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The Arabic Version of the Pittsburgh Fatigability Scale for Older Adults: Translation and Validation

Mutasim D. Alharbi[1], Fayaz Khan[1], Aya Saeb[2], Nancy W. Glynn[3] and Baian A. Baattaiah[1*]

Abstract

Background The Pittsburgh Fatigability Scale (PFS) was developed to assess perceived physical and mental fatigability in older adults (≥ 60 years). No perceived fatigability questionnaire has been validated to date for use among the Arabic older adult population. The aim of this study was to translate the PFS into Arabic language, and to assess the reliability and validity of the translated version among an Arabic older adult population.

Methods The primary design of this methodological study was cross-sectional. The PFS was translated into Arabic using the forward-backward translation method according to established guidelines. Internal consistency was evaluated by Cronbach's alpha coefficient. The test-retest reliability was evaluated using intraclass correlation coefficients over a two-week interval. Construct validity was evaluated by exploratory and confirmatory factor analyses. The convergent and discriminant validity were measured by calculating Spearman's correlation coefficients between the PFS– Arabic version and the Arabic versions of the Fatigue Severity Scale (FSS), Perceived Stress Scale (PSS), and WHO-5 Well-Being Index.

Results The validity and reliability sample included 277 older adults with a mean age of 66.0 ± 5.3. For the PFS– Arabic version, the intraclass correlation coefficient for test-retest reliability for both the physical and mental subscale was high (0.97). Cronbach's alpha for the PFS– Arabic version was 0.75 for the physical fatigability subscale and 0.71 for the mental fatigability subscale. The results of the factor analyses revealed that a four-factor model of PFS– Arabic version physical and mental subscales was a good model fit in our sample. Both subscales of PFS– Arabic version showed moderate correlation with FSS ($r = 0.3$, $p < 0.0001$) and weak correlation with PSS ($r = 0.2$). The WHO-5 showed a moderate correlation with PFS– Arabic Physical subscale ($r = -0.3$) and weak correlation with PFS– Arabic Mental subscale ($r = -0.2$).

Conclusion The PFS– Arabic version showed good psychometric properties and is recommended for use among Arabic-speaking populations to assess perceived fatigability in older adults.

Keywords Arabic version, Fatigability, Older adults, Psychometric properties, Reliability, Validity

*Correspondence:
Baian A. Baattaiah
bbaattaiah@kau.edu.sa
[1]Department of Physical Therapy, Faculty of Medical Rehabilitation Sciences, King Abdulaziz University, P.O. Box 80324, Jeddah 21589, Saudi Arabia
[2]Department of Internal Medicine, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia
[3]Department of Epidemiology, School of Public Health, University of Pittsburgh, Pittsburgh, PA, USA

Background

The older adult population in the Arab region has observed increases similar to the global trends [1]. The proportion of the Arabic population aged 60 and above is expected to increase from 6% in 2000 to 9.5% in 2030 and 15.2% by 2050, which is considered to be a seven-fold growth of the aging population in 2030–2050 compared to 2000–2015 [1]. This makes the geriatric population in the Arab countries an important segment of society that should receive particular attention regarding their health and well-being.

Fatigability refers to the inability of an individual to sustain a given physical or mental task due to the limiting demands placed by perceptions of fatigue [2]. It is a common complaint among older adults that rapidly emerged in rehabilitation literature as a less biased and more objective measure of fatigue in relation to activity of fixed intensity and duration [2]. Fatigability can be measured in terms of two concepts: perceived fatigability and performance fatigability. Perceived fatigability is based on the overall subjective experience of fatigue on self-reported questionnaires that contextualized to activities commonly performed by older adults, whereas performance fatigability is based on a more objective method that assesses performance deterioration (i.e., slowing down) during a task, typically walking [2]. The available aging literature reveals that the prevalence rates for perceived physical and mental fatigability varies widely, from 20 to 90% depending on the assessment measure, characteristics of the study population, and sex differences [3]. Additionally, many studies show that fatigability is inversely associated with physical activity [4, 5], cardiorespiratory fitness [6], and sleep quality [7].

A wide range of tools is available to measure fatigability in older adults. These tools come in various forms, including questionnaires [8], performance tests [9], wearable sensors [10], and energy expenditure measurement [11], all designed to measure different aspects of fatigability [3]. Some of the available tools can be costly, time-consuming and may be too challenging for very old or frail adults [12, 13]. Accordingly, Glynn et al. developed the Pittsburgh Fatigability Scale (PFS) as a comprehensive instrument that centers on operationalizing the concept of fatigability to assess the true impact of physical and mental fatigue on the functionality and independence of older adults [8].

