* 2011;41(3):180-90.
330. Korakakis V, Patsiaouras A, Malliaropoulos N. Cross-cultural adaptation of the VISA-P questionnaire for Greek-speaking patients with patellar tendinopathy. *Br J Sports Med.* 2014;48(22):1647-52.
331. Maffulli N, Longo UG, Testa V, Oliva F, Capasso G, Denaro V. VISA-P score for patellar tendinopathy in males: adaptation to Italian. *Disabil Rehabil.* 2008;30(20-22):1621-4.
332. Acharya GU, Kumar A, Rajasekar S, Samuel AJ. Reliability and validity of Kannada version of Victorian Institute of Sports Assessment for patellar tendinopathy (VISA-P-K) questionnaire. *J Clin Orthop Trauma.* 2019;10(Suppl 1):S189-S92.
333. Hernandez-Sanchez S, Hidalgo MD, Gomez A. Cross-cultural adaptation of VISA-P score for patellar tendinopathy in Spanish population. *J Orthop Sports Phys Ther.* 2011;41(8):581-91.
334. Frohm A, Saartok T, Edman G, Renstrom P. Psychometric properties of a Swedish translation of the VISA-P outcome score for patellar tendinopathy. *BMC Musculoskelet Disord.* 2004;5:49.
335. Guermazi M, Poiraudou S, Yahia M, Mezganni M, Fermanian J, Habib Elleuch M, et al. Translation, adaptation and validation of the Western Ontario and McMaster Universities osteoarthritis index (WOMAC) for an Arab population: the Sfax modified WOMAC. *Osteoarthritis Cartilage.* 2004;12(6):459-68.
336. Faik A, Benbouazza K, Amine B, Maaroufi H, Bahiri R, Lazrak N, et al. Translation and validation of Moroccan Western Ontario and McMaster Universities (WOMAC) osteoarthritis index in knee osteoarthritis. *Rheumatol Int.* 2008;28(7):677-83.
337. Rabbani MG, Haq SA, Bellamy N, Islam MN, Choudhury MR, Naheed A, et al. Development, linguistic and clinimetric validation of the WOMAC VA3.01 Bangla for Bangladesh Index. *Rheumatol Int.* 2015;35(6):997-1003.
338. Xie F, Li SC, Goeree R, Tarride JE, O'Reilly D, Lo NN, et al. Validation of Chinese Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in patients scheduled for total knee replacement. *Qual Life Res.* 2008;17(4):595-601.
339. Symonds T, Hughes B, Liao S, Ang Q, Bellamy N. Validation of the Chinese Western Ontario and McMaster Universities Osteoarthritis Index in Patients From Mainland China With Osteoarthritis of the Knee. *Arthritis Care Res (Hoboken).* 2015;67(11):1553-60.
340. Wigler I, Neumann L, Yaron M. Validation study of a Hebrew version of WOMAC in patients with osteoarthritis of the knee. *Clin Rheumatol.* 1999;18(5):402-5.
341. Bae SC, Lee HS, Yun HR, Kim TH, Yoo DH, Kim SY. Cross-cultural adaptation and validation of Korean Western Ontario and McMaster Universities (WOMAC) and Lequesne osteoarthritis indices for clinical research. *Osteoarthritis Cartilage.* 2001;9(8):746-50.
342. Ebrahimzadeh MH, Makhmalbaf H, Birjandinejad A, Keshtan FG, Hoseini HA, Mazloumi SM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in Persian Speaking Patients with Knee Osteoarthritis. *Arch Bone Jt Surg.* 2014;2(1):57-62.
343. Alghadir A, Anwer S, Iqbal ZA, Alsanawi HA. Cross-cultural adaptation, reliability and validity of the Arabic version of the reduced Western Ontario and McMaster Universities Osteoarthritis index in patients with knee osteoarthritis. *Disabil Rehabil.* 2016;38(7):689-94.
344. Nakarmi S, Haq SA, Vaidya B. Translation, validation and cross-cultural adaptation of the Nepali version of WOMAC® LK 3.1. *Int J Rheum Dis.* 2019;22:1877-1883.
345. Kuptniratsaikul V, Rattanachaiyanont M. Validation of a modified Thai version of the Western Ontario and McMaster (WOMAC) osteoarthritis index for knee osteoarthritis. *Clin Rheumatol.* 2007;26(10):1641-5

Tabel 7: Translation, adaption and validation of knee PROMs.

