# Validity and reliability of the Greek version of the Modified Fatigue Impact Scale in multiple sclerosis patients

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**Fatigue in multiple sclerosis (MS) may be attributed to a variety of biological and psychological factors. Scales addressing the multidimensionality of fatigue are used in MS evaluation, although adequacy of data on their reliability and validity is questionable. The aim of the present study was to provide evidence for the validity and reliability of the Greek version of the Modified Fatigue Impact Scale (MFIS). The MFIS was translated into Greek and administered to 99 MS patients and 75 controls. Exploratory factor analysis was carried out and reliability measures were calculated. Discriminant validity was also assessed. The mean MFIS score was 33.8 (SD 17.8). Two factors (physical and cognitive) were extracted through factor analysis; a psychosocial factor was not identified. Reliability measures (intraclass correlation coefficient, Cronbach's α, Pearson's correlation) yielded high values. Patients and nonpatients differed statistically significantly in the MFIS scores; no statistically significant differences in MFIS score according to the type of MS were observed. It can be concluded that the Greek version of MFIS is valid and reliable, although questions about the scale dimensions remain. Further modifications and cultural adaptation of the scale may help create a useful tool for screening and assessment of fatigue in MS patients.** *International Journal of Rehabilitation Research* **37:271–276 © 2014 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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## Introduction

The Multiple Sclerosis Council for Clinical Practice and Guidelines defined fatigue as 'a subjective lack of physical and/or mental energy that is perceived by the individual or caregiver to interfere with usual or desired activities' (Multiple Sclerosis Council for Clinical Practice Guidelines, 1998). It is considered as the most common disabling symptom by 65–90% of all multiple sclerosis (MS) patients (Krupp *et al.*, 1988; Fisk *et al.*, 1994; Jette and Keysor, 2003), causing limitations in daily activities, with a major impact on quality of life (Amato *et al.*, 2001; Pittion-Vouyovitch *et al.*, 2006) and being one of the main reasons for unemployment (Smith and Arnett, 2005).

Researchers report that fatigue in MS may be attributed to a variety of biological and psychological factors (Van Kessel and Moss-Morris, 2006). This has led to the adoption of fatigue as a subjective and multidimensional construct measured with a variety of measuring instruments. These instruments are based on various conceptual approaches and incorporate the following scales: Fatigue Severity Scale (FSS), Modified Fatigue Impact Scale (MFIS), Fatigue Impact Scale (FIS), Fatigue Assessment Instrument (FAI), and Fatigue Descriptive Scale (FDS). The above scales have been used by clinicians and researchers in different countries (Krupp *et al.*, 1989; Schwartz *et al.*, 1993; Fisk *et al.*, 1994; Multiple Sclerosis Council for Clinical Practice Guidelines, 1998; Iriate *et al.*, 1999). The Multiple Sclerosis Council for Clinical Practice Guidelines (1998) recommended the MFIS for use in clinical practice and research. The MFIS is a shortened version of the FIS with three subscales (physical, cognitive, and psychosocial); it is one of the most widely used instruments in its field. Numerous researchers have examined the psychometric properties of the MFIS with a variety of MS samples across various countries – Italy, Spain, Belgium, and Slovenia (Kos *et al.*, 2005), Poland (Gruszczak *et al.*, 2009), Portugal (Pavan *et al.*, 2007), France (Debouverie *et al.*, 2009), and Holland (Rietberg *et al.*, 2010). The reproducibility, validity, and responsiveness of the scale were investigated and differences in the psychometric properties between countries were studied. In Poland, Gruszczak *et al.* (2009) examined the validity and reliability of MFIS; in Belgium, Kos *et al.* (2003) evaluated the reliability, validity, and responsiveness of the Dutch version of MFIS; in Holland, Rietberg *et al.* (2010) determined reproducibility, responsiveness, and concurrent validity of MFIS; in Portugal, Pavan *et al.* (2007) carried out a cross-cultural adaptation and validation study of the MFIS; and in France, Debouverie *et al.* (2009) culturally adapted the scale. Nevertheless, questions on the structural validity of the scale and especially the psychosocial dimension remain. Sufficient data on exploratory factor analysis (EFA) of the scale are lacking and modifications of the scale have been proposed (Mills *et al.*, 2010; Amtmann *et al.*, 2012).

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The validity and reliability of the MFIS have not been examined in Greece so far. The aim of the present study was therefore to provide validity and reliability evidence for the Greek version of the MFIS (MFIS-Greek), including results from EFA in a sample of Greek MS patients. On the basis of previous research findings across Europe, it was hypothesized that the MFIS would be a valid and reliable measure assessing fatigue in Greek MS patients, although structural concerns were also expected.