Interestingly, the PFS is the only validated participant-centered questionnaire for the assessment of perceived physical and mental fatigability in older adults. The PFS questionnaire has been translated, validated, and cross-culturally adapted into different languages, including Spanish [14], Dutch [15], simplified Chinese [16], traditional Chinese [17], Korean [18], and in various settings (i.e., adults with chronic conditions, older adults vulnerable to accelerated mobility decline) across the world [19, 20]. Considering that, in Arabic, an instrument to measure perceived fatigability that is suitable for older adults is still lacking. The unavailability of a valid and reliable questionnaire like the PFS to measure fatigability has limited our capability to distinguish older adults who exhibit poor mobility and decline in physical function, as well as identify intervention effects. To fill in the gap, our study aimed to translate the PFS into Arabic language, and to assess the reliability and validity of the translated version among the Arabic older adult's population.

Given the consequences associated with fatigability on function, daily activities, and participation in daily life, early and regular assessment of fatigability may play a major role in the early detection and therefore positive health-related outcomes [21]. In addition, it will help the rehabilitation specialist to evolve an effective management protocol to improve such symptoms. Further, translating and validating this scale into Arabic will add to the fundamental knowledge pertaining to rehabilitation communities focusing on older adults and it will provide a necessary Arabic-language scale for research and clinical practice that may promote overall health.

Methods

Study design and participant selection

The primary design of this methodological study was cross-sectional. Data were collected from older adults living in Saudi Arabia through face-to-face interviews or by completing a digital survey link. The study was conducted in accordance with the guidelines proposed in the Declaration of Helsinki. The ethical approval for the study was reviewed and obtained in February 2022 from the Faculty of Medical Rehabilitation Sciences-Institutional Review Board at King Abdulaziz University, Jeddah, Saudi Arabia (FMRS-EC2022-022).

A convenient sample of older adult participants was recruited between February of 2022 and January of 2023 through flyers given to various communities and settings, such as primary health care and rehabilitation centers, geriatric clinics, and community gatherings to participate in this study voluntarily. Inclusion criteria were age of 60 years and older and able to read and understand Arabic. Participants who did not meet the study's inclusion criteria were excluded from participation.

Translation procedure of the PFS

The PFS is a 10-item, self-administered questionnaire for reporting the level of physical and mental fatigue an individual expected or imagined they would feel immediately after performing ten activities with different range of intensity and duration across set of domains including leisure time, physical, household, and social activities [8]. The participants were asked to indicate the level

of physical and mental fatigue for each of the 10 statements on a scale of 0–5 (0 = no fatigue) to 5 (5 = extreme fatigue). The total score is the sum of the ten separate statements ranging from 0 to 50, with higher scores indicating greater perceived physical and mental fatigability. More sever fatigability is indicated by a PFS Physical score of ≥ 15 and Mental score of ≥ 13 [3, 20]. The PFS demonstrated high internal consistency (Cronbach's alpha of 0.88) and excellent test–retest reliability (intraclass correlation = 0.86) for the English version. Additionally, evidence from several translated versions of the PFS, including Simplified-Chinese, Spanish, and Dutch, demonstrated good internal consistency, construct validity, and convergent validity [14–16].

To begin the process of translating the PFS, permission was first obtained from the developer. A license agreement from the University of Pittsburgh to translate the PFS into Arabic was also signed before beginning the study. According to evidence-based practice, it is recommended that the translation be applied in several stages by adopting the method of knowledge extraction, forward-backward translation, and experimental translation by specialized committees composed of translators specialized in both the Arabic language and PFS, to ensure that the translated content is suitable for Arab and Islamic culture on one hand, while preserving scientific meaning on the other hand [22, 23]. The process of the PFS– Arabic version translation started with forward translation where two bilingual translators (one with medical and one with non-medical backgrounds) who are native Arabic speakers independently translated the English version of the PFS into Arabic. The two translated versions of the PFS were then reviewed and synthesized into one translated version by an expert committee which consisted of three physical therapists and a geriatrician. The committee's aim was to compare both versions and resolve any discrepancies to produce a version that was language colloquial and understood by older adults. The process continued after that when two bilingual translators who were native English speaking backward translated the preliminary Arabic version of the PFS into English. Both translators did not have a medical background and were blinded to the original version of the PFS. The expert committee reviewed again both versions to ensure the accuracy and fidelity of the original English form.

To ensure the validity of items in the pre final version of the translated PFS, ten experts including physical, occupational, and respiratory therapists re-evaluated the items of the scale for conceptual and semantic equivalence and rated the relevance of the items to appropriately measure fatigability. The raters were asked to rate on a 4-point Likert scale. A content validity index score of 0.8 and above was considered acceptable [24]. The pre final version was then administered randomly to 20 older adults to test each item and ensure the clarity and comprehensibility of the translated PFS. The raters were asked to rate on a 4-point Likert scale. A face validity score of 0.8 and above was acceptable [24]. The expert committee revised, refined, and proofread the pre final version based on the responses from the experts and the sample of the intended population and produced the final translated version of the PFS. The final version of the PFS– Arabic was then approved by the developer and is available upon written request at: https://www.publichealth.pitt.edu/pittsburgh-fatigability-scale [25].