Calf PROMs translation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
<b>LLFI</b>									
<i>Lower Limb Functional Index</i>									
Spanish (Cuesta-Vargas et al. 2014) (346)	No	Yes	No	No	No	No	No	No	
Turkish (Duruturk et al. 2015) (347)	No	Yes	No	Test	Yes	No	No	No	
<b>MTSS-score</b>									
<i>Medial Tibial Stress Syndrome Score</i>									
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
English (Winters et al. 2016) (348)	No	Yes	No	No	No	No	No	No	
<p>346. Cuesta-Vargas AI, Gabel CP, Bennett P. Cross cultural adaptation and validation of a Spanish version of the Lower Limb Functional Index. Health Qual Life Outcomes. 2014;12:75.</p> <p>347. Duruturk N, Tonga E, Gabel CP, Acar M, Tekindal A. Cross-cultural adaptation, reliability and validity of the Turkish version of the Lower Limb Functional Index. Disabil Rehabil. 2015;37(26):2439-44.</p> <p>348. Winters, M, Franklyn, M, Moen, MH, Weir, A, Backx, FJG, &amp; Bakker, EWP. (2016). The medial tibial stress syndrome score: item generation for a new patient reported outcome measure. South African Journal of Sports Medicine, 28(1), 11-16.</p>									

Tabel 8: Translation, adaption and validation of calf PROMs.

Ankle PROMs translation

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
<b>AAOS-FAQQ</b>									
<i>American Academy of Orthopaedic Surgeons Foot and Ankle Outcomes Questionnaire</i>									
Korean (Kim et al. 2015) (349)	No	Yes	No	Yes	Yes	Yes	No	No	
Spanish (González-Sánchez et al. 2016) (350)	No	Yes	No	No	No	No	No	No	
Spanish (Zelle et al. 2017) (351)	No	Yes	No	Yes	Yes	Yes	No	No	
<b>AOFAS-AHS</b>									
<i>American Orthopaedic Foot &amp; Ankle Society Hindfoot Score</i>									
	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Rodrigues et al. 2008) (352)	No	Yes	No	Test	Yes	No	No	No	
Dutch (Boer et al. 2017a) (353)	No	Yes	No	No	Yes	No	No	No	
German (Kostuj et al. 2014) (354)	No	Yes	No	No	Yes	Yes	No	No	
Italian (Leigheb et al. 2016) (355)	No	Yes	No	Test	Yes	No	No	No	
Persian (Sayyed-Hossainian et al. 2018) (356)	No	Yes	No	Test	Yes	Yes	No	No	
Persian	No	Yes	No	Test	Yes	No	No	No	

(Vosoughi et al. 2018) (357)									
Turkish (AKbaba et al. 2016) (358)	No	Yes	No	Yes	Yes	Yes	No	No	

**AOS**  
*Ankle Osteoarthritis Scale*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Canadian-French (Angers et al. 2016) (358)	No	Yes	No	Yes	No	Yes	No	No	

**ATRS**  
*The Achilles Tendon Total Rupture Score*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Zambelli et al. 2016) (359)	No	Yes	No	Yes	Yes	Yes	No	No	From English !
Chinese (Cui et al. 2017) (360)	No	Yes	No	Unertain	Yes	Uncertain	No	No	From English !
Danish (Ganestam et al. 2013) (361)	No	Yes	No	No	No	No	No	No	From Swedish
Dutch (Opdam et al. 2016) (362)	No	Yes	No	Yes	No	Yes	No	No	From English !
English (Carmont et al. 2013) (363)	No	No	Yes	No	No	No	No	No	The wording of the undocumented English translation was changed by the researchers
French	No	Yes	No	Test	Yes	No	No	No	From English !



