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Examination of the Dimensionality of Fatigue

The Construction of the Fatigue Assessment Scale (FAS)

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Summary: This paper reports on two studies. The goal of Study I was to examine the dimensionality of existing fatigue scales. The aims of Study II were to construct a new self-report fatigue instrument and to examine its psychometric qualities. In Study I, 876 respondents completed the Fatigue Scale (Chalder et al., 1993), the Checklist Individual Strength (Vercoulen, Alberts, & Bleijenberg, 1999), the Emotional Exhaustion subscale of the MBI-NL (Schaufeli & Van Dierendonck, 1994), and the Energy and Fatigue subscale of the WHOQOL-100 (De Vries & Van Heck, 1995). Exploratory factor analyses and Mokken Scale Analyses provided strong support for the unidimensionality of each of these fatigue questionnaires. Furthermore, when all four measures were combined, only one factor was found, providing support for the view that fatigue is unidimensional. Based on these analyses, a new measure, the 10-item Fatigue Assessment Scale (FAS), was constructed in Study II. The instrument was administered to a sample of 1893 participants, representative of the Dutch population. The FAS showed a good reliability and content validity. Strong support was obtained for the unidimensionality of the scale.

Introduction

Profound fatigue is a common complaint in medical practice (e.g., Bensing, Hulsman, & Schreurs, 1996). It is a symptom of many chronic physical diseases, like multiple sclerosis, cancer, Parkinson's disease, rheumatoid arthritis, and psychiatric disorders such as depression (Lewis & Wessely, 1992). In some diseases, fatigue is even the core symptom as, for example, in the Chronic Fatigue Syndrome (CFS). Moreover, fatigue can also play a role in temporary physical conditions such as pregnancy and infections. Finally, apart from being an indicator of disease, fatigue may also result from the use of medication or medical treatments, such as chemotherapy.

Although fatigue, along with headache, is the most frequently reported symptom in general practice (e.g., Foets & Sixma, 1991), not much systematic theorizing has taken place yet. However, some authors (e.g., Bartley & Chute, 1947; Smets, Garssen, Bonke, Vercoulen, & De Haes, 1995; Vercoulen et al., 1998) have developed a theory about the onset and perpetuation of fatigue. For example, Vercoulen et al. (1998) have focused on the persistence of fatigue in CFS patients. In their model of fatigue, attribution effects, level of physical activity, sense of control over symptoms, and focusing on bodily symptoms play substantial roles. As an alternative, a biopsychosocial approach has been proposed as the most suitable way of examining fatigue (e.g., David et al., 1990; Lewis & Wessely, 1992; Ware, 1993). The view that fatigue is related to various types of extreme stimulation involving low as well as high physical and/or information-processing demands (De Rijk, Schreurs, & Bensing, 1999), and the belief that fatigue links with symptom perception models (e.g., Pennebaker, 1982) are promising steps toward further theorizing (Finkelman, 1994).

In spite of the efforts to develop such frameworks, in most current fatigue studies the definition of the construct is poorly described (Barofsky & Legro, 1991).

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Nevertheless, fatigue is often divided into physical and mental components. Physical fatigue refers to (1) an acutely painful phenomenon which arises in overstressed muscles after exercise (Grandjean, 1979), and (2) a symptom which emerges in circumstances such as prolonged physical exertion without sufficient rest or sleep disturbances due to medication (Rockwell & Burr, 1977). According to Meijman (1997), mental fatigue reflects reduced psychological capacity and less willingness to act adequately due to earlier mental or physical effort. As a consequence, there is reduced competence and willingness to develop or maintain goal-directed behavior aimed at adequate performance (Meijman & Schaufeli, 1996). Chalder et al. (1993) support this distinction. Gaillard (1996) assumes that there are fundamental distinctions between physical and mental fatigue. Be that as it may, due to complex interactions between physical and mental elements in task and job demands and consequences of effort, it is difficult to separate these elements.