## Patients and methods

For the purposes of the study, the scale was translated into Greek and backwards translated by bilingual experts to ensure accuracy of the translation. EFA was carried out for testing construct validity, and differences in fatigue between MS patients and healthy controls were tested to assess discriminant validity. Cronbach's α was used for assessing reliability in terms of internal consistency and intraclass correlation was used to assess reliability in terms of stability of the responses. The time interval between the two assessments was 1 week to avoid a learning effect (Thomas and Nelson, 2003). The procedures are detailed below.

### Participants

The study was carried out at the Department of Neurology of the University Hospital Attikon in Athens and at the Department of Neurology of the University of Ioannina, School of Medicine, between September 2011 and May 2012. All the patients were invited to participate in the study at the outpatient department of the neurological clinics. On the visiting day, they filled in the questionnaires in a private clinic room in the presence of the principal researcher, who provided explanations when necessary. A total of 99 MS patients were recruited consecutively on the basis of their medical records. The sample size was sufficient for factor analysis, given the number of questionnaire items (21 items) and the expected number of factors (two or three factors) (Henson and Roberts, 2006). All the patients were Greek adults (older than 18 years of age) with a definite diagnosis of MS according to the revised McDonald *et al.*'s (2001) criteria.

Exclusion criteria were as follows: relapse less than 1 month before the assessment (a), relapse between the two assessments (b), coexisting disease (c), and inability to visit the clinic, follow the instructions provided by the principal researcher, or respond to the questionnaires [Expanded Disability Status Scale (EDSS) < 7.0] (d) (Rietberg *et al.*, 2010).

A group of 75 participants were selected randomly among the visitors of the Atticon Hospital. The control group was matched to the patients' sex and age, with no chronic diseases and no medications for any reason during the previous months. Seventy-two patients and all the control participants responded to the MFIS, FSS, and a demographic questionnaire at two time-points separated by a 1-week interval.

### Instruments

The MFIS is a 21-item self-assessment questionnaire. Respondents indicate the fatigue they experienced throughout the last 4 weeks. Permission to use the MFIS for the purposes of the present study was obtained from Dr D. Miller. Translation validity evidence of the MFIS was then provided through the following steps (Beaton *et al.*, 2000; Thomas and Nelson, 2003): (a) forward translation of the MFIS into Greek by a group of two medical doctors and two PhD holders from the university with English as their primary language; (b) backward translation of the MFIS-Greek into English by a second group of two medical doctors and two PhD holders from foreign universities; and (c) 10 MS patients and 10 nonpatients were asked to complete the MFIS-Greek and identify the items requiring modification. The 20 patients and nonpatients indicated that all the 21 items of the MFIS-Greek were accurate and no further linguistic adaptations were required.

The FSS, one of the most widely used scales, is a nine-item self-administered unidimensional rating scale (Krupp *et al.*, 1989). For the purpose of the present study, we used the validated Greek version of the FSS (Bakalidou *et al.*, 2013). The EDSS (Kurtzke, 1983) was used to record disability in the sample of MS patients by a certified clinician.

### Ethics

The research ethics committee of the Attikon University Hospital approved the study protocol. All the participants signed an informed consent.

### Statistics

The assumption of normal distribution of the collected data was tested using the Kolmogorov–Smirnov test. Item analysis was carried out and EFA with direct oblimin rotation was carried out to investigate the factor structure of the MFIS. The number of extracted factors was determined using Horn's parallel analysis (as detailed in the Results section).

The reliability of MFIS-Greek was evaluated by assessing the instrument's internal consistency, repeatability, and its test–retest reliability. Internal consistency was assessed with Cronbach's α coefficient using the data obtained from the initial MFIS-Greek assessment. In addition, the version of Cronbach's α 'if item deleted' was calculated for each item. Repeatability was defined as the stability of participants' responses over time and was determined by calculating Pearson's correlation ($r$) between the initial and the reassessment total scores. The following categories of Pearson's $r$ values were used for interpretation: 0.00–0.19, very weak correlation; 0.20–0.39, weak correlation; 0.40–0.69, moderate correlation; 0.70–0.89, strong correlation; and 0.90–1.00, very strong correlation. The test–retest reliability of the

instrument was defined as the degree to which the participants maintained their opinion in the repeated measurements, taking into account the error in measurements as a proportion of the total variance. Test–retest reliability was evaluated using the intraclass correlation coefficient (ICC) with a 95% confidence interval. The Cronbach's $\alpha$ and ICC values were characterized as follows: 0.00–0.25, negligible; 0.26–0.49, low; 0.50–0.69, moderate; 0.70–0.89, high; and 0.90–1.00, excellent. The scores of the two assessments were tested for systematic differences using the paired *t*-test.

