

Validation of the Neck Disability Index in Serbian Patients With Cervical Radiculopathy



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ABSTRACT

Objective: The purpose of this study was to translate the Neck Disability Index into the Serbian language (NDI-S) and to investigate the validity of this version for use in Serbian population.

Methods: Fifty patients with cervical radiculopathy were enrolled in the study and completed a multidimensional questionnaire, including NDI-S. Inclusion criteria were ages between 18 and 65 years, Serbian speaking, no cognitive or hearing impairment, sharp and radiating neck and upper extremity pain that has lasted less than 12 months, radiculopathy signs evaluated by electromyoneurography and disc herniation, or spondylotic changes of cervical spine visualized on magnetic resonance imaging. Exclusion criteria were malignancy, previous cervical spine discectomy, trauma of the cervical spine and myelopathy, polyneuropathy, fibromyalgia, and psychiatric disorders. Validity was determined by the correlation of the Neck Disability Index, with pain measured by visual analogue scale, characteristics related to pain, and mental status. Also, factor structure of NDI-S was explored through factor analysis. Reliability was assessed through internal consistency (Cronbach's α and item-total correlations).

Results: Correlation analysis between pain and NDI-S showed significant values ($P < .01$). The NDI-S correlated well with patients mental status ($r = 0.421$, $P < .01$). Cronbach's α of NDI-S was 0.85, denoting excellent internal consistency of the questionnaire. Item-total correlations were significant and ranged from 0.328 to 0.789. Factor analysis demonstrated a 2-factor structure with an explained variance of 55%.

Conclusion: The NDI-S is a valid questionnaire to measure neck and arm pain related to disability in Serbian patients with cervical radiculopathy. (J Manipulative Physiol Ther 2018;41:496-502)

Key Indexing Terms: *Radiculopathy, Cervical; Rehabilitation*

INTRODUCTION

Cervical radiculopathy (CR) typically presents as neck pain radiating to the upper extremity and is most commonly due to the compression of a cervical nerve root that causes pain and disability.¹ Cervical radiculopathy affects approximately 1 person per 1000 of a population per year and is most often caused by degenerative spondylosis or a disk herniation.¹ One study reports that patients with upper arm pain are more disabled and have less improved quality of life compared with patients who have neck pain only.² Quantification of neck and upper extremity pain-related disability is crucial for the evaluation of the treatment and also for assessing clinical outcomes of disability.³

The Neck Disability Index (NDI) is a questionnaire developed by Vernon and Mior⁴ that measures problems with neck movements, neck pain intensity, effect of neck pain on concentration, and the level of interference in daily life activities. It has been translated and validated in many study populations and has shown stable psychometric properties.⁴⁻⁶ To our

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knowledge, no specific disease questionnaire that assesses disability in patients with neck pain and CR has ever been validated in Serbia. Therefore, the purpose of this study was to translate and validate the NDI in Serbian patients with CR.

METHODS

Translation and Adaptation

The translation process was in accordance with standard methods that have been adopted internationally.⁷ The NDI was first translated into Serbian by 2 research study doctors who were fluent in English and blinded to each other. The translation was examined by the study team that included research study doctors and 1 doctor from an English-speaking area (a Serbian doctor living and working in London). The Serbian version of the NDI (NDI-S) was then translated into English again by a professional translator who was blinded to the original English version of the NDI. The Serbian translation, English translation, and the original English version of the NDI were then reviewed by the study team again. After that, we pretested the questionnaire in a pilot study, which included 20 people with neck pain, to find possible problems in practice. The only problem in the translation process was the translation of the word “recreation” in the tenth, last item of the questionnaire. In Serbian, the word “recreation” refers to sports activities and exercise only, while in English it refers to all leisure time activities. So, we replaced “recreation” with “recreation and leisure time activities” (sports, walking, visiting friends, etc). In general, participants in the pilot study commented that the questions were clear. The final review of the translation included underlining and correction of grammatical errors. We did not notice any grammatical errors. The whole procedure of NDI translation lasted 1 month.

Ethics Approval

The study was approved by the Medical School, University of Belgrade’s research ethics committee. All participants provided signed informed consent before enrollment.

Data Collection

This was a cross-sectional study including patients with CR who were seeking physical medicine treatment at the Institute and Clinic for Rehabilitation (Medical School, University of Belgrade). The minimum required sample size was determined to be 47 on the basis of 0.80 power and a significance level of 0.05 to detect a correlation coefficient of at least 0.4 between NDI-S and other variables.⁸ The final sample included 50 patients.