There is no consensus about the physical versus mental contrast. Before the 1990s, fatigue was seen as a unidimensional construct (e.g., Lee, Hicks, & Nono Mercia, 1991). Thereafter, mainly due to the fast growing body of studies on CFS, fatigue has gained increased attention (Alberts, Vercoulen, & Bleijenberg, 2001). Nowadays, many authors conceive of fatigue as a multidimensional construct (e.g., Gawron, French, & Funke, 2001; Smets et al., 1995). For instance, Smets et al. (1995) discern five components: General fatigue, physical fatigue, reduction in activity, reduction in motivation, and mental (cognitive) fatigue. Others, for instance Schwartz, Jandorf, and Krupp (1993), have developed three-dimensional scales. The latter authors distinguish the following fatigue dimensions: situation-specific fatigue, consequences of fatigue, and response to rest/sleep.

Support for the multidimensionality has been obtained predominantly through factor analyses and the employment of the eigenvalue exceeding unity criterion (Kaiser, 1960) for determining the number of factors (e.g., Chalder et al., 1993; Vercoulen et al., 1994; Vertommen et al., 1989). However, this criterion often overestimates the number of dimensions by causing factors to split into bloated specifics (e.g., Kline, 1987; Rummel, 1970). In contrast, a few studies (e.g., Smets et al., 1995) have used confirmatory factor analysis to demonstrate multidimensionality. Interestingly, when Smets et al. (1995) tested both a five-factor solution and a four-factor solution, an equal goodness of fit was found. Whether a one-factor solution would fit the data equally well was not examined.

Some researchers have expressed serious doubts regarding the putative superiority of a multidimensional structure of fatigue. In an explorative study of the structure of fatigue, Studts, De Leeuw, and Carlson (2001) failed to find support for distinguishing cognitive, emotional, somatic, and general aspects of fatigue. Åhsberg (2000), who initially divided perceived fatigue after work into lack of energy, physical exertion, physical discomfort, lack of motivation, and sleepiness, noted that, while distinguishing these five dimensions, lack of energy appeared to be a general latent factor, which represented a large proportion of the common variance. Taking these recent studies into account, it seems safe to conclude that the dimensionality of fatigue has not been convincingly demonstrated.

Because of the ongoing discussion about the definition and nature of fatigue, there is no standard way to measure the construct. Fatigue can be assessed using *objective* measures such as reaction time or number of errors (Åkerstedt, 1990), and *subjective* methods such as diaries (e.g., Vercoulen et al., 1996), interviews (e.g., Meesters & Appels, 1996), and questionnaires (e.g., Chalder et al., 1993). The application of questionnaires is a common procedure in large-scale studies. Recently, several questionnaires for measuring fatigue have been reviewed by Friedberg and Jason (1998) and Alberts et al. (2001). These reviews demonstrated that most fatigue questionnaires are developed for specific patient groups, such as patients with cancer, multiple sclerosis, and CFS (e.g., Fisk et al., 1994; Ray, Weir, Phillips, & Cullen, 1992; Smets, 1997; Vercoulen et al., 1994), or ill persons in general (Alberts, Smets, Vercoulen, Garssen, & Bleijenberg, 1997; Krupp, LaRocca, Muir-Nash, & Steinberg, 1989; Schwartz et al., 1993). Little is known about the applicability of these questionnaires in healthy populations. One of the few questionnaires developed for use in hospital populations as well as community populations is the Fatigue Scale (FS; Chalder et al., 1993). The two reviews also reveal that multidimensional fatigue scales are seen as more comprehensive, and hence as more adequate for providing a complete description of an individual's fatigue experience (Alberts et al., 2001). The rationale for such a view is that these scales take into consideration that persons with the same overall score nevertheless may differ substantially in their experience (Smets et al., 1995). However, it is admitted that disadvantages of multidimensional scales are their length and, often, the contamination of fatigue with somatic illness. Furthermore, the overviews of fatigue assessment instruments show that fatigue is also frequently measured using subscales of broader measures. The Emotional Exhaustion scale in burnout questionnaires (e.g., MBI; Maslach & Jackson, 1996) and the Energy and Fatigue subscale of the World Health Organization Quality of Life assessment instrument (WHOQOL-100; WHOQOL group, 1998) are good examples of this approach.

