Cross-cultural adaptation and measurement properties of the Arabic version of the Patient-Specific Functional Scale in patients with lower extremity musculoskeletal disorders

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ABSTRACT

Purpose: To cross-culturally adapt the Patient-Specific Functional Scale (PSFS) into Arabic language and to examine its measurement properties in patients with lower extremity musculoskeletal disorders.

Materials and methods: The original English version of the PSFS was cross-culturally adapted into modern standard Arabic language following Beaton’s guidelines. Patients with lower extremity musculoskeletal disorders (N = 116) were recruited to examine the test–retest reliability, measurement error, floor and ceiling effects, and construct validity of the Arabic PSFS. Construct validity was tested by examining eight predefined correlational hypotheses.

Results: Participants in the current study indicated that the Arabic PSFS was clear and understandable. The Arabic PSFS had very good test–retest reliability (ICC = 0.86) with no floor or ceiling issues. The standard error of measurement and the minimal detectable change of the Arabic PSFS were 0.64 and 1.49 points respectively indicating acceptable measurement error. The majority of the predefined construct validity hypotheses (75%) were supported by the results justifying the construct validity of the Arabic PSFS.

Conclusions: The Arabic PSFS is a comprehensible and easy to use measure. The Arabic PSFS has very good test–retest reliability, acceptable measurement error, and evidence supporting its construct validity as measure of activity limitation in patients with lower extremity musculoskeletal disorders.

IMPLICATIONS FOR REHABILITATION

- Rehabilitation specialist can confidently interpret patient’s score in the Arabic PSFS to represent the extent of activity limitation.
- Patients with unchanged clinical status will have similar scores in the Arabic PSFS with repeated administrations of the scale over time.
- The Arabic PSFS can be used in daily clinical practice and in research studies to measure activity limitation in Arabic-speakers with lower extremity musculoskeletal disorders.
- The Arabic PSFS enables rehabilitation specialist to quantify activity limitation in a way that is relevant to the culture and life style of Arabic-speakers.

Introduction

Current clinical practice guidelines for musculoskeletal disorders recommend patient-centered care [1]. The delivery of such care requires the use of patient-centered outcome measures. The Patient-Specific Functional Scale (PSFS) is a patient-centered outcome measure with patient-generated items [2]. Patients determine the activities that they have difficulty with and rate the level of difficulty in performing these activities making the scale tailored and relevant to each individual patient experience [2]. The PSFS has demonstrated very good measurement properties including evidence of good test–retest reliability, acceptable measurement error, evidence supporting its construct validity and responsiveness in different musculoskeletal disorders [3]. Reports in the literature also suggested that the PSFS has better responsiveness compared to measures with pre-specified items (outcome measures with fixed items) [4–6]. Additionally, the PSFS has also been established to be appropriate for use at a group-level comparisons and for tracking group-level change over time [7].

A number of patient-reported outcome measures (PROM) were culturally adapted to measure activity limitation in Arabic-speaking patients with lower extremity musculoskeletal disorders [8–12]. Although validity and reliability of these measures have been established, these PROM need to be supplemented with patient-centered outcome measure such as PSFS given that these measures still lack activities that are important to the culture and life style of Arabic-speakers. Examples of such activities include floor sitting (heel sitting and cross-legged sitting), using floor toilet (squat toilet), and prayer-related postures and movements.

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Given its ease of use, patient-centered nature, in addition to the evidence supporting its measurement properties, the PSFS has been cross-culturally adapted to different languages and cultures [6,13–18]. To the best of our knowledge, there is no patient-specific outcome measure (with patient-generated items) available in Arabic language. Adaptation of the PSFS into Arabic language would provide a tool to capture activity limitation in Arabic-speaking patients that is specific and unique to their experience and life style. The aim of this study was to cross-culturally adapt the PSFS into modern standard Arabic language and to examine its measurement properties in patients with lower extremity musculoskeletal disorders. We hypothesized that the adapted Arabic PSFS (1) would be comprehensible and easy to use; (2) would demonstrate evidence supporting its reliability (good to excellent test–retest reliability and acceptable measurement error) and construct validity along with the absence of floor and ceiling issues.

