


Original Research

# Cross-Culturally Adapted Versions of Patient Reported Outcome Measures for the Lower Extremity

Yongni Zhang<sup>1</sup><sup>a</sup>, Jiayi Ren<sup>2</sup>, Yaning Zang<sup>3</sup>, Wenhao Guo<sup>1</sup>, Ashley Disantis<sup>4,5</sup>, Robroy L Martin<sup>4,6</sup>

<sup>1</sup> Rangos School of Health Sciences, Duquesne- China Health Institute, <sup>2</sup> Shuguang Hospital of Shanghai University of Traditional Chinese Medicine, <sup>3</sup> Department of Kinesiology, Shanghai University of Sport, <sup>4</sup> Department of Physical Therapy, Duquesne University, <sup>5</sup> UPMC Children's Hospital of Pittsburgh, <sup>6</sup> UPMC Center for Sports Medicine

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### Background

A large number of patient reported outcome measures (PROMs) have been developed in the English language for various lower extremity orthopaedic pathologies. Twenty different PROMs were recommended for 15 specific musculoskeletal lower extremity pathologies or surgeries. However, the availability of cross-culturally adapted versions of these recommended PROMs is unknown.

### Purpose

The purpose of this study was to identify the cross-culturally adapted versions of recommended PROMs for individuals experiencing orthopedic lower extremity pathologies or undergoing surgeries, and to identify the psychometric evidence that supports their utilization.

### Study design

Literature Review

### Methods

PubMed, Embase, Medline, Cochrane, CINAHL, SPORTDiscus and Scopus were searched for cross-culturally adapted translated studies through May 2022. The search strategy included the names of the 20 recommended PROMs from previous umbrella review along with the following terms: reliability, validity, responsiveness, psychometric properties and cross-cultural adaptation. Studies that presented a non-English language version of the PROM with evidence in at least one psychometric property to support its use were included. Two authors independently evaluated the studies for inclusion and independently extracted data.

### Results

Nineteen PROMS had cross-culturally adapted and translated language versions. The KOOS, WOMAC, ACL-RSL, FAAM, ATRS, HOOS, OHS, MOXFQ and OKS were available in over 10 different language versions. Turkish, Dutch, German, Chinese and French were the most common languages, with each language having more than 10 PROMs with psychometric properties supporting their use. The WOMAC and KOOS were both available in 10 languages and had all three psychometric properties of reliability, validity, and responsiveness supporting their use.

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<sup>a</sup> Corresponding author:

Yongni Zhang

111A Health Sciences Building 600 Forbes Ave Pittsburgh, PA 15282, US

Email [zhzh19920903@163.com](mailto:zhzh19920903@163.com)

## Conclusion

Nineteen of the 20 recommended instruments were available in multiple languages. The PROM most frequently cross-culturally adapted and translated were the KOOS and WOMAC. PROMs were most frequently cross-culturally adapted and translated into Turkish. International researchers and clinicians may use this information to more consistently implement PROMs with the most appropriate psychometric evidence available to support their use.

## Level of evidence

3a

## INTRODUCTION

Patient reported outcome measures (PROMs) are widely used in orthopaedic settings.<sup>1-5</sup> The decision regarding which PROM to use should be based on the available psychometric evidence. Although a large number of PROMs have been developed in the English language for various lower extremity orthopaedic pathologies, the psychometric evidence supporting their use is highly variable.<sup>6-10</sup> An umbrella review by Zhang et al.<sup>11</sup> assessed 19 systematic reviews and found that 20 different PROMs were recommended for 15 specific musculoskeletal lower extremity pathologies or surgeries. However, the availability of cross-culturally adapted versions of these recommended PROMs is unknown.

The usefulness of a PROM can be defined by the instrument's psychometric properties, including evidence for reliability, validity, and responsiveness. Test-retest reliability defines the stability of a score over time for patients who have not changed.<sup>1,2,12</sup> A useful value for clinicians related to test-retest reliability is minimal detectable change (MDC) which is the change in score outside of measurement error. This reflects a true change in the patient.<sup>1,2,12</sup> Validity refers to the degree to which the instrument measures the construct it was intended to measure.<sup>2,12</sup> PROMs commonly offer evidence for concurrent validity which is the degree to which the scores of a PROM relate to scores on other instruments that measure the same or similar construct.<sup>1,2,12</sup> Responsiveness is the ability of an instrument to detect a meaningful change in patient status over time. It can be defined with a value for minimal clinically important difference (MCID).<sup>1,2,12,13</sup> A PROM may be more useful to clinicians and researchers when there is evidence for the three psychometric properties of reliability, validity, and responsiveness.

Cross-cultural adaptation studies are needed to translate PROMs into a variety of languages that will allow for more international implementation.<sup>14</sup> Cross-cultural adaptation studies ensure that the items and responses for the translated PROMs have the same meaning as the original language version.<sup>15</sup> Clinicians and researchers need to not only be aware of recommended PROMs for specific lower extremity pathologies, but also be aware of which versions are cross-culturally adapted. The purpose of this study was to identify the cross-culturally adapted versions of recommended PROMs for individuals experiencing orthopedic lower extremity pathologies or undergoing surgeries, and

to identify the psychometric evidence that supports their utilization.

## METHOD

The current study utilized the results of a previous umbrella review to identify which of the 20 recommended PROMs have been translated and cross-culturally adapted.<sup>11</sup> (Table 1) A literature review was conducted on PubMed, Embase, Medline, Cochrane, CINAHL, SPORTDiscus and Scopus Search from database inception to May 2022. The search strategy and terms are listed in Table 2. Studies were included if a non-English language version of one of the 20 recommended PROMs was cross-culturally adapted into another language while providing evidence of one psychometric property (reliability, validity and responsiveness) to support its use. Studies on individuals less than age 18 were excluded. Two authors independently evaluated the studies for inclusion and independently completed data extraction. Any conflicts were resolved by a third author. Cross-culturally adapted language versions for each of the 20 recommended PROMs were identified and recorded. The supporting psychometric properties for reliability, validity, and responsiveness for each version were extracted and recorded on a data collection spreadsheet for tabulation.

## RESULTS

The search identified 9064 articles. 312 met the inclusion criteria. (Figure 1) Of the 20 recommended PROMs, 19 were cross-culturally adapted into languages other than English (Table 3 and Figure 1). The Knee Injury and Osteoarthritis Outcome Score (KOOS), The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), ACL-Return to Sport after Injury Scale (ACL-RSL), Functional Ankle Ability Measure (FAAM), Achilles tendon Total Rupture Score (ATRS), Hip dysfunction and Osteoarthritis Outcome Score (HOOS), Oxford hip score (OHS), The Manchester-Oxford Foot Questionnaire (MOXFQ) and Oxford hip score (OKS) were available in over 10 different language versions. (Figure 2) A breakdown of the PROMs available in languages other than English are presented in Figure 3. Turkish, Dutch, German, Chinese, and French were the most common languages. Each of these versions had more than 10 PROMs with psychometric properties supporting their use.

