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ORIGINAL ARTICLE

Validation of the Hindi version of the Multidimensional Fatigue Inventory-20 (MFI-20) in Indian cancer patients

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Abstract
Objective The present study was designed to validate the Hindi version of the Multidimensional Fatigue Inventory-20 (MFI-20) in Indian oncology population.
Methods The original English version of the MFI-20 was translated into Hindi (hMFI-20) using the translation and back translation processes. The hMFI-20 was administered to 200 cancer patients. The item analysis for hMFI-20 was carried out using the corrected item-total correlation. The confirmatory factor analysis (CFA) was employed to test whether the original factor structure of MFI-20 is confirmed for the hMFI-20. Further, convergent and discriminant validities were also tested. The reliability of the hMFI-20 was evaluated by computing composite reliability and Cronbach's α coefficient.
Results Corrected item-total correlation value for each of the items of hMFI-20 was greater than 0.6. Results of the CFA (comparative fit indices (CFI) = 0.91, root mean squared residual (RMR) = 0.04, root mean square error of approximation (RMSEA) = 0.028, and χ^2=45.68, p>0.05) indicated that the five-factor model provided a good fit to the data. The findings indicated that hMFI-20 has a good convergent (composite reliability (CR) >0.7; average variance extracted value (AVE) >0.5) and discriminant (maximum shared variance (MSV) < AVE; average shared variance (ASV) < AVE; square root of AVE > inter-factor correlations) validities. The Cronbach's α coefficient for the total hMFI-20 was 0.8 and was more than 0.7 for each of the five factors.
Conclusions We conclude that the hMFI-20 has a high internal consistency and reasonable construct validity. Therefore, the hMFI-20 is a reliable and valid tool to assess the multidimensional fatigue in Indian oncology population. However, we recommend further validation of hMFI-20 in population of cancer patients of different linguistic settings and regions of India.

Keywords Fatigue · Cancer · Multidimensional fatigue inventory · Confirmatory factor analysis · Reliability

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Introduction

Measuring fatigue is important as it is usually associated with the diagnosis, stage, and treatment modalities of the disease [1–10] and can be adequately performed with a self-report scale. The magnitude of fatigue varies among cancer patients between 17 and 95 % depending upon the types of methods used for its measurement [8]. It has been reported that the higher the level of fatigue, the lower are the health-related quality of life (HrQoL) and general well being of cancer patients [1, 11–13]. Fatigue can be used as an indicator of a health problem as has been reported in the case of myocardial infarction [14]. Furthermore, it can also be considered as an indicator of treatment outcome [15]. It has been unequivocally accepted that fatigue evaluation is an interesting and promising area of research [16]. Omitting its measurement may lead to incomplete evaluation of treatment outcomes.

Numerous one-dimensional and multi-dimensional inventories have been developed for the assessment of fatigue [17–19]. Among those, the Multidimensional Fatigue Inventory-20 (MFI-20), developed by a Dutch research group

[18], is widely used to measure fatigue in cancer patients [20]. The MFI-20 is a self-report assessment tool capable of measuring several dimensions of fatigue, such as general fatigue (GF), physical fatigue (PF), mental fatigue (MF), reduced motivation (RM), and reduced activity (RA). A higher score obtained using MFI-20 always reflects an elevated level of fatigue. The psychometric properties of this inventory have been tested at the time of its development in human subjects as diverse as cancer patients receiving radiotherapy, patients with the chronic fatigue syndrome, psychology students, medical students, army recruits, and junior physicians [18]. The MFI-20 has also been translated into other languages by the native investigators and tested for its robustness across cross-cultural settings [21–24].

In India, neither an independently developed construct nor a translated version of any existing constructs to measure fatigue of cancer patients is available. Therefore, in the present study, we thought it worthwhile to translate the original English version of the MFI-20 [18] into one of the Indian vernaculars, i.e., Hindi, the most of the Indians speak. We hypothesized that the translated version (Hindi MFI-20, hereafter hMFI-20) will be equally effective in measuring fatigue through testing its reliability and validity in a sample of cancer patients mainly drawn from the southeastern region of India.

Methods

Patient sample

Newly diagnosed 200 cancer patients of southeastern region of India, visiting the outdoor patient department (OPD) of the Regional Cancer Center (RCC), Pt. J.N.M. Medical College, Dr. B.R. Ambedkar Memorial Hospital, Raipur, Chhattisgarh, were selected. Firstly, the patient selection was based on inclusion criteria. Thereafter, the final selection was undertaken on the basis of the written consent given by the eligible patients. This strategy falls in the category of probability sampling especially because occurrence of a consenting patient in a group is a random phenomenon [25]. Detailed information on socio-demographics, anthropometrics and clinical characteristics were obtained for each patient.

The study obtained ethics approval of the Institutional Ethics Committee for Human Research of the Pt. Ravishankar Shukla University, Raipur, India.

Study design

The study was carried out using a cross-sectional study design. Each cancer patient completed the questionnaire once only.

Inclusion criteria

The inclusion criteria were (i) patients with good communication skill in Hindi, (ii) age range 25–50 years, (iii) diagnosis not more than 1 year, (iv) recipients of ≤ one cycle of chemotherapy, and (v) in good general conditions with Karnofsky performance status (KPS) ranging between 100 and 80 [26]. The 100 % KPS score implies that the patient is in normal condition without any complaints; whereas, 0 % means death of the patient [27].

Procedure

Inventory (MFI-20)

A prior permission (through email) for translation and validation of the original English version of MFI-20 was obtained from the author [18]. The MFI consists of 20 items. The inventory is divided in to five dimensions, such as GF (item numbers 1, 5, 12, 16), PF (item numbers 2, 8, 14, 20), MF (item numbers 7, 11, 13, 19), RA (item numbers 3, 6, 10, 17), and RM (item numbers 4, 9, 15, 18). Response to each item is measured on a scale of 1–5; thus, a maximum score of 20 could be obtained for each dimension.

Translation procedure

The original English version of MFI-20 was validated in Hindi using translation and back translation processes adopted by Tian and Hong [21]. In the first step, the original English version of the MFI-20 was translated into Hindi by two bilingual university teachers. In the second step, translated version of MFI-20 was back translated in English by two other bilingual university teachers. In the third step, the back-translated English version of MFI-20 was compared with its original English version to test the consistency. The final version of hMFI-20 was obtained following removal of the discrepancies between the translated and back-translated versions. This was achieved through unequivocal consensus.

Administration of Hindi version of MFI-20

The hMFI-20 was administered to the cancer patients (N=200), when they visited the outdoor patient department (OPD) of the RCC for consultation. Data collection was carried out between February–April 2014. The patients were assured that their responses will be kept confidential and will never be shared with others. They were advised to give their honest response on each item.

Data analyses

Item analysis

Item analysis for hMFI-20 was carried out using the item-total correlation test. In compliance with the cutoff value reported by Hair et al. [28], we retained an item in the instrument with the corrected item-total correlation equal to or greater than 0.6.

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was used to test whether the original factor structure of MFI-20 is confirmed for the translated version. Further, the fitness of model with the data was evaluated by computing the absolute and comparative fit indices (CFI). Absolute fit indices include chi-square goodness-of-fit, root mean squared residual (RMR), and root mean square error of approximation (RMSEA). A good model fit was ascertained with a lower chi-square value at $p>0.05$ [29]. It was further substantiated by RMR and RMSEA values less that 0.05 [30] and 0.08 [31], respectively. In addition, a value greater than 0.9 for CFI was considered to be the good fit [32].

Construct validity

A valid and reliable construct is expected to have the following characteristics: (a) it should represent all associated observations and alternative measures and (b) it should also be relevant to other constructs of interest [33]. Of the three types of validity, namely content, construct, and criterion, in this study, we chose construct validity that includes both convergent and discriminant validity, and it was assessed using CFA.

Convergent validity

It is always important to gauge relationship among measures of the same construct. We measured this using convergent validity and tested the magnitude of relationship between the items and their latent factor [34].

Convergent validity of the hMFI-20 was evaluated and considered to be confirmed on the basis of (a) standardized regression coefficient (β) of each item (>0.5), (b) composite reliability (CR>0.7), and (c) average variance extracted value (AVE>0.5) of each factor [28, 35, 36]. These tests therefore complement results of the convergent validity. With reference to regression coefficient, items of the scale are independent predictors of the outcome variables, such as GF, PF, MF, RA, and RM.

Discriminant validity

Discriminant validity indicates the degree of correlation between paired factors in the same scale [37]. We tested and confirmed the discriminant validity on the basis of (a) maximum shared variance (MSV<AVE), (b) average shared variance (ASV<AVE), and (c) square root of AVE greater than inter-factor correlations [28].

Construct reliability

Construct reliability of the hMFI-20 was considered to be confirmed on the basis of composite reliability (CR >0.7) [36].

Internal consistencies

The internal consistencies of the hMFI-20 were evaluated by computing Cronbach's α coefficient [38]; a value greater than 0.7 was considered fairly reliable.

Descriptive statistics, corrected item-total correlation, and internal consistency were computed using SPSS (version 16). CFA was carried out with the help of SPSS AMOS (version 22). CR, AVE, MSV, ASV, and square root of AVE were calculated using stats tool package. In this study, we rejected all statistical hypotheses at $p\leq 0.05$.

Results

Socio-demographic, anthropometric, and clinical characteristics of 200 cancer patients, consisting of 100 males and 100 females, are summarized in Table 1. The mean age of the sample was 42.1 years with the averages for male and female patients, respectively, were 42.7 and 41.5 years. While all male patients were suffering from cancer in head and neck region, 50 % female patients were suffering from cervical cancer and the remaining from breast cancer. Educational background of the most of the patients (96 %) was below the graduation level. Of the total patients, 146 (73 %) were inhabitants of rural areas and 54 (27 %) were from urban areas of Chhattisgarh. The evaluation of Karnofsky performance status of all patients indicated that all of them were in good condition. Of the 200 patients, 49.5 % received one cycle of chemotherapy; whereas, the remaining 50.5 % did not receive any cycle of chemotherapy at the time of the study (Table 1).

Item analysis

Corrected item-total correlation

The corrected item-total correlation coefficient for each of the items of hMFI-20 was greater than 0.6 (Table 2).

Table 1 Patients characteristics

Characteristic	All	Male	Female
Number (%)	200	100 (50)	100 (50)
Age, median/mean (SD) years	43/42.1 (6.9)	45/42.7 (7.3)	42/41.5 (6.4)
BSA m^2, mean (SD)	1.6 (0.18)	1.61 (0.18)	1.6 (0.18)
BMI kg/m^2, mean (SD)	22.2 (5.6)	22.2 (6.8)	22.2 (4.3)
Marital status, *n* (%)	195 (97.0)	97 (97.0)	98 (98.0)
Education			
Less than graduate	192 (96.0)	97 (97.0)	95 (95.0)
≥Graduate	8 (4.0)	3 (3.0)	5 (5.0)
Background, *n* (%)			
Rural	146 (73.0)	69 (69.0)	77 (77.0)
Urban	54 (27.0)	31 (31.0)	23 (23.0)
Smokers, *n* (%)	77 (38.5)	77 (77.0)	–
Alcohol users, *n* (%)	74 (37.0)	74 (74.0)	–
Sleeping pill users, *n* (%)	13 (6.5)	13 (13.0)	–
Karnofsky performance status, *n* (%)			
100	21 (10.5)	10 (10.0)	11 (11.0)
90	168 (84.0)	86 (86.0)	82 (82.0)
80	11 (5.5)	4 (4.0)	7 (7.0)
Site of primary tumor, *n* (%)			
Head and neck	100 (50.0)	100 (100)	–
Cervical	50 (25.0)	–	50 (50.0)
Breast	50 (25.0)	–	50 (50.0)
Chemotherapy (CT)			
CT cycles			
CT cycle # 0, *n* (%)	101 (50.5)	44 (43.56)	57 (56.44)
CT cycle # 1, *n* (%)	99 (49.5)	56 (56.57)	43 (43.43)

SD standard deviation, *BSA* body surface area, *BMI* body mass index, *CT* chemotherapy

Table 2 Corrected item-total correlation for hMFI-20

Factor	Item no.	Corrected item-total correlation*
General fatigue	1	0.79
	5	0.78
	12	0.73
	16	0.68
Physical fatigue	2	0.73
	8	0.63
	14	0.76
	20	0.69
Mental fatigue	7	0.77
	11	0.74
	13	0.62
	19	0.77
Reduced activity	3	0.75
	6	0.64
	10	0.77
	17	0.75
Reduced motivation	4	0.71
	9	0.69
	15	0.75
	18	0.80

*All correlation coefficients are significant at $p<0.001$

Therefore, all 20 items were retained in the instrument for further analysis.

