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Abstract	*Background:*
	Cancer-related fatigue (CRF) is the most common and distressing symptom reported by breast cancer survivors. The primary aim of this study was to translate and evaluate psychometrically for the first time a Spanish version of the Piper Fatigue Scale-Revised (S-PFS-R).
	Methods:
	One hundred and eleven women with stage I–IIIA breast cancer who had completed their primary cancer therapy in the previous 6 months with the exception of hormone therapy completed the S-PFS-R, the Profile of Mood States (POMS) Fatigue (POMS-F) and Vigor subscales (POMS-V), and bilateral force handgrip testing. Data analysis included test–retest reliability, construct validity, criterion-related validity, and exploratory factor analyses.
	Results:
	Test–retest reliability was satisfactory ($r > 0.86$), and all subscales showed moderate to high construct validity estimates [corrected item-subscale correlations (Pearson $r = \geq 0.65$)]. The exploratory factor analysis revealed four dimensions with 75.5 % of the common variance explained. The S-PFS-R total score positively correlated with the POMS-F subscale ($r = 0.50$–0.78) and negatively with the POMS-V subscale ($r = -0.13$ to -0.44) confirming criterion-related validity. Negative correlations among force handgrip testing, subscales, and total scores were weak ($r = -0.26$ to -0.29).
	Conclusions:
	The Spanish version of PFS-R shows satisfactory psychometric properties in a sample of breast cancer survivors. This is the first study to translate the PFS-R into Spanish and further testing is warranted.

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1

2 The Piper Fatigue Scale-Revised: translation and psychometric
3 evaluation in Spanish-speaking breast cancer survivors

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6 **Barbara F. Piper · Manuel Arroyo-Morales**

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38 cancer survivors. This is the first study to translate the PFS-
39 R into Spanish and further testing is warranted.
40

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Introduction

44

45 Cancer-related fatigue (CRF) is the most commonly
46 reported and distressing symptom affecting 42–91 % of
47 cancer patients [1]. Despite this fact, limited data continue
48 to exist that describe the incidence, severity, and correlates
49 of CRF and response to CRF treatments in ethnically
50 diverse populations such as nonwhites, Hispanics/Latinos,
51 and non-English-speaking populations [1, 2]. In the few
52 studies published, Hispanic women who have cancer and
53 are elderly and unemployed are at higher risk to experience
54 increased CRF and symptom burden [1].

In the United States, breast cancer is the most commonly diagnosed cancer in women [4]. Similarly, breast cancer is the most commonly diagnosed cancer in Hispanic women and is the leading cause of death [5]. The World Health Organization estimated that the incidence of breast cancer in 2008 in South America was 114,898 cases and in Spain, 22,027 cases [6].

Unfortunately, several gaps exist to translating evidence-based guidelines into practice, including the limited translation of multidimensional fatigue questionnaires to assess CRF in non-English-speaking cancer populations [7]. The Piper Fatigue Scale-Revised (PFS-R) was initially developed for assessing CRF in breast cancer patients [8] and has been subsequently validated in different languages [9–12] but never before this in Spanish-speaking populations.

In the US alone, 45.5 million Americans identify themselves as Hispanic or Latino. Hispanics are the largest and fastest growing minority group [4], and nearly 400 million people speak Spanish worldwide [13]. Despite these facts, there is only one other previously developed CRF instrument in Spanish [14].

The aim of this study was to evaluate acceptability, construct validity, criterion validity, and reliability of a Spanish version of PFS-R (S-PFS-R) in breast cancer survivors.

Methods

Design: a cross-sectional study

Sample/setting

Eligibility criteria included: (1) within the first year of initial diagnosis of early stage breast cancer (stage I–IIIA) in female outpatients; (2) age between 25 and 65 years; (3) completion of primary cancer therapy with the exception of hormonal therapy within the past 6 months; and (4) absence of comorbidities. A final sample of 111 patients of Virgen de las Nieves Hospital (Granada, Spain) completed the questionnaires and force handgrip test at enrollment in the same order (S-PFS-R, POMS and force handgrip test, Time 1). A subsample of 40 of these same women agreed to complete the S-PFS-R 48 h later in a second visit for test–retest reliability (Time 2).

Instruments

The Piper Fatigue Scale-Revised (PFS-R): The PFS-R consists of 22, 11-point (0–10) numeric rating scales that assess fatigue by patient self-report. In the first step of translation, two Spanish-speaking researchers who were able to speak, read, and write in English translated independently the original American PFS-R into Spanish. The researchers then agreed a common version after any disagreements between the American version and the S-PFS-R were discussed in a consensus meeting. In the second step of translation, an English-speaking native translated the S-PFS-R into English (back translation) and this version was compared to the American one. To evaluate the Spanish version, conceptual equivalence was considered the main criterion [15].