**Table 1. Recommended Patient Reported Outcome Measures**

| Systematic review recommended PROMs | Pathology/ Surgical Procedure  |
|-------------------------------------|--|
| ACL-RSI                             | Anterior cruciate ligament injury  |
| A-FORM                              | Recovery after Ankle Fractures   |
| ATRS                                | Achilles' tendon rupture   |
| AKPS                                | Patellofemoral pain syndrome   |
| FAAM                                | Chronic Ankle instability  |
| FADI                                | Chronic Ankle instability  |
| HAGOS                               | Groin pain   |
|                                     | Hip Arthroscopy for labral pathology   |
|                                     | Non-arthritic hip joint pain, femoroacetabular impingement, Hip labral pathology |
| HOS                                 | Hip Arthroscopy for labral pathology   |
|                                     | Non-arthritic hip joint pain, femoroacetabular impingement, Hip labral pathology |
| HOS combined with NAHS              | Hip Arthroscopy  |
| HOOS                                | Hip osteoarthritis   |
|                                     | Total Hip Arthroplasty for osteoarthritis  |
| iHOT-12                             | Hip Arthroscopy for labral pathology   |
|                                     | Non-arthritic hip joint pain, femoroacetabular impingement, hip labral pathology |
| iHOT-33                             | Hip Arthroscopy for labral pathology   |
|                                     | Non-arthritic hip joint pain, femoroacetabular impingement, Hip labral pathology |
| KOOS                                | Total Knee Arthroplasty for osteoarthritis                                       |
| KOS-ADLS                            | Patellofemoral pain syndrome   |
| MOXFQ                               | Foot or ankle diseases   |
|                                     | Surgery for hallux valgus  |
| OHS                                 | Total Hip Arthroplasty for osteoarthritis  |
| OKS                                 | Total Knee Arthroplasty for osteoarthritis                                       |
| SEFAS                               | Surgery for hallux valgus  |
|                                     | Rheumatoid arthritis in the foot and ankle                                       |
| WOMAC                               | Knee osteoarthritis  |
|                                     | Total Hip Arthroplasty for osteoarthritis  |
|                                     | Total Knee Arthroplasty for osteoarthritis                                       |
| WORQ                                | Total Knee Arthroplasty for osteoarthritis                                       |

Abbreviations: ACL-RSI, ACL-Return to Sport after Injury Scale; A-FORM, Ankle-fracture outcome of rehabilitation measure; AKPS, Anterior Knee Pain Scale; ATRS, Achilles tendon Total Rupture Score; FAAM, Functional Ankle Ability Measure; FADI, Foot and Ankle Disability Index; HAGOS, The Copenhagen Hip and Groin Outcome Score; HOS, Hip Outcome Score; HOOS, Hip dysfunction and Osteoarthritis Outcome Score; IHOT, International Hip Outcome Tool; KOOS, Knee Injury and Osteoarthritis Outcome Score; KOS-ADLS, Knee Outcome Survey of Daily Living Scale; MOXFQ, The Manchester-Oxford Foot Questionnaire; NAHS, Non-Arthritic Hip Score; OHS, Oxford hip score; OKS, Oxford Knee Score; SEFAS, Self-Reported Foot and Ankle Score; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index; WORQ, The Work Osteoarthritis or joint replacement questionnaire

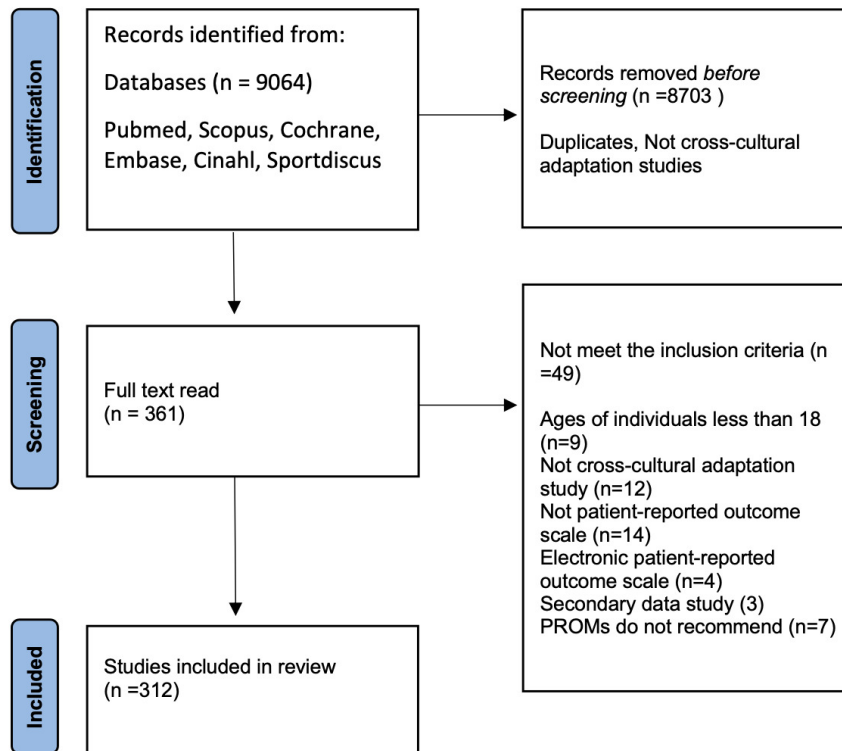
The cross-culturally adapted translated PROMs with all three psychometric properties for reliability, validity and responsiveness are listed in Tables 4, 5, and 6. They corresponded to the hip, knee, and foot and ankle, respectively. Cross-culturally adapted PROMs that do not have all three psychometric properties are listed in the Appendix. In addition, the number of research studies supporting each of the psychometric properties of reliability, validity, and responsiveness for the hip, knee, and foot and ankle are also shown in Tables 4, 5, and 6, respectively.

The WOMAC and the KOOS were both available in 10 languages and had all three psychometric properties of reliability, validity, and responsiveness supporting their use.

The HOOS and OHS were both available in seven languages having all three psychometric elements of reliability, validity and responsiveness supporting their use. The most well studied PROMs were the German-WOMAC, Spanish-WOMAC, Swedish-KOOS and Swedish-SEFAS. (Tables 4-6) There were 124 cross-culturally adapted PROMs that had only studies providing evidence for reliability and/or validity. (Appendix)

**DISCUSSION**

Of the 20 PROMs with appropriate psychometric properties that were previously identified by Zhang et al.,<sup>11</sup> 19 have