Questionnaires

The first survey questions elicited sociodemographic data on age, sex, educational status, and marital status. Then, all participants completed a battery of self-report questionnaires in the same sequence. All questionnaires included in the study have been previously translated into Arabic and validated among the Arabic-speaking population. Permissions to use the included questionnaires were professionally sought from the first or corresponding authors before the study began. The time required to fill out the questionnaires did not exceed 10 minutes from start to finish.

Fatigue Severity Scale (FSS) is a 9-item scale that assesses how severe fatigue is and how it affects a person's activities during the past week. Participants were asked to rate how fatigue affects certain activities on a seven-point format where 1 (strongly disagree) to 7 (strongly agree). The total score is then divided by 9 to get the mean score. The mean score of less than 4 indicates no fatigue. The Arabic version of the FSS demonstrated high internal consistency and good relative reliability [26]. The FSS was used to determine the convergent validity of the PFS.

The Perceived Stress Scale (PSS) is a 10-item scale that is most often used for assessing stress perception. Participants were asked to rate their feelings and thoughts during the last month on a four-point format 0 (never) to 4 (very often). Total scores ranged from 0 to 40, with higher scores indicating higher perceived stress. The scale had a high internal consistency and excellent test-retest reliability for the Arabic version [27]. The PSS was used to determine the discriminant validity of the PFS.

The WHO-5 Well-Being Index is a 5-item questionnaire that has been used as a measure of subjective well-being. Participants were asked to rate how well each of the 5 items applied to them in the last 14 days. Participants score each item from 0 (none of the time) to 5 (all of the time). The raw score ranging from 0 to 25 is multiplied by 4 to give the final score from 0 to 100, with higher scores indicating best subjective well-being. It was reported that the WHO-5 demonstrated high internal

consistency and good test–retest reliability among older adults when translating the WHO-5 into Arabic [28]. The WHO-5 was used to determine the discriminant validity of the PFS.

Data analysis

The data were analyzed using statistical software SPSS version 23 (SPSS, Inc., Chicago, IL, USA), and the factor structure was analyzed using AMOS 23. The target sample size was determined based on the confirmatory factor analysis model, which required a minimum of 10 participants for each item of a scale. Since the PFS consists of 20 items for both physical and mental subscales, we sought a minimum sample size of 200 participants to be recruited in this study [29]. Descriptive statistics such as means and standard deviation (mean ± SD) and percentages (%) were used to describe the different characteristics of the participants and the psychometric analyses used in this study were as discussed below.

Internal consistency

Internal consistency describes the degree to which items on a given scale produce similar scores, i.e., the degree to which they assess the same construct. The internal consistency of the scale was measured by Cronbach's alpha coefficient [30].

Test-retest reliability

Test-retest reliability is a measure of an instrument's consistency and stability over time. The PFS– Arabic version was administered twice using a longitudinal component with a two-week interval after the baseline assessment. The intra-correlation coefficient (ICC) was used to measure the strength of agreement.

Convergent and discriminant validity

Convergent validity measures how a certain construct in the PFS– Arabic version correlates to the established instruments that measure the same construct. On the contrary, discriminant validity refers to the extent to which the PFS– Arabic version is not related to the established instruments that measure different constructs. Spearman's rank correlation coefficient (r) was used to determine the correlation between the different instruments. The magnitudes of the correlations were determined as follows: a weak correlation if $|r|$ value was <0.3, a moderate correlation if $|r|$ was between 0.3 and <0.5, and a strong correlation if $|r|$ was ≥ 0.50 [31].

Construct validity

Exploratory factor analysis (EFA) determined the factor structure using the Kaiser–Mayer–Olkin (KMO) measure and Bartlett's test of sphericity. The factors were considered significant and confirmed to have a satisfactory factor structure by KMO estimates (above 0.70), and Bartlett's test of ($p \leq 0.001$) [32].

Confirmatory factor analysis (CFA) was performed using SPSS AMOS to evaluate the construct validity of the scale [33–35]. The model of fit was determined significant and acceptable with the following criteria: a significant χ^2, comparative fit index (CFI > 0.9), chi-square fit statistics/degree of freedom (CMIN/DF < 5), goodness of fit index (GFI > 0.9), and the root mean square error of approximation (RMSEA < 0.08) [36, 37].