Materials and methods

Setting and participants

The General Administration for Research and Studies at the Ministry of Health provided the ethical approval of the study and participants signed informed consent forms prior to participation. Participants were recruited from the outpatient physical therapy departments at King Fahad General Hospital and King Abdullah Medical Complex, Jeddah, Saudi Arabia using convenience sampling from December 2018 to February 2019. Participants were recruited if they had lower extremity musculoskeletal disorders. We hypothesized that the adapted Arabic PSFS (1) would be comprehensible and easy to use; (2) would demonstrate evidence supporting its reliability (good to excellent test–retest reliability and acceptable measurement error) and construct validity along with the absence of floor and ceiling issues.

Procedure

The first phase of the study included the translation and cross-cultural adaptation of the PSFS into modern standard Arabic language (Figure 1). A permission was obtained from the original scale developer to adapt the PSFS into Arabic language. The translation and cross-cultural adaptation of the original English PSFS into Arabic language was conducted based on Beaton’s guidelines for cross-cultural adaptation of PROM [19]. The original English PSFS was translated into modern standard Arabic by two independent native-Arabic speakers (physical therapy professor and professional translator) producing two independent forward translations. The forward translators then synthesized the two forward translations into one Arabic version. The synthesized Arabic version was then back translated into English by two independent bilingual professional translators. After the back translation, an expert committee reviewed all translations and reached consensus on the pre-final Arabic version of the PSFS. The Expert committee included methodologist, health professionals, language professionals, and the forward and backward translators. Twenty participants with lower extremity musculoskeletal disorders were then asked to complete the pre-final Arabic PSFS and then were interviewed individually to check the comprehensibility and clarity of the scale including instructions and scoring scheme. After testing the pre-final Arabic version, the final Arabic version of the PSFS was reached (Supplementary Appendix 1). The second phase of the study included testing the measurement properties of the final Arabic PSFS (Figure 1). Participants recruited in this phase completed the final Arabic PSFS, the Arabic versions of the Numeric Pain Rating Scale (NPRS) [20], Lower Extremity Functional Scale (LEFS) [12], Global Assessment of Function (GAF) [12], and RAND-36 Item Health Survey (RAND-36) [21]. Two to seven days later, participants completed the second administration of the same outcome measures (except RAND-36) and also completed the Global Rating of Change Scale (GRC) in Arabic [12,22].

Patient-Specific Functional Scale

Participants were asked to identify up to five important activities that they had difficulty with or were unable to perform due to their lower extremity musculoskeletal disorder [2]. In addition to specifying the activities, participants were asked to rate, on an 11-point scale, the level of difficulty associated with each activity. The scale anchors were 0 (unable to perform activity) to 10 (able
to perform activity at same level as before injury or problem). The PSFS total score (0–10) was the average score of the items listed by each participant with higher score indicating better functional ability.

**Lower Extremity Functional Scale**

LEFS is a PROM indicating the extent of activity limitation caused by lower extremity disorders [23]. Each of the 20 items of the LEFS was scored from 0 (extreme difficulty or unable to perform activity) to 4 (no difficulty). LEFS total score ranges from 0 to 80 (summing scores on all items) with higher score indicating better lower extremity function. The Arabic version of the LEFS has been shown to be valid and reliable in patients with lower extremity musculoskeletal disorders [12].

**Numeric Pain Rating Scale**

Participants were asked to rate their average pain intensity in the last 24 h. Pain was rated on 0 (no pain) to 10 (most severe pain imaginable) scale. Previous report supported the validity and reliability of the Arabic NPRS [20].

**Global Assessment of Function**

Participants were asked to rate their perceived functional ability on 0 (unable to perform any activity of daily living) to 100 scale (able to perform all activities of daily living without difficulty). The validity and reliability of the Arabic GAF have been established and reported previously [12,22].

**RAND 36-item Health Survey**

RAND-36 is a generic measure quantifying eight health-related domains on 0–100 scale with higher scores indicating better health [24]. These domains are physical functioning, bodily pain, role limitations due to physical health problems, role limitations due to personal or emotional problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions. Previous report supported the validity and reliability of the Arabic RAND-36 [21].

**Global Rating of Change Scale**

In the second visit, participants were asked to rate the change in their condition on a −5 (very great deal worse) to 5 (very great deal better) scale with 0 being no change [25]. Participants completed an Arabic GRC [12,22] and those scoring −1, 0, or 1 were considered unchanged in the current study.