**Figure 1. PRISMA Search Diagram**

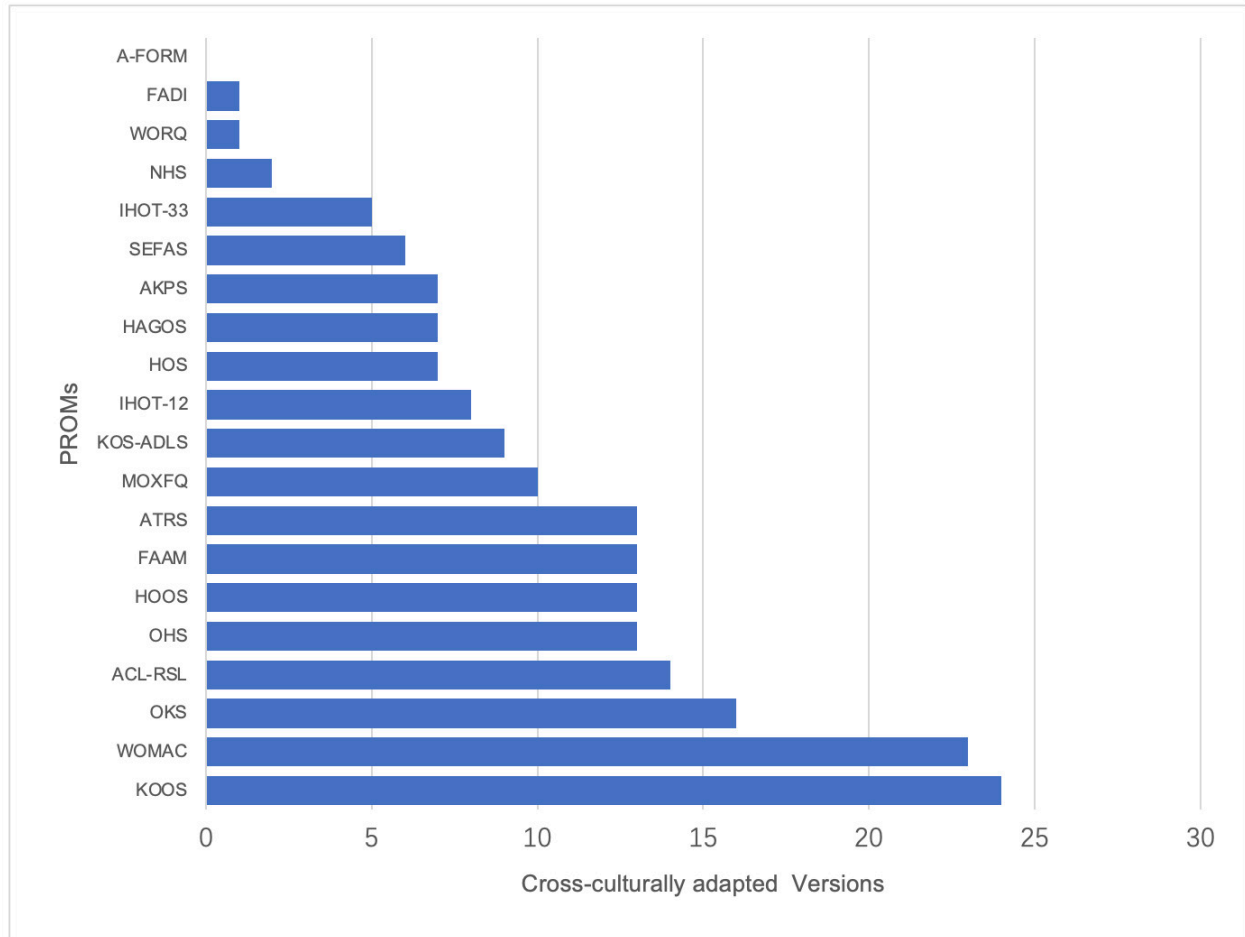
been cross-culturally adapted into language versions other than English. The KOOS and WOMAC were found to be available in 24 and 23 different languages, respectively. The most commonly culturally adapted language was Turkish, with 14 PROMs. There were 64 cross-culturally adapted translated PROMs with all three psychometric properties for reliability, validity, and responsiveness. To the authors' knowledge, this is the first review that summarizes the availability of cross-culturally adapted PROMs for either lower or upper extremity pathologies. The result of this study can be a useful resource for international clinicians and researchers when choosing a PROM to use based on the evidence available in their languages of interest.

While there are a variety of reasons PROMs may be cross-culturally adapted, pathology prevalence and length of time the PROM has been in use may be important factors. The authors' identified nine PROMs that were cross-culturally adapted into 10 different languages, while 11 PROMs were cross-culturally adapted into less than 10. The most common cross-culturally adapted PROMs, the KOOS and WOMAC, were developed for use in knee osteoarthritis. Similarly, the HOOS and OHS, available in 13 different languages, were originally developed for use in hip osteoarthritis. Osteoarthritis is a prevalent pathology worldwide,<sup>307</sup> which may explain the high frequency in which these PROMs were cross-culturally adapted into a language other than English.

The KOOS and the WOMAC, were developed in 1988 and 1998, respectively.<sup>308,309</sup> These instruments may be cross-

culturally adapted at a higher frequency because of the length of time these instruments have been available. However, PROMs developed more recently, such as the ACL-RSL, FAAM, and ATRS, have also been cross-culturally adapted into 14, 13, and 13 different languages, respectively. (Figure 2) Anterior cruciate ligament tears, Achilles tendon ruptures, and ankle instability are common pathologies. This may help to explain why a larger number of language versions for these instruments exist, despite being developed more recently.

In addition to the pathology prevalence and length of time the PROM has been in use, the frequency at which PROMs are cited in published research studies may also influence whether the instrument has been cross-culturally adapted into languages other than English. The umbrella review by Zhang et al.<sup>11</sup> found the WOMAC, HOOS, KOOS, ATRS, and FAAM were the most commonly cited instruments. These PROMs were also found to be the most frequently cross-culturally adapted. When specifically looking at these PROMs, the WOMAC consists of 24 items divided into three subscales: pain (5 items), stiffness (2 items) and physical function (17 items).<sup>310</sup> The HOOS consists of 40 items<sup>311</sup> while the KOOS consists of 42 items, with each PROM being divided into five subscales: 1) pain, 2) symptoms, 3) activities of daily living, 4) sport and recreation function, and 5) knee-related quality of life.<sup>312</sup> ATRS consists of 10 items<sup>313</sup> and the FAAM consists of a 29-item questionnaire divided into two subscales: activities of daily living (21 item) and sports (8 times).<sup>314</sup>



**Figure 2. Number of Language Versions Available for Recommended Patient Reported Outcome Measures**

Abbreviations: ACL-RSI, ACL-Return to Sport after Injury Scale; ADLS, Activities of Daily Living Scale; A-FORM, Ankle-fracture outcome of rehabilitation measure; AKPS, Anterior Knee Pain Scale; ATRS, Achilles tendon Total Rupture Score; FAAM, Functional Ankle Ability Measure; FADI, Foot and Ankle Disability Index; HAGOS, The Copenhagen Hip and Groin Outcome Score; HOS, Hip Outcome Score; HOOS, Hip dysfunction and Osteoarthritis Outcome Score; IHOT, International Hip Outcome Tool; KOOS, Knee Injury and Osteoarthritis Outcome Score; MOXFQ, The Manchester-Oxford Foot Questionnaire; NAHS, Non-Arthritic Hip Score; OHS, Oxford hip score; OKS, Oxford Knee Score; SEFAS, Self-Reported Foot and Ankle Score; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index; WORQ, The Work Osteoarthritis or joint replacement questionnaire

According to the results of this study, there are 64 cross-culturally adapted language PROMs supported by all three properties of reliability, validity, and responsiveness. (Tables 4-6) Studies that cross-culturally adapt PROMs commonly offer evidence for reliability and validity with evidence for responsiveness being infrequently studied. (Appendix) This may be due to the fact that responsiveness studies require a more challenging longitudinal study design.