Results

Translation of the PFS

In order to adapt the original PFS to the Arabic cultural and social context, we needed to remove the example 'bridge' from participating in a social activity (item h) and the example 'Zumba' from a high-intensity activity (item j) for cultural relevance. Additionally, we converted the unit pounds (item g) into the unit kilograms, as it is commonly used in Arabic culture. Lastly, we added 'home maintenance' as an example of light household activity (item c) that is widely accepted as a cultural habit for older people in most Arab societies. All these cultural modifications were approved by the developer and members of the expert committee.

Sample description

The sample included 277 participants with a mean age of 66.0 ± 5.3 (SD) years, of whom 128 (46.2%) were men and 149 (53.8%) were women. Both subscales of the PFS showed no sign of ceiling or floor effects across the full sample. The ceiling and floor effect for the PFS Physical scale was (0.36%, $n = 1$) and floor effect for the PFS Mental scale was (1.08%, $n = 3$) and ceiling effect was (0.72%, $n = 2$). Detailed characteristics of the study participants are shown in Table 1.

Perceived fatigability severity among participants

The mean PFS– Arabic Physical and Mental scores were 23.0 ± 8.3 points and 19.7 ± 7.4 points, respectively (Table 1). Overall, of the 277 participants, 235 (84.8%) had a PFS– Arabic Physical score ≥ 15 (Table 2). Of those, 44.7% ($n = 124$) were classified as having the most severe physical fatigability (PFS– Arabic Physical score ≥ 25). We found similar rates of perceived physical fatigability severity across sex (Table 2).

Perceived mental fatigability severity rates were similar as PFS– Arabic Physical. Overall, of the 277 participants, 235 (84.8%) had a PFS– Arabic Mental score ≥ 13 (Table 3). Of those, 53.4% ($n = 148$) were classified as having the most severe mental fatigability (PFS– Arabic Mental score ≥ 20). We found similar rates of perceived mental fatigability severity across sex (Table 3).

Table 1 Characteristics of participants (*N* = 277)

Characteristic	Mean ± SD
Age, 60–80 yrs	66.0 ± 5.3
PFS– Arabic Physical score, 0–50 points	23.0 ± 8.3
PFS– Arabic Mental score, 0–50 points	19.7 ± 7.4
FSS, 1–9	4.0 ± 1.1
PSS, 0–40	18.5 ± 4.8
WHO-5, 0-100	59.3 ± 18.1
	Frequency (%)
Sex	
Male	128 (46.2)
Female	149 (53.8)
Marital Status	
Married	220 (79.4)
Divorced	26 (9.4)
Widow	24 (8.7)
Single	7 (2.5)
Level of Education	
PhD	8 (2.9)
Master	26 (9.4)
Bachelor	135 (48.7)
High school or less	108 (39)

Data are presented as mean ± standard deviation, range, frequency (n) and percentages (%)

PFS– Arabic: Pittsburgh Fatigability Scale– Arabic Version; PSS: Perceived Stress Scale; FSS: Fatigue Severity Scale

Table 2 Rates of perceived physical fatigability severity using the Pittsburgh Fatigability scale– arabic version overall and by sex (*N* = 277)

	Overall (*N* = 277)	Men *n* = 128	Women *n* = 149
Less Severe Fatigability PFS– Arabic < 15	42 (15.2)	23 (18)	19 (12.8)
More Severe Fatigability PFS– Arabic 15–24	111 (40.1)	50 (39)	61 (40.9)
Most Severe Fatigability PFS– Arabic ≥ 25	124 (44.7)	55 (43)	69 (46.3)

Data are presented as frequency n and percentages (%)

PFS– Arabic: Pittsburgh Fatigability Scale– Arabic Version

Table 3 Rates of perceived mental fatigability severity using the Pittsburgh Fatigability scale– arabic version overall and by sex (*N* = 277)

	Overall (*N* = 277)	Men *n* = 128	Women *n* = 149
Less Severe Fatigability PFS– Arabic < 13	42 (15.2)	17 (13.3)	25 (16.8)
More Severe Fatigability PFS– Arabic 13–19	87 (31.4)	42 (32.8)	45 (30.2)
Most Severe Fatigability PFS– Arabic ≥ 20	148 (53.4)	69 (53.9)	79 (53.0)

Data are presented as frequency n and percentages (%)

PFS– Arabic: Pittsburgh Fatigability Scale– Arabic Version

Participants reported an overall higher burden of most severe mental (53.4%) compared to physical (44.7%) fatigability.

Reliability

Internal consistency

Tables 4 and 5 represents the descriptive characteristics of PFS– Arabic physical and mental items with mean, standard deviation, skewness, kurtosis, item total correction, and alpha if the item is deleted. The corrected item-total correlation for the PFS scales was above 0.30, which is acceptable. The Cronbach's alpha value for the PFS– Arabic Physical scale was 0.75 and for the PFS– Arabic Mental scale was 0.71.