The item convergent validity of the MFIS-Greek was evaluated by examining the correlations between the total score of each subscale and its item scores at the initial assessment. Discriminant validity was evaluated by running an independent-sample *t*-test to determine whether there were differences in the total score of MFIS between the patients and the control group. Concurrent validity was evaluated using Pearson's correlation with the only suitable instrument, that is, the FSS scale validated in MS patients in Greece.

## Results

Table 1 shows the sociodemographic and personal characteristics of the participants. The mean age of the patients was 43.2 years (SD 10.2), and 24% (24/99) were men. The mean MFIS-Greek scores were 33.8 (SD 17.8) and 33.0 (SD 20.0) for the first and the second assessment, respectively. The mean EDSS score was 2.4 (SD 1.6), indicating low disability. The Kolmogorov–Smirnov test and probability–probability plots showed that the normal distribution ($z = 0.438$, $P = 0.991$) was an acceptable model for the MFIS-Greek data.

To decide on the number of factors to retain in the factor analysis, Horn's parallel analysis was used. According to this method, only the first two factors achieved eigenvalues larger than those for the corresponding factors on the basis of the randomly generated data. In the actual dataset, the first two factors had eigenvalues 11.8 and 2.1, whereas in the randomly generated datasets, the 95% percentiles of these eigenvalues were 1.8 and 1.6, respectively. The third eigenvalue was 0.91 for the actual dataset, whereas in the randomly generated datasets, the mean of the third eigenvalue was 1.4 (and its 95% percentile equal to 1.5). Hence, two factors were extracted, which explained 66.7% of the total variance.

Item analysis showed that patients scored the items 6, 13, and 21 above 2 on average [mean (SD) values 2.1 (1.3), 2.0 (1.4), and 2.2 (1.1), respectively; Table 2], all belonging to the physical factor. The other items belonging to the physical factor were 1, 4, 7, 9, 10, 14, 17, and 20; the remaining items 2, 3, 5, 8, 11, 12, 15, 16, 18, and 19 were assigned to the cognitive factor in the factor analysis. The overall Cronbach's $\alpha$ was 0.960 (ranging from 0.958 to 0.960 with individual items deleted), indicating excellent internal consistency (Table 2). The various reliability measures are summarized in Table 3. The ICC was also high, indicating that the MFIS-Greek total scores were highly consistent between the two occasions (initial assessment and reassessment), whereas the paired-samples *t*-test between the initial assessment and the reassessment indicated no statistically significant systematic bias. The Pearson correlation coefficient was 0.864, thereby indicating stability of participants' responses over time.

Examination of item convergent validity showed that all item intercorrelations for all item pairings were strong or excellent. Pearson's *r* ranged from 0.699 to 0.894 for the cognitive subscale and from 0.651 to 0.884 for the

**Table 1 Demographic characteristics of the participants**

| Variables | Mean | SD | *N* |
|---|---|---|---|
| Age | | | |
| MS patients | 43.17 | 10.19 | 99 |
| Controls | 38.83 | 10.09 | 75 |
| Sex | | | |
| MS patients | | | 99 |
| Men | | | 24 |
| Women | | | 48 |
| Controls | | | 75 |
| Men | | | 24 |
| Women | | | 51 |
| MFIS – 1st assessment | | | |
| MS patients | 33.75 | 17.84 | 99 |
| Controls | 18.10 | 14.65 | 75 |
| MFIS – 2nd assessment | | | |
| MS patients | 33.04 | 20.04 | 72 |
| Controls | 15.72 | 14.86 | 75 |
| EDSS | | | |
| MS patients | 2.40 | 1.56 | 99 |

EDSS, Expanded Disability Status Scale; MFIS, Modified Fatigue Impact Scale; MS, multiple sclerosis.