**LIMITATIONS**

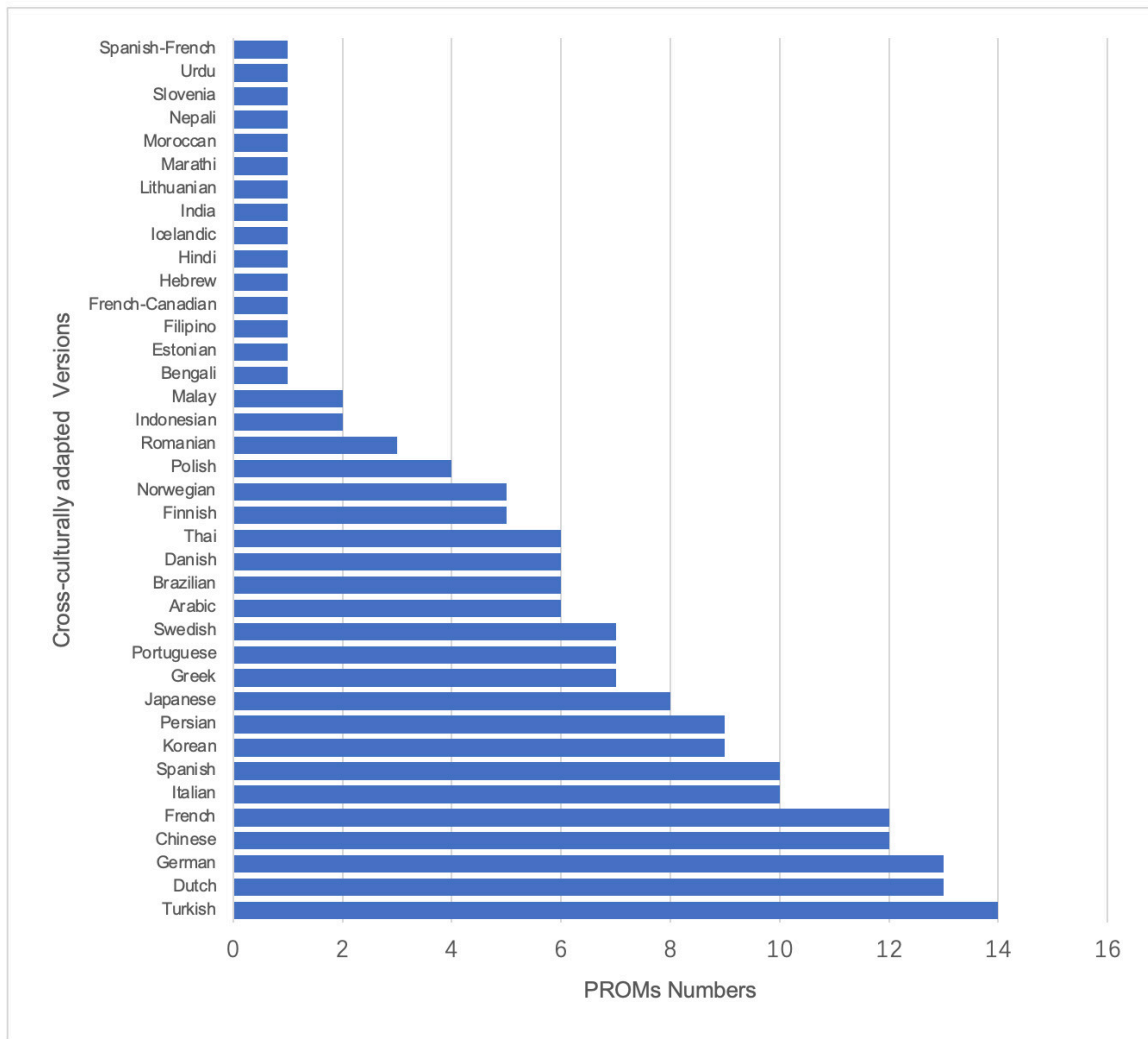
A limitation of this study is that this review does not include a comprehensive search of all PROMs. Only cross-culturally adapted PROMs that were recommended in other systematic reviews were included in this review. Additionally, this review focused solely on musculoskeletal lower extremity pathologies. Regional and global PROMs, as well as those that pertain to the spine and upper extremity were not included in this current review. The study did not present the details regarding specific values that define reliability, validity and responsiveness for each PROM.

**CONCLUSION**

Of the 20 recommended PROMs identified in a previous review by Zhang et al.,<sup>11</sup> 19 were cross-culturally adapted into languages other than English. The PROMs most frequently cross-culturally adapted were the KOOS and WOMAC with 23 and 24 languages available, respectively. PROMs were most frequently cross-culturally adapted into Turkish. International researchers and clinicians may use this information to more consistently implement PROMs with the most appropriate psychometric evidence available to support their use.

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**CONFLICTS OF INTEREST**

The authors certify that they have no affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article



**Figure 3. Number of Language Versions Available for Recommended Cross-culturally Adapted Patient Reported Outcome Measures**

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**Table 2. Search Strategy**

|   |  |
|---|--|
| (Reliability) OR (validity) OR (responsiveness) OR ("psychometric properties") OR ("cross-cultural adaptation") | <p>ACL-Return to Sport after Injury Scale (ACL-RSI)</p> <p>Ankle-fracture outcome of Rehabilitation Measure (A-FORM)</p> <p>Anterior Knee Pain Scale (AKPS)</p> <p>Achilles tendon Total Rupture Score (ATRS)</p> <p>Functional Ankle Ability Measure (FAAM)</p> <p>Foot and Ankle Disability Index (FADI)</p> <p>The Copenhagen Hip and Groin Outcome Score (HAGOS)</p> <p>Hip Outcome Score (HOS)</p> <p>Hip dysfunction and Osteoarthritis Outcome Score (HOOS)</p>   |
| AND   | <p>International Hip Outcome Tool (IHOT)</p> <p>Knee Injury and Osteoarthritis Outcome Score (KOOS)</p> <p>Knee Outcome Survey-Activities of Daily Living Scale (KOS-ADLS)</p> <p>The Manchester-Oxford Foot Questionnaire (MOXFQ)</p> <p>Non-Arthritic Hip Score (NAHS)</p> <p>Oxford Hip Score (OHS)</p> <p>Oxford Knee Score (OKS)</p> <p>Self-Reported Foot and Ankle Score (SEFAS)</p> <p>The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)</p> <p>The Work Osteoarthritis or Joint Replacement Questionnaire (WORQ)</p> |