Test–retest reliability

Test–retest reliability was assessed for 50 participants who were willing to answer the scale at two-week intervals. The PFS– Arabic Physical pre-mean scores (the initial test) were 21.1 ± 9.4 and the post-mean scores (retest) were 21.2 ± 8.8. The ICC was calculated as (0.97, 95% CI: 0.96 to 0.99, $p \leq 0.0001$). For the PFS– Arabic Mental pre-mean scores (the initial test) were 19.2 ± 10.9 and the post-mean scores (retest) were 19.4 ± 9.7. The ICC was calculated as (0.97, 95% CI: 0.95 to 0.98, $p \leq 0.0001$).

Validity

Content validity and face validity

The content validity was performed including 10 experts who were working within the same area of interest, and the Content Validity Index (CVI) was measured as 0.9. Twenty subjects from the intended population performed the face validity and the Face Validity Index (FVI) was calculated as 0.9, which is in the acceptable range.

Convergent and discriminant validity

In the analysis of convergent validity, both subscales of the PFS– Arabic showed a moderate significant correlation with FSS ($r = 0.3$, $p < 0.0001$). For discriminant validity, the PFS– Arabic Physical and Mental subscales showed a weak correlation with PSS ($r = 0.2$). Additionally, there were moderate and weak negative correlations between the PFS– Arabic Physical and Mental subscales with WHO-5 score (r = -0.3 and r = -0.2) respectively.

Factorial structural

The Exploratory Factor Analysis (EFA) results demonstrated a KMO value of 0.75 and a significant Bartlett's test of sphericity value ($p \leq 0.0001$) for the PFS– Arabic Physical scale and a KMO value of 0.72 and a significant Bartlett's test of sphericity value ($p \leq 0.0001$) for the PFS– Arabic Mental scale, indicating subject adequacy for factor analysis.

Table 4 Descriptive statistics of Pittsburgh Fatigability Scale– Arabic Version Physical subscale

Item	M	SD	sk	ku	r_{it}	a_{iid}
PFS– Arabic Physical (a = 0.75)						
1. Leisurely walk for 30 min	2.07	1.35	0.27	-0.53	0.30	0.74
2. Brisk or fast walk for 1 h	2.87	1.48	-0.32	-0.74	0.30	0.75
3. Light household activity for 1 h	2.27	1.37	0.16	-0.71	0.55	0.71
4. Heavy gardening or outdoor work for 1 h	2.16	1.67	0.08	-1.23	0.45	0.72
5. Watching TV for 2 h	2.21	1.44	-0.16	-0.93	0.40	0.73
6. Sitting quietly for 1 h	1.81	1.49	0.21	-1.12	0.45	0.72
7. Moderate to high intensity strength training for 30 min	2.31	1.67	-0.04	-1.21	0.38	0.74
8. Participating in a social activity for 1 h	2.32	1.34	-0.15	-0.78	0.52	0.72
9. Hosting a social event for 1 h	2.52	1.34	-0.25	-0.75	0.41	0.73
10. High intensity activity for 30 min	2.42	1.69	-0.11	-1.19	0.38	0.75

Abbreviations M: Mean; SD: Standard Deviation; sk: Skewness; ku: Kurtosis; rit: Corrected item total correlation; aiid: Cronbach's alpha if item deleted

PFS– Arabic: Pittsburgh Fatigability Scale– Arabic Version

Table 5 Descriptive statistics of Pittsburgh Fatigability Scale– Arabic Version Mental subscale

Item	M	SD	sk	ku	r_{it}	a_{iid}
PFS– Arabic Mental (a = 0.71)						
1. Leisurely walk for 30 min	2.0	1.48	0.25	-0.83	0.40	0.69
2. Brisk or fast walk for 1 h	2.19	1.42	0.13	-0.78	0.34	0.70
3. Light household activity for 1 h	1.88	1.35	0.34	-0.56	0.42	0.68
4. Heavy gardening or outdoor work for 1 h	1.65	1.43	0.43	-0.78	0.43	0.68
5. Watching TV for 2 h	2.14	1.34	0.03	-0.62	0.34	0.70
6. Sitting quietly for 1 h	1.71	1.39	0.45	-0.52	0.39	0.69
7. Moderate to high intensity strength training for 30 min	1.80	1.49	0.42	-0.77	0.37	0.69
8. Participating in a social activity for 1 h	2.06	1.26	0.11	-0.55	0.39	0.69
9. Hosting a social event for 1 h	2.38	1.32	-0.08	-0.65	0.34	0.70
10. High intensity activity for 30 min	1.86	1.47	0.38	-0.69	0.31	0.70