(Buckinx et al. 2019) (364)									
Greek (Touzopoulos et al. 2017) (365)	No	Yes	No	Test	Yes	No	No	No	From English !
Italian (Vascellari et al. 2016) (366)	No	Yes	No	No	Yes	No	No	No	From English !
Norwegian (Myhrvold et al. 2017) (367)	No	Yes	No	No	No	No	No	No	From Swedish
Persian (Ansari et al. 2016) (368)	No	Yes	No	Yes	Yes	Yes	No	No	From English !
Polish (Bakowski et al. 2017) (369)	No	Yes	No	Test	Yes	No	No	No	From English !
Sweden (Nilsson-Helander et al. 2007) (370)	?	?	?	?	?	?	No	No	The English version is undocumented
Turkish (Mutlu et al. 2005) (371)	No	Yes	No	Yes	Yes	Yes	No	No	From Swedish

### FAAM

#### *Foot and Ankle Ability Measure*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Moreira et al. 2016) (372)	Yes	No	Yes	Yes	Yes	Yes	No		Yes
Chinese (González-Sancéz et al. 2016) (373)	Yes	No	Test	Yes	Yes	No	No		Yes
Dutch (Weel et al. 2016) (374)	Yes	No	Test	No	Yes	No	No		Yes
French	No	Yes	No	Test	Yes	Yes	No	No	

(Borloz et al. 2011) (375)									
German (Nauck, Lohrer, 2009) (376)	No	Yes	No	Yes	No	Yes	No	No	
Japanese (Uematsu et al. 2015) (377)	No	Yes	No	Yes	No	Yes	No	No	
Spanish (Cervera-Garvi et al. 2017) (378)	No	Yes	No	Yes	Yes	Yes	Yes	No	
Thai (Arunakul et al. 2015) (379)	No	Yes	No	No	No	No	No	No	
Turkish (Celik et al. 2016) (380)	No	Yes	No	Yes	Yes	Yes	No	No	

### FAOS

#### *Foot & Ankle Outcome Score*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Imoto et al. 2009) (381)	No	Yes	No	Test	Yes	Yes	No	No	From English
Chinese (Ling et al. 2018) (382)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Danish (Larsen et al. 2017) (383)	No	Yes	No	Yes	Yes	Yes	No	No	From Swedish
Dutch (van den Akker-Scheek et al. 2013) (384)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Dutch (Sierevelt et al. 2015) (385)	No	Yes	No	Test	Yes	No	Yes	No	From English

English (Chen et al. 2012) (386)	?	?	?	?	?	?	No	No	There is no documented English translation
German (van Bergen et al. 2014) (387)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Korean (Lee et al. 2013) (388)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Persian (Negahban et al. 2010) (389)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Spanish (Pellegrini et al. 2019) (390)	No	Yes	No	Yes	Yes	Yes	No	No	From English
Swedish (Roos et al. 2001) (391)	?	?	?	?	?	?	No	No	No documented translation to English
Thai (Anghong, 2016) (392)	No	Yes	No	No	No	No	No	No	From English
Turkish (Karatepe et al. 2009) (393)	No	Yes	No	Test	Yes	Yes	No	No	From English

**FFI**

*Foot Function Index*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (Yi et al. 2015) (394)	No	Yes	No	Yes	Yes	Yes	No	No	
Brazilian-Portuguese (Yi et al. 2017) (395)	No	Yes	No	Yes	Yes	Yes	No	No	
Chinese (González-Sánchez et al. 2017) (396)	No	Yes	No	Unclear	Yes	Unclear	No	No	
French	No	Yes	No	Test	Yes	Yes	No	No	

(Pourtier-Piotte et al. 2015) (397)									
Italian (Vetrano et al. 2014) (398)	No	Yes	No	Test	No	No	No	No	
Persian (Mousavian et al. 2019) (399)	No	Yes	No	No	No	No	No	No	
Spanish (Pod et al. 2013) (400)	No	Yes	No	Test	Yes	Yes	Yes	No	
Thai (Srimakarat et al. 2018) (401)	No	Yes	No	Yes	Yes	Yes	No	No	
<b>FFI modified PROMs</b>									
Brazilian-Portuguese (Stéfani et al. 2017) (402) <i>FFI-R 68-item scale</i>	No	Yes	No	Test	Yes	No	No	No	
Chinese/Taiwan (Wu et al. 2008) (403) <i>Modified 21-item scale</i>	No	Yes	No	No	No	No	No	No	
German (Naal et al. 2008b) (404) <i>Modified 18-item scale</i>	No	Yes	Yes	Yes	Yes	Yes	No	No	
Italian (Martinelli et al. 2014) (405) <i>Modified 18-item scale</i>	No	Yes	No	Yes	Yes	Yes	No	No	
Italian (Venditto et al. 2015) (406) <i>Modified 17-item scale</i>	No	Yes	No	Yes	Yes	Yes	No	No	
Korean (Huh et al. 2016) (407)	No	Yes	No	Yes	Yes	Yes	No	No	