Objectives

The aim of Study I was to examine the dimensionality of four fatigue scales in a healthy population, in particular a sample that is representative of the working population. These four fatigue scales are reliable, valid, and frequently employed. In Study II, we administered a new fatigue instrument to a representative Dutch sample.

Study I

Materials and Methods

Subjects

Sample 1 was used to test the dimensionality of fatigue. Participants (n = 876) lived equally in the Dutch regions and were obtained via random telephone calls. All selected respondents worked at least 20 hours per week, and agreed to complete a number of questionnaires as part of a longitudinal study. In total, 452 men (M = 41 years, SD = 9.3, range 20–63 years) and 412 women (M = 39 years, SD = 9.8, range 18–65) participated in this study (total response = 48%); gender was unknown for 12 respondents. 27% of the respondents were single (n = 234), and 638 persons (73%) were married or lived together with a partner. Some 46% (n = 399) had a college education. Lower educated people were somewhat underrepresented and highly educated persons slightly overrepresented in this sample. However, this is not uncommon for this kind of study (Saris, 1988). With respect to gender, marital status, and age, the sample is representative for the Dutch working population (CBS, 1999).

Questionnaires

Sample 1 completed four fatigue scales: The Checklist Individual Strength-20 (CIS-20; Vercoulen et al., 1999), the Emotional Exhaustion subscale (EE scale) from the Dutch version of the Maslach Burnout Inventory (MBI; Maslach & Jackson, 1986; MBI-NL; Schaufeli & Van Dierendonck, 1994), the Energy and Fatigue subscale from the World Health Organization Quality of Life assessment instrument (EF-WHOQOL-100; WHOQOL group 1995, Dutch version De Vries & Van Heck, 1995), and the Fatigue Scale (FS; Chalder et al., 1993; Dutch translation by De Vries, 1998).

The CIS consists of 20 statements and provides a total fatigue score and scores for four components of fatigue: Subjective Experience of Fatigue (SEF; eight items), Reduced Concentration (CON; five items), Reduced Motivation (MOT; four items), and Reduced Physical Activity level (PA; three items). Respondents use a 7-point rating scale (1, *yes, that is true*, to 7, *no, that is not true*). The reliability coefficient, estimated by lowerbound Cronbach's α, for the total score was .90; and for the subscales .88, .92, .83, and .87, respectively (Vercoulen et al., 1999). The CIS has been shown to yield different scores for CFS patients, MS patients, and patients with abdominal pain. Moreover, the subscales of the CIS correlated significantly with comparable scales (Vercoulen et al., 1999). Although the CIS was developed for CFS patients, the questionnaire is claimed to be also appropriate for healthy populations (Beurskens et al., 2000).

The EE MBI-scale comprises five items, each with a 7-point rating scale ranging from 1, *never,* to 7, *always.* The scale has well-established validity and a high reliability (coefficient α = .83) (Schaufeli & Van Dierendonck, 1994).

The EF subscale of the WHOQOL-100 contains four items answered on a 5-point Likert scale (1, *never,* to 5, *always*): two positively phrased items using the word "energy" and two negatively phrased using the word "fatigue". Its Cronbach's α was .95 and the Energy and Fatigue scale correlated highly with the Fatigue and Vigor subscales of the POMS (De Vries & Van Heck, 1997).

The 11 item FS distinguishes Mental Fatigue (four items), describing cognitive difficulties, and Physical Fatigue (seven items). This measure uses a 5-point rating scale (1, *never,* to 5, *always*). It is also possible to calculate a total fatigue score. The scale was found to be both reliable and valid (Chalder et al., 1993) and has shown sensitivity to treatment changes (Deale, Chalder, Marks, & Wessely, 1997). Cronbach's α for the entire measure was .89; and for the subscales .82 and .85, respectively (Chalder et al., 1993).