**Table 3. Available Language Versions for Recommended Patient Reported Outcome Measures**

| PROMs Language versions |   |
|-------------------------|---|
| ACL-RSL                 | Arabic <sup>16</sup> ; Brazilian <sup>17</sup> ; Chinese <sup>18,19</sup> ; Dutch <sup>20,21</sup> ; French <sup>22</sup> ; German <sup>23</sup> ; Italian <sup>24-26</sup> ; Japanese <sup>27</sup> ; Korean <sup>28</sup> ; Lithuanian <sup>29</sup> ; Norwegian <sup>30</sup> ; Spanish <sup>31</sup> ; Swedish <sup>32</sup> ; Turkish <sup>33</sup>  |
| ATRS                    | Chinese <sup>34</sup> ; Danish <sup>35</sup> ; Dutch <sup>36,37</sup> ; French <sup>38</sup> ; Greek <sup>39</sup> ; Italian <sup>40</sup> ; Korean <sup>41</sup> ; Norwegian <sup>42</sup> ; Persian <sup>43</sup> ; Portuguese <sup>44</sup> ; Polish <sup>45</sup> ; Swedish <sup>46</sup> ; Turkish <sup>47</sup>   |
| AKPS                    | Arabic <sup>48</sup> ; Brazilian <sup>49</sup> ; Dutch <sup>50,51</sup> ; French <sup>52</sup> ; Greek <sup>53</sup> ; Norwegian <sup>54</sup> ; Spanish <sup>55</sup>  |
| A-FORM                  | N/A   |
| FAAM                    | Brazilian <sup>56</sup> ; Chinese <sup>57</sup> ; Danish <sup>58</sup> ; Dutch <sup>59</sup> ; Finnish <sup>60</sup> ; French <sup>61</sup> ; German <sup>62</sup> ; Italian <sup>63</sup> ; Japanese <sup>64</sup> ; Persian <sup>65</sup> ; Spanish <sup>66,67</sup> ; Thai <sup>68</sup> ; Turkish <sup>69-71</sup>  |
| FADI                    | Italian <sup>72</sup>   |
| HAGOS                   | Brazilian <sup>73</sup> ; Chinese <sup>74</sup> ; Danish <sup>75,76</sup> ; Dutch <sup>77-79</sup> ; Italian <sup>80</sup> ; Norwegian <sup>76</sup> ; Swedish <sup>81</sup>  |
| HOOS                    | Chinese <sup>82</sup> ; Dutch <sup>83</sup> ; French <sup>84</sup> ; German <sup>85,86</sup> ; Italian <sup>87</sup> ; Japanese <sup>88</sup> ; Korean <sup>89</sup> ; Persian <sup>90</sup> ; Polish <sup>91,92</sup> ; Portuguese <sup>93,94</sup> ; Romanian <sup>95</sup> ; Thai <sup>96</sup> ; Turkish <sup>97</sup>  |
| HOS                     | Brazilian <sup>98</sup> ; German <sup>99,100</sup> ; Korean <sup>101</sup> ; Portuguese <sup>102</sup> ; Romanian <sup>103</sup> ; Spanish <sup>104</sup> ; Turkish <sup>105</sup>  |
| IHOT-12                 | Dutch <sup>106</sup> ; French <sup>107</sup> ; German <sup>108</sup> ; Greek <sup>109</sup> ; Japanese <sup>110</sup> ; Swedish <sup>111</sup> ; Turkish <sup>112</sup>   |
| IHOT-33                 | Chinese <sup>113</sup> ; Dutch <sup>114</sup> ; French <sup>115</sup> ; German <sup>116</sup> ; Spanish <sup>117</sup> ; Thai <sup>118</sup>  |
| KOOS                    | Arabic <sup>119-122</sup> ; Chinese <sup>123-127</sup> ; Danish <sup>128</sup> ; Dutch <sup>129-131</sup> ; Finnish <sup>132</sup> ; French <sup>133,134</sup> ; Filipino <sup>135</sup> ; German <sup>136</sup> ; Greek <sup>137</sup> ; Hindi <sup>138</sup> ; Icelandic <sup>139</sup> ; India <sup>140</sup> ; Indonesian <sup>141</sup> ; Italian <sup>142,143</sup> ; Japanese <sup>144-147</sup> ; Malay <sup>148</sup> ; Norwegian <sup>128</sup> ; Persian <sup>149-154</sup> ; Polish <sup>155,156</sup> ; Portuguese <sup>157-159</sup> ; Spanish <sup>160-162</sup> ; Swedish <sup>171-173</sup> ; Turkish <sup>163,164</sup> ; Urdu <sup>165</sup> |
| KOS-ADLS                | Arabic <sup>166,167</sup> ; Chinese <sup>168</sup> ; French <sup>169</sup> ; German <sup>170</sup> ; Greek <sup>171</sup> ; Persian <sup>152</sup> ; Polish <sup>172</sup> ; Portuguese <sup>173</sup> ; Turkish <sup>174</sup>   |
| MOXFQ                   | Chinese <sup>175</sup> ; Dutch <sup>176</sup> ; Finnish <sup>177</sup> ; French <sup>178</sup> ; German <sup>179,180</sup> ; Italian <sup>181</sup> ; Korean <sup>182</sup> ; Persian <sup>183</sup> ; Spanish <sup>184,185</sup> ; Turkish <sup>186,187</sup> ;  |
| NHS                     | Portuguese <sup>188</sup> ; Turkish <sup>189</sup>  |
| OHS                     | Chinese <sup>190</sup> ; Danish <sup>191,192</sup> ; Dutch <sup>193</sup> ; French <sup>194</sup> ; German <sup>195-197</sup> ; Indonesian <sup>198</sup> ; Italian <sup>199</sup> ; Japanese <sup>200</sup> ; Korean <sup>201</sup> ; Persian <sup>202,203</sup> ; Romanian <sup>103</sup> ; Spanish <sup>204,205</sup> ; Turkish <sup>206</sup>   |
| OKS                     | Arabic <sup>207-209</sup> ; Chinese <sup>210-218</sup> ; Dutch <sup>219</sup> ; Estonian <sup>220</sup> ; Finnish <sup>221</sup> ; French <sup>222,223</sup> ; German <sup>224,225</sup> ; Greek <sup>226</sup> ; Japanese <sup>146,227</sup> ; Korean <sup>228</sup> ; Persian <sup>229</sup> ; Portuguese <sup>230</sup> ; Slovenia <sup>231</sup> ; Spanish <sup>205,232</sup> ; Thai <sup>233</sup> ; Turkish <sup>234</sup>  |
| SEFAS                   | Danish <sup>235</sup> ; German <sup>236</sup> ; Spanish- French <sup>237</sup> ; Swedish <sup>238-242</sup> ; Thai <sup>243</sup> ; Turkish <sup>244</sup>  |
| WORQ                    | Korean <sup>245</sup>   |
| WOMAC                   | Arabic <sup>246,247</sup> ; Bengali <sup>248</sup> ; Brazilian <sup>249-251</sup> ; Chinese <sup>252-256</sup> ; Dutch <sup>131,257-259</sup> ; Finnish <sup>260-262</sup> ; French <sup>263</sup> ; French-Canadian <sup>264,265</sup> ; German <sup>266-272</sup> ; Greek <sup>273,274</sup> ; Hebrew <sup>275</sup> ; Italian <sup>276,277</sup> ; Japanese <sup>278,279</sup> ; Korean <sup>280,281</sup> ; Malay <sup>282</sup> ; Marathi <sup>283</sup> ; Moroccan <sup>284</sup> ; Nepali <sup>285</sup> ; Persian <sup>286,287</sup> ; Spanish <sup>288-295</sup> ; Swedish <sup>296-298</sup> ; Thai <sup>299,300</sup> ; Turkish <sup>301-303</sup>   |

