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Psychometric properties of the Fatigue Assessment Scale (FAS) in women with breast problems[1]

Jolanda De Vries[2] (*Tilburg University, The Netherlands*),
Alida F. Van der Steeg (*Emma Children's Hospital, The Netherlands*), and
Jan A. Roukema (*Tilburg University, The Netherlands*)

ABSTRACT. To examine the usefulness of the Fatigue Assessment Scale (FAS) in women with benign breast problems (BBP) and women with early stage breast cancer (BC). Women with a palpable lump in the breast or an abnormality on a screening mammography (N = 560) completed the FAS (four time points) and measures of anxiety, depressive symptoms, neuroticism, and fatigue. The FAS appeared to have a good fit in the total population (Comparative Fit Index (CFI) = .96; $\times^2_{(29)}$ = 104.5; p < .001; Nonnormed Fit Index (NNFI) = .95; Root Mean Square Error of Approximation (RMSEA) = .091), the BC group (CFI = .95; $X^2_{(32)}$ = 69.6, p < .001; NNFI = .91; RMSEA = .090), and the BBP group (CFI = .95; $\times^2_{(34)}$ = 99.9, p < .001; NNFI = .92; RMSEA = .105). The internal consistency (.89 total group) and the test-retest reliability (BBP group; r = .88 three months interval) were good. The FAS was a distinct factor from depressive symptoms, neuroticism, and state anxiety. In conclusion, the FAS has good reliability and validity in women with breast problems and measures fatigue without substantial overlap with depressive symptoms, state anxiety, and neuroticism.

KEY WORDS. Fatigue. Breast cancer. Benign breast problems. FAS. Instrumental study.

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[2] Correspondence: Dept. of Medical Psychology. Tilburg University P.O. Box 90153. 5000 LE Tilburg (The Netherlands). E-mail: j.devries@uvt.nl

RESUMEN. Se examina la utilidad de la Escala de Evaluación de la Fatiga (FAS) en mujeres con problemas benignos de mama (BBP) y en mujeres con cáncer precoz de mama (BC). Las mujeres con un nódulo palpable en la mama o una anomalía en una mamografía de cribado ($N = 560$) completaron la FAS (en cuatro momentos) y medidas de ansiedad, síntomas depresivos, neuroticismo, y fatiga. La FAS tuvo un buen ajuste en la población total (CFI = 0,96; $\times^2_{(29)} = 104{,}5$, $p < 0{,}001$; NNFI = 0,95; RMSEA = 0,091), en el grupo de BC (CFI = 0,95; $X^2_{(32)} = 69{,}6$, $p < 0{,}001$; NNFI = 0,91; RMSEA = 0,090) y en el grupo BBP (CFI = 0,95; $\times^2_{(34)} = 99{,}9$, $p < 0{,}001$; NNFI = 0,92; RMSEA = 0,105). La consistencia interna (0,89 para el grupo total) y la fiabilidad test-retest (grupo BBP, $r = 0{,}88$ intervalo de tres meses) fueron buenas. La FAS diferenció síntomas depresivos, neuroticismo, estado de ansiedad. En conclusión, la FAS tiene una buena fiabilidad y validez en mujeres con problemas de mama y mide fatiga sin superponerse de forma importante con síntomas depresivos, estado de ansiedad y neuroticismo.

PALABRAS CLAVE. Fatiga. Cáncer de mama. Problemas benignos de mama. FAS. Estudio instrumental.