Statistical Procedure

Means, standard deviations, and Cronbach's α were calculated for each (sub)scale. The dimensionality of the four fatigue scales was studied at the item level by conducting exploratory factor analyses (principal components analysis), followed by Mokken scale analyses (Mokken & Lewis, 1982; Sijtsma, 1998; Sijtsma & Molenaar, in press). The latter method was applied because factor analysis is vulnerable to the influence of differences in the items' frequency distributions (Nunnally, 1978, p. 144), which may produce artifactual "difficulty factors". Mokken scale analysis is based on the scalability coefficient for item pairs, H (Molenaar, 1997), that equals the ratio of the items' covariance and their maximum covariance given the items' univariate frequency distributions. In this way, the effect of different frequency distributions is eliminated. Thus, Mokken scale analysis does not produce artifacts due to differences in frequency distributions.

Both exploratory factor analysis and Mokken scale analysis were also done using the complete set of items ($k = 40$) of the four scales. The scree plot (Cattell, 1966) of the exploratory factor analyses was examined to scrutinize the dimensionality of the fatigue scales. The computer program Mokken Scale analysis for Polytomous items (MSP; Molenaar & Sijtsma, 2000) uses cluster analysis for selecting unidimensional subscales from a larger set of items. Each subscale is selected to optimize the *scale H* for the subset of items selected (the *scale H* is a weighted mean of the *item pair H*s, discussed before). For reliably ordering persons on a (sub)scale, the *scale H* has to be at least .3 (default in MSP; Molenaar & Sijtsma, 2000). However, higher values are desirable because they indicate higher measurement reliability, and a *scale H* > .5 is interpreted as indicative of a strong scale. The quality of individual items as contributors to reliable person-ordering is guaranteed by only admitting items to a scale if the item scalability coefficient (*item H;* a weighted mean of all item pair *H*s in which the studied item figures) is at least .3 (Molenaar & Sijtsma, 2000).

MSP is one of the few programs for item response theory analysis (Van der Linden & Hambleton, 1997) that has an automated item selection procedure. The associations among the total scores of the eight (sub)scales were calculated using Pearson correlations. In addition, factor analyses were conducted (1) at the (sub)scale level of the four questionnaires, and (2) with the total scores of the four questionnaires. For Mokken Scale Analysis, one can use only single item scores, not sum scores. Therefore, an analysis of the total scores of the (sub)scales cannot be performed using this procedure.

Results

Mean, standard deviation, and Cronbach's α of the fatigue questionnaires are shown in Table 1. Inspection of these results reveals that no excessive high or low scores were found in this sample.

The scree plots (Cattell, 1966) based on exploratory factor analysis revealed that MBI-EE, WHOQOL-EF, and FS were each based on one factor (see Figure 1 for the scree plots). The single factors extracted from the separate scales explained between 40% (FS) and 69% (WHOQOL-EF) of the (observed) variance. The scree plot of the CIS-20 suggests the extraction of either one factor or four factors. Mokken Scale Analyses, on the other hand, showed that each questionnaire formed one reliable scale (Table 2). Therefore, it was concluded that the CIS-20 is also best conceived of as a unidimensional scale. The factor structure and the scalability, using coefficient *H* of the four questionnaires, were explored separately.

Exploratory factor analysis at the item level, using the total set of 40 items of the four scales together, yielded one factor, that explained 42% of the total variance. Based on recommendations by Hemker, Sijtsma, and Molenaar (1995), MSP was used with scalability lowerbounds of .0, .3, .4, and .5, respectively, for item selection using all 40 items. Following these authors' rules of thumb for interpreting the results from applying the cluster analysis four times using different lower bounds, it could be concluded that 37 items formed one reliable scale with *scale H* = .47 (Table 2). Values between .4 and

Table 1. Mean, standard deviation, and reliability coefficient of the (sub)scales.

(Sub)scale	*M*	*SD*	α
CIS Total score	51.25	23.70	.94
CIS-Subjective Experience of Fatigue	22.59	22.59	.93
CIS-Reduction of Concentration	12.13	6.87	.88
CIS-Reduction of Motivation	10.04	5.25	.82
CIS-Reduction in Physical Activity	6.60	4.16	.84
MBI-Emotional Exhaustion	2.57	1.12	.87
WHOQOL-Energy and Fatigue	10.08	2.75	.85
Fatigue Scale Total score	19.80	5.86	.87
FS-Mental Fatigue	6.90	2.15	.76
FS-Physical Fatigue	12.90	4.45	.85

Note. CIS = Checklist Individual Strength, MBI = Maslach Burnout Inventory; WHOQOL = World Health Organization Quality of Life; FS = Fatigue Scale.