**Statistical analysis**

**Floor and ceiling effects**

The Arabic PSFS was screened for the presence of floor and ceiling effects. More than 15% of the participants reaching the minimum or the maximum score in the Arabic PSFS were used to indicate the presence of floor and ceiling issues in the Arabic PSFS respectively [26]. The presence of floor and ceiling effects indicate that the scale is not able to differentiate between participants at the lower and upper ends of the scale, respectively [26].

**Test–retest reliability and measurement error**

Intraclass correlation coefficient for absolute agreement (ICCabsolute: two-way random effects model) was used to examine the test–retest reliability of the Arabic PSFS [27,28]. The standard error of measurement (SEM: square root of the error variance), and the minimal detectable change at the 90% confidence (MDC90 = 1.65 × 2 × SEM) were used to quantify the scale’s measurement error [26–28].

**Construct validity using hypothesis testing**

Eight pre-defined hypotheses were tested in order to examine the construct validity of the Arabic PSFS as a measure of activity limitation (Table 1). Spearman’s correlation coefficient was used to test the bivariate correlation between outcome measures. All statistical analyses were conducted using IBM SPSS Statistics 26 (IBM Corp, Armonk, NY).

**Sample size estimation**

The minimum required sample size for examining the construct validity of the Arabic PSFS was determined to be 50 (good rating) based on the consensus-based standards for the selection of health measurement instruments (COSMIN) [29]. This sample size is slightly higher than the required sample size (N = 46) for detecting the hypothesized correlation of at least 0.4 between the Arabic PSFS and the LEFS using an alpha value of 5% and 80% power [30]. A sample size of 30 (fair rating) was considered the minimum required sample for examining the test–retest reliability and measurement error based on COSMIN guidelines [29]. The minimum required sample size for test–retest reliability was also computed using an estimated ICC of 0.85, 0.2 confidence interval width with 95% confidence level yielding a sample size of 30 participants [31]. An ICC value of 0.85 represents the mean test–retest reliability estimate from prior studies that examined the test–retest reliability of the PSFS in patients with musculoskeletal disorders [3,6,13–16,18,32–36].

**Results**

The cross-cultural adaptation steps (forward translation, synthesis, backward translation) were completed with no major issues. The expert committee slightly modified the scale’s instructions in order to enhance the flow and comprehensibility. The 20 participants recruited for testing the pre-final version of the Arabic PSFS indicated via interview that scale including instructions and scoring scheme were understandable and clear. At this point, the final version of the Arabic PSFS was reached and its measurement properties were tested in the second phase.
One hundred and sixteen participants were recruited for the second phase of the study (Figure 1, Tables 2 and 3). Sixty-three participants (54.3%) reported three activities that they had difficulty with, while 40 (34.5%) and 13 (11.2%) participants reported 4 and 5 activities, respectively. None of the participants had any missing data in the Arabic PSFS.

Floor and ceiling effects
The Arabic PSFS had no floor or ceiling issues given that only four participants (3.4%) reached the maximum score while none of the participants (0%) reached the minimum score.

Test–retest reliability and measurement error
Thirty participants out of the 86 (randomly selected) who completed the Arabic PSFS twice had no change in their condition according to their GRC response. The mean duration between the test and retest sessions was 2.85 days (range: 2–7 days). The Arabic PSFS had very good test–retest reliability (Table 4). The scale’s SEM and MDC90 can be found in Table 4.

| Variable | Mean (SD) or N (%) |
|----------|-------------------|
| Age (years) | 41.87 (16.42) |
| Sex | Male 76 (65.5), Female 40 (34.5) |
| Height (m) | 1.66 (0.10) |
| Mass (kg) | 79.94 (16.52) |
| Body mass index (kg/m²) | 28.94 (5.92) |
| Site of dysfunction | Hip and thigh 14 (12.07), Knee 85 (73.28), Leg, ankle, and foot 17 (14.65) |
| Lower extremity surgery | Yes 44 (37.93), No 72 (62.07) |
| Time after surgery (months) | 12.53 (27.40) |
| Duration of symptoms (months) | 23.80 (44.02) |
| Educational level | Elementary school 14 (12.1), Middle school 13 (11.2), High school 27 (23.3), Undergraduate degree 55 (47.4), Postgraduate degree 7 (6) |

Table 3. Outcome measures for all participants at baseline (N = 116).