Abbreviations M: Mean; SD: Standard Deviation; sk: Skewness; ku: Kurtosis; rit: Corrected item total correlation; aiid: Cronbach's alpha if item deleted

PFS– Arabic: Pittsburgh Fatigability Scale– Arabic Version

Confirmatory Factor Analysis (CFA) was performed to analyze the model fit for a 4-factor structure: (i) social activity, (ii) sedentary activity, (iii) lifestyle activity, (iv) moderate activity for both physical and mental components [15, 18]. The results of the model showed a good model fit for the physical component [CMIN/DF = 4.09; GFI = 0.92; CFI = 0.87; RMSEA = 0.12] and mental component [CMIN/DF = 3.35; GFI = 0.94; CFI = 0.85; RMSEA = 0.09]. (Figures 1 and 2).

Discussion

The current study aimed to translate the PFS into Arabic language, and to assess the reliability and validity of the translated version among an Arabic older adult population aged 60 years and older. The PFS– Arabic version demonstrated good internal consistency and acceptable test–retest reliability. The PFS– Arabic version also demonstrated evidence supporting its validity as a measure of perceived fatigability among an Arabic older adult population. Additionally, our findings indicated that PFS– Arabic score was moderately associated with FSS, weakly associated with PSS, and weakly to moderately negatively associated with WHO-5. The Arabic version of the 10-item PFS thus can be used in clinical practice and research among the Arabic older adult population as a valid measure of perceived fatigability. The assessment of fatigability is a recommended component of the rehabilitation of older adults as it can identify older adults with a high risk of mobility and functional limitations.

Surprisingly, our results revealed that the majority of participants reported a higher burden of most severe mental fatigability (i.e., PFS Mental ≥ 20). This may have resulted from certain cultural norms and expectations that may place greater cognitive demands on individuals in specific contexts, potentially affecting their mental fatigue levels. Limited available data on the topic of mental health in Arab cultures limits our ability to contextualize this important finding in order to better understand how individual, lifestyle, and environmental factors contribute to mental health and well-being. Taken together, these findings support and extend a recent commentary that underscores the need to assess perceived fatigability "in terms of racial and ethnic diversity." [3]. This is of high importance, as identifying those at a higher risk of developing physical and mental fatigability, particularly among Arabic-speaking individuals, will guide healthcare

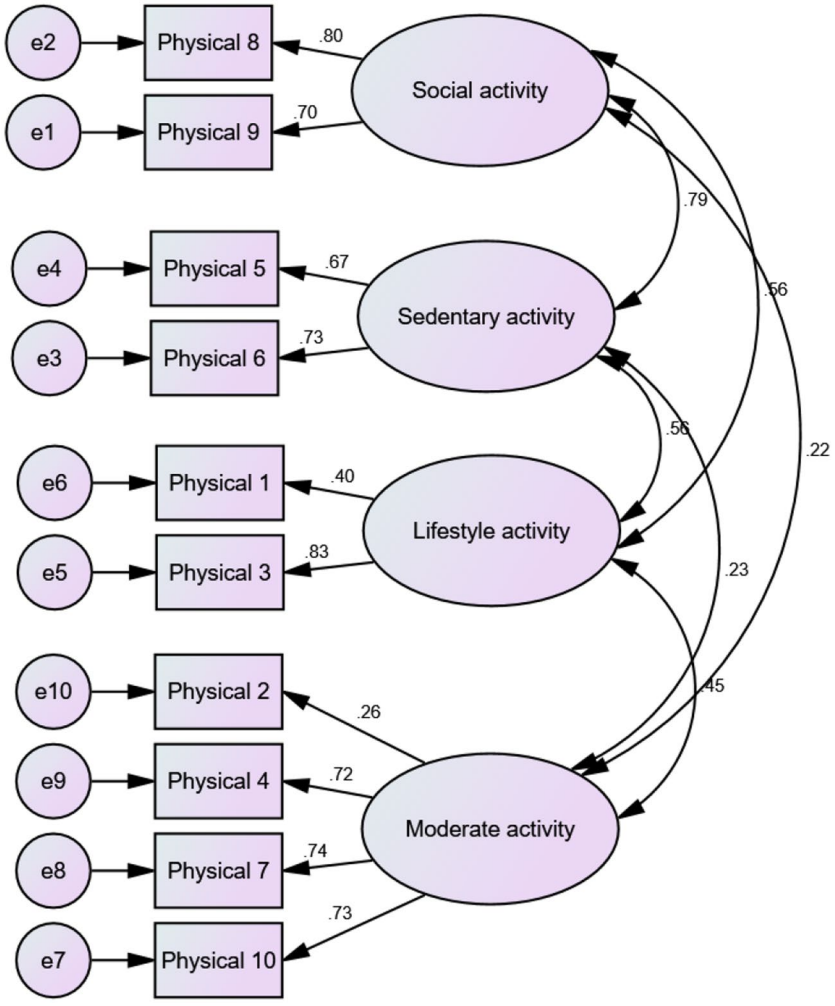

Fig. 1 CFA path diagram showing the Pittsburgh fatigability scale– Arabic version physical subscale model

providers to develop a holistic approach that considers the individual's specific needs (e.g., better sleep, nutrition, and stress management) and underlying health conditions, which is essential for effective fatigability management in older adults.