Table 2. Results of Mokken Scale Analyses per Scale (lowerbound = .3).

Scale	*K*	*n*	*H*	Min(*itemH*)–max(*itemH*)
Checklist Individual Strength	20	849	.47	.31–.56
MBI-Emotional Exhaustion	5	872	.59	.51–.66
WHOQOL-Energy and Fatigue	4	857	.70	.68–.73
Fatigue Scale	10 (Item11 removed)	872	.48	.37–.56
Complete set of 40 items	37	832	.47	.34–.56
Fatigue Assessment Scale	10	1835	.47	.37–.55

Note. MBI = Maslach Burnout Inventory; WHOQOL = World Health Organization Quality of Life assessment instrument; *k* = number of items; *n* = number of subjects; *H* = scalability coefficient; *itemH* = item scalability coefficient.

Table 3. Correlations among the (sub)scales.

(Sub)scale	1	2	3	4	5	6	7	8
1. CIS-Subjective Experience of Fatigue	–	.58	.65	.49	.60	.78	.43	.78
2. CIS-Reduction of Concentration		–	.55	.54	.48	.51	.66	.54
3. CIS-Reduction of Motivation			–	.55	.49	.59	.44	.58
4. CIS-Reduction in Level of Physical Activity				–	.34	.48	.42	.44
5. MBI-Emotional Exhaustion					–	.62	.46	.63
6. WHOQOL-Energy and Fatigue						–	.44	.76
7. FS-Mental Fatigue							–	.54
8. FS-Physical Fatigue								–

Note. All *p*s < .001. CIS = Checklist Individual Strength, MBI = Maslach Burnout Inventory; WHOQOL = World Health Organization Quality of Life; FS = Fatigue Scale.

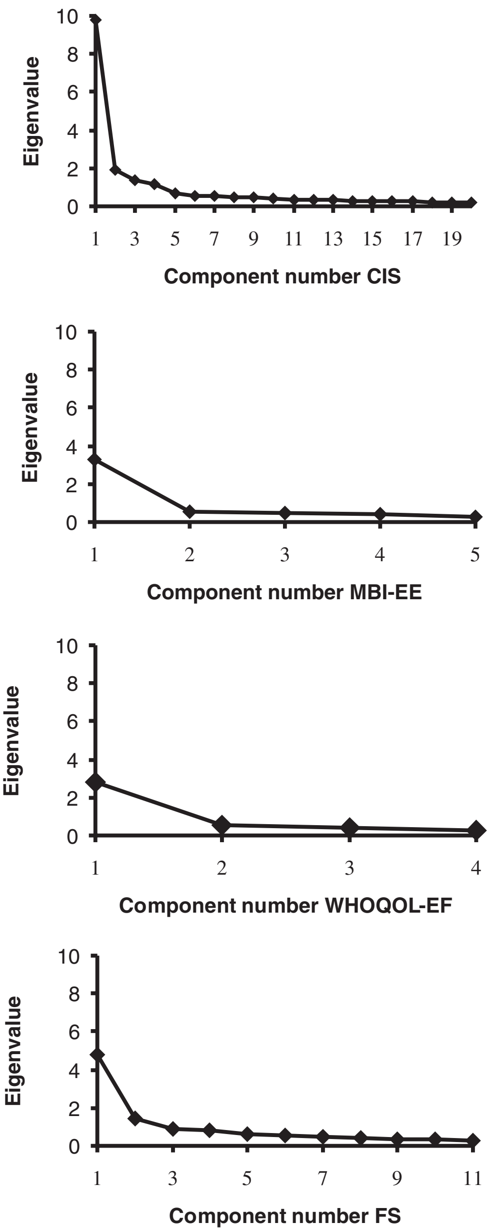

Figure 1. Scree plot of the item-level factor analysis on the four fatigue questionnaires.