Fatigue is a major problem in cancer patients. A cause is cancer therapy, but fatigue can remain a problem long after the ending of treatment (De Jong, Courtens, Abu-Saad, and Schouten, 2002; Jean-Pierre *et al*., 2007; Jereczek-Fossa, Marsiglia, and Orecchia, 2002). Like chronic fatigue in general, this cancer-related fatigue (CRF) is characterized by the subjective and persistent feeling of tiredness that is not resolved by rest or sleep and is disproportional compared with patients' activity level (Jean-Pierre *et al*., 2007). The specific component of CRF is its cause, namely cancer (*e.g.,* treatment and disease process). Given its subjectivity, fatigue is mainly measured with self-report questionnaires. Recently, the questionnaires that have been used for measuring CRF have been reviewed (Jean-Pierre *et al*., 2007). These questionnaires could be divided into unidimensional and multidimensional measures, cancer-specific or generic fatigue measures, and fatigue measures and fatigue subscales of questionnaires assessing other concepts. The use of generic fatigue measures was considered a disadvantage. Disease-specific measures have the important advantage that they are tailored for use in a cancer population. Hence, they are expected to have higher test-retest reliability and sensitivity to change. However, they have the obvious disadvantage of being less useful in benign patients or healthy persons.

Apart from fatigue, cancer patients often suffer from depressive symptoms and anxiety (Akechi, Okuyama, Imoto, Yamawaki, and Uchitomi, 2001; Hall, A'Hern, and Fallowfield, 1999; Woods and Williams, 2002). Fatigue is related to depression and anxiety (Servaes, Van der Werf, Prins, Verhagen, and Bleijenberg, 2001). Fatigue is even a classic symptom of depression. In addition, fatigue is an aspect of the personality characteristic neuroticism (Costa and McCrae, 1989). Therefore, assessing fatigue without substantial overlap with related concepts, such as depression, is perceived as an important challenge (Jean-Pierre *et al*., 2007).

The Fatigue Assessment Scale (FAS) (Michielsen, De Vries, and Van Heck, 2003), a generic 10-item questionnaire, has been shown to measure fatigue independently from

depression and neuroticism (De Vries, Michielsen, Van Heck, and Drent, 2004; Michielsen *et al*., 2003). In a recent review on fatigue scales in stroke patients, the FAS was considered the best option for assessing fatigue in stroke patients (Mead *et al*., 2007).

The major aim of this instrumental study (Montero and León, 2007; Ramos-Álvarez, Moreno-Fernández, Valdés-Conroy, and Catena, 2008) was to examine the usefulness of the FAS to measure fatigue in women with early stage breast cancer (BC group) and benign breast problems (BBP group). The internal consistency, test-retest reliability, sensitivity to change, and construct validity (convergent and divergent) were predicted to be good. Concerning divergent validity, the FAS was expected to assess fatigue distinct from depressive symptoms, state anxiety, and neuroticism. We included the BC and the BBP group in order to show that the FAS has equally good psychometric properties in both women who after baseline measurement appeared to have breast cancer and those who appeared to have a benign breast problem.

Method

Sample

Women visiting the outpatient clinics of the St. Elisabeth Hospital Tilburg (September 2002 and February 2007), the Maasland Hospital Sittard (August 2004-December 2005), or the Jeroen Bosch Hospital Den Bosch (January 2006-February 2007), the Netherlands, with a palpable lump in the breast or an abnormality on a screening mammography were asked to participate in a prospective follow-up study examining the role of personality characteristics in patients' quality of life scores after diagnosis and possible treatment. The study concerned women with early stage breast cancer (BC group) and women with a benign breast problem (BBP group). Therefore, women with advanced breast cancer were not asked to participate. Women with previous breast problems in their medical history were excluded from the study. When the women were asked to participate in the study and completed the first set of questionnaires, it was unknown whether they had breast cancer or a benign breast problem. Once diagnosis was known, diagnosis was the reference point for subsequent measurement times for benign patients. For breast cancer patients the reference point was surgical treatment, because otherwise follow-up measures would interfere with timing of treatment modalities. From the patients who were referred by their general practitioner to the Department of Surgery of one of the participating hospitals and were eligible for participation in the study (N = 752), 560 (74.5%) agreed to participate. The most important reasons for not participating were the length of the questionnaires and the amount of stress the women experienced which they felt compromised concentration while completing the questionnaires. Four patients were excluded from the study because they had a locally advanced carcinoma or proven systemic disease. In addition, a number of women did not fully or correctly complete the questionnaires. All participants gave written informed consent.