The Profile of Mood States (POMS): The POMS consists of 63 Likert scale items that measure mood states. Only the POMS-Vigor (POMS-V; $n = 8$ items) and the POMS-Fatigue (POMS-F; $n = 7$ items) subscales were used in this study to determine criterion- and divergent-related validity of the Spanish PFS-R [16]. The POMS was used in previous studies to psychometrically evaluate the PFS-R [17].

The force handgrips on affected and unaffected arms were used to test the divergent validity of the Spanish PFS-R. Handgrip strength was measured using a digital dynamometer (TKK 5101 Grip-D; Takey, Tokyo, Japan). The subjects in stand position with arm adducted at the side and the elbow bended 90° were asked to squeeze the handle as forcefully as possible. Patients performed the test twice, allowing a 3-min rest period between measures. The average value of the two trials was used in data analysis.

Patients meeting the eligibility criteria were approached during their last oncology treatment by a radiation or medical oncologist between March 2008 and April 2010 to explain the study. After signing a written informed consent, participants were asked to complete the study instruments.

Data analysis

The percentage of missing values for each S-PFS-R item was calculated to determine the acceptability of the Spanish version of the PFS-R. To evaluate the multidimensionality of the S-PFS-R using principal axis factoring (PAF) with Direct Oblimin Rotation, Kaiser–Mayer–Olkin's (KMO) was carried out to test the suitability of the data for factor analysis [18]. KMO scores above 0.90 are considered excellent. Bartlett's test of sphericity [19] was applied to analyze the extent to which the correlation matrices departed from orthogonality.

Cronbach's α coefficient was used to examine the internal consistency of the dimensions generated in the S-PFS-R. Construct validity of the dimensions was evaluated by using Pearson product–moment correlations with the S-PFS-R items.

Test–retest reliability was analyzed using Pearson correlations. The Statistical Package for the Social Sciences (SPSS) version 19.0 was used to perform the analyses and $p < 0.05$ was preset for statistical significance.

151 **Results**

152 The sample ($n = 111$) consisted of Caucasian women from
153 the Granada metropolitan area with early stage breast cancer
154 diagnosed within 1 year of their initial cancer diagnosis and
155 within 6 months of their primary cancer therapy, who had a
156 mean age of 49.1 ± 8.2 years. The majority were university
157 educated (41.5 %), married (56.3 %), reporting a moderate
158 level of fatigue (S-PFS-R total score = 5.7). Most had stage II
159 breast cancer (48.6 %), had received radiation and chemo-
160 therapy (89.2 %), and had received lumpectomy (68.5 %).
161 Eighteen patients refused to participate in this study.

162 Acceptability

163 The questionnaire response rate was good. Less than 5 %
164 of values were missing for any item with the exception of
165 item 4 (8.1 %), which was the question most frequently left
166 unanswered (i.e., sexuality item). Completion of the
167 22-item questionnaire required 9–12 min. Readability and
168 reading ease were evaluated using Flesch–Kincaid grade
169 scales (range 0–12) and Flesch reading ease assessments
170 (optimum score = <60 %). The questionnaire was easy to
171 understand and easy to complete.

172 The KMO measure produced a coefficient of 0.89,
173 indicating satisfactory sampling adequacy to perform a
174 factor analysis. Bartlett's test of sphericity also produced a
175 figure of [2 = 1,038.0, $df = 105$ ($p < 0.001$)], indicating
176 that the correlation matrix was unlikely to be an identity
177 matrix and was therefore suitable to perform a factor
178 analysis. In the PAF, the communalities ranged from 0.255
179 to 0.896. Following the PAF with Direct Oblimin Rotation,
180 a satisfactory percentage of total variance was explained
181 (75.5 %) by four factors (57.9, 8.1 and 5.0 and 4.3 %,
182 respectively). This finding is similar to the original four-
183 factor solution reported by Piper et al. but dissimilar to the
184 three-factor solution found in French-speaking women with
185 breast cancer [11]. The Pattern Matrix for the S-PFS-R is
186 shown in Table 2. Factor I included items 1, 2, 3, 5, 6, and
187 11 that represented a combination of the dimensions pro-
188 posed by Piper and was designated behavioral/severity.
189 Factor II included items 12, 13, 14, 15, 16, and 19 repre-
190 senting the original PFS-R sensory and mood dimension
191 and was designated the sensory/mood dimension. Factor III
192 included 5 items (17, 18, 20, 21, and 22) representing a
193 cognitive dimension. Finally, Factor IV included 4 items
194 (7, 8, 9, and 10) representing the PFS-R affective meaning
195 dimension. Using an item loading cutoff value of 0.40, no

Table 1 Factor analysis

Item	Original PFS-R dimension	Factors			
		I	II	III	IV
1. Distress		**.451**	.238	.316	.242
2. Work/school activities		**.702**	.197	.204	.120
3. Visit/socialize friend		**.647**	.272	.003	.273
4. Sexual activity		.299	.274	.243	−.118
5. Activities you enjoy	(Behavioral/severity)	**.730**	.269	.254	.132
6. Fatigue intensity/severity		**.761**	.242	.429	.266
7. Pleasant/unpleasant		.217	.365	.354	**.627**
8. Agreeable/disagreeable		.277	.224	.317	**.739**
9. Protective/destructive		.273	.261	.271	**.491**
10. Positive/negative		.110	.426	.222	**.518**
11. Normal/abnormal	(Affective/meaning)	**.577**	.368	.108	.371
12. Strong/weak		.296	**.489**	.136	.163
13. Awake/sleepy		.220	**.579**	.376	.248
14. Lively/listless		.281	**.763**	.306	.242
15. Refresh/tired	(Sensory/mood)	.358	**.688**	.385	.376
16. Energetic/unenergetic		.389	**.656**	.239	.461
17. Patient/impatient		.369	.206	**.579**	.218
18. Relaxed/tense		.273	.249	**.499**	.219
19. Exhilarated/depressed	(Cognitive)	.252	***.608***	.293	.310
20. Ability to concentrate		.185	.337	**.737**	.275
21. Ability to remember		.147	.190	**.862**	.050
22. Ability to think clearly		.144	.226	**.713**	.169

Items loading for the four-factor solution using principal axis factoring and oblique solution ($n = 111$)

196 double loadings were detected. Item 4 (sexuality) was not
197 attributable to any factor (Table 1).

198 Construct validity

199 Table 2 displays the correlations among the S-PFS-R item
200 scores, subscale scores, and total fatigue scores. No item-
201 subscale correlation was lower than the correlation
202 between the item and the other four subscales, indicating
203 an adequate consistency. Cronbach's alpha was $\alpha = 0.886$
204 on the behavior/severity subscale, $\alpha = 0.867$ on the sen-
205 sory/mood subscale, $\alpha = 0.909$ on the cognitive subscale,
206 and $\alpha = 0.939$ on the affective meaning subscale. Item–
207 subscale correlations were high for all four subscales
208 ($r \geq 0.63$), except for item 4 ($r = 0.53$). Correlations
209 among the total fatigue score and the S-PFS-R subscales
210 were high for all subscales ($r \geq 0.86$).
211 We elected to maintain the same number of items as in
212 the original version of the PFS-R [8] and decided not to
213 make any changes in the total S-PFS-R score to facilitate

214 comparisons with other versions of the questionnaire. We
215 tested the new four-factor solution for reliability and cri-
216 terion validity. Good test–retest reliability was found for
217 the subscales and total fatigue scores between study
218 enrollment (Time 1) and 48 h later (Time 2). Pearson's
219 correlation coefficients were found for the Behavioral/
220 Severity subscale ($r = 0.92$), $r = 0.86$ for the sensory/
221 mood subscale, $r = 0.90$ for cognitive subscale, $r = 0.87$
222 for the affective meaning subscale, and $r = 0.91$ for the
223 total fatigue score.

224 Criterion-related validity

225 Criterion validity was assessed by correlating the total
226 S-PFS-R score and four subscale scores with the stan-
227 dardized POMS-F and POMS-V subscales. A positive
228 correlation was found between the S-PFS-R scores and the
229 POMS-F subscale ($r = 0.50$ to 0.78), and a negative cor-
230 relation was found between the S-PFS-R scores and the
231 POMS-V subscale ($r = -0.13$ to -0.44). As expected,

Table 2 Pearson's correlations of items, subscales, and the PFS-R total fatigue score

Item/subscale	Behavioral severity	Sensory/mood	Cognitive	Affective meaning	Total
Behavioral/severity					0.886*[b]
1. Distress	0.786[a]				0.751*
2. Work/school activities	0.822*[a]				0.740*
3. Visit/socialize friend	0.813*[a]				0.694*
4. Sexual activity	0.530*[a]				0.438*
5. Activities you enjoy	0.841*[a]				0.691*
6. Fatigue intensity/severity	0.680*[a]				0.600*
11. Normal/abnormal	0.834*[a]				0.754*
Sensory/mood					0.867*[b]
12. Strong/weak		0.743*[a]			0.681*
13. Awake/sleepy		0.776*[a]			0.717*
14. Lively/listless		0.815*[a]			0.732*
15. Refresh/tired		0.902*[a]			0.830*
19. Exhilarated/depressed		0.633*[a]			0.722*
Cognitive					0.909*[b]
17. Patient/impatient			0.829*[a]		0.748*
18. Relaxed/tense			0.824*		0.688*
20. Ability to concentrate			0.776*		0.722*
21. Ability to remember			0.821*[a]		0.650*
22. Ability to think clearly			0.837*[a]		0.701*
Affective meaning					0.939*[b]
7. Pleasant/unpleasant				0.692*[a]	0.608*
8. Agreeable/disagreeable				0.699*[a]	0.606*
9. Protective/destructive				0.723*[a]	0.699*
10. Positive/negative				0.733*[a]	0.617*

* Factor I: behavioral−severity; II: sensory/mood dimension; III: cognitive dimension; IV: affective dimension

[a] Values show corrected item−subscale correlations (item−rest correlations)

[b] Correlation between scores on (1) the specific subscale and (2) total fatigue scale

232 negative correlations were found between the fatigue scale
233 and the force handgrip tests in dominant arm ($r = 0.26$ to
234 -0.37; all $p < 0.01$) and non-dominant arm ($r = -0.27$ to
235 -0.38; all $p < 0.01$).

236 **Discussion**

237 The acceptability of the S-PFS-R was satisfactory. The
238 structure of the S-PFS-R also was adequate. Item–subscale
239 correlations were >0.63 in all cases except for item 4,
240 lower than the correlations reported for the Italian version
241 [9], but similar to results presented for the Dutch version
242 [12] and higher than those reported for the French version
243 [11]. Lower correlations were found for item 4 of S-PFS-R.
244 This item showed the highest percentage of missing data
245 (i.e., 8.1 %). This may be due to the sensitivity of this item
246 making some patients to choose not to answer.
247 Internal consistency for the four subscales of the S-PFS-
248 R was high (Cronbach's $\alpha > 0.86$). Therefore, the statisti-
249 cal analyses performed in this study support the accept-
250 ability, reliability, and validity of the S-PFS-R. A positive
251 correlation was found between the S-PFS-R scores and the
252 POMS-F subscale, and a negative correlation was found
253 between the S-PFS-R scores and the POMS-V subscale.
254 These are similar to findings reported in other studies [11,
255 12]. In line with other psychometric validation studies [11,
256 12], these findings may suggest that the cognitive and
257 sensory/mood subscale assess an aspect of fatigue that
258 differs from the other subscales in this population. The lack
259 of understanding or asking patients to double interpret both
260 mental and physical aspects simultaneously within the
261 same item might explain the difficulty that Spanish breast
262 cancer survivors had in distinguishing among these dif-
263 ferent dimensions.
264 As for criterion validity, correlations of the PFS-R with
265 the POMS-F ($0.50 < r > 0.78$) subscale were moderate
266 and reasonable with the POMS-V ($-0.13 < r > -0.44$)
267 subscale. These inter-instrument correlational analyses
268 further support criterion validity of the S-PFS-R and are
269 similar to findings reported with the Italian version [9]. In
270 addition, force handgrip testing in the dominant and non-
271 dominant arms is considered to be a good physical indi-
272 cator that has high relevance to health status in breast
273 cancer survivors [20]. These handgrip tests showed nega-
274 tive correlations with the S-PFS-R. These results demon-
275 strate criterion-related validity of S-PFS-R by showing
276 higher correlations with the S-PFS-R total score.

277 Limitations

278 Several limitations must be acknowledged. Although an
279 adequate number of subjects were included in this study, a
280 larger sample might have given better psychometric results.
281 The patients had just completed their primary oncology
282 treatment within the past 6 months and thus could be
283 expected to have lower levels of CRF. Nevertheless, our
284 study population showed moderate levels of CRF. Finally,
285 the ability to be able to include Spanish-speaking Hispanic/
286 Latino survivors of breast cancer in future studies will be
287 extremely helpful to evaluate cross-cultural and ethnic
288 differences in breast cancer survivors.

289 **Summary**

290 The Spanish version of the PFS-R (S-PFS-R) shows sat-
291 isfactory psychometric properties in breast cancer survivors
292 during their first year since diagnosis. Thus, the PFS-R
293 Spanish version may be useful to use in Spanish-speaking
294 breast cancer survivors and for making cross-ethnic and
295 cross-cultural comparisons across Spanish-speaking breast
296 cancer survivors, their English-speaking counterparts in the
297 United States, and in women survivors in other countries.

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