With respect to reliability scores, the value of Cronbach's alpha for our translated version of the PFS was 0.75 for physical fatigability and 0.71 for mental fatigability, showing good internal consistency among the items of our translated version measuring perceived fatigability. In line with our findings, the English and several translated versions of the PFS have reported strong to excellent internal consistency (Cronbach's alpha ranging from 0.80 to 0.92) [8, 14–16]. In the evaluation of reliability, the PFS– Arabic version showed excellent test–retest reliability. The reliability for both the physical and mental subscale was (ICC: 0.97), which is comparable to the reliability of the original English version of the scale (ICC = 0.86). The reliability of the PFS– Arabic version is also higher than values obtained from the Dutch study (ICC = 0.81) and Simplified-Chinese (ICC = 0.80) in older adults [15, 16].

In the evaluation of convergent validity, we observed that both subscales of the PFS– Arabic version were moderately correlated with FSS. In this context, it can be assumed that people with greater perceived physical and mental fatigability are likely to have higher fatigue levels. Despite methodological differences and sample variations, our findings concur with findings obtained from other translated PFS studies [14–17]. In addition, discriminant validity of both the PFS– Arabic Physical and Mental subscales showed weak to moderate correlations with PSS and WHO-5, given the possibility of that greater perceived physical and mental fatigability could be associated with higher perceived stress and worse subjective well-being. Despite the intention of evaluating the discriminant validity and different constructs, the trend of possible correlations between fatigability, perceived stress and subjective well-being can be explained as fatigue could be associated with greater decline in health

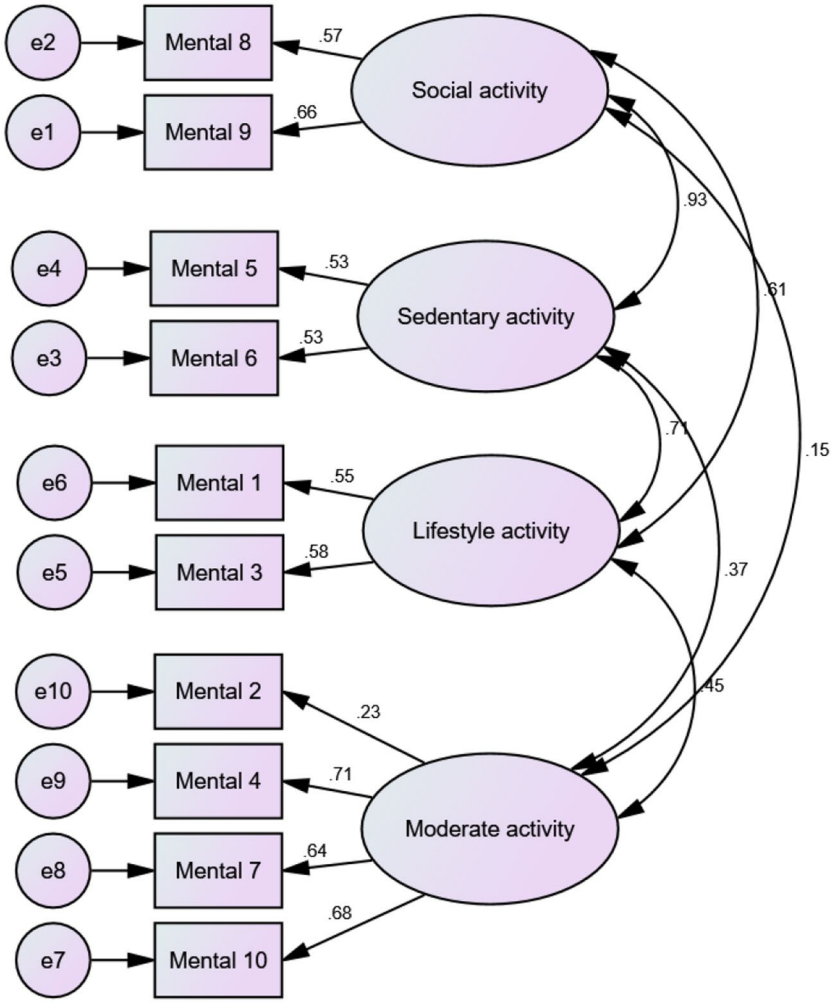

Fig. 2 CFA path diagram showing the Pittsburgh fatigability scale– Arabic version mental subscale model

or difficulties in maintaining work that may increase sensitivity to stress due to higher energy expenditure when performing a given task [38]. Thus, our findings suggest the potential interactions between fatigue and psychosocial and functional status, which may add important knowledge to develop strategies for increasing longevity and quality of life [39].