Instruments

– The FAS (Michielsen *et al*., 2003) is a fatigue questionnaire consisting of 10 items. Five questions of the FAS reflect physical fatigue and five assess mental

fatigue. Although these two aspects of fatigue are represented in the questionnaire, the FAS has shown to be unidimensional in various populations (Michielsen *et al*., 2003; Michielsen, De Vries, Van Heck, Van de Vijver, and Sijtsma, 2004), as well as in sarcoidosis patients (De Vries *et al.*, 2004; Michielsen, De Vries, Drent, and Peros-Golubicic, 2005). The unidimensional structure indicates that the FAS total score should be used. The response scale is a 5-point scale (1, *never* to 5, always). Scores on the FAS range from 10 to 50. The Cronbach alpha of the FAS in a random sample of the Dutch working population was .90 and in a sarcoidosis population .89. In addition, the FAS had the highest factor loading in a factor analysis incorporating five fatigue questionnaires (De Vries, Michielsen, and Van Heck, 2003; Michielsen *et al*., 2003). Correlations between the FAS and the Beck Depression Inventory were .59 (De Vries *et al*., 2004 and between the FAS and the CES-D .65 (Michielsen *et al*., 2003).

- The World Health Organization Quality of Life assessment instrument (WHOQOL-100; WHOQOL group, 1995; Dutch version De Vries and Van Heck, 1995) consists of 100 items that are divided in 24 facets covering six domains (*Physical health, Psychological health, Level of independence, Social relationships, Environment, and Spirituality / Religion / Personal beliefs*) and an overall QoL and general health facet. The reliability and validity are satisfactory (De Vries and Van Heck, 1997; WHOQOL group, 1998), also in breast cancer (Den Oudsten, Van Heck, Van der Steeg, Roukema, and De Vries, 2009), and the sensitivity to change is good (Bonomi, Patrick, Bushnell, and Martin, 2000; O'Carroll, Smith, Couston, Cossar, and Hayes, 2000). Each facet consists of four questions with 5-point Likert type response scales. In the present study, only the facet Energy and Fatigue, a unidimensional fatigue scale, was employed. A higher score indicates less fatigue. In a population consisting of persons with the chronic fatigue syndrome and healthy persons, Cronbach's alpha of the facet Energy and Fatigue was .95 and the correlation with the POMS scale Fatigue was -.85 (De Vries and Van Heck, 1997). Thus, this facet has good validity and reliability.
- The Center for Epidemiological Studies-Depression Scale (CES-D) (Radloff, 1977) is a 20-item scale designed to measure the presence and degree of depressive symptoms. It has a 4-point response scale. For the Dutch population, reliability and criterion validity appeared to be good (Beekman *et al*., 1997). For instance, the internal consistency was .87 (Penninx *et al*., 2001). Furthermore, the sensitivity was 100% and the specificity 88% (Beekman *et al*., 1997).
- The State-Trait Anxiety Inventory (STAI, Dutch version Van der Ploeg, Defares, and Spielberger, 1980) consists of two scales, each containing 20 items, with a 4-point response scale (1, *not at all* to 4, *very*). It is a widely used measure with good reliability and validity (Spielberger, Gorsuch, and Lushene, 1970; Van der Ploeg *et al*., 1980). In the present study, only the state scale was employed. Test-retest correlations were .86 for women with a 1 ½ hour time interval. Cronbach alphas ranged between .87 and .91 and in a stress test, scores on state anxiety increased (Van der Ploeg *et al*., 1980).