Inclusion criteria included age between 18 and 65 years, Serbian speaking, no cognitive or hearing impairment, sharp and radiating neck and upper extremity pain that has lasted less than 12 months, radiculopathy signs evaluated by electromyoneurography, and disc herniation or spondylotic changes of cervical spine visualized on magnetic resonance imaging.

Exclusion criteria were malignancy, previous cervical spine discectomy, trauma of the cervical spine and myelopathy, polyneuropathy, fibromyalgia, and psychiatric disorders.

Before therapy procedures, patients received a self-administered questionnaire covering several domains, such as sociodemographic and lifestyle data (sex, age, marital status, job status, smoking status, physical activity level) and intensity of neck and upper arm pain information, measured by visual analogue scale (VAS). Patients were asked about duration and frequency of pain, and they were also asked about the intensity of the worst and least pain measured by VAS in the past week, the intensity of pain at the moment of the interview and in the last 24 hours, nonsteroidal anti-inflammatory drugs (NSAIDs) consumption, NDI-S, and patient health questionnaire for depression (PHQ-9).

The VAS consisted of a horizontal line, 100 mm in length, with end points labeled “no pain” and the “worst, unbearable pain.”⁹ The patient was asked to place a mark on the line that corresponded to the intensity of the pain they were experiencing.

The PHQ-9 is a questionnaire for depression, with 9 questions that assess how often the respondent has been bothered by that symptom over the past 2 weeks, assigning values of 0 to 3 points (0, not at all; 1, several days; 2, more than half of the days; 3, nearly every day). A PHQ-9 score of 5, 10, 15, and 20 represents mild, moderate, moderately severe, and severe depression.¹⁰

The Neck Disability Index is a condition-specific questionnaire for self-reported disability. It is adapted from the Oswestry Low Back Pain Questionnaire¹¹ and consists of 10 items referring to different activities (personal care, lifting, driving, work, sleeping, concentration, reading, recreation) and pain (pain intensity, headache), with 6 possible answers for each item. Patients are instructed to choose only 1 answer that most closely suits their condition at the present time. The score of each item varies between 0 (no pain and no functional limitation) and 5 (worst pain and maximal limitation), resulting in a total score of 0 (no disability) to 50 (totally disabled).

Statistical Analysis

The statistical analysis was conducted with SPSS version 21.0 for Windows (IBM Corp, Armonk, New York). To describe the demographic and pain-related characteristics of the patients, simple counts percentage, mean, and median values were used.

According to Vernon, 1 or 2 missing items were accepted, and the average score per item (total score divided by 9 or 8) was inserted.¹² If 3 or more items remained unanswered, the questionnaire was regarded as unacceptable and removed from further analyses.¹²

Potential floor and ceiling effects were determined by calculating the number of patients who obtained the lowest or the highest possible NDI-S scores. Floor and ceiling effects were considered to be present if more than 15% of patients achieved the lowest or highest score, respectively.¹³

Validity and Reliability

The most important characteristics of the questionnaire are validity and reliability, which were investigated in this study. There are 3 types of validity evidence: content validity, criterion validity, and construct validity. In clinical settings, content validity refers to the correspondence between test items and the symptom content of a syndrome; it is important during development of the original version of the questionnaire, and it was not investigated in this study. The criterion validity is the extent to which a measure is related to an outcome. The criterion validity of NDI-S was analyzed using correlations of the NDI-S with criterion variables that were connected with CR and neck and arm pain, PHQ-9, number of visits with medical doctors, VAS, the frequency of analgesics consumption, and the absence from work due to pain. Construct validity is “the degree to which a test measures what it claims, or purports, to be measuring.”¹⁴ To investigate the construct validity, factor analysis with applied varimax rotation was used. Also, the Kruskal-Wallis test was used to investigate the ability of NDI-S to differentiate between subgroups with different levels and duration of pain.

Reliability refers to the degree to which a measurement technique can be depended upon to secure consistent results upon repeated application. In this study, the method of internal consistency was used (ie, Cronbach’s α coefficient), and we analyzed the item-total correlations.