With respect to instrument validity, the results of factor analysis in this study demonstrated good construct validity of each of the four subscale structures of the Arabic version of the PFS Physical and Mental (social, sedentary, lifestyle, and moderate intensity activity). Specifically, the physical and mental fatigability subscales showed good model fit based on the CMIN/DF, GFI, CFI, and RMSEA values. By way of comparison, our finding is consistent with factor analysis undertaken with the Korean version of the scale indicating good model fit and providing evidence to support the construct validity of the PFS– Arabic version as a measure of fatigability in older adults [18]. However, it is contradicting the Dutch version where they reported poor model fit [15]. The possible explanation for this difference is that they use the two-factor solutions for their model and the sample was drawn from Dutch hospitalized older adults.

Although our translated version of the PFS demonstrated strong psychometric properties and associations of moderate strength with FSS score, several limitations should be acknowledged. Despite the different questionnaires used, there were no other validated Arabic-language questionnaires investigating perceived fatigability. This would require further research to develop a new questionnaire or translate an existing one considering commonly performed activities with specified duration and intensity. Another limitation is that our study used only self-report questionnaire to test the PFS convergent validity and did not have objective measurements of physical function. It would be useful to include any common objective measures to enhance the clinical usefulness of the scale. Moreover, our study was limited by including only people who were able to read in Arabic

in order to complete the given survey. As literacy rate remain significant among older adults in many Arabic-speaking populations [40], such criterion may affect sample representation and thus limit the generalizability of our findings to broader population. Future studies should incorporate methods such as hetero questionnaire where the survey is administered by the investigators/trained interviewers to allow illiterates people to participate in such studies and therefore ensure the inclusion of more representative sample. In addition, it was beyond the scope of the current study to include the analysis exploring the association between educational level and PFS scoring. As such association might be particularly important, specifically with mental fatigability, we highly encourage future research to explore this matter further. Lastly, a worth mentioning limitation of our study was that the test-retest reliability was assessed on a subset of 50 participants who responded to a follow-up communication. This limited sample may introduce selection bias, as those who completed the test-retest component may differ systematically from the broader study population. Factors such as willingness to participate, availability, or specific characteristics of this subset might affect the generalizability of the reliability findings. Future studies with larger and more representative samples are needed to confirm the reliability of these measures.

Age-related change is an inevitable part of life for everyone. The clinical implication of such a scale serves as a baseline for measuring the unique needs of the older patient. A healthcare professional who includes the PFS– Arabic version in the daily routine should have ample opportunity to optimize function and promote healthy aging throughout developing personalized rehabilitation plan focused on optimal intensity, duration, and mode of exercise prescription. The PFS– Arabic version can be an extremely valuable tool in preventing physical and mental functional decline and disability and, thus, maximizing optimal aging.

Conclusion

The Arabic language version of the PFS is a reliable and valid questionnaire for measuring fatigability in Arabic older adults. It contains a broad range of activities that older individuals frequently engage in and range in specified duration and intensity from low to high. Currently, it is the only existing, validated assessment questionnaire that addresses both perceived physical and mental fatigability in a single tool. Geriatric rehabilitation professionals are strongly advised to examine patients' fatigability during clinical visits so they may conduct additional evaluations and provide the best therapies.

Abbreviations

PFS	Pittsburgh Fatigability Scale
PFS– Arabic	Pittsburgh Fatigability Scale– Arabic version
PSS	Perceived Stress Scale
FSS	Fatigue Severity Scale

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Author contributions

All authors contributed substantially to the manuscript. MDA contributed to study design, data collection, and completion of the manuscript. BAB collected and processed the data and drafted the manuscript. FK performed statistical analyses, data interpretation, and drafted the manuscript. AS reviewed literature and drafted the manuscript. NWG supervised the study process and revised the manuscript draft for important intellectual content. All authors have read and approved the final version of the manuscript.

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Data availability

Data for the present study will be made accessible upon reasonable request from the principal investigator or corresponding author.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the guidelines proposed in the Declaration of Helsinki and was reviewed and approved by the ethics committee of the Faculty of Medical Rehabilitation Sciences (FMRS), King Abdulaziz University, Jeddah, Saudi Arabia (FMRS-EC2022-022). The study protocol, procedures, and participants' rights were explained to the participants and written informed consent was obtained from all participants prior to their participation.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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