**Table 2 Item analysis of the Modified Fatigue Impact Scale-Greek questionnaire**

| Items | Mean (SD)[a] | Cronbach's $\alpha$ if item deleted |
|---|---|---|
| 1 | 1.61 (1.07) | 0.960 |
| 2 | 1.43 (1.24) | 0.959 |
| 3 | 1.21 (1.02) | 0.959 |
| 4 | 1.39 (1.16) | 0.958 |
| 5 | 1.75 (1.21) | 0.959 |
| 6 | 2.09 (1.27) | 0.959 |
| 7 | 1.79 (1.33) | 0.960 |
| 8 | 1.43 (1.18) | 0.959 |
| 9 | 1.47 (1.27) | 0.958 |
| 10 | 1.88 (1.22) | 0.958 |
| 11 | 1.11 (1.12) | 0.959 |
| 12 | 1.32 (1.26) | 0.958 |
| 13 | 2.02 (1.37) | 0.959 |
| 14 | 1.61 (1.29) | 0.959 |
| 15 | 1.22 (1.23) | 0.958 |
| 16 | 1.25 (1.14) | 0.958 |
| 17 | 1.73 (1.23) | 0.958 |
| 18 | 1.25 (1.17) | 0.958 |
| 19 | 1.44 (1.25) | 0.958 |
| 20 | 1.79 (1.34) | 0.958 |
| 21 | 2.23 (1.14) | 0.959 |
| Overall $\alpha$: 0.960 | | |

[a]The available response range for all items is 0–4.

**Table 3 Measures of reliability of the Modified Fatigue Impact Scale-Greek questionnaire**

| Characteristics | Measure/test | Value | Significance (*P*) |
|---|---|---|---|
| Internal consistency | Cronbach's α | 0.960 | <0.001 |
| Repeatability | Pearson's *r* | 0.864 | <0.001 |
| Test–retest reliability at initial assessment | ICC (95% CI) | 0.861 | <0.001 |
| Test–retest reliability at reassessment | Paired-samples *t*-test | – | 0.539 |

CI, confidence interval; ICC, intraclass correlation coefficient.

**Table 4 Convergent validity of the Modified Fatigue Impact Scale-Greek questionnaire (item-total score correlations)**

| | Pearson's *r* |
|---|---|
| MFIS cognitive subscale item | |
| 2 | 0.814 |
| 3 | 0.803 |
| 5 | 0.753 |
| 8 | 0.699 |
| 11 | 0.794 |
| 12 | 0.857 |
| 15 | 0.884 |
| 16 | 0.888 |
| 18 | 0.852 |
| 19 | 0.894 |
| MFIS physical subscale item | |
| 1 | 0.651 |
| 4 | 0.762 |
| 6 | 0.776 |
| 7 | 0.681 |
| 9 | 0.852 |
| 10 | 0.870 |
| 13 | 0.811 |
| 14 | 0.744 |
| 17 | 0.884 |
| 20 | 0.871 |
| 21 | 0.803 |

MFIS, Modified Fatigue Impact Scale.

physical subscale (Table 4). This supports the notion that all the items within each subscale of MFIS-Greek are related to the same construct.

In terms of discriminant validity, the independent-sample *t*-test showed a statistically significant difference between the mean scores of the patients (33.0, SD 18.1) and the control group (18.1, SD 14.6; $t = 5.833$, $P < 0.001$). The analysis of variance showed that the differences in the mean MFIS-Greek total score with respect to disease type were not statistically significant [$F(3, 94) = 1.302$, $P = 0.279$]. Concurrent validity with the FSS was high (Pearson's $r = 0.772$, $P < 0.001$).

## Discussion

According to the findings of the present study, the MFIS-Greek is a valid tool for assessment of fatigue in MS patients. However, some questions should be raised regarding the structural validity of the MFIS and further modifications may be necessary. The major concern refers to the three-dimensional model proposed previously (Kos *et al.*, 2005). Our factor analysis confirmed the multidimensional structure, but did not confirm the number of the factors. To our knowledge, this is the first EFA challenging the three factors and our findings are in accordance with other researchers' observations disputing the proposed structure of the scale or even the validity of the items included. Although researchers agree that the physical and the cognitive subscales are valid, the psychosocial subscale as a separate entity is questionable because only two items have been described as belonging to it and researchers have failed to consistently reproduce this factor. The Multiple Sclerosis Council for Clinical Practice Guidelines (1998) proposed three factors (physical factor items: 4, 6, 7, 10, 13, 14, 17, 20, 21; cognitive factor items: 1, 2, 3, 5, 11, 12, 15, 16, 18, 19; psychosocial factor items: 8, 9) and Kos *et al.* (2005), who explored dimensionality of MFIS in four countries, confirmed the proposed structure despite differences in item allocation (assigning items 1 and 8 to the psychosocial factor). However, Kos *et al.* (2005) stated that the cognitive and physical subscales were homogeneous whereas the psychosocial subscale had a weak homogeneity (being related to the physical factor) and should therefore be interpreted with caution. Our study confirms that the psychosocial factor, if present, provides limited information and the items primarily included in this factor may well be classified within the two-factor model. For item 9 (outdoor activities), all previous studies considered it as a component of the physical factor, which is in agreement with our results. For item 8 (motivation to participate in social activities), there is no consensus: Mills *et al.* (2010) and Amtmann *et al.* (2012) consider it a component of the physical factor, but Kos *et al.* (2005) assigns it to the psychosocial factor and our study assigns it to the cognitive factor. Kos *et al.* (2005) attributed their results to the possible interaction of physical and cognitive possibilities with psychosocial functioning, especially when the individual is influenced by the fatigue. The phrasing of this item mentioning motivation and social functioning may account for the conflicting results. Perhaps, the Greek patients emphasized the motivational component rather than actual activity; thus, cultural or linguistic issues deserve further attention.