Internal consistency examines the inter-item correlations within an instrument and indicates how well the items fit together conceptually.¹⁵ Cronbach’s α coefficient is ranged from 0 to 1. A coefficient of 0 indicates no reliability, and 1 indicates perfect reliability. Generally, if the reliability is above 0.80, it is said to have very good reliability; if it is below 0.50, it would not be considered a very reliable test. Values over 0.70 would be considered acceptable.¹⁵ The following correlation coefficients were accepted: 0 to 0.19 as very weak, 0.20 to 0.39 as weak, 0.40 to 0.59 as moderate, 0.60 to 0.79 as strong, and 0.80 to 1 as very strong.¹⁶

RESULTS

Descriptive Data

Fifty patients with CR who fulfilled inclusion criteria were included in the study: 35 females and 15 males; mean age was 44.5 ± 10 (Table 1). Basic demographic data and lifestyle habits are outlined in the Table 1.

The mean value of NDI-S was 18.9 ± 7.42 , denoting moderate disability. Of the 50 participants involved in the study, 17 participants (34%) had 1, the same missing item (“driving”). No missing data occurred across all other items of the NDI-S. No floor or ceiling effects were identified because there were no patients with the highest or the lowest NDI-S scores. The mean PHQ-9 score was 8.26 ± 4.99 , denoting subdepression.

Table 1. Basic Demographic and Lifestyle Characteristics of Study Participants

Characteristics	n = 50
Age, mean $\pm$ SD	44.5 $\pm$ 10.0
Sex, n (%)	
Female	35 (70)
Male	15 (30)
Education, n (%)	
Secondary school	31 (62)
Higher school (< 3 y for degree)	5 (10)
Higher school (> 3 y for degree)	14 (28)
Physical activity (h), median (range)	8.5 (0, 42)
Smoking, n (%)	
Yes	15 (30)
No	35 (70)
Marital status, n (%)	
Married	32 (64)
Divorced	7 (14)
Widowed	1 (2)
Single	10 (20)
Work status, n (%)	
Employed	38 (76)
Unemployed	10 (20)
Retired	2 (4)

SD, standard deviation.

Validity and Reliability

Correlation analysis between pain and NDI-S showed significant values (Table 2). Specifically, the intensity of usual arm pain ($r = 0.521$, $P < .001$), the intensity of pain in the past 24 hours ($r = 0.465$, $P < .001$), the intensity of current pain at the moment of the interview ($r = 0.511$, $P < .001$), the intensity of the highest pain in the past week ($r = 0.457$, $P < .001$), and the intensity of the lowest pain in the past week ($r = 0.438$, $P < .001$). Correlation between neck pain and NDI-S was significant ($P < .05$). Absence from work due to pain strongly correlated with NDI-S ($r = 0.643$, $P < .0001$). Taking NSAIDs showed significant correlation with NDI-S ($r = -0.524$, $P < .0001$). Measures of depression (PHQ-9 scores) correlated well

Table 2. Pain, Characteristics Related to Pain, and Correlations With NDI-S

Characteristics	n = 50	r	P Value
Pain (VAS) (Mean ± SD)			
Intensity of neck pain	3.78 ± 1.93	0.307 ^a	.030
Intensity of arm pain	4.36 ± 2.01	0.514 ^a	.001
Intensity of pain past 24 h	4.82 ± 2.44	0.509 ^a	.001
Current pain	4.35 ± 2.54	0.537 ^a	.001
Highest pain past wk	6.99 ± 2.28	0.461 ^a	.001
Lowest pain past wk	2.87 ± 2.26	0.448 ^a	.001
Frequency of pain past wk, n (%)		0.288 ^b	.042
Once	1 (2)		
Two and 3 times	7 (14)		
Almost every day	16 (32)		
Every day	26 (52)		
Number of visits with MD, median (range)	3 (0-20)	0.135 ^b	.348
Taking NSAIDs, n (%)		−0.524 ^b	.001
High dose	24 (48)		
Low dose	20 (40)		
Not taking	6 (12)		
PHQ-9, Mean ± SD	8.26 ± 4.99	0.421 ^a	.002
Absence of work due to pain, n (%)	38 (76)	0.643 ^b	.001
Yes	26 (68)		
No	12 (32)		

MD, medical doctor; NDI-S, Serbian version of the Neck Disability Index; NSAIDs, nonsteroidal anti-inflammatory drugs; PHQ-9, patient health questionnaire-9; SD, standard deviation; VAS, visual analogue scale.

^a Pearson correlation coefficient.

^b Spearman's correlation coefficient.

with NDI-S values ($r = 0.421$, $P < .01$). Frequency of pain also correlated with NDI-S ($r = 0.288$, $P < .05$), while significant correlations in relation to number of visits with medical doctors was not observed ($r = 0.135$, $P = .348$).