– The Neuroticism-Extraversion-Openness Five Factor Inventory (NEO-FFI; Costa and McCrae, 1989; Dutch version Hoekstra, Ormel, and De Fruyt, 1996) is developed to study an individual's personality. The following five personality factors are tested: neuroticism, extraversion, openness, agreeableness and conscientiousness. The questionnaire consists of 60 items with a 5-point response scale (1, *totally disagree* to 5, *totally agree*). The psychometric properties are good (Costa and McCrae, 1989, Hoekstra *et al*., 1996). In the present study only the factor neuroticism was used. This factor assesses six aspects belonging to neuroticism, including fatigue. The Cronbach alpha's of this factor ranged from .82 to .88. Test-retest correlations were .80 and .82. Furthermore, this factor correlated .62 with the state anxiety scale of the STAI and .68 with the total score of the CES-D (Hoekstra *et al*., 1996).

Medical information, *e.g.,* diagnosis and adjuvant treatment, were obtained from the medical records of the patients.

Procedure

All women completed the questionnaires four times: before diagnosis (T1) and one (T2), three (T3), and six (T4) months after diagnosis (benign patients) or surgical treatment (breast cancer patients). This means that T1 was one month after diagnosis for the benign patients and one month after surgery for the breast cancer patients. Subsequently, T3 and T4 were three and six months after diagnosis for the benign group and after surgical treatment for the breast cancer group. Questionnaires were completed at home or in the hospital, prior to their check up/visit.

Statistical procedure

Confirmatory factor analysis (AMOS 4.0) (Arbuckle, 1999), method maximum likelihood, was used to test the structure of the FAS in the total group as well as both subgroups (BC and BBP). The estimation method used was maximum likelihood. The internal consistency was calculated using Cronbach's alpha coefficients for the total group and both subgroups. A value of .70 or higher is being considered as evidence of good reliability (Nunnally, 1978). Test-retest reliability was examined in the BBP group by calculating Pearson correlations between T2 and T3 and between T3 and T4. To provide information on convergent validity, Pearson correlations were calculated for the total group and the two subgroups between the FAS and the facet Energy and Fatigue of the WHOQOL-100. To examine the divergent validity of the FAS, factor analyses (principal axis factoring; varimax rotation) were conducted concerning a) fatigue and depressive symptoms, b) fatigue and neuroticism, and c) fatigue and state anxiety. In each factor analysis, a forced two-factor solution was used, because each time two distinct constructs were expected (criterion for a significant factor loading > .30). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was examined. A KMO of .50 or lower is considered barely acceptable, a value between .50- .70 is mediocre, between .70- .80 is good, between .80- .90 is great, and a KMO of .90 or higher is considered superb (Field, 2005). Finally, analysis of variance (ANOVA) for repeated measures was used to examine

scores on the FAS across time in both patient subgroups. If the subgroups were different with regard to one or more demographic characteristics, these aspects were included in the ANOVA as covariates. If indicated, independent sample t-tests and paired t-tests were used to examine differences between subgroups at one time point and differences between two measurement times, respectively. Except for the confirmatory factor analyses, all analyses were done with SPSS for Windows (version 14).

Results

Demographic characteristics of the participants are shown in Table 1. In the group of women suspected of having breast cancer (N = 560), 204 appeared to have early stage breast cancer (BC group) and 356 appeared to have a benign breast problem (BBP group) after T1. Women in the BC group appeared to have scored higher on state anxiety at T1 compared with women in the BBP group ($t_{(461)}$ = -6.637; $p < .001$). Women who participated in the study were younger ($t_{(546)}$ = 2.96; $p = .003$) than the non-participants. Across time, a number of patients dropped out of the study. In the BBP group, the drop out percentage was 44.1 and was significantly higher compared with the BC group (drop out 27.7%; Chi-square(1) = 13.52; $p < .001$). Apart from this difference, the patients who dropped out of the study did not differ from the patients who remained in the study with regard to having children, having paid work, educational level, marital status, age and fatigue scores at the various time points.

TABLE 1. Patient characteristics of the study participants.