.5 usually are interpreted as "medium" results. Two CIS-20 items (numbers 5 and 7) and one FS item (number 11) measured another trait than the 37 selected items. Table 2 shows that the *item H*s varied from .34 to .56, meaning that items contribute differently to the reliability of the person-ordering based on all 37 items.

The correlations between the scores of the eight (sub)scales were moderate to strong, ranging from .33 to .78 (all *p*s < .001); see Table 3. The Cronbach's α of the used (sub)scales was satisfactory, with the α's ranging from .76 (FS-Mental Fatigue) to .94 (CIS-20 total score). When the scores of the four subscales of the CIS-20, the two subscales of the FS, the WHOQOL-EF, and the MBI-EE were subjected to a factor analysis, the scree plot (Cattell, 1966) indicated one factor. This factor explained 61% of the variance. Separate analyses, not reported here, revealed that the same strong one-factor solution was found when the sample was split according to gender and age. The same results were also obtained when only the total scores of the four scales, ignoring subscales, were used (59% of the variance explained).

To summarize, factor analyses consistently revealed one factor, both at the item and the (sub)scale level. Neither sex nor age groups influenced these outcomes. Mokken Scale Analyses also yielded a one-scale solution. So, the four questionnaires used in this study all seem to measure *one* construct: Fatigue.

Discussion

Exploratory factor analyses for the four fatigue questionnaires consistently indicated one factor at the item level as well as at the (sub)scale level. Mokken Scale Analyses also resulted in a one-scale solution. So, the four questionnaires used in this study all seem to measure one unidimensional construct. The unidimensionality of the construct allows for the construction of a new, short, and easy to administer scale.

Study II

The aim of Study II was twofold: to construct a new self-report fatigue instrument and then to test its content validity and reliability.

Materials and Methods

Subjects

Two large respondent groups participated in Study II. Sample 1 was used to construct the new fatigue scale; Sample 2 was the validation group. Sample 1 (n = 876) was described above. Participants in Sample 2 (n = 1,893), which was a representative sample of the Dutch population, completed a computer-administered questionnaire. The respondents of the latter sample were all members of an internet-based telepanel. Every week a questionnaire, which was downloaded from the telepanel's internet site, was administered to this panel of approximately 2000 households. The sample consisted of 1128 men (age: M = 46 years, SD = 15.4, range 16–87 years) and 765 women (age: M = 42 years, SD = 14.7, range 16–87 years). Fifty-seven percent of the total group had a paid job. Twenty-four percent (n = 454) had a college education.

Procedure

First, items were removed, which could only be completed by specific groups (e.g., workers), were asking two things at the same time, or had a low face validity. A semantic procedure was followed to select items from the remaining item pool. The WHOQOL Group (1998) also used this method. There are two reasons for selecting items for the FAS on a semantic basis. The FAS is constructed to represent all semantic fatigue categories. A purely statistical selection of items would likely not cover all kinds of different experiences of fatigue. For instance, this could have led to a set of items that were only related to physical fatigue. Secondly, a statistical selection would be based on data of working respondents. It might be possible that a different statistical selection would be obtained when data of patients were analyzed. The generalizability of the selection would be questionable in this way. Thus, a content analysis of the questions was done in order to identify semantically equivalent questions. The number of questions was hereby reduced. Questions with limited face validity were deleted. The items were then grouped into categories reflecting a similar type of fatigue. Judgments by the first two authors regarding semantic equivalence and categorization were based on consensual agreement. After the semantic analysis, in each semantic group the item with the highest factor loading on the one-factor solution of the 40 items was chosen. In addition, an extra item concerning mental exhaustion was included. The reason to include this particular item was to ensure that the two domains of fatigue that are most often used (mental and physical fatigue), were asked about in a balanced way. Subsequently, the new 10-item scale, the Fatigue Assessment Scale (FAS), was presented to Sample 2. For examining the psychometric qualities of the FAS, Cronbach's α was calculated, and factor analysis and Mokken scale analysis were conducted at the item level.