<i>Modified 18-item scale</i>									
Polish (Rutkowski et al. 2017) (408) <i>FFI-R 34-item scale</i>	No	Yes	No	Test	Yes	No	No	No	
Turkish (Yagci et al. 2019) (409)	No	Yes	No	Yes	Yes	Yes	No	No	

**VISA-A**  
*Victorian Institute of Sports Assessment-Achilles*

	Dual panel translation	Forward-backwards translation	Other methods of translation	Cognitive interviews	Tested in relevant patient groups	Modifications (cultural)	Dimensionality tested in	Cross-cultural DIF tested	Comments
Brazilian-Portuguese (de Mesquita et al. 2018) (410)	No	Yes	No	Yes	No	Yes	No	No	Delphi decision among Brazilian physiotherapists regarding wording
Chilean-Spanish (Keller et al. 2018) (411)	No	Yes	No	Yes	Yes	Yes	No	No	
Danish (Iversen et al. 2016) (412)	No	Yes	No	Yes	No	Yes	No	No	
Dutch (Sierevelt et al. 2018) (413)	No	Yes	No	No	No	No	No	No	
French (Kaux et al. 2016c) (414)	No	Yes	No	Yes	Yes	Yes	No	No	
German (Lohrer, Nauck, 2009) (415)	No	Yes	No	Yes	Yes	Yes	No	No	
Italian (Maffulli et al. 2008b) (416)	No	Yes, one translator each way	No	No	No	No	No	No	
Spanish	No	Yes	No	Yes	Yes	Yes	Yes	No	

(Hernández-Sanchez et al. 2017) (417)									
Swedish (Silbernagel et al. 2005) (418)	No	Yes	No	Yes	Yes	Yes	No	No	
Turkish (Dogramaci et al. 2009) (419)	No	Yes	No	Yes	Yes	Yes	No	No	

349. Kim JB, Kim JK, Seo SG, Lee DY. Validity, reliability, and responsiveness of the Korean version of American Academy of Orthopedic Surgeons Foot and Ankle questionnaire. *J Foot Ankle Surg.* 2015;54(1):46-50.

350. Gonzalez-Sanchez M, Velasco-Ramos E, Ruiz-Munoz M, Cuesta-Vargas AI. Cross-cultural adaptation and validation of the Spanish version of the American Academy of Orthopaedic Surgeons-Foot and Ankle Module (AAOS-FAMsp). *J Orthop Surg Res.* 2016;11(1):74.

351. Zelle BA, Francisco BS, Bossmann JP, Fajardo RJ, Bhandari M. Spanish Translation, Cross-Cultural Adaptation, and Validation of the American Academy of Orthopaedic Surgeons Foot and Ankle Outcomes Questionnaire in Mexican-Americans With Traumatic Foot and Ankle Injuries. *J Orthop Trauma.* 2017;31(5):e158-e62.

352. Alloza RCRDMJMMAMIMSPMCJFM. Translation, cultural adaptation and validity of the " American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale. *Acta Ortopédica Brasileira.* 2008;16(2).

353. de Boer AS, Tjioe RJC, Van der Sijde F, Meuffels DE, den Hoed PT, Van der Vlies CH, et al. The American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Scale; translation and validation of the Dutch language version for ankle fractures. *BMJ Open.* 2017;7(8):e017040.

354. Kostuj T, Schaper K, Baums MH, Lieske S. German Validation of the AOFAS ankle hindfoot scale. *Fuß & Sprunggelenk* 2014;12:100-106.

355. Leigh M, Janicka P, Andorno S, Marcuzzi A, Magnani C, Grassi F. Italian translation, cultural adaptation and validation of the "American Orthopaedic Foot and Ankle Society's (AOFAS) ankle-hindfoot scale". *Acta Biomed.* 2016;87(1):38-45.