Characteristics	*Total group (n=560)*	*BBP group (n=356)*	*BC group (n=204)*
Demographic factors			
Age: mean (SD)	54.9 (10.5)	52.7 (10.5)	58.7 (9.2)
Living with a partner#: yes/no/missing	78.6/18.2/3.2	80.3/16.9/2.8	75.5/20.6/3.9
Children: yes/no/missing	83.2/13.8/3.0	82.6/14.3/3.1	84.3/12.7/3.0
Educational level#: low / middle / high/missing	33.8/42.9/18.6/4.7	31.5/43.3/20.2/5.0	37.7/42.2/15.7 /4.4
Paid work#: yes/no/missing	45.7/52.1/2.2	51.4/46.3/2.3	36.3/61.8/1.9
Psychological factors			
Fatigue (FAS)	20.5 (7.2)	21.0 (7.2)	19.7 (7.0)
Fatigue (WHOQOL-100)	14.3 (3.4)	14.0 (3.5)	14.8 (3.3)
Depressive symptoms	10.7 (8.4)	10.7 (8.8)	10.5 (7.7)
Neuroticism	30.8 (7.1)	31.2 (7.0)	30.2 (7.1)
State anxiety#	42.8 (14.0)	39.8 (13.1)	48.2 (14.1)

Note. For age and the psychological factors mean±sd are presented. * p < .05; # p < .005; FAS=Fatigue Assessment Scale; WHOQOL-100=World Health Organization Quality of Life assessment instrument-100.

Internal structure

Subsequently, the structure of the FAS was tested with a confirmatory factor analysis. In the total group, the model without allowing for any correlated error terms

had a Comparative Fit Index (CFI) of .93 (Nonnormed Fit Index (NNFI) = .92; Root Mean Square Error of Approximation (RMSEA) = .110). To reach a better fit, the model required six correlations of two error terms ('bothered by fatigue' with 'tired quickly'; 'don't do much' with 'problems starting things'; 'don't do much' with 'mentally exhausted'; 'problems starting things' with 'problems thinking clearly'; 'problems starting things' with 'no desire to do anything'; 'no desire to do anything' with 'mentally exhausted') to reach a CFI of .96 ($\chi^2_{(29)} = 104.5$, $p < .001$; NNFI = .95; RMSEA = .091) (see Figure 1). Within the BC group, the CFI of the basic model was only .77. However, the CFI could be increased to .95 ($\chi^2_{(32)} = 69.6$, $p < .001$; NNFI = .91; RMSEA = .090) by adding three correlations between error terms ('bothered by fatigue' with 'tired quickly'; 'problems starting things' with 'problems thinking clearly' and 'problems starting things' with 'no desire to do anything'). The CFI of the basic model in the BBP group was .84. This could be increased to .95 by adding one correlation between the error terms of the questions 'bothered by fatigue' and 'tired quickly' ($\chi^2_{(34)} = 99.9$, $p < .001$; NNFI = .92; RMSEA = .105). Any additional correlation between error terms did not result in a better fit.

Reliability

The internal consistency (Cronbach's alpha) of the FAS for the total group was .89. For the BC and BBP groups separately, the alphas were .88 and .90, respectively. The test-retest correlations, examined in the BBP group, between T2 and T3 (two months interval) was .87 ($p < .001$) and between T3 and T4 (three months interval) the correlation was .88 ($p < .001$).

Validity

In the total group, the correlation with the WHOQOL-100 facet Energy and Fatigue was -.70 ($p < .001$). In the subgroups the correlations was the approximately the same ($r = -.67$, $p < .001$ for BBP group and $r = -.74$, $p < .001$ for BC group). After removing the overlap in items between the FAS and the WHOQOL-100 facet Energy and Fatigue (2 items), the correlations between both scales remained practically the same (total $r = -.69$; BBP group $r = -.66$; BC group $r = -.73$, all p's $< .001$).

TABLE 2. Factor loadings of the fatigue (FAS) and depressive symptoms (CES-D) items in a two-factor solution.