Cronbach's α of NDI-S was 0.852, denoting good correlation between items and excellent internal consistency of the questionnaire. The item to total score correlations of NDI-S are presented in Table 3. The data show that correlations were good, from moderate to strong, and statistically significant. The weakest correlation was observed between personal care and NDI-S total score ($r = 0.328$, $P = .020$).

Table 3. Descriptive Statistics of NDI-S and Item to Total Score Correlations

NDI-S Total Score and Items	Mean ± SD/ Median (Range)	r	P Value
NDI-S Total score	18.9 ± 7.42		
Pain	2 (0-5)	0.372	.008
Personal care	1 (0-3)	0.328	.020
Lifting	1 (0-5)	0.613	<.001
Reading	2 (0-4)	0.653	<.001
Headaches	1 (0-4)	0.542	<.001
Concentration	1 (0-5)	0.682	<.001
Work	2 (0-4)	0.697	<.001
Driving	2 (0-5)	0.761	<.001
Sleeping	2.34 ± 1.32	0.753	<.001
Recreation	2.04 ± 1.26	0.789	<.001

NDI-S, Serbian version of the Neck Disability Index; SD, standard deviation.

Table 4. Results of Factor Analysis of NDI-S (Unrotated and Varimax Rotated Solution)

Item of NDI-S	Unrotated		Varimax Rotation	
	Factor 1	Factor 2	Factor 1	Factor 2
Pain	0.404	0.630	0.142	0.734 ^a
Personal care	0.305	0.777	−0.004	0.834 ^a
Lifting	0.617	0.129	0.537 ^a	0.348
Reading	0.663	−0.408	0.767 ^a	−0.133
Headaches	0.553	−0.238	0.602 ^a	−0.016
Concentration	0.692	0.044	0.626 ^a	0.298
Work	0.674	−0.250	0.719 ^a	0.018
Driving	0.771	−0.112	0.758 ^a	0.182
Sleeping	0.774	0.028	0.729 ^a	0.261
Recreation	0.811	0.095	0.718 ^a	0.389

NDI-S, Serbian version of the Neck Disability Index.

^a Factor loading ≥ 0.5 .

The factor analysis showed good construct validity and yielded 2 factors explaining 55% of the variance: factor 1 explaining 42% of the variance, and factor 2 explaining the additional 13%. Factor 1 represents recreation, sleeping, driving, work, reading, lifting, and concentration (factor of daily living). Factor 2 represents pain and personal care (Table 4).

Table 5. Comparison of the NDI-S Scores Across Subgroups With Different Pain Characteristics

TABLE 2. Comparison of the NDI-S Scores between Smokers and Nonsmokers with Painful Oral Ulcers					
		Current Pain (VAS $\geq$ 5), n (%)		<i>P</i> Value	
		Yes	No		
		22 (44)	28 (56)		
NDI-S (mean $\pm$ SD)		22.72 $\pm$ 7.53	15.32 $\pm$ 5.89	.002	
		Duration of Symptoms, n (%)			
		Less than 1 mo	1 to 3 mo	3 to 6 mo	6 to 12 mo
		6 (12)	12 (24)	6 (12)	26 (52)
NDI-S (mean $\pm$ SD)		24.33 $\pm$ 7.17	16.17 $\pm$ 6.62	13.5 $\pm$ 4.64	20.19 $\pm$ 7.40
		.031			

NDI-S, Serbian version of the Neck Disability Index; SD, standard deviation; VAS, visual analogue scale.

An analysis of NDI-S and its ability to discriminate between subgroups with different neck and arm pain is shown in Table 5. There was significant difference in NDI-S total scores between groups with different levels and duration of pain (Table 5) ($Z = -2.995$, $P < .01$; $\chi^2 = 8.841$, $P < .05$).

DISCUSSION

This study was conducted with the purpose of validating the NDI in Serbian patients with CR. The NDI-S showed acceptable psychometric properties that corresponded to those of translations in other languages. To our knowledge, this study is the first validity study of NDI in Serbian patients. No specific-disease questionnaire that assesses disability in patients with neck pain and CR has ever been validated in Serbia. The sample size in this study was adequate,^{8,17} with clear inclusion criteria and was heterogeneous in terms of demographic variables, pain, and pain symptoms behavior.