Not only is the dimensionality of MFIS under question but also the components of the two traditional physical and cognitive factors can be disputed. In our study, the physical factor included 11 items and the cognitive included 10 items, in contrast to the original structure incorporating nine items into the physical factor and 10 into the cognitive factor. Besides the previously mentioned relocation of items 8 and 9 (to the cognitive and the physical factor, respectively), item 1 (alertness) was further classified under the physical factor. As a result,

physical factor now has two additional items compared with the initial assessment by the MS council. This item has received special attention from researchers in the past, and it has been considered rather problematic, as Amtmann *et al.* (2012) confirmed the classification of item 1 under the cognitive factor, whereas Kos *et al.* (2005) classified it under the psychosocial factor and Mills *et al.* (2010) removed it completely. These discrepancies may also be attributed to different interpretations by different populations, probably related to cultural and linguistic adaptation. These conflicting results were recognized by Elbers *et al.* (2012), who concluded that structural and cross-cultural validity of the MFIS are questionable. Mills *et al.* (2010) also posed the problem of the structure of the MFIS and suggested that a 13-item scale with two factors may have better validity (i.e. if the items 4, 14, and 17 were excluded from the physical subscale and the items 1, 2, 3, 5, and 11 from the cognitive subscale). Perhaps, a radical modification of the original scale incorporating recent advances in the pathophysiology of fatigue in MS may lead to a more valid and shorter FIS for MS patients.

Our results are encouraging in terms of the item convergent validity and the reliability of the scale because all the items were related to the total score and Cronbach's $\alpha$ and ICC values were excellent, thus indicating that the responses of our sample were internally consistent and stable across time.

Fatigue in MS is a multifaceted issue with somatic and psychosocial dimensions and perhaps a one-dimensional approach is inadequate, especially when cultural and other factors (e.g. geographical location and climate) are considered. The MFIS scores vary significantly across countries: the median ($M$) score for the Greek patients was 33.5, whereas Kos *et al.* (2005) reported $M = 45$ in Belgium, $M = 40.5$ in Italy, $M = 37.5$ in Slovenia, and $M = 32.5$ in Spain, and Rietberg *et al.* (2010) reported a median score of the MFIS of 41 in the Netherlands. As climate conditions seem to affect fatigue in patients with MS (Freal *et al.*, 1984), our findings may reflect similar climate conditions in Southern European countries.

The MFIS total score in our study showed a significant correlation with FSS, a finding comparable with that of Kos *et al.* (2005) and Rietberg *et al.* (2010), indicating that both scales are appropriate tools for measuring fatigue in MS patients, whereby different components of fatigue are assessed as MFIS focuses on the impact of fatigue in daily life (Kos *et al.*, 2005). The correlation observed in our study is slightly stronger than reported previously, a fact probably related to an extended physical subscale (11 items in our study vs. nine in the past). As FSS is a purely physical component scale, our finding reflects the affinity of these two scales toward the physical factor. Amtmann *et al.* (2012) compared the psychometric properties of the two fatigue scales (MFIS and FSS) in MS and recommended that the researchers who are interested in assessing both physical and cognitive fatigue should administer the MFIS as it is a more precise tool for measurement of high levels of fatigue. Nevertheless, the researchers who are interested in measuring physical fatigue in patients whose fatigue ranges from mild to moderate can choose either instrument.

Neither external validity nor extended convergent validity by means of other fatigue scales has been examined. The latter was not possible in Greece as only recently the FSS has been validated in the Greek population and other validated scales are not available for MS patients. Internal validity was also not addressed and it would be beneficial to assess it in the future using Rasch modeling. Moreover, responsiveness to clinical changes was not examined and the topic remains open for future research.

### Conclusion

The study showed that the MFIS-Greek is valid and reliable, provided that the clinicians using it are careful with data interpretation and keep in mind the multidimensionality of fatigue in MS. Further research with modified versions of MFIS and cultural adaptation of the scale may help create a useful tool for screening and assessment of fatigue in MS patients.

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### Conflicts of interest

There are no conflicts of interest.

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