Items	*Depressive symptoms*	*Fatigue*
Sad	.75	
Depressed	.72	-
Could not shake off the blues	.72	-
Fearful	.66	-
Crying spells	.66	-
Trouble keeping my mind on what I was doing	.64	-
Sleep was restless	.57	-
Appetite was poor	.55	-
Everything I did was an effort	.55	.49
Enjoyed life	-.52	-
Happy	-.51	-
Lonely	.49	-
Talked less	.48	-
Bothered by things	.47	-
Can concentrate quite well Q10	-	-
Hopeful about the future	-	-
Life a failure	-	-
Just as good as other people	-	-
Tired very quickly Q2	-	*.85*
Bothered by fatigue Q1	-	*.80*
Physically exhausted Q5	-	*.79*
Don't do much during the day Q3	-	*.70*
Problems to start things Q6	-	*.65*
Mentally exhausted Q9	*.49*	*.60*
No desire to do anything Q8	*.42*	*.60*
Enough energy for everyday life Q4	-	*-.52*
Problems to think clearly Q7	*.42*	*.50*
Could not get 'going'	.49	.49
People disliked me	-	-
People were unfriendly	-	-

Note. Indicates no factor loading higher than .39. Items in italics are FAS-items. The regular font style is used for the Center for Epidemiological Studies-Depression Scale items.

A factor analysis on the FAS-items and the CES-D items with a forced two-factor solution, showed clear factors, Fatigue and Depressive symptoms (KMO = .92). Two depressive symptom items had cross-loadings on the fatigue dimension (see Table 2). These items (everything I did was an effort, could not get 'going') concerned the CES-D subscale Somatic Retarded Activity and had a similar or only slightly higher factor loading on the Depressive symptoms factor than on Fatigue factor. Three FAS items (problems to think clearly, no desire to do anything, mentally exhausted) had cross-loadings on the CES-D dimension. A factor analysis on the FAS-items and the Neuroticism-items again showed clear factors (KMO = .90). The two factors found were Fatigue and

Neuroticism (see Table 3), without any substantial cross-loadings. The factor analysis on the items from the anxiety and fatigue scales showed a clear state anxiety and a clear fatigue dimension (KMO = .95; see Table 4). No substantial cross-loadings existed.

TABLE 3. Factor loadings of the fatigue (FAS) and the neuroticism (NEO-FFI) items in a two-factor solution.

Items	*Neuroticism*	*Fatigue*
Often tense and nervous	.65	-
Seldom sad or depressed	-.58	-
Feel less	.57	-
Big strain	.57	-
Seldom anxious or worried	-.53	-
Feel completely useless	.50	-
When things go wrong, often discouraged and want to give up	.49	-
Often helpless	.49	-
Seldom lonely or sad	-.47	-
Not a worrier	-.46	-
Feel ashamed	-	-
Often angry about how I am treated	-	-
Physically exhausted Q5	-	*.80*
Tired very quickly Q2	-	*.79*
Bothered by fatigue Q1	-	*.75*
Mentally exhausted Q9	-	*.72*
Problems to start things Q6	-	*.72*
Don't do much during the day Q3	-	*.70*
No desire to do anything Q8	-	*.69*
Problems to think clearly Q7	-	*.59*
Enough energy for everyday life Q4	-	*-.51*
Can concentrate quite well Q10	-	-

Note. Mean scores no factor loading higher than .40. Items in italics are FAS-items. The regular font style is used for the Neuroticism-Extraversion-Openness Five Factor Inventory items.

TABLE 4. Factor loadings of the fatigue (FAS) and the state anxiety (STAI) items in a two-factor solution.

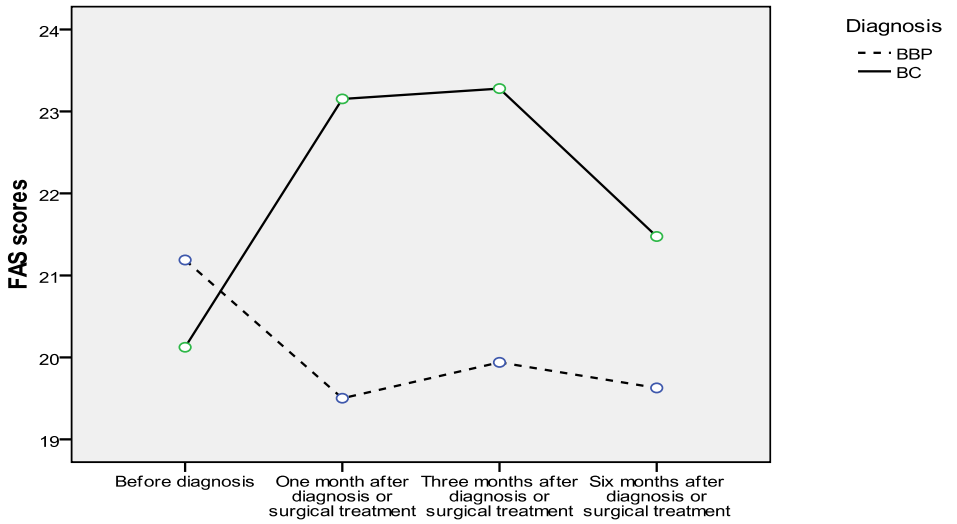
Items	*State anxiety*	*Fatigue*
Am nervous	.83	-
Feel comfortable	-.82	-
Am jittery	.82	-
Am relaxed	-.80	-
Feel restless	.79	-
Am frightened	.79	-
Feel calm	-.78	-
Feel steady	-.76	-
Am worried	.75	-
Feel pleasant	-.75	-
Worry over misfortunes	.74	-
Feel satisfied	-.73	-
Feel content (item 8)	-.71	-
Am tense	.70	-
Feel hunted	.69	-
Feel self-confident	-.69	-
Feel secure	-.66	-
Feel confused	.56	-
Feel indecisive	.48	-
Feel at ease	-	-
Tired very quickly Q2	-	*.82*
Physically exhausted Q5	-	*.80*
Bothered by fatigue Q1	-	*.78*
Problems to start things Q6	-	*.72*
Don't do much during the day Q3	-	*.71*
Mentally exhausted Q9	-	*.70*
No desire to do anything Q8	-	*.66*
Problems to think clearly Q7	-	*.58*
Enough energy for everyday life Q4	-	*-.53*
Can concentrate quite well Q10	-	-

Note. Mean scores no factor loading higher than .40. Items in italics are FAS-items. The regular font style is used for the state anxiety items of the State-Trait Anxiety Inventory.

FAS scores across time

The ANOVA for repeated measures showed that fatigue scores changed over time ($F_{(2.679)}$ = 5.43, p = .001; partial eta squared = .06; observed power = .93). This fatigue score pattern between the two groups were different across time ($F_{(2.679)}$ = 14.36, p < .001; partial eta squared = .153; observed power = 1.00). At T1, fatigue scores in the BBP group were slightly higher than in the BC group and subsequently decreased. From T2 onwards, the BC group scored higher on fatigue (see Figure 1).

FIGURE 1. Fatigue scores of the BBP and BC group across time.



Discussion

The aim of this study was to examine the usefulness of the FAS for measuring fatigue in women with early stage breast cancer (BC group) and benign breast problem (BBP group). Results showed that the internal consistency of the FAS was good and there is strong evidence for the unidimensional structure of the FAS. We have shown that the FAS has good test-retest reliability in BC and BBP patients and demonstrated signficant change in fatigue levels over time in both the BC and BBP groups, and pre-/post-surgery in the BC group. Furthermore, the validity of the FAS was also good. These findings are in accordance with the results from earlier studies among other types of populations (De Vries *et al*., 2003; De Vries *et al*., 2004; Michielsen *et al*., 2003). In these previous studies, the reliability of the FAS appeared to be good in a sample representative for the general Dutch population, a working population, and sarcoidosis patients and these studies also supported a unidimensional conceptualization of fatigue. In the present article, these claims also hold for the BC and BBP groups. In addition, it could be demonstrated that the validity of the FAS was also good. Recently, Jean-Pierre *et al*. (2007) called assessing fatigue without a substantial overlap with related concepts a challenge. We have shown that there is a significant amount of variance in FAS scores beyond that explained by depressive symptoms, neuroticism, and state anxiety. This suggests that the FAS indeed assess fatigue without a substantial overlap with these other constructs.

The relationship between depressive symptoms and fatigue has often been found, because fatigue is one of the symptoms of depression. However, in the present study

items of the CES-D and the FAS loaded on two different factors as in the development phase of the FAS (Michielsen *et al*., 2003). Only two depressive symptoms items appeared to have substantial factor loadings (> .40) on the Fatigue factor, but these cross-loadings were as high or lower than the loadings on the primary factor. A triplet of FAS items had cross-loadings on the Depressive symptoms factor, although the loadings on the Fatigue factor were clearly higher. The present finding that fatigue and depressive symptoms are distinct concepts is in line with a study on breast cancer survivors (Bower, Ganz, Aziz, and Fahey, 2002). They found that fatigue was not secondary to depression, but co-occurred with depression as part of a coordinated response elicited by cytokine actions of the central nervous system.

No substantial cross-loadings were found between the FAS and two other related concepts, e.g., neuroticism (NEO-FFI) and state anxiety (STAI). Concerning neuroticism this is particularly important because energy/fatigue is one of the six facets of neuroticism. Apparently, the FAS does not tap into fatigue as part of personality.

In all three factor analyses, question 10 of the FAS (Can concentrate quite well) either had a substantial cross-loading (depressive symptoms) or had a factor loading < .40. In previous studies this FAS-item had the lowest factor loading of the all items (Michielsen *et al*., 2004) and had a substantial cross-loading on a depressive symptom factor (De Vries *et al*., 2004). Therefore, we suggest to remove question 10, resulting in a 9-item questionnaire, when using the FAS in breast cancer patients. However, when a researcher explicitly wants to include an item on concentration, question 10 can be used.

A limitation of the present study is the dropout rate. This is especially relevant with regard to the analyses across time. The dropout rate was higher in the BBP group. The patients who did not remain in the study differed from the patients who remained in the study with regard to age. Younger patients, more often in the BBP group, more frequently dropped out of the study. The main reason for dropout in the BBP group was that patients no longer wanted to be confronted with their visits to the hospital. In the BC group stress was the main reason for dropping out of the study. Fortunately, participants who left the study did not differ with regard to fatigue, depressive symptoms, neuroticism, and state anxiety from those who completed all questionnaires. Another limitation is the lack of several additional fatigue measures to further examine the construct validity of the FAS. Only one other fatigue measure, the facet Energy and Fatigue of the WHOQOL-100, was used in addition to the FAS. In previous studies, several other fatigue questionnaires were employed in addition to the FAS and each time the FAS appeared the best fatigue measure (De Vries *et al*., 2003; Mead *et al*., 2007). In addition, the FAS is shown to assess fatigue apart from related concepts, a feature that other fatigue measures used in cancer populations has not shown to posses. Future studies should compare the usefulness of the FAS with other fatigue measures among BC and BBP patients. A previous case-study showed that the FAS was capable of detecting change in a sarcoidosis patient (Hoitsma *et al*., 2006).

In conclusion, the FAS is unidimensional and has good psychometric qualities in women with breast cancer and benign breast problems. Importantly, we have shown that the FAS assess fatigue distinctly from the related concepts depressive symptoms, neuroticism, and state anxiety. Given these psychometric properties, its shortness, and ease of administration, it is a valuable tool for assessing fatigue in BC and BBP groups.

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