The NDI-S is the first self-administered questionnaire for the assessment of neck and arm pain available in Serbia, and it demonstrates good validity and reliability. The translation of the original NDI was done according to standard methods, which have been adopted internationally.⁷ In this study, there were more female patients, which is similar to other validity studies.¹⁸⁻²⁰

The general impression of the participants was that the questions were easy to understand. Unclear questions were not very frequent, and they were explained by the observer. No floor or ceiling effects were present that were in accordance with other studies.²¹⁻²³ There were 17 participants (34%) who were missing 1 item concerning "driving." These participants said that they were nondrivers. Higher level of the missing section, "driving," was similar to other studies.^{10,19,23-25} Misterska et al²⁶ reported 25%

participants who omitted the item. Swanenburg et al¹⁹ noted 20.4% participants who did not drive. Japanese²⁵ and Greek²⁴ versions reported the highest percentage of nonrespondents (38.2% and 44.6%, respectively). Also, 1 study that reported no missing data in NDI was found.⁶

In our study, the mean age in the group of drivers and nondrivers was similar (44.27 ± 9.55 and 44.88 ± 11.24 , respectively), without significant difference ($Z = -0.256$, $P > .05$). There were more women (16 [94.11%]) in the group of unanswered question, "driving," in relation to men (1 [5.88%]), and there was significant difference ($\chi^2 = 7134$, $P < .05$). So, we conclude that a significant portion of women in Serbia generally do not drive, and that is probably the reason for the high percentage of the missing item, "driving."

According to Vernon and Mior,⁴ there were 5 categories of disability on the basis of the total score of the NDI: 1 to 4, no disability; 5 to 14, mild disability; 15 to 24, moderate disability; 25 to 34, severe disability; and more than 35, complete disability. In our study, participants showed a moderate level of disability. This is comparable to the majority of the validity studies.^{11,19-21,23} However, Guzy et al²² reported mild disability in their sample size (NDI = 14.48), but they excluded patients with upper extremity pain. Cramer et al²⁷ found severe disability in their patients, but the inclusion criteria in their study considered patients with a VAS score over 4.

The NDI-S correlated well with pain intensity ($r = 0.438-0.521$), supporting that greater pain was correlated with worsening function in activities of daily living (high scores on the NDI-S). This was in accordance with other studies.^{18,28,29}

In other validity studies,^{6,19-22,28} we rarely saw correlation coefficients between NDI and pain (VAS) above 0.6. For this kind of data, we generally considered correlations above 0.4 (0.4-0.59) to be relatively strong. So, it can be concluded that there was relatively strong strength in

correlation between pain and NDI-S. A good correlation between taking NSAIDs and NDI-S ($r = -0.524$) was found. In addition, other methods of pain assessment (eg, frequency of pain and absence from work due to pain) also correlated well with NDI-S.

According to these results, NDI-S seems to be an adequate instrument to measure neck and arm pain. It is consistent with the study by Shashua et al.²³ Also, results showed that NDI-S could differentiate between groups of patients with different pain characteristics, which improved its construct validity. Measures of depression by PHQ-9 correlated well ($r = 0.421$) with NDI-S values, and that indicated a great value of NDI-S in measuring mental status.

Correlation between NDI and mental status measured by the 36-item short form survey (SF-36) questionnaire was also reported in the study by Jorritsma et al.²⁰ Weak correlation ($r = 0.34$) between NDI and mental status measured by the SF-36 questionnaire was found in the study by Jorritsma et al. Kesiktaş et al found a strong correlation between mental health (measured by SF-36) and NDI ($r = 0.60$).⁶ To our knowledge, the PHQ-9 was not used for validity in these and other studies of NDI validation.

Factor analysis revealed 2 factors for the NDI-S, explaining 55% of variance. This result was similar to other studies, which extracted 2 factors explaining 56.4%,²³ 55%,⁵ and 54.09%²² of variance. Factor analysis in Greek and German validity studies yielded 1 factor explaining 44.77%²⁴ and 39.8%²⁷ of variance, respectively.

In our study, factor 1 represents recreation, sleeping, driving, work, reading, lifting, and concentration; it is associated with daily living. Factor 2 represents pain and personal care. The item “personal care” also belonged to activities of daily living, but its loading on factor 2 could be explained by its weak correlation with total NDI-S score.

In the present study, Cronbach’s α was 0.85, which is considered very good internal consistency. Other studies also found very similar values of Cronbach’s α , ranging from 0.82 to 0.88.^{6,20,22} Item to total score correlations were good, and correlation coefficient ranged from moderate to strong.

The weakest correlation was observed between personal care and NