Spine

SPINE Volume 40, Number 2, pp E68-E76

HEALTH SERVICES RESEARCH

Cultural Adaptation, Reliability, and Validity of Neck Disability Index in Indian Rural Population

A Marathi Version Study

Sibi Daniel Joseph, MPT,* Bharati Bellare, PhD,† and Howard Vernon, DC, PhD‡

Study Design. A cross-sectional study to develop a cultural adaptation of the Marathi–neck disability index (NDI) and to investigate its validity and reliability.

Objective. To conduct a study concerning the cultural adaptation of the NDI and investigate the validity and reliability of its Marathi version in patients with neck pain.

Summary of Background Data. The NDI is a reliable instrument for evaluating self-rated disability due to neck pain, but there is no published Marathi version and also it has not been tested on a rural population yet. Successful linguistic and cultural translation may allow appropriate cross-cultural comparison for clinical and laboratory research analysis, even in the rural parts of the Maharashtra state of India, where English is not the language of communication.

Methods. Eighty-one patients having neck pain for at least 3 months were included in the study. The NDI and visual analogue scale for pain were completed by all subjects. Test-retest reliability was determined by using intraclass correlation coefficient and Pearson correlation analysis. For the determination of construct validity, the relation between the NDI and visual analogue scale was examined by Pearson correlation analysis.

Results. Intraclass correlation coefficient score for test-retest reliability was 0.95 and the Cronbach α was 0.97. For construct-related validity the correlation of the NDI–Marathi version was found to be 0.95 ($P < 0.0001$).These results showed that the construct validity of the Marathi version of the NDI was excellent.

Conclusion. The results suggest that the Marathi version of the NDI that is validated in this study is an easy to comprehend, reliable, and valid instrument for the measurement for the limitation of activities of daily living and pain caused by neck disorders in the Marathi-speaking population.

Key words: neck pain, neck disability index.

Level of Evidence: 2

Spine 2015;40:E68–E76

Neck pain is the major symptom of cervical spine disorders and is also a common complaint in most communities. Among musculoskeletal complaints, it is second only to low back pain problems in prevalence. Annually, about 30% of the population experiences neck pain.[1] Although not life threatening, neck pain can limit work efficiency and activities of daily living and often put significant burden on workers and employers in terms of work absenteeism.[2]

Valid and reliable tests are said to be the cornerstones in clinical research. Although measuring health status is considered to be an important component of clinical practice, reflecting the degree of disability, region-specific functional questionnaires measuring everyday activity limitations due to chronic neck pain are highly recommended. The pain disability index and the impact profile are very much accepted functional instruments measuring generalized pain, but they are not specifically designed for patients experiencing neck pain.[1]

The Neck Disability Index (NDI) was designed by Vernon and Mior to assess how neck pain affects the activities of daily living. The NDI has also proven to be a valid and reliable instrument in several cross-cultural studies that were conducted in Turkish, Brazilian, Portuguese, German, French, Swedish (though modified), Korean, Iranian, Dutch, Greek, Italian, Arabic, Japanese, Spanish, and Thai languages.[1,3–16] Disability-related outcome measures are needed specifically for non-English speaking patients in India. Instead of developing a new scale, we preferred to adjust and adopt an existing instrument—the NDI. This would help the exchange of information across cultural and linguistic barriers with carefully tested psychometric properties of the translated versions.

From the *MGM Institute of Physiotherapy, Aurangabad, Maharashtra, India; †MGM School of Physiotherapy, Mumbai, Maharashtra, India; and ‡Canadian Memorial Chiropractic College, Toronto, Ontario, Canada.

Acknowledgment date: February 10, 2014. First revision date: April 4, 2014. Second revision date: June 8, 2014. Third revision date: August 6, 2014. Fourth revision date: October 2, 2014. Acceptance date: October 14, 2014.

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work.

Relevant financial activities outside the submitted work: employment, grants, travel/accommodations/meeting expenses.

Address correspondence and reprint requests to Sibi Daniel Joseph, MPT, Department of Physiotherapy, MGM Institute of Physiotherapy, MGM Campus, N-6 CIDCO, Aurangabad, Maharashtra, India; E-mail: sibdanjo2k@yahoo.com

DOI: 10.1097/BRS.0000000000000681

India is a country of diversity and there are many languages spoken here. Maharashtra is the second largest state in the country in terms of population and the third largest in terms of area. Marathi is the official language spoken in the state of Maharashtra. Being one of the most populous states, we can consider Marathi to be one among the widely spoken languages in the country.[17] To our knowledge, there is no tool available in Marathi to measure the disability of neck dysfunction till date. Although there exists a Hindi version of the NDI, there was a need to translate the NDI into Marathi, for the benefit of the rural population who may not be conversant in Hindi.[18]

The aim of this study was to conduct the Marathi language validation and cross-cultural adaptation study of the NDI on Marathi-speaking Indian rural population having chronic neck pain. The objectives included translating the NDI into the Marathi language and testing the Marathi version of the NDI for reliability and validity in patients with chronic neck pain.

MATERIALS AND METHODS

Study Design
Cross-sectional study.

Sample Size
The sample size was calculated by the formula proposed by Walter *et al*.[19] An intraclass correlation coefficient (ICC) value of 0.9 could be expected and ICC values greater than 0.70 were considered to be acceptable. Thus, a sample size of at least 18 patients was calculated to achieve an agreement of 80% at a significance level of 0.05.[4,5,19,20] However, in this study, a total sample size of 81 patients was considered.

Participants
Patients with chronic neck pain were recruited from the outpatient department of physiotherapy of the MGM Hospital, Aurangabad. A total of 81 patients (11 males, 70 females) were included in the study who met the inclusion criteria. The study was conducted between July 1, 2013 and December 31, 2013. All the participants gave their informed written consent.

Inclusion Criteria
Patients with chronic neck pain (pain that lasted for more than 3 months duration) were included in the study.

Exclusion Criteria
Patients with serious diseases, causing disability, regional tumors or metastasis, vertebral fractures and disc herniation that require surgical treatment, psychiatric disorders, traumatic injuries, neck surgery, pregnancy, and those who could not read and speak Marathi were excluded from the study.

Scale

Neck Disability Index
The NDI designed by Vernon and Mior[21] was a modification of the Oswestry Disability Questionnaire. The scale has 10 sections: pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. Each consists of 6 responses. Item scores range from 0 (no disability) to 5 (total disability).[22] The total score is out of 50.

Translation
Permission for the translation of the NDI was obtained *via* e-mail from Dr. Howard Vernon before the study. During the translation period, the cross-cultural adaptation design proposed by Beaton *et al*[23] was used as a guideline. Translation from English to Marathi was performed by 2 bilingual translators (a professional translator and a post-graduate student of Physiotherapy) independently whose primary language was Marathi. One of the translators was blind to the purpose of the study and the concepts being examined in the questionnaire. This was to provide equivalency from a clinical point of view, rather than literal equivalence. The other translator was informed about the purpose of the study and the concepts being quantified. This was for reflecting the language used by the population and highlighting terms in the original questionnaire, the translation of which might have been ambiguous.

The 2 translations were then compared and discrepancies that may reflect more ambiguous wording in the original or discrepancies in the translation process were resolved. Poorer wording choices were identified and these were later resolved in a discussion between the translators. A consensus version was produced by synthesizing both translations and discussing disagreements.

The consensus version was then back translated into English by 2 teachers, having a Masters degree in English literature, and Marathi being their mother tongue. They were totally blinded to the original version of the index and did not know the purpose of the study. The 2 back translated English versions were then compared with the original version of the NDI. The bilingual expert committee team consisting of 4 translators and 2 physiotherapists reviewed the Marathi version of the questionnaire to ensure cross-cultural equivalence. This formed the prefinal version for field testing. The Marathi version of the NDI was then compared with the original one to achieve schematic, idiomatic, experimental, and conceptual equivalence.

The last stage of the process was to test the prefinal version. Forty patients with chronic neck pain that lasted more than 3 months completed the translated questionnaire in Marathi to determine any misunderstandings and deviations in the translation. The acceptability and comprehensibility of the translation were tested item by item. Each subject completed the questionnaire and was later interviewed to probe about what he or she thought was meant by each questionnaire item and the chosen response. Both the meaning of the item and the response was explored to test the acceptability of the translated version of the NDI questionnaire. All the linguistic changes made in the prefinal version after pilot testing were discussed with the original developer.

After the pilot study, the new version was then administered to 81 patients who had neck pain for more than 3 months.

Twenty-four hours later, patients were asked to answer the same questionnaire for retest. Demographic characteristics and other related historical data were recorded for each patient. The visual analogue scale (VAS) was used to evaluate the level of pain (0, no pain; 10, severe pain).

Reliability Measurements

Test-Retest Reliability

For test-retest reliability, the questionnaire was administered 2 times. The period between the 2 measurements was kept only for 24 hours deliberately, so that the pain status would not change due to a longer time period. Test-retest reliability was determined by using ICC. The ICC (2,1) is used to evaluate rater reliability and has become the preferred index because it reflects both correlation and agreement. During this period, no medical treatment was administered. ICC may vary from 0.00 to 1.00 where values of 0.60 to 0.80 are regarded as evidence of good reliability, those above 0.80 indicating excellent reliability. According to Portney and Watkins,[24] for most clinical measurements, reliability should exceed 0.90 to ensure reasonable validity.[25] Internal consistency was measured using the Cronbach coefficient α. This reflects the extent to which items measure various aspects of the same characteristics and nothing else. The Cronbach α also ranges from 0.00 to 1.00. Therefore, a value that approaches 0.90 is high and the scale can be considered reliable.[24] An interitem correlation matrix was formed and also the correlation of each individual item of the NDI questionnaire with the total score was done.

Validity

Content Validity

Content validity is defined as the degree to which the content of a HR-PRO (health-related patient-reported outcomes) instrument is an adequate reflection of the construct to be measured. This was assessed by judging whether all the items in the NDI are relevant for the construct to be measured, for the study population and for the purpose of the HR-PRO. Experts in the translation committee judged the relevance of the items for the construct. Patients were considered as experts when judging the relevance of the items for the patient population. The comprehensiveness of the items was analyzed by taking 3 aspects into account: content coverage of the items, the description of the domains, and the theoretical foundation. Large floor and ceiling effects could be an indication that a scale is not comprehensive depending on the missing items. The COSMIN checklist was also used to quantify the content validity.[26]

Construct Validity

Construct validity is the degree to which the scores of an HR-PRO instrument are consistent with hypothesis based on the assumption that the HR-PRO instrument validly measures the construct to be measured. Correlations ranging from 0.00 to 0.25 indicate little or no relationship, those from 0.25 to 0.50 suggest a fair relationship, values of 0.50 to 0.75 are moderate to good, and values above 0.75 are considered to be good to excellent. COSMIN checklist was also used for the hypothesis testing.[20] Our hypothesis was that a positive correlation between the Marathi-NDI and the VAS would fall in the "moderate" range. Data were analyzed using SPSS version 20 (IBM Corp., Armonk, NY)

The mean and standard deviations of each item and the total score were analyzed. As for single missing items several strategies have been developed. In this study 1 or 2 missing items were accepted and the average score per item (total score divided by 9 or 8) was inserted. The interitem correlation for all items was also done. ICC was used to evaluate rater reliability internal consistency was assessed using the Cronbach coefficient α. Standardized item-total score correlation of the NDI were analyzed by calculating correlation coefficients between each item and the sum of all other items excluding the item investigated. ICC and test-retest reliability of all items of the NDI was also done individually. Construct validity was analyzed using the Pearson correlation coefficient between NDI and VAS scores.

RESULTS

The mean age of the patients who participated in the study was 31.93 ± 8.26 years that ranged from 19 to 48 years.

Adaptation

Findings after the process of adaptation of the Marathi-NDI were as follows. In the second and third sections, related to "personal care" and "lifting" the patients were not able to understand the literal translation of the word extra pain in Marathi, so it was replaced by existent pain (instead of without extra pain we used "without increase in my existent pain" I can look after myself).

In the fifth section, there was no exact word in Marathi language for infrequently, hence it was replaced by seldom. The question on driving in the eighth section was not relevant to the population included for the study because most of them did not drive, hence with prior permission with Dr. Howard Vernon this word was explained as travelling only for those patients who did not drive in the rural and female population. However, no change was made in the questionnaire.

As recreation is not part of our culture, especially in the rural population, the patients found it difficult to understand the exact meaning of recreation. Hence, it was explained to them as the activities they usually do in their leisure time, in the tenth section.

Test-Retest Reliability

A total of 81 patients were included in the study. In 2 questionnaires, 2 items were missing in total. These questionnaires were complemented by the averaged score per item method.

ICC score for test-retest reliability was found to be 0.95 that showed excellent reliability. The Cronbach α for internal consistency was 0.97 that indicates high reliability.

Absolute reliability was 0.97 with a standard error of measurement equal to ± 7. Sociodemographic, clinical

TABLE 1. Sociodemographic and Clinical Characteristics of the Population Enrolled

No.	Sex	Age (yr)	NDI Score Out of 50		VAS Out of 10		Comorbidities	Use of Drugs	Education	Marital Status
			Test	Retest	Test	Retest				
1	F	22	4	4	3	3	Yes	Yes	Elementary	Married
2	F	21	4	5	2.4	3	Yes	Yes	Elementary	Unmarried
3	F	23	1	2	1	2	Yes	Yes	Elementary	Married
4	F	24	18	9	6	4.7	Yes	Yes	Elementary	Married
5	F	32	16	15	6	6	No	No	Elementary	Married
6	F	33	2	2	2	2	Yes	Yes	Elementary	Married
7	F	37	1	1	1	1	No	No	Elementary	Married
8	F	45	14	14	5	5	No	No	Elementary	Married
9	F	44	2	2	2.6	2.4	No	No	Elementary	Married
10	F	43	2	2	2.4	2	No	No	Elementary	Married
11	F	23	2	2	2.3	2.5	No	No	Elementary	Married
12	M	21	14	14	5	5	No	No	Elementary	Married
13	M	19	2	2	2	2	No	No	Elementary	Unmarried
14	F	44	0	4	1	3	Yes	Yes	Elementary	Married
15	F	35	4	4	3.2	3.4	Yes	Yes	Elementary	Married
16	F	42	10	9	4.8	4.6	Yes	Yes	High school	Married
17	M	40	3	3	1.6	1.6	Yes	Yes	Elementary	Married
18	F	48	15	15	5.2	5.3	Yes	No	Elementary	Married
19	M	22	13	14	5	6	Yes	Yes	Elementary	Unmarried
20	M	25	4	4	3.3	3.3	Yes	No	Elementary	Married
21	M	26	7	6	4	4	Yes	No	Elementary	Married
22	F	27	15	13	6	5.8	Yes	No	Elementary	Married
23	M	28	`12	8	4.8	4.3	Yes	No	Elementary	Married
24	M	33	13	14	4.7	4.7	Yes	No	Elementary	Married
25	F	33	13	18	4.8	6	Yes	No	Elementary	Married
26	F	35	30	27	8	7.6	Yes	No	Elementary	Married
27	F	34	21	18	6.8	5.4	Yes	No	Elementary	Married
28	F	34	5	5	2	2	Yes	No	Elementary	Unmarried
29	F	21	10	9	2.6	2.2	Yes	No	Elementary	Unmarried
30	M	22	19	19	5.8	5.7	Yes	No	Elementary	Married
31	F	31	15	15	5	5	Yes	No	High school	Married
32	M	22	5	4	3	3	Yes	No	High school	Married
33	M	21	29	33	7.8	8.4	Yes	No	High school	Unmarried
34	F	23	19	17	5.4	5.3	Yes	No	High school	Unmarried
35	F	24	19	19	5.4	5.4	Yes	No	High school	Married
36	F	32	4	4	2.8	2.8	Yes	No	High school	Married
37	F	33	4	5	2.7	2.6	Yes	No	High school	Married
38	F	37	1	2	1	2	No	No	Elementary	Married
39	F	45	18	9	4.9	4.6	Yes	Yes	High school	Married
40	F	44	16	15	5.4	5	Yes	Yes	High school	Married
41	F	43	2	2	1.4	1.8	Yes	Yes	High school	Married

(*Continued*)

TABLE 1. (*Continued*)

No.	Sex	Age (yr)	NDI Score Out of 50		VAS Out of 10		Comorbidities	Use of Drugs	Education	Marital Status
			Test	Retest	Test	Retest				
42	F	23	1	1	1	1	Yes	Yes	High school	Married
43	F	21	14	14	4.8	4.8	No	Yes	High school	Unmarried
44	F	19	2	2	2	2	No	Yes	University	Unmarried
45	F	44	2	2	2	2	No	Yes	High school	Married
46	F	35	2	2	2	2	No	Yes	High school	Married
47	F	42	14	14	5	5	No	Yes	High school	Married
48	F	40	2	2	2	1.8	No	Yes	High school	Married
49	F	48	0	4	2	4	No	Yes	High school	Married
50	F	22	4	4	2	3.6	No	Yes	High school	Married
51	F	25	10	9	4.8	4	No	Yes	High school	Married
52	F	26	3	3	2.4	2.5	No	Yes	High school	Married
53	F	27	15	15	5.2	5	No	Yes	University	Married
54	F	28	13	14	4.7	5	No	Yes	University	Married
55	F	33	4	4	2	4	No	Yes	University	Married
56	F	33	7	6	3.7	4.2	No	Yes	University	Married
57	F	35	15	13	5.3	4.7	Yes	Yes	University	Married
58	F	35	12	8	4.6	3.9	Yes	Yes	University	Married
59	F	34	13	14	4.6	4.6	Yes	No	Elementary	Married
60	F	21	13	18	4.6	5.4	Yes	No	Elementary	Married
61	F	22	30	27	8	6.7	Yes	No	Elementary	Married
62	F	31	21	18	6	6	Yes	No	Elementary	Married
63	F	19	5	5	2.8	3	Yes	No	Elementary	Married
64	F	23	10	9	4.8	4	Yes	No	Elementary	Married
65	F	26	19	19	5.7	5.7	Yes	No	Elementary	Married
66	F	34	15	15	5.2	5.2	Yes	No	Elementary	Married
67	F	33	4	4	2	2.2	Yes	No	Elementary	Married
68	F	31	29	33	8	8	Yes	No	Elementary	Married
69	F	32	19	17	4.7	4.8	Yes	No	Elementary	Married
70	F	34	19	19	4.6	4.6	Yes	No	Elementary	Married
71	F	32	4	4	3	3	Yes	No	Elementary	Married
72	F	34	4	5	2.4	3	Yes	No	Elementary	Married
73	F	42	1	2	1	2	Yes	No	Elementary	Married
74	F	41	18	9	6	4.7	Yes	No	Elementary	Married
75	F	42	16	15	6	6	Yes	No	Elementary	Married
76	F	44	2	2	2	2	Yes	No	Elementary	Married
77	F	37	1	1	1	1	Yes	No	Elementary	Married
78	F	38	14	14	5	5	Yes	No	Elementary	Married
79	F	44	2	2	2.6	2.4	Yes	No	Elementary	Married
80	F	39	2	2	2.4	2	Yes	No	Elementary	Married
81	F	28	2	2	2.3	2.5	Yes	No	Elementary	Married

VAS indicates visual analogue scale; NDI, neck disability index.

TABLE 2. Descriptive Statistics for NDI Total Score for 81 Patients

	Mean	Standard Deviation
NDI score for test data	9.74	7.91
NDI score for retest data	9.40	7.59

NDI indicates neck disability index.

TABLE 3. Descriptive Statistics

	Mean	Standard Deviation	N
Pain	1.20	1.48	81
Personal care	0.80	1.08	81
Lifting	0.62	0.87	81
Work	0.83	1.03	81
Headaches	1.37	1.52	81
Concentration	1.39	0.90	81
Sleeping	0.38	0.96	81
Driving	0.90	1.07	81
Reading	1.33	1.34	81
Recreation	0.91	1.21	81
Total	9.77	7.90	81

characteristics, descriptive statistics, interitem correlation matrix, item-total statistics, ICC, and test-retest reliability of all items of the NDI individually are represented in Tables 1 to 6, respectively.

For content-related validity, translation of the questionnaire seemed to be valid and the instrument was well accepted by the patients as well as approved by the committee of translators. Explained in the "Materials and Methods" section.[20]

For construct-related validity, the correlation of the NDI-Marathi version was found to be 0.95 ($P < 0.0001$). These results showed that the construct validity of the Marathi version of NDI was excellent.[20]

DISCUSSION

This study was conducted with the purpose of translating the original NDI according to literature guidelines into Marathi language and to validate the psychometric properties of the NDI-Marathi version. The translation of the NDI questionnaire was done according to the guidelines for the process of cross-cultural adaptation of self-report measures proposed by Beaton *et al*.[23] The process involved 2 bilingual translators who did the translation into Marathi from the original English version. A consensus version was produced by synthesizing both translations and discussing disagreements.

The consensus version was then back translated into English by 2 teachers, having a Masters degree in English literature, and Marathi being their mother tongue. The 2 back translated English versions were then compared with the original version of the NDI. The bilingual expert committee team consisting of 4 translators and 2 physiotherapists; reviewed the Marathi version of the questionnaire to ensure cross-cultural equivalence. This formed the prefinal version for field testing. Marathi version of the NDI was then compared with the original one to achieve schematic, idiomatic, experimental, and conceptual equivalence.

The last stage of the process was to test the prefinal version. This study showed that the Marathi translation of the NDI is a valid and reliable method of measuring disability in Marathi speaking patients with neck pain.

Test-retest reliability was found to be ICC = 0.95 and the Cronbach coefficient of α for internal consistency was 0.97 at 24-hour interval (ICC values above 0.80 were accepted as excellent reliability). The time interval between the administrations of the 2 tests was deliberately kept only for 24 hours, so that the pain status would not change due to a longer time gap. These results are very similar to those of Vos *et al* (Dutch

TABLE 4. Interitem Correlation Matrix

	Pain	Personal Care	Lifting	Work	Headaches	Concentration	Sleeping	Driving	Reading	Recreation
Pain	1.00	0.50	0.54	0.53	0.46	0.30	0.36	0.21	0.32	0.39
Personal care	0.50	1.00	0.17	0.38	0.55	0.32	0.25	00.04	0.26	0.28
Lifting	0.54	0.17	1.00	0.61	0.46	0.25	0.43	0.35	0.34	0.32
Work	0.53	0.38	0.61	1.00	0.53	0.10	0.65	0.24	0.32	0.43
Headaches	0.46	0.55	0.46	0.53	1.00	0.42	0.35	0.27	0.57	0.50
Concentration	0.30	0.32	0.25	0.10	0.42	1.00	0.23	0.29	0.55	0.50
Sleeping	0.36	0.25	0.43	0.65	0.35	0.23	1.00	0.19	0.50	0.65
Driving	0.21	−0.04	0.35	0.24	0.27	0.29	0.19	1.00	0.66	0.50
Reading	0.32	0.26	0.34	0.32	0.57	0.55	0.50	0.66	1.00	0.74
Recreation	0.39	0.28	0.32	0.43	0.50	0.50	0.65	0.50	0.74	1.00

TABLE 5. Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach α if Item Deleted
Pain	8.56	48.17	0.58	0.50	0.85
Personal care	8.97	54.02	0.45	0.49	0.86
Lifting	9.14	54.32	0.57	0.55	0.85
Work	8.93	52.08	0.62	0.69	0.85
Headaches	8.40	45.99	0.68	0.63	0.84
Concentration	8.38	54.93	0.50	0.42	0.86
Sleeping	9.39	53.16	0.59	0.70	0.85
Driving	8.87	54.36	0.43	0.63	0.86
Reading	8.44	47.55	0.70	0.78	0.84
Recreation	8.86	48.71	0.72	0.71	0.84

version of the NDI)[27] and Telci *et al* (Turkish version).[1,10] In both of the studies the ICC was found to be 0.97.

In the Brazilian Portuguese version of the NDI,[3] the test-retest ICC was also found to be 0.97; however, the internal consistency coefficient was 0.74, which is lower than the value obtained in this study. In the validation of a French version of the NDI, Wlodyka-Demaille *et al*[6] reported similar figures for test-retest reliability at day 1 and day 2 ($r = 0.93$). Internal consistency was not reported. Recently, validation of a slightly modified version of the NDI for a Swedish speaking population was reported and like the French version, the study failed to report internal consistency.[7] Test-retest measures were found to be 0.99 in the Swiss study. In the German version of the NDI, the ICC was 0.92 and the Cronbach coefficient α was 0.96, which is closer to the values in this study.[5]

TABLE 6. ICC and Test-Retest Reliability of All Items of the NDI Individually

	ICC	α
Pain	0.96	0.98
Personal care	0.84	0.91
Lifting	0.66	0.80
Work	0.79	0.88
Headache	0.68	0.80
Concentration	0.88	0.94
Sleeping	0.97	0.98
Driving	0.85	0.92
Reading	0.95	0.97
Recreation	0.87	0.93

Reliability coefficient for all 10 items α = 0.86.

ICC indicates intraclass correlation coefficient; NDI, neck disability index.

A Hindi version of this questionnaire has been reported with test-retest ICC at 0.99, which is slightly higher than the Marathi version.[18] In the Greek, Italian, Japanese, and Thai versions, the ICC were 0.85, 0.84, 0.88, and 0.85, respectively, which is much lower than the values obtained in this study.[11,12,14,16] Also, Vernon and Mior the developers of the questionnaire administered the NDI to patients having neck pain as a result of whiplash injury and in patients complaining of neck pain with an interval of 2 days and found the ICC was 0.89.[4] All of these results are similar to our findings indicating a high adaptation of the NDI into the Maharashtrian culture.

For construct-related validity, the correlation with VAS was found to be 0.95 ($P < 0.0001$). This is actually higher than that previously reported by Vernon and Mior and may indicate that, in Maharashtrian culture, pain and disability are understood to be very similar concepts. These results showed that the construct validity of the Marathi version of the NDI was excellent.[15]

Content validity (face validity) is concerned with whether a measurement seems to measure the intended parameters in a given situation. In this study, translation of the questionnaire was determined to be valid by the study team as well as by patients. The layout of the questionnaire and clear structure and clarity of the questions enhanced its face validity.

The Cronbach α for all the 10 items was 0.86. As with other correlation statistics, this index ranges from 0.00 to 1.00. Therefore, a value that approaches 0.90 is high and the scale can be considered internally consistent.

The means and standard deviations for each item and the total score were analyzed. It was seen that "concentration" had the highest and "sleeping" had the lowest mean. All item pairs were well correlated except for personal care, work, concentration, and sleeping (Cronbach α was less than 0.25)

Except for personal care and driving, each of the other items has a correlation of approximately 0.50 or higher with the total. Finally, we found that the α increased to 0.85 and 0.86 for "concentration" and "driving," respectively, when these

items are not included, thus indicating that the scale is more homogenous when these items are omitted. In the test-retest reliability of all items of the NDI, all the items had individual α scores above 0.80 indicating high internal consistency.

In our study, 40 patients said that they did not drive. Coming from a rural background could be the reason, and in the countryside, most of females in the house are dependent on the male members in the family and are not allowed to learn driving because they still live in a male-dominated society. This is likely not the case in an urban setting. Considering that this translated version should be applicable to both the urban as well as the rural population, this term was not replaced completely, instead the word driving was modified just verbally as travelling only to the patients who did not understand the term "driving." However, no changes were made in the translated version. The large amount of missing responses for driving could not be considered as a translation issue because that finding is consistent with other studies as well.[11] According to statistical analyses of this study, this Marathi version of the NDI showed similar results to those presented in the English version of the NDI as well as other versions of 7 different languages. To our knowledge, this Marathi version of the NDI is the first condition-specific outcome instrument for neck pain to have been validated in Marathi. Development and validation of multiple-language versions of existing validated questionnaire plays a key role in standardizing the outcome measurement and increasing the statistical power of clinical studies. Our results demonstrate that the NDI was successfully cross-culturally translated into Marathi and at the same time, it retains the properties of the original version, thereby standardizing the outcome measurement further.

Limitations of the Study

The findings of this study can be generalized to Maharashtrians with only chronic neck pain, but not those whose pain was due to whiplash injury because these subjects were not included. One limitation of our study is that we could not expand the assessment of the criterion validity of the Marathi-NDI because there is no other scale (available to be considered as the "gold standard," *e.g.*, 36-Item Short Form Health Survey) in the same language. As well, we did not correlate the NDI to any physical test measurement. This is recommended for future studies.

Exploratory factor analysis was deliberately not done in this study because the sample size was not large enough. Future studies can incorporate this test with larger sample size.

Test interval was kept only for 24 hours so that the pain status would not change due to a longer time period but due to this short time gap, the patients may recall some responses from the previous day. This aspect could be explored in future studies.

CONCLUSION

These results suggest that the Marathi version of the NDI validated in this study is an easy to comprehend, reliable, and valid instrument for the measurement of the limitation of activities of daily living and pain caused by neck disorders in the Marathi speaking population.

➢ Key Points

- ❑ Marathi translation of the NDI is a valid and reliable method of measuring disability in Marathi speaking patients with neck pain.
- ❑ The result of this study showed that the construct validity of the NDI was excellent correlating the NDI with VAS.
- ❑ Marathi version of the NDI is the first condition-specific outcome instrument for neck pain to have been validated in Marathi.
- ❑ The NDI was successfully cross-culturally translated into Marathi and at the same time, it retains the properties of the original version, there by standardizing the outcome measurement further.

Acknowledgments

We acknowledge Dr. Kavitha Raja, Principal JSS College of Physiotherapy, Mysore for her constant scientific guidance and participation in discussions throughout this study.

References

1. Telci EA, Karaduman A, Yakut Y, et al. The cultural adaptation, reliability, and validity of neck disability index in patients with neck pain. *Spine* 2009;34:1732–5.
2. Evans R, Bronfort G, Schulz C, et al. Supervised exercise with and without spinal manipulation performs similarly and better than home exercise for chronic neck pain. A randomized controlled trial. *Spine* 2012;37:903–14.
3. Cook C, Richardson JK, Braga L, et al. Cross-cultural adaptations and validation of the Brazilian Portuguese version of the neck disability index and neck pain and disability scale. *Spine (Phila Pa)* 2006;31:1621–7.
4. Vernon H. The neck disability index: state of the art, 1991–2008. *J Manipulative Physiol Ther* 2008;31:491–502.
5. Swanenburg J, Humphreys K, Langenfeld A, et al. Validity and reliability of a German version of the neck disability index (NDI-G). *Man Ther* 2014;19:52–8.
6. Wlodyka-Demaille S, Poiraundeau S, Catanzariti JF, et al. French translation and validation of 3 functional disability scales for neck pain. *Arch Phys Med Rehabil* 2002;83:376–86.
7. Ackelman B, Lindgren U. Validity and reliability of a modified version of the neck disability index. *J Rehabil Med* 2002;34:284–87.
8. Lee H, Nicholson LL, Adams RD, et al. Development and psychometric testing of Korean language versions of 4 neck pain and disability questionnaires. *Spine* 2006;31:1841–5.
9. Mousavi SJ, Parnianpour M, Montazeri A, et al. Translation and validation study of the Iranian versions of the neck disability index and the neck pain and disability index. *Spine* 2007;32:E825–31.
10. Jorritsma W, Geertzen JH, Dijkstra PU, et al. Neck pain and disability scale and neck disability index: validity of Dutch language versions. *Eur Spine J* 2012;21:93–100.
11. Trouli MN, Vernon HT, Kakavelakis KN, et al. Translation of the neck disability index and validation of the Greek version in a sample of neck pain patients. *BMC Musculoskelet Disord* 2008:106.
12. Monticone M, Ferrante S, Vernon H, et al. Development of the Italian version of the neck disability index: cross-cultural adaptation, factor analysis, reliability, validity, and sensitivity to change. *Spine* 2012;37:1038–44.

13. Shaheen AA, Omar MT, Vernon H. Cross-cultural adaptation, reliability, and validity of the Arabic version of neck disability index in patients with neck pain. *Spine* 2013;38:609–15.
14. Nakamaru K, Vernon H, Aizawa J, et al. Cross-cultural adaptation, reliability and validity of the Japanese version of the neck disability index. 2012;37:1343–7.
15. Andrade OJ, Delgado M, Almecija RR. Validation of the Spanish version of the neck disability index. *Spine* 2010:35:114–8.
16. Uthaikhup S, Paungmali A, Pirunsan U. Validation of Thai versions of the neck disability index and neck pain and disability scale in patients with neck pain. *Spine* 2011;36:1415–21.
17. Mohite KS, Pawar J. Problems and prospectus of tourism in Maharashtra. *ISRJ* 2013;3.
18. Shakil H, Khan S, Thakur P. Test-retest reliability and validity of Hindi version of neck disability index in patients with neck pain. *Indian J Physiother Occup Ther* 2011;5:167–9.
19. Walter SD, Eliasziw M, Donner A. Sample size and optimal designs for reliability studies. *Stat Med* 1998;17:101–10.
20. Briggs KK, Lysholm J, Tegner Y, et al. The reliability, validity, and responsiveness of the Lysholm score and Tegner activity scale for anterior cruciate ligament injuries of the knee: 25 years later. *Am J Sports Med* 2009;37:890–7.
21. Vernon H, Mior S. The neck disability index: a study of reliability and validity. *J Manipulative Physiol Ther* 1991;14: 409–15.
22. Fairbank JC, Cooper J, Davies JB. The Oswestry Low Back Pain Disability Questionnaire. *Physiotherapy* 1980;68:271–3.
23. Beaton DE, Bombardier C, Guillemin F, et al. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine* 2000;25:3186–91.
24. Portney LG, Watkins MP. *Foundation of Clinical Research: Application to Practice*. Norwalk, CT: Appleton & Lange; 1993.
25. Yakut E, Duger T, Oksuz C, et al. Validation of the Turkish version of the Oswestry Disability Index for patients with low back pain. *Spine* 2004;29:581–5.
26. Mokkink L, Terwee C, Knol D, et al. The COSMIN checklist for evaluating the methodological quality of studies on measurement properties: a clarification of its content. *BMC Med Res Methodol* 2010;10:1–8.
27. Vos CJ, Verhagen AP, Koes BW. Reliability and responsiveness of Dutch version of the neck disability index in patients with acute neck pain in general practice. *Eur Spine J* 2006;15:1729–36.