Results

We removed 12 of the 40 items before the semantic analysis. Among these were five work-related items (e.g., MBI "I feel used up at the end of the workday"), a question asking about two things at the same time (FS "Do you feel sleepy or drowsy?"), and items which were not strongly related to fatigue (FS "Do you make slips of the tongue when speaking?"). There appeared to be nine semantic groups of items: (1) being bothered by fatigue (two items; e.g., "Do you have problems with tiredness" FS1), (2)

Table 4. Factor loadings of the FAS-items, ordered by size.

FAS item	*Fatigue*
I get tired very quickly	.78
Physically, I feel exhausted	.77
I am bothered by fatigue	.76
Mentally, I feel exhausted	.74
I feel no desire to do anything	.67
I don't do much during the day	.65
I have problems to think clearly	.65
I have problems to start things	.64
I have enough energy for everyday life	.63
When I am doing something, I can concentrate quite well	.57

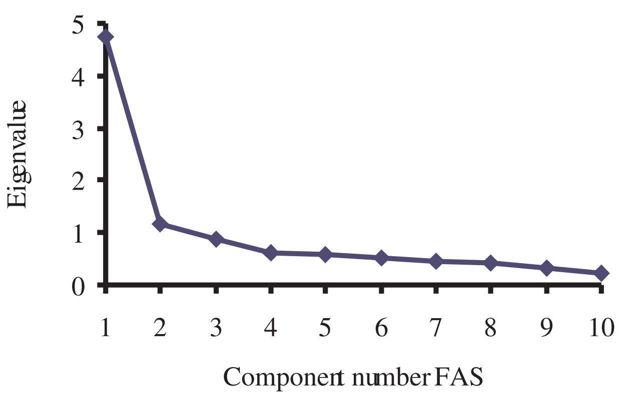

Figure 2. Scree plot of the factor analysis on the Fatigue Assessment Scale (FAS).

feeling physically tired (nine items; e.g., "Physically, I feel exhausted" CIS4), (3) speed of getting tired (two items; e.g., "I get tired very quickly" CIS16), (4) level of energy (three items, e.g., "Are you lacking in energy" FS6), (5) concentration (five items; e.g., "I can concentrate well" CIS11), (6) inability to think clearly (two items; e.g., "Do you have problems thinking clearly" FS10), (7) quantity of daily activities (three items; e.g., "I do quite a lot within a day" CIS7), (8) problems in starting things (one item; "Do you have problems starting things" FS4), and (9) feeling no desire to do anything (1 item; "I feel no desire to do anything" CIS18). Subsequently, from each semantic group the item was selected with the highest factor loading of the semantic group on the factor that was identified in the 40-item factor analysis, performed in Study I. As explained above, an extra item concerning mental fatigue was included in the test population. Thus, the FAS consists of ten items (see Appendix). A 5-point Likert frequency rating scale was chosen to accompany the items.

Cronbach's α of the FAS was .87. Factor analysis indicated that the ten items measured one factor, explaining 48% of the variance (see Table 4 and Figure 2), also when genders or age groups were separated. Based on item selection using several lower-bound values for H, Mokken scale analyses revealed that the 10 items formed one reliable scale (H = .47). Individual *item H*s varied from .37 to .55 (Table4). Also here, our conclusion is that the 10 items measure the same trait.

Discussion

The four fatigue questionnaires used in Study I all appear to be unidimensional. Consequently, fatigue is assumed to be one construct. A new, 10-item fatigue measure, the Fatigue Assessment Scale (FAS), is constructed, based on a semantic analysis of the forty items of the four questionnaires, employed in Study I. The FAS has promising psychometric qualities.

The findings in Study I regarding the dimensionality of fatigue are in line with the ideas of Lewis and Wessely (1992), who conceive of fatigue as a continuum. However, they assume that, when fatigue is measured with emotional, behavioral, and cognitive components, it is likely that the concept is multidimensional. The latter view also reflects the ideas of Smets et al. (1995) and Gawron et al. (2001), who have argued that, despite the absence of a definition of fatigue, there is agreement that fatigue is a multidimensional concept. The present study does not support this position. For instance, the CIS-20, which is supposed to measure four separate dimensions of fatigue in patient populations as well as in the population of workers, showed a clear unidimensional structure in our sample. In relation to this, it is quite remarkable that the cut-off point for the multidimensional CIS-20, to indicate a fatigue level which shows that someone is at risk for sick leave or work disability, is fixed on the total score (Bültmann et al., 2000), and is not a combination of cut-off points for the four dimensions. This seems to support our findings.