Confirmatory factor analysis

Prior to conducting CFA, it is a prerequisite to test the multivariate normality for the data by computing *z*-statistic [39]. According to Bentler [40], normality is confirmed when *z*-statistic is less than 5. We proceeded with the testing of the hypothesized model especially since we obtained *z*-statistic less than 5.0 in our case.

Results of CFA indicated that there is a significant standardized estimate (β) of all the items on their respective factors and specifically, the values of β ranged from 0.75 to 0.85 for GF, from 0.7 to 0.81 for PF, from 0.7 to 0.87 for MF, from 0.76 to 0.92 for RA, and from 0.77 to 0.95 for RM. However, relationships among the factors were insignificant, confirming that all the five factors are empirically distinct from each other (Fig. 1).

We found that the hypothesized model has a good fitting for our data. The validity of this statement was based on the following indicators: the chi-square was not significant ($\chi^2=45.68$, $p>0.05$), the comparative fit index was higher than 90 % (CFI=0.91), root mean square residual was less than 0.05 (RMR=0.04), and root mean square error of approximation was less than 0.08 (RMSEA=0.028) (Table 3).

Construct validity

Convergent validity

In the present study, β ranged from 0.70 to 0.95 for all five factors of hMFI-20 (Fig. 1). Further, CR and AVE values were greater than 0.7 and 0.5, respectively, for each of the five factors (Table 4). These findings indicated that hMFI-20 has a good convergent validity.

Discriminant validity

The values of MSV (range 0.03–0.04) and ASV (range 0.01–0.03) of each of the five factors of hMFI-20 were less than the AVE (Table 4). Further, square root of AVE value was greater than the correlations involving the factors of hMFI-20 (Table 4). These results indicated that the hMFI-20 has good discriminant validity.