Abbreviations: ACL-RSI, ACL-Return to Sport after Injury Scale; A-FORM, Ankle-fracture outcome of rehabilitation measure; AKPS, Anterior Knee Pain Scale; ATRS, Achilles tendon Total Rupture Score; FAAM, Functional Ankle Ability Measure; FADI, Foot and Ankle Disability Index; HAGOS, The Copenhagen Hip and Groin Outcome Score; HOS, Hip Outcome Score; HOOS, Hip dysfunction and Osteoarthritis Outcome Score; IHOT, International Hip Outcome Tool; KOOS, Knee Injury and Osteoarthritis Outcome Score; KOS-ADLS, Knee Outcome Survey of Daily Living Scale; MOXFQ, The Manchester-Oxford Foot Questionnaire; NAHS, Non-Arthritic Hip Score; OHS, Oxford hip score; OKS, Oxford Knee Score; SEFAS, Self-Reported Foot and Ankle Score; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index; WORQ, The Work Osteoarthritis or joint replacement questionnaire



**Table 4. The Cross-culturally Adapted Translated Hip Patient Reported Outcome Measures with all three Psychometric Properties**

| Hip PROM<br>(Number of Language Versions) | Language Version | Reliability  | Validity             | Responsiveness |
|---|------------------|--------------|----------------------|----------------|
| HAGOS                                     | Chinese          | 174          | 174                  | 174            |
| HOOS                                      | French           | 184          | 184                  | 184            |
|   | German           | 186          | 285,86               | 186            |
|   | Italian          | 187          | 187                  | 187            |
|   | Japanese         | 188          | 188                  | 188            |
|   | Korean           | 189          | 189                  | 189            |
|   | Polish           | 291,92       | 291,92               | 192            |
|   | Chinese          | 182          | 182                  | 182            |
|   | HOS              | German       | 299                  | 299,100        |
| Korean                                    |                  | 101          | 101                  | 101            |
| Turkish                                   |                  | 105          | 105                  | 105            |
| IHOT-12                                   | French           | 107          | 107                  | 107            |
|   | German           | 108          | 108                  | 108            |
|   | Greek            | 109          | 109                  | 109            |
|   | Japanese         | 110          | 110                  | 110            |
|   | Swedish          | 111          | 111                  | 111            |
| IHOT-33                                   | Chinese          | 113          | 113                  | 113            |
|   | German           | 116          | 116                  | 116            |
| OHS                                       | Chinese          | 190          | 190                  | 190            |
|   | German           | 195          | 3195-197             | 2196,197       |
|   | Indonesian       | 198          | 198                  | 198            |
|   | Italian          | 199          | 199                  | 199            |
|   | Japanese         | 200          | 200                  | 200            |
|   | Korean           | 201          | 201                  | 201            |
|   | Spanish          | 204,205      | 204,205              | 204            |
| WOMAC                                     | Chinese          | 3252-254     | 5252-256             | 2254,256       |
|   | Dutch            | 4131,257-259 | 4131,257-259         | 259            |
|   | Finnish          | 2260,261     | 3260-262             | 260            |
|   | German           | 3266,267,272 | 4266,267,269,270,272 | 3268,269,271   |
|   | Italian          | 1276         | 1276                 | 277            |
|   | Korean           | 1280         | 2280,281             | 280            |
|   | Spanish          | 4289,292,295 | 5288,289,292-294     | 4290-293       |
|   | Swedish          | 3296-298     | 3296-298             | 297            |
|   | Thai             | 2299,300     | 2299,300             | 299            |
|   | Turkish          | 3301-303     | 3301-303             | 301            |

Abbreviations: HAGOS, The Copenhagen Hip and Groin Outcome Score; HOS, Hip Outcome Score; HOOS, Hip dysfunction and Osteoarthritis Outcome Score; IHOT, International Hip Outcome Tool; OHS, Oxford hip score; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index

**Table 5. The Cross-culturally Adapted Translated Knee Patient Reported Outcome Measures with all three Psychometric Properties**

| Knee<br>(Number of Language Versions) | Language Version | Reliability          | Validity                 | Responsiveness       |                  |
|---------------------------------------|------------------|----------------------|--------------------------|----------------------|------------------|
| ACL-RSL                               | Dutch            | 1 <sup>20</sup>      | 1 <sup>20</sup>          | 1 <sup>21</sup>      |                  |
| AKPS                                  | Brazilian        | 1 <sup>49</sup>      | 1 <sup>49</sup>          | 1 <sup>49</sup>      |                  |
| KOOS                                  | Chinese          | 5 <sup>123-127</sup> | 5 <sup>123-127</sup>     | 2 <sup>125,127</sup> |                  |
|                                       | French           | 2 <sup>133,134</sup> | 2 <sup>133,134</sup>     | 2 <sup>133,134</sup> |                  |
|                                       | Hindi            | 1 <sup>138</sup>     | 1 <sup>138</sup>         | 1 <sup>138</sup>     |                  |
|                                       | Japanese         | 1 <sup>144</sup>     | 3 <sup>144,145,147</sup> | 1 <sup>146</sup>     |                  |
|                                       | Persian          | 4 <sup>149-152</sup> | 2 <sup>149-152</sup>     | 1 <sup>154</sup>     |                  |
|                                       | Portuguese       | 3 <sup>157-159</sup> | 3 <sup>157-159</sup>     | 2 <sup>157-159</sup> |                  |
|                                       | Spanish          | 2 <sup>160,162</sup> | 3 <sup>160-162</sup>     | 3 <sup>160-162</sup> |                  |
|                                       | Swedish          | 3 <sup>304-306</sup> | 3 <sup>304-306</sup>     | 3 <sup>304-306</sup> |                  |
|                                       | Turkish          | 1 <sup>163</sup>     | 1 <sup>163</sup>         | 1 <sup>164</sup>     |                  |
|                                       | KOS-ADLS         | Dutch                | 2 <sup>129,130</sup>     | 2 <sup>129,130</sup> | 1 <sup>130</sup> |
|                                       |                  | Arabic               | 2 <sup>166,167</sup>     | 2 <sup>166,167</sup> | 1 <sup>167</sup> |
| Chinese                               |                  | 1 <sup>168</sup>     | 1 <sup>168</sup>         | 1 <sup>168</sup>     |                  |
| Persian                               |                  | 1 <sup>152</sup>     | 1 <sup>152</sup>         | 1 <sup>152</sup>     |                  |
| Polish                                |                  | 1 <sup>172</sup>     | 1 <sup>172</sup>         | 1 <sup>172</sup>     |                  |
| Portuguese                            |                  | 1 <sup>173</sup>     | 1 <sup>173</sup>         | 1 <sup>173</sup>     |                  |
| OKS                                   |                  | Arabic               | 3 <sup>207-209</sup>     | 3 <sup>207-209</sup> | 1 <sup>209</sup> |
|                                       | Finish           | 1 <sup>221</sup>     | 1 <sup>221</sup>         | 1 <sup>221</sup>     |                  |
|                                       | German           | 2 <sup>224,225</sup> | 2 <sup>224,225</sup>     | 1 <sup>225</sup>     |                  |
|                                       | Japanese         | 1 <sup>227</sup>     | 1 <sup>227</sup>         | 1 <sup>146</sup>     |                  |