| Variable | Mean (SD) |
|----------|-----------|
| PSFS (0–10) | 3.30 (1.80) |
| LEFS (0–80) | 37.84 (16.07) |
| GAF (0–100) | 55.36 (19.17) |
| NPRS (0–10) | 4.77 (2.48) |
| RAND-36 physical functioning (0–100) | 42.66 (23.80) |
| RAND-36 emotional well-being (0–100) | 63.83 (22.88) |
| RAND-36 pain (0–100) | 46.27 (23.37) |

Table 4. Arabic PSFS test–retest reliability and measurement error.

| | Mean (SD) | Mean difference* (95% CI) | ICCagreement (95% CI) | SEMagreement | MDC90 |
|---|----------|--------------------------|----------------------|--------------|-------|
| Test | 2.82 (1.61) | –0.25 (–0.59 to 0.09) | 0.86 (0.74–0.93) | 0.64 | 1.49 |
| Retest | 3.06 (1.92) | - |

Construct validity using hypothesis testing
Six out the eight pre-defined construct validity hypotheses were supported by the results (Tables 1 and 5). The Arabic PSFS showed positive correlation (>0.4) with LEFS, GAF, and RAND-36 physical functioning (Table 5). The correlations of the Arabic PSFS with the NPRS and RAND-36 pain were below the hypothesized level (Table 5). As hypothesized, the Arabic PSFS showed low correlation with RAND-36 emotional well-being (Table 5). The correlation of the Arabic PSFS with LEFS was higher than that with the NPRS as hypothesized. Additionally, the correlation of the Arabic PSFS with the RAND-36 physical functioning was higher than that with the RAND-36 pain as hypothesized (Table 5).

Discussion
In the current study, the PSFS was adapted to modern standard Arabic language making it applicable to all Arabic-speaking countries. The use of modern standard Arabic, understood by all Arabic speakers, enables all Arabic-speaking countries to use the adapted scale while the use of any regional Arabic dialect would have greatly reduced the applicability of the adaptation to just few countries. The adapted Arabic PSFS was comprehensible and easy to use as indicated by participants who were interviewed in the first phase of the study. Patients were able to understand scale’s instructions and scoring scheme with no difficulty. All participants were able determine at least three activities that they had difficulty with and rated these activities with no difficulty supporting the relevance and comprehensibility of the adapted Arabic version. The lack of floor and ceiling issues in the Arabic PSFS, consistent with previous reports [3], indicates that the scale is suitable for patients with lower extremity musculoskeletal disorders. The absence of floor and ceiling effects would allow the scale to measure changes over time in activity limitation (responsiveness) [26] although this was not examined in the current study and needs to be formally tested.

The Arabic PSFS demonstrated very good test–retest reliability as indicated by the point estimate of the ICC and its 95% confidence interval (Table 4) that fall above the threshold of 0.7 for acceptable reliability [26,37]. The results of the test–retest reliability indicate that patients with lower extremity musculoskeletal disorders and stable clinical condition will have similar scores in the Arabic PSFS with different administrations over time. The reliability estimate of the Arabic PSFS reported in the current study (ICC = 0.86) is in line with prior reports in the literature of the PSFS reliability. In a systematic review, Horn et al. reported the test–retest reliability coefficient (ICC) of the PSFS in musculoskeletal disorders to be from 0.76 to 0.97 [3]. A number of research studies examining the PSFS test–retest reliability were published after the aforementioned systematic review. In these studies, the PSFS has been reported to have ICC value from 0.71 in patients upper extremity musculoskeletal disorders to 0.87 in patients primary shoulder complaint [32–36]. The Swedish, Brazilian, Nepali, and Turkish versions of the PSFS [6,13,15,16,18] has been reported to have similar reliability estimates with values ranging from 0.79 to

Table 4. Arabic PSFS test–retest reliability and measurement error.

ICC: intraclass correlation coefficient (two-way random model for agreement); SEM: standard error of measurement for agreement; MDC90: minimal detectable change with 90% confidence.

*Test score minus the retest score.
The Arabic PSFS was hypothesized to have higher correlation with LEFS and RAND-36 physical functioning compared to NPRS and RAND-36 pain. This pattern of correlation was expected because PSFS, LEFS, and RAND-36 physical functioning measure the same construct, activity limitation, while measures of pain quantify related but not similar construct compared to PSFS. Our results supported these hypotheses and are consistent with prior reports. In patients with knee disorders, PSFS showed higher correlation with SF-36 physical functioning compared to SF-36 bodily pain [38]. PSFS has also been reported to have higher correlation with activity limitation measures compared to measure of pain intensity in patients with low back pain [6,16], shoulder disorders [15], and in patients with proximal humeral fracture [40]. These reports in the literature support the finding of the current study.

Given that they measure different constructs, we expected the Arabic PSFS to have low correlation with the RAND-36 well-being. Consistent with our hypothesis, the Arabic PSFS showed low correlation ($r = 0.13$) with RAND-36 emotional well-being. This pattern of correlation has been reported previously in literature supporting our findings. In patients with knee disorders, Chatman et al. reported low correlation between PSFS and SF-36 mental health [38]. Novak et al. also reported low correlation between PSFS and SF-36 mental component score in patient with upper extremity nerve injury [41].

Rehabilitation specialists in Arabic-speaking countries interested in quantifying the extent of activity limitation in a way that is patient-centered, and relevant to the culture and life style of their patients would benefit from the Arabic PSFS adapted in the current study. The Arabic PSFS is practical outcome measure for rehabilitation specialists given that it is short, easy to administer and applicable to large number of health conditions not only musculoskeletal disorders. The most attractive feature of the PSFS is that it is patient-generated where patients determine (no pre-specified items) the activities that they have difficulty with. This feature is very important to rehabilitation specialists in Arabic-speaking countries because commonly used PROMs quantifying activity limitation are mostly developed in western cultures thus lack some important daily activities for Arabic-speakers.

Although the PSFS is applicable to all patients with musculoskeletal disorders, we examined the measurement properties of the Arabic PSFS specifically in patients with lower extremity musculoskeletal disorders given the prevalence and impact of these disorders [42]. The measurement properties of the Arabic PSFS need to be examined in patients with upper extremity and spine-related musculoskeletal disorders before the scale could be recommended for use in these populations. Given that outcome measures used in the current study were self-reported, participants were required to be able to read Arabic language. Only four potential participants were excluded from participation due to illiteracy, thus this requirement did not negatively influence the study’s external validity. Fifteen participants with spine surgery, neurological, or cardiopulmonary disorders were excluded.

### Table 5. Correlation between the Arabic PSFS and other measures ($N = 116$).

| Variable                      | Spearman’s $r$ (95% CI) | $p$   |
|-------------------------------|-------------------------|-------|
| LEFS                          | 0.65 (0.52 to 0.75)     | <0.001|
| GAF                           | 0.65 (0.53 to 0.75)     | <0.001|
| NPRS                          | -0.16 (-0.36 to 0.04)   | 0.09  |
| RAND-36 physical functioning  | 0.64 (0.53 to 0.73)     | <0.001|
| RAND-36 emotional well-being  | 0.13 (-0.07 to 0.33)    | 0.17  |
| RAND-36 pain                  | 0.38 (0.22 to 0.52)     | <0.001|

$r$: Spearman’s correlation coefficient; CI: confidence interval; LEFS: Lower Extremity Functional Scale; GAF: Global Assessment of Function; NPRS: Numeric Pain Rating Scale.
from the study given the expected influence of these disorders on physical function. We believe that the number of excluded subjects is reasonable and that the sample recruited in the current study is still representative of most patients with lower extremity musculoskeletal disorders. Although the current study had good sample size in general, the large confidence interval for the test–retest reliability estimate suggests that a larger sample might be needed to estimate the scale reliability with narrower confidence interval thus greater confidence in the point estimate of the scale reliability. The current study did not examine the responsiveness of the Arabic PSFS. Thus, the ability of the scale to detect change in activity limitation over time is not established yet. Additionally, future work is needed to determine the magnitude of change in the Arabic PSFS that is deemed important by patients (minimal important change).

In summary, this study was conducted to cross-culturally adapt the PSFS into modern standard Arabic language and to examine its measurement properties in patients with lower extremity musculoskeletal disorders. The adapted Arabic PSFS was comprehensible and easy to use as indicated by participants. The Arabic PSFS also demonstrated very good test–retest reliability, acceptable measurement error, and evidence supporting its construct validity with no floor or ceiling issues. Rehabilitation specialists can use the Arabic PSFS in daily clinical practice and in research studies to measure activity limitation in Arabic-speakers with lower extremity musculoskeletal disorders.

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Disclosure statement

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