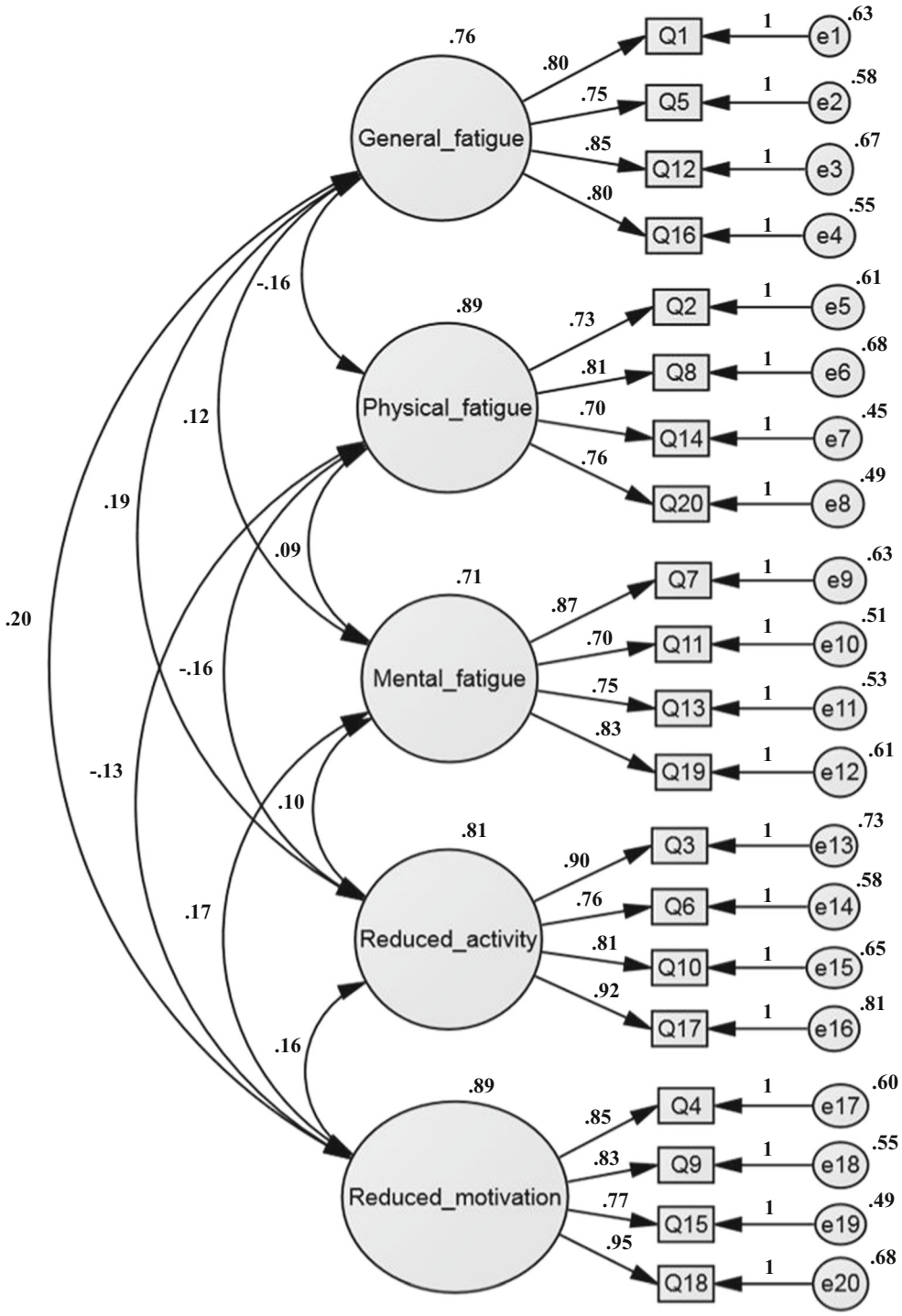

Fig. 1 Factorial validity of the translated Hindi version of the Multidimensional Fatigue Inventory-20

Table 3 Decision on model goodness of fit for hMFI-20

	χ^2	CFI	RMR	RMSEA
Good fitting values	Not significant	Higher than 0.9	0.05 or less	Less than 0.08
Resulted values	(45.68; p=0.62>0.05)—not significant	0.91	0.04	0.028
Decision	Good fitting	Good fitting	Good fitting	Good fitting

χ^2 chi-square, *CFI* comparative fit index, *RMR* root mean square residual, *RMSEA* root mean square error of approximation

Table 4 Convergent and discriminant validities for hMFI-20

	CR	AVE	MSV	ASV	RA	GF	PF	MF	RM
RA	0.91	0.72	0.04	0.02					
GF	0.88	0.64	0.04	0.03	0.19				
PF	0.84	0.56	0.03	0.02	−0.16	−0.16			
MF	0.87	0.62	0.03	0.01	0.10	0.12	0.09		
RM	0.91	0.73	0.04	0.03	0.16	0.20	0.13	0.17	

CR composite reliability, *AVE* average variance extracted, *MSV* maximum shared variance, *ASV* average shared variance, *RA* reduced activity, *GF* general fatigue, *PF* physical fatigue, *MF* mental fatigue, *RM* reduced motivation

Construct reliability

The composite reliability (CR) for each factor was higher than 0.6 (ranged between 0.84 and 0.91).

Internal consistency

The Cronbach's α coefficient for the entire hMFI-20 scale was 0.8. The coefficients for all factors were also computed, and the values were found to be greater than 0.7 (0.81 for GF, 0.82 for PF, 0.81 for MF, 0.75 for RA, and 0.8 for RM). All coefficients were statistically significant at $p<0.001$.

Discussion

In this study, we examined the validity and reliability of the Hindi version of the MFI-20. Reasons for our endeavor are justified because of the following: (1) in India, not a single construct equivalent to MFI-20 is available, in any vernacular languages, to measure the magnitude of fatigue in cancer patients; and (2) the MFI-20 is one of the most reliable and globally accepted and validated construct for the purpose. It is indeed difficult to imagine how the oncologists are measuring the magnitude of fatigue in the large population of cancer patients in India without the availability of a comparable construct.

Fatigue is a common consequence of cancer and many other chronic and acute diseases. The measurement of fatigue is not simple, and no such objective approach has yet been developed to accomplish measurement of fatigue among Indian cancer patients. The current approach to measure fatigue in the population of cancer patients is based on subjective paradigm. To the best of our knowledge and belief, the English version of the MFI-20 is the most ideal subjective tool to measure fatigue among cancer patients and survivors of cancer. The MFI-20 is multidimensional in nature with social, psychological, and physiological aspects. It has been translated into many different languages for the assessment of fatigue in diverse group of subjects [21–23, 41]. The hMFI-20 was constructed following the established procedures of the scale development [21, 33]. The reliability and validity were checked by administering the hMFI-20 inventory in a large sample of cancer patients ($n=200$). The subjects responded to all the items of the hMFI-20, and there was no missing data. This indicates that they fully comprehended all items of the inventory.

The corrected item-total correlations for all items of hMFI-20 ranged between 0.62 and 0.80. This indicates that all items of the five factors were in an acceptable range as reported by Hair et al. [28] and therefore, retained in the instrument.

Subsequently, the five-factor model was tested by CFA through a structural equation modeling approach to check whether the assumptions of the dimensions of the model fit our data of cancer patients. The results confirmed the assumptions of the dimensionality and corroborate with the observations reported earlier [21, 22, 42]. The findings of CFA emanated from our study also complemented multidimensionality of the original five-factor model related to MFI-20. In addition, values of the absolute and comparative fit indices indicated and supported a good model fit to the data. In the present study, the cutoff point for these indices related to the model was comparable with those reported by Hair et al. [28], Barrett [29], Byrne [30], MacCallum et al. [31], Hu and Bentler [32]. Numerous researchers have also confirmed the criteria of model fit for all these indices for other constructs [43–45].

Further, our results indicate that hMFI-20 has good convergent and discriminant validities. Resultant higher values of AVE of each factor with regard to its correlation with other factors confirmed the convergent validity of hMFI-20. Similarly, discriminant validity was established on the basis of maximum shared variance (MSV<AVE), average shared variance (ASV<AVE), and square root of AVE greater than inter-factor correlations. Our results on discriminant validity are in agreement with the criteria laid down by Hair et al. [28].

Furthermore, the estimated values for construct reliability computed as composite reliability of each of the factors of hMFI-20 were more (range 0.84–0.91) than 0.7 [36]. This implied that the inventory has good reliability. Cronbach's α coefficients were in the good range, and the values of intercorrelations for all factors ranged between 0.75 and 0.82. Our observations are comparable with the findings reported earlier [18, 20, 22, 42, 46]. These findings strengthen our assumption that the hMFI-20 is a reliable inventory and could be used to assess fatigue level in Indian cancer patients. Furthermore, the hMFI-20 also does not suffer from any item redundancy, and the factors are capable of measuring assumptions of the multidimensional fatigue in cancer patients independently and fairly accurately.

Strengths and limitations

The strength of the study includes the following: (1) adequate sample size was selected randomly from cross-sectional oncology population, (2) the responses on the inventory were complete, (3) there were no instances of missing data either on the inventory or in the biographical information input, and (4) each of the factors was adequate with their respective items. The hMFI-20 was well accepted by our sample of oncology population.

However, the limitations of the present study are the following: (1) "criterion-related validity" was not performed through determining correlation between the hMFI-20 and other available measures, (2) criterion validity was not determined using groups with different levels of fatigue, (3) test-retest reliability of the hMFI- 20 was not conducted, (4) differences in responsiveness to multiple treatments along a longitudinal time scale was not examined, and (5) lack of universality. The responses and acceptability might differ when the study design will be implemented to oncology population of India in different regions with diverse cultures and different native languages.

Conclusion

In conclusion, the Hindi version of MFI-20 (hMFI-20) has a high internal consistency and reasonable construct validity. Thus, the hMFI-20 with valid factor structure is a reliable and convincing tool to assess the multidimensional fatigue in Indian oncology population. We have a hunch that the hMFI-20 may yield inconsistent results when it is used on cancer patients of other regions of India. Therefore, we recommend that testing of MFI-20 should be carried out on cancer patients along different linguistic settings and regions of the Indian subcontinent with about 20 different officially recognized languages and diverse culture. It is also desirable to conduct further extensive study to test the validity of the hMFI-20 obtaining responses, along a longitudinal time scale, from patients receiving multiple treatments. Such an endeavor will certainly substantiate the strengths and merits of the hMFI-20 along with its parent English version. On the basis of our results, we suggest that hMFI-20 may be used as one of the tools to assess the cancer-related fatigue in clinics. The hMFI-20 will enable the clinicians to plan the treatment strategy for fatigue management, in addition to cancer treatment.

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Conflicts of interest None of the funding source influenced the study design, collection, analysis, interpretation of data, and decision to submit the manuscript. We state that we have had full access to all the data in the study and that we agree to allow the journal to review our data if requested.

Disclosures None

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