Abbreviations: ACL-RSI, ACL-Return to Sport after Injury Scale; AKPS, Anterior Knee Pain Scale; KOOS, Knee Injury and Osteoarthritis Outcome Score; KOS-ADLS, Knee Outcome Survey of Daily Living Scale OKS, Oxford Knee Score

**Table 6. The Cross-culturally Adapted Translated Foot and Ankle Patient Reported Outcome Measures with all three Psychometric Properties**

| Foot and Ankle<br>(Number of Language Versions) | Language Version | Reliability          | Validity                 | Responsiveness       |
|---|------------------|----------------------|--------------------------|----------------------|
| ATRS  | Chinese          | 1 <sup>34</sup>      | 1 <sup>34</sup>          | 1 <sup>34</sup>      |
|   | Dutch            | 1 <sup>37</sup>      | 1 <sup>37</sup>          | 1 <sup>36</sup>      |
| MOXFQ   | German           | 2 <sup>179,180</sup> | 2 <sup>179,180</sup>     | 2 <sup>179,180</sup> |
|   | Italian          | 1 <sup>181</sup>     | 1 <sup>181</sup>         | 1 <sup>181</sup>     |
|   | Spanish          | 2 <sup>184,185</sup> | 2 <sup>184,185</sup>     | 2 <sup>184,185</sup> |
| SEFAS   | Danish           | 1 <sup>235</sup>     | 1 <sup>235</sup>         | 1 <sup>235</sup>     |
|   | German           | 1 <sup>236</sup>     | 1 <sup>236</sup>         | 1 <sup>236</sup>     |
|   | Swedish          | 3 <sup>238-240</sup> | 4 <sup>238-240,242</sup> | 4 <sup>238-241</sup> |

Abbreviations: ATRS, Achilles tendon Total Rupture Score; MOXFQ, The Manchester-Oxford Foot Questionnaire; SEFAS, Self-Reported Foot and Ankle Score



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**Appendix. Cross-culturally adapted PROMs psychometric properties. Number of the supporting psychometric properties for reliability, validity, and responsiveness for each PROMs language version are listed. PROMs language versions supported by evidence of reliability, validity, and responsiveness are highlighted in bold.**

| PROMs        | Language         | Reliability    | Validity | Responsiveness |
|--------------|------------------|----------------|----------|----------------|
| ACL-RSL      | Arabic           | 1              | 1        | 0              |
|              | Brazilian        | 1              | 1        | 0              |
|              | Chinese          | 2              | 2        | 0              |
|              | <b>Dutch</b>     | <b>1</b>       | <b>1</b> | <b>1</b>       |
|              | French           | 0              | 1        | 0              |
|              | German           | 1              | 1        | 0              |
|              | Italian          | 3              | 3        | 0              |
|              | Japanese         | 1              | 1        | 0              |
|              | Korean           | 1              | 1        | 0              |
|              | Lithuanian       | 1              | 1        | 0              |
|              | Norwegian        | 1              | 1        | 0              |
|              | Spanish          | 1              | 1        | 0              |
|              | Swedish          | 1              | 1        | 0              |
|              | Turkish          | 1              | 1        | 0              |
|              | ATRS             | <b>Chinese</b> | <b>1</b> | <b>1</b>       |
| Danish       |                  | 1              | 1        | 0              |
| <b>Dutch</b> |                  | <b>1</b>       | <b>1</b> | <b>1</b>       |
| French       |                  | 1              | 1        | 0              |
| Greek        |                  | 1              | 1        | 0              |
| Italian      |                  | 1              | 1        | 0              |
| Korean       |                  | 1              | 1        | 0              |
| Norwegian    |                  | 1              | 1        | 0              |
| Persian      |                  | 1              | 1        | 0              |
| Portuguese   |                  | 1              | 1        | 0              |
| Polish       |                  | 1              | 1        | 0              |
| Swedish      | 1                | 1              | 0        |                |
| Turkish      | 1                | 1              | 0        |                |
| AKPS         | Arabic           | 1              | 1        | 0              |
|              | <b>Brazilian</b> | <b>1</b>       | <b>1</b> | <b>1</b>       |
|              | Dutch            | 2              | 1        | 0              |
|              | French           | 1              | 1        | 0              |
|              | Greek            | 1              | 1        | 0              |
|              | Norwegian        | 1              | 1        | 0              |
|              | Spanish          | 1              | 1        | 0              |
| FAAM         | Brazilian        | 1              | 1        | 0              |
|              | Chinese          | 1              | 1        | 0              |
|              | Danish           | 0              | 1        | 0              |
|              | Dutch            | 1              | 1        | 0              |
|              | Finnish          | 0              | 1        | 0              |
|              | French           | 1              | 1        | 0              |
|              | German           | 1              | 1        | 0              |
|              | Italian          | 1              | 1        | 0              |
| Japanese     | 1                | 1              | 0        |                |

| PROMs   | Language       | Reliability | Validity | Responsiveness |
|---------|----------------|-------------|----------|----------------|
|         | Persian        | 1           | 1        | 0              |
|         | Spanish        | 1           | 0        | 0              |
|         | Thai           | 1           | 1        | 0              |
|         | Turkish        | 1           | 1        | 0              |
| FADI    | Italian        | 1           | 1        | 0              |
| HAGOS   | Brazilian      | 1           | 1        | 0              |
|         | <b>Chinese</b> | <b>1</b>    | <b>1</b> | <b>1</b>       |
|         | Danish         | 1           | 2        | 0              |
|         | Dutch          | 3           | 3        | 0              |
|         | Italian        | 1           | 1        | 0              |
|         | Norwegian      | 0           | 1        | 0              |
|         | Swedish        | 1           | 1        | 0              |
| HOOS    | <b>Chinese</b> | <b>1</b>    | <b>1</b> | <b>1</b>       |
|         | Dutch          | 1           | 1        | 0              |
|         | French         | 1           | 1        | 1              |
|         | German         | 1           | 2        | 1              |
|         | Italian        | 1           | 1        | 1              |
|         | Japanese       | 1           | 1        | 1              |
|         | Korean         | 1           | 1        | 1              |
|         | Persian        | 1           | 1        | 0              |
|         | Polish         | 2           | 2        | 1              |
|         | Portuguese     | 2           | 2        | 0              |
|         | Romanian       | 1           | 1        | 0              |
|         | Thai           | 1           | 1        | 0              |
|         | Turkish        | 1           | 1        | 0              |
| HOS     | Brazilian      | 1           | 1        | 0              |
|         | German         | 2           | 2        | 1              |
|         | Korean         | 1           | 1        | 1              |
|         | Portuguese     | 0           | 1        | 0              |
|         | Romanian       | 1           | 1        | 0              |
|         | Spanish        | 1           | 1        | 0              |
|         | Turkish        | 1           | 1        | 1              |
| IHOT-12 | Dutch          | 1           | 1        | 0              |
|         | French         | 1           | 1        | 1              |
|         | German         | 1           | 1        | 1              |
|         | Greek          | 1           | 1        | 1              |
|         | Japanese       | 1           | 1        | 1              |
|         | Swedish        | 1           | 1        | 1              |
|         | Turkish        | 1           | 1        | 0              |
| IHOT-33 | Chinese        | 1           | 1        | 1              |
|         | Dutch          | 1           | 1        | 0              |
|         | French         | 1           | 1        | 0              |
|         | German         | 1           | 1        | 1              |
|         | Spanish        | 1           | 1        | 0              |
|         | Thai           | 1           | 1        | 0              |

| PROMs    | Language   | Reliability | Validity | Responsiveness |
|----------|------------|-------------|----------|----------------|
| KOOS     | Arabic     | 4           | 4        | 0              |
|          | Chinese    | 5           | 5        | 2              |
|          | Danish     | 1           | 1        | 0              |
|          | Dutch      | 2           | 2        | 1              |
|          | Finnish    | 1           | 1        | 0              |
|          | French     | 2           | 2        | 2              |
|          | Filipino   | 1           | 1        | 0              |
|          | German     | 1           | 1        | 0              |
|          | Greek      | 1           | 1        | 0              |
|          | Hindi      | 1           | 1        | 1              |
|          | Icelandic  | 1           | 1        | 0              |
|          | India      | 1           | 1        | 0              |
|          | Indonesian | 1           | 1        | 0              |
|          | Italian    | 2           | 2        | 0              |
|          | Japanese   | 1           | 3        | 1              |
|          | Malay      | 1           | 1        | 0              |
|          | Norwegian  | 0           | 1        | 0              |
|          | Persian    | 4           | 4        | 1              |
|          | Polish     | 2           | 0        | 2              |
|          | Portuguese | 3           | 3        | 2              |
|          | Spanish    | 2           | 3        | 3              |
|          | Swedish    | 3           | 3        | 3              |
|          | Turkish    | 1           | 1        | 1              |
| Urdu     | 1          | 1           | 0        |                |
| KOS-ADLS | Arabic     | 2           | 2        | 2              |
|          | Chinese    | 1           | 1        | 1              |
|          | French     | 1           | 0        | 1              |
|          | German     | 1           | 1        | 0              |
|          | Greek      | 1           | 1        | 0              |
|          | Persian    | 1           | 1        | 1              |
|          | Polish     | 1           | 1        | 1              |
|          | Portuguese | 1           | 1        | 1              |
| MOXFQ    | Chinese    | 1           | 0        | 1              |
|          | Dutch      | 1           | 1        | 0              |
|          | Finnish    | 0           | 1        | 0              |
|          | French     | 1           | 1        | 0              |
|          | German     | 2           | 2        | 2              |
|          | Italian    | 1           | 1        | 1              |
|          | Korean     | 1           | 1        | 0              |
|          | Persian    | 1           | 1        | 0              |
|          | Spanish    | 2           | 2        | 2              |
|          | Turkish    | 2           | 2        | 0              |
|          | NHS        | Portuguese  | 0        | 1              |
| Turkish  |            | 1           | 1        | 0              |



| PROMs           | Language       | Reliability | Validity | Responsiveness |
|-----------------|----------------|-------------|----------|----------------|
| OHS             | Chinese        | 1           | 1        | 1              |
|                 | Danish         | 1           | 2        | 0              |
|                 | Dutch          | 0           | 1        | 0              |
|                 | French         | 0           | 1        | 0              |
|                 | German         | 1           | 3        | 2              |
|                 | Indonesian     | 1           | 1        | 1              |
|                 | Italian        | 1           | 1        | 1              |
|                 | Japanese       | 0           | 1        | 1              |
|                 | Korean         | 1           | 1        | 1              |
|                 | Persian        | 2           | 2        | 0              |
|                 | Romanian       | 0           | 1        | 0              |
|                 | Spanish        | 2           | 2        | 1              |
|                 | Turkish        | 0           | 1        | 0              |
|                 | OKS            | Arabic      | 3        | 3              |
| Chinese         |                | 6           | 9        | 0              |
| Dutch           |                | 1           | 1        | 0              |
| Estonian        |                | 1           | 1        | 0              |
| Finish          |                | 1           | 1        | 1              |
| French          |                | 1           | 1        | 0              |
| German          |                | 2           | 2        | 1              |
| Greek           |                | 1           | 1        | 0              |
| Japanese        |                | 1           | 1        | 1              |
| Korean          |                | 1           | 1        | 0              |
| Persian         |                | 1           | 1        | 0              |
| Portuguese      |                | 1           | 1        | 0              |
| Slovenia        |                | 1           | 1        | 0              |
| Spanish         |                | 1           | 1        | 0              |
| Thai            | 1              | 1           | 0        |                |
| Turkish         | 1              | 1           | 0        |                |
| SEFAS           | Danish         | 1           | 1        | 1              |
|                 | German         | 1           | 1        | 1              |
|                 | Spanish-French | 0           | 1        | 0              |
|                 | Swedish        | 3           | 4        | 4              |
|                 | Thai           | 1           | 1        | 0              |
| Turkish         | 1              | 1           | 0        |                |
| WORQ            | Korean         | 1           | 1        | 0              |
| WOMAC           | Arabic         | 2           | 2        | 0              |
|                 | Bengali        | 1           | 1        | 0              |
|                 | Brazilian      | 2           | 3        | 0              |
|                 | Chinese        | 2           | 5        | 2              |
|                 | Dutch          | 4           | 4        | 1              |
|                 | Finnish        | 2           | 3        | 1              |
|                 | French         | 0           | 0        | 1              |
| French-Canadian | 2              | 2           | 0        |                |
| German          | 3              | 4           | 3        |                |

| PROMs | Language | Reliability | Validity | Responsiveness |
|-------|----------|-------------|----------|----------------|
|       | Greek    | 2           | 2        | 0              |
|       | Hebrew   | 1           | 1        | 0              |
|       | Italian  | 1           | 1        | 1              |
|       | Japanese | 1           | 2        | 0              |
|       | Korean   | 1           | 2        | 1              |
|       | Malay    | 1           | 1        | 0              |
|       | Marathi  | 0           | 1        | 0              |
|       | Moroccan | 1           | 1        | 0              |
|       | Nepali   | 1           | 1        | 0              |
|       | Persian  | 2           | 2        | 0              |
|       | Spanish  | 4           | 5        | 4              |
|       | Swedish  | 3           | 3        | 1              |
|       | Thai     | 2           | 2        | 1              |
|       | Tturkish | 3           | 3        | 1              |