A possible reason why the results of Study I do not support multidimensionality could be that, compared with groups of predominantly healthy persons, patients focus more on symptoms and, therefore, distinguish more aspects of fatigue. Maybe fatigue is unidimensional for nonpatient groups and multidimensional for patients. However, Studts et al. (2001) found no difference in the dimensionality of fatigue between chronic pain patients and healthy controls. Hopefully, the outcomes of Study I will reopen the discussion about the dimensionality of fatigue.

For practical reasons, it was impossible to include all relevant fatigue questionnaires in Study I. Therefore, a selection of questionnaires had to be made. The four instruments that were chosen are reliable, valid, and frequently used in Western countries. To our knowledge, this selection of measures forms a good representation of the available unidimensional and multidimensional fatigue questionnaires. The use of other assessment instruments might have led to different results. It is interesting to note, however, that this study is not the only one that found a one-factorial solution using purportedly multidimensional instruments. Studts et al. (2001) also found a one-factor solution in data obtained with several other ostensibly multidimensional fatigue questionnaires. In conclusion, fatigue seems to be a unidimensional construct.

In Study II, a new, 10-item fatigue scale, the FAS, was constructed, based on semantic and empirical considerations. Subsequently, this instrument was tested in a large sample, representative for the Dutch population. The reliability of the FAS was satisfactory. In addition, it could be shown that the FAS measures one construct, namely *fatigue*. This outcome was also obtained when separate analyses were conducted on subgroups (gender or different age groups). Similarly, Mokken scale analyses revealed that the ten FAS-items formed one reliable scale. In sum, the FAS has shown good psychometric qualities in a representative Dutch population.

The test sample in this study was a representative sample from the Dutch population. Little can be said about the applicability to other groups, for example, patients suffering from a lung disease, cancer patients, and so on. It would be interesting to compare in future research FAS-scores in healthy working people, working but ill people, and ill people who cannot work due to their disease. Furthermore, it could be argued that the difference in questionnaire administration (paper-and-pencil versus computerized) could lead to different response patterns. However, Mitchell, Klein, and Balloun (1996) found that mode of administration, paper-and-pencil or computerized, did not impact findings. In addition, in a study by Gaudron (2000), computer anxiety did not artificially modify scores during computer administration.

In conclusion, a 10-item unidimensional fatigue questionnaire (FAS) was developed, which is short and easy to use. Its psychometric qualities are promising, but require further examination in future research.

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Appendix

Fatigue Assessment Scale (FAS)

The following ten statements refer to how you usually feel. For each statement you can choose one out of five answer categories, varying from Never to Always. 1 = Never, 2 = Sometimes; 3 = Regularly; 4 = Often; and 5 = Always.

	Never	Sometimes	Regularly	Often	Always
1. I am bothered by fatigue (WHOQOL)	1	2	3	4	5
2. I get tired very quickly (CIS)	1	2	3	4	5
3. I don't do much during the day (CIS)	1	2	3	4	5
4. I have enough energy for everyday life (WHOQOL)	1	2	3	4	5
5. Physically, I feel exhausted (CIS)	1	2	3	4	5
6. I have problems starting things (FS)	1	2	3	4	5
7. I have problems thinking clearly (FS)	1	2	3	4	5
8. I feel no desire to do anything (CIS)	1	2	3	4	5
9. Mentally, I feel exhausted	1	2	3	4	5
10. When I am doing something, I can concentrate quite well (CIS)	1	2	3	4	5

Note. Between brackets, the questionnaire is given from which the item is taken.
WHOQOL = World Health Organization Quality of Life assessment instrument; CIS = Checklist Individual Strength; FS = Fatigue Scale.
Items 4 and 10 require reversed scoring. The scale score is calculated by summing all items.