356. Sayyed-Hosseini SH, Hassankhani GG, Bagheri F, Alavi N, Shojaie B, Mousavian A. Validation of the Persian Version of the American Orthopedic Foot and Ankle Society Score (AOFAS) Questionnaire. *Arch Bone Jt Surg.* 2018;6(3):233-9.

357. Vosoughi AR, Roustaei N, Mahdaviazad H. American Orthopaedic Foot and Ankle Society ankle-hindfoot scale: A cross-cultural adaptation and validation study from Iran. *Foot Ankle Surg.* 2018;24(3):219-23.

358. Anay Akbaba Y, Celik D, Ogut RT. Translation, Cross-Cultural Adaptation, Reliability, and Validity of Turkish Version of the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Scale. *J Foot Ankle Surg.* 2016;55(6):1139-42.

358. Angers M, Svolte A, Balg F, Allard JP. Cross-cultural adaptation and validation of the Ankle Osteoarthritis Scale for use in French-speaking populations. *Can J Surg.* 2016;59(2):123-7.

359. Zambelli R, Pinto RZ, Magalhaes JM, Lopes FA, Castilho RS, Baumfeld D, et al. Development of the Brazilian Portuguese version of the Achilles Tendon Total Rupture Score (ATRS BrP): a cross-cultural adaptation with reliability and construct validity evaluation. *BMC Sports Sci Med Rehabil.* 2016;8:11.

360. Cui J, Jia Z, Zhi X, Li X, Zhai X, Cao L, et al. The chinese version of achilles tendon total rupture score: cross-cultural adaptation, reliability and validity. *Health Qual Life Outcomes.* 2017;15(1):2.

361. Ganestam A, Barfod K, Klit J, Troelsen A. Validity and reliability of the Achilles tendon total rupture score. *J Foot Ankle Surg.* 2013;52(6):736-9.

362. Opdam KTM, Zwiers R, Wiegierinck JI, Kleipool AEB, Haverlag R, Goslings JC, et al. Reliability and validation of the Dutch Achilles tendon Total Rupture Score. *Knee Surg Sports Traumatol Arthrosc.* 2018;26(3):862-8.

363. Carmont MR, Silbernagel KG, Nilsson-Helander K, Mei-Dan O, Karlsson J, Maffulli N. Cross cultural adaptation of the Achilles tendon Total Rupture Score with reliability, validity and responsiveness evaluation. *Knee Surg Sports Traumatol Arthrosc.* 2013;21(6):1356-60.

364. Buckinx F, Lecoq G, Bornheim S, Van Beveren J, Valcu A, Daniel C, et al. French translation and validation of the Achilles Tendon Total Rupture Score "ATRS". *Foot Ankle Surg.* 2019.

365. Touzopoulos P, Verweridis A, Giakas G, Drosos GI. Validation and cross-cultural adaptation of Greek version of Achilles tendon Total Rupture Score. *Foot Ankle Surg.* 2019;25(1):8-12.

366. Vascellari A, Spennacchio P, Combi A, Grassi A, Patella S, Bisicchia S, et al. Cross-cultural adaptation and multi-centric validation of the Italian version of the Achilles tendon Total Rupture Score (ATRS). *Knee Surg Sports Traumatol Arthrosc.* 2018;26(3):854-61.

367. Myhrvold SB, Sandnes O, Hoelsbrekken SE. Validity and reliability of the Norwegian translation of the Achilles tendon Total Rupture Score. *Knee Surg Sports Traumatol Arthrosc.* 2018;26(7):2045-50.

368. Ansari NN, Naghdi S, Hasanvand S, Fakhari Z, Kordi R, Nilsson-Helander K. Cross-cultural adaptation and validation of Persian Achilles tendon Total Rupture Score. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(4):1372-80.

369. Bakowski P, Rubczak S, Wolff-Stefaniak M, Grygorowicz M, Piontek T. Reliability and validity of the Polish version of the Achilles tendon Total Rupture Score. *Knee Surg Sports Traumatol Arthrosc.* 2018;26(7):2074-9.

370. Nilsson-Helander K, Thomee R, Silbernagel KG, Thomee P, Faxen E, Eriksson BI, et al. The Achilles tendon Total Rupture Score (ATRS): development and validation. *Am J Sports Med.* 2007;35(3):421-6.
371. Kaya Mutlu E, Celik D, Kilicoglu O, Ozdincler AR, Nilsson-Helander K. The Turkish version of the Achilles tendon Total Rupture Score: cross-cultural adaptation, reliability and validity. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(8):2427-32
372. Moreira TS, Magalhaes Lde C, Silva RD, Martin RL, Resende MA. Translation, cross-cultural adaptation and validity of the Brazilian version of the Foot and Ankle Ability Measure questionnaire. *Disabil Rehabil.* 2016;38(25):2479-90.
373. Gonzalez-Sanchez M, Li GZ, Ruiz Munoz M, Cuesta-Vargas AI. Foot and ankle ability measure to measure functional limitations in patients with foot and ankle disorders: a Chinese cross-cultural adaptation and validation. *Disabil Rehabil.* 2017;39(21):2182-9.
374. Weel H, Zwiers R, Azim D, Sierevelt IN, Haverkamp D, van Dijk CN, et al. Validity and reliability of a Dutch version of the Foot and Ankle Ability Measure. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(4):1348-54.
375. Borloz S, Crevoisier X, Deriaz O, Ballabeni P, Martin RL, Luthi F. Evidence for validity and reliability of a French version of the FAAM. *BMC Musculoskelet Disord.* 2011;12:40.
376. Nauck T, Lohrer H. Translation, cross-cultural adaptation and validation of the German version of the Foot and Ankle Ability Measure for patients with chronic ankle instability. *Br J Sports Med.* 2011;45(10):785-90.
377. Uematsu D, Suzuki H, Sasaki S, Nagano Y, Shinozuka N, Sunagawa N, et al. Evidence of validity for the Japanese version of the foot and ankle ability measure. *J Athl Train.* 2015;50(1):65-70.
378. Cervera-Garvi P, Ortega-Avila AB, Morales-Asencio JM, Cervera-Marin JA, Martin RR, Gijon-Nogueron G. Cross-cultural adaptation and validation of Spanish version of The Foot and Ankle Ability Measures (FAAM-Sp). *J Foot Ankle Res.* 2017;10:39.
379. Arunakul M, Arunakul P, Suesiritumrong C, Anghthong C, Chernchujit B. Validity and Reliability of Thai Version of the Foot and Ankle Ability Measure (FAAM) Subjective Form. *J Med Assoc Thai.* 2015;98(6):561-7.
380. Celik D, Malkoc M, Martin R. Evidence for reliability, validity and responsiveness of Turkish Foot and Ankle Ability Measure (FAAM). *Rheumatol Int.* 2016;36(10):1469-76.
381. Aline Mizusaki Imoto MSP, Reynaldo Rodrigues Jorge Mitsuo Mizusaki. TRANSLATION, CULTURAL ADAPTATION AND VALIDATION OF FOOT AND ANKLE OUTCOME SCORE (FAOS) QUESTIONNAIRE INTO PORTUGUESE. *Acta Ortop Bras.* 2009;17(4):232.
382. Ling SKK, Chan V, Ho K, Ling F, Lui TH. Reliability and validity analysis of the open-source Chinese Foot and Ankle Outcome Score (FAOS). *Foot (Edinb).* 2018;35:48-51.
383. Larsen P, Boe AM, Iyer AB, Elsoe R. Danish translation of the Foot and Ankle Outcome Score. *Dan Med J.* 2017;64(12).
384. van den Akker-Scheek I, Seldentuis A, Reininga IH, Stevens M. Reliability and validity of the Dutch version of the Foot and Ankle Outcome Score (FAOS). *BMC Musculoskelet Disord.* 2013;14:183.
385. Sierevelt IN, Beimers L, van Bergen CJA, Haverkamp D, Terwee CB, Kerkhoffs G. Validation of the Dutch language version of the Foot and Ankle Outcome Score. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(8):2413-9.
386. Chen L, Lyman S, Do H, Karlsson J, Adam SP, Young E, et al. Validation of foot and ankle outcome score for hallux valgus. *Foot Ankle Int.* 2012;33(12):1145-55.
387. van Bergen CJ, Sierevelt IN, Hoogervorst P, Waizy H, van Dijk CN, Becher C. Translation and validation of the German version of the foot and ankle outcome score. *Arch Orthop Trauma Surg.* 2014;134(7):897-901.
388. Lee KM, Chung CY, Kwon SS, Sung KH, Lee SY, Won SH, et al. Transcultural adaptation and testing psychometric properties of the Korean version of the Foot and Ankle Outcome Score (FAOS). *Clin Rheumatol.* 2013;32(10):1443-50.
389. Negahban H, Mazaheri M, Salavati M, Sohani SM, Askari M, Fanian H, et al. Reliability and validity of the foot and ankle outcome score: a validation study from Iran. *Clin Rheumatol.* 2010;29(5):479-86.
390. Pellegrini MJ, Ponichak R, Nunez A, Escudero MI, Carcuro G, Cortes AA. Cross-cultural adaptation and validation of the Foot and Ankle Outcome Score (FAOS) into Spanish (Chile). *Foot Ankle Surg.* 2019.
391. Roos EM, Brandsson S, Karlsson J. Validation of the foot and ankle outcome score for ankle ligament reconstruction. *Foot Ankle Int.* 2001;22(10):788-94.
392. Anghthong C. Validity and reliability of Thai version of the Foot and Ankle Outcome Score in patients with arthritis of the foot and ankle. *Foot Ankle Surg.* 2016;22(4):224-8.
393. Karatepe AG, Gunaydin R, Kaya T, Karlibas U, Ozbek G. Validation of the Turkish version of the foot and ankle outcome score. *Rheumatol Int.* 2009;30(2):169-73
394. Yi LC, Staboli IM, Kamonseki DH, Budiman-Mak E, Arie EK. Translation and cross-cultural adaptation of FFI to Brazilian Portuguese version: FFI - Brazil. *Rev Bras Reumatol.* 2015;55(5):398-405.
395. Yi LC, Cabral ACC, Kamonseki DH, Budiman-Mak E, Vidotto MC. Translation and cultural adaptation of the revised foot function index for the Portuguese language: FFI-R Brazil. *Sao Paulo Med J.* 2017;135(6):573-7.
396. Gonzalez-Sanchez M, Ruiz-Munoz M, Li GZ, Cuesta-Vargas AI. Chinese cross-cultural adaptation and validation of the Foot Function Index as tool to measure patients with foot and ankle functional limitations. *Disabil Rehabil.* 2018;40(17):2056-61.
397. Pourtier-Piotte C, Pereira B, Soubrier M, Thomas E, Gerbaud L, Coudeyre E. French validation of the Foot Function Index (FFI). *Ann Phys Rehabil Med.* 2015;58(5):276-82.
398. Vetrano M, Vulpiani MC, Erroi D, Vadala A, Ferretti A, Saraceni VM. Cross-cultural adaptation and reliability of the Italian version of the Foot Function Index (FFI-I) for patients with plantar fasciitis. *J Sports Med Phys Fitness.* 2014;54(5):636-43.

399. Mousavian A, Mohammadi A, Seyed-Hosseini SH, Shahpari O, Elahpour N, Orooji A, et al. Reliability and Validity of the Persian Version of the Foot Function Index in Patients with Foot Disorders. *Arch Bone Jt Surg*. 2019;7(3):291-6.
400. Paez-Moguer J, Budiman-Mak E, Cuesta-Vargas AI. Cross-cultural adaptation and validation of the Foot Function Index to Spanish. *Foot Ankle Surg*. 2014;20(1):34-9.
401. Pitchanart Srimakarat AJ, Siriporn Janchai, Natthiya Tantisiriwat. Reliability and Validity of Foot Function Index Thai Version [FFI-TH]. *J Med Assoc Thai*. 2018;101(2):253-60.
402. Stefani KC, Pereira MVF, Oliveira PR, Wun PYL. Translation, Cultural Adaptation and Validation of the Foot Function Index - Revised (Ffi-R). *Acta Ortop Bras*. 2017;25(5):188-93.
403. Wu SH, Liang HW, Hou WH. Reliability and validity of the Taiwan Chinese version of the Foot Function Index. *J Formos Med Assoc*. 2008;107(2):111-8.
404. Naal FD, Impellizzeri FM, Huber M, Rippstein PF. Cross-cultural adaptation and validation of the Foot Function Index for use in German-speaking patients with foot complaints. *Foot Ankle Int*. 2008;29(12):1222-8.
405. Martinelli N, Scotto GM, Sartorelli E, Bonifacini C, Bianchi A, Malerba F. Reliability, validity and responsiveness of the Italian version of the Foot Function Index in patients with foot and ankle diseases. *Qual Life Res*. 2014;23(1):277-84.
406. Venditto T, Tognolo L, Rizzo RS, Iannuccelli C, Di Sante L, Trevisan M, et al. 17-Italian Foot Function Index with numerical rating scale: development, reliability, and validity of a modified version of the original Foot Function Index. *Foot (Edinb)*. 2015;25(1):12-8.
407. Huh JW, Eun IS, Ko YC, Park MJ, Hwang KM, Park SH, et al. Reliability and Validity of the Korean Version of the Foot Function Index. *J Foot Ankle Surg*. 2016;55(4):759-61.
408. Rutkowski R, Galczynska-Rusin M, Gizinska M, Straburzynski-Lupa M, Zdanowska A, Romanowski MW, et al. Adaptation and Validation of the Foot Function Index-Revised Short Form into Polish. *Biomed Res Int*. 2017;2017:6051698.
409. Yagci G, Erel S, Okunakol V. Validation of the Turkish version of the Revised Foot Function Index for patients with foot and ankle disorders. *Foot Ankle Surg*. 2019
410. de Mesquita GN, de Oliveira MNM, Matoso AER, de Moura Filho AG, de Oliveira RR. Cross-cultural Adaptation and Measurement Properties of the Brazilian Portuguese Version of the Victorian Institute of Sport Assessment-Achilles (VISA-A) Questionnaire. *J Orthop Sports Phys Ther*. 2018;48(7):567-73.
411. Keller A, Wagner P, Izquierdo G, Cabroler J, Caicedo N, Wagner E, et al. Cross-cultural adaptation and validation of the VISA-A questionnaire for Chilean Spanish-speaking patients. *J Orthop Surg Res*. 2018;13(1):177.
412. Iversen JV, Bartels EM, Jorgensen JE, Nielsen TG, Ginnerup C, Lind MC, et al. Danish VISA-A questionnaire with validation and reliability testing for Danish-speaking Achilles tendinopathy patients. *Scand J Med Sci Sports*. 2016;26(12):1423-7.
413. Sierevelt I, van Sterkenburg M, Tol H, van Dalen B, van Dijk N, Haverkamp D. Dutch version of the Victorian Institute of Sports Assessment-Achilles questionnaire for Achilles tendinopathy: Reliability, validity and applicability to non-athletes. *World J Orthop*. 2018;9(1):1-6.
414. Kaux JF, Delvaux F, Oppong-Kyei J, Dardenne N, Beaudart C, Buckinx F, et al. Validity and reliability of the French translation of the VISA-A questionnaire for Achilles tendinopathy. *Disabil Rehabil*. 2016;38(26):2593-9.
415. Lohrer H, Nauck T. Cross-cultural adaptation and validation of the VISA-A questionnaire for German-speaking achilles tendinopathy patients. *BMC Musculoskelet Disord*. 2009;10:134.
416. Maffulli N, Longo UG, Testa V, Oliva F, Capasso G, Denaro V. Italian translation of the VISA-A score for tendinopathy of the main body of the Achilles tendon. *Disabil Rehabil*. 2008;30(20-22):1635-9.
417. Hernandez-Sanchez S, Poveda-Pagan EJ, Alakhdar-Mohmara Y, Hidalgo MD, Fernandez-de-Las-Penas C, Arias-Buria JL. Cross-cultural Adaptation of the Victorian Institute of Sport Assessment-Achilles (VISA-A) Questionnaire for Spanish Athletes With Achilles Tendinopathy. *J Orthop Sports Phys Ther*. 2018;48(2):111-20.
418. Silbernagel KG, Thomeer R, Karlsson J. Cross-cultural adaptation of the VISA-A questionnaire, an index of clinical severity for patients with Achilles tendinopathy, with reliability, validity and structure evaluations. *BMC Musculoskelet Disord*. 2005;6:12
419. Dogramaci Y, Kalaci A, Kucukkubas N, Inandi T, Esen E, Yanat AN. Validation of the VISA-A questionnaire for Turkish language: the VISA-A-Tr study. *Br J Sports Med*. 2011;45(5):453-5

Tabel 9: Translation, adaption and validation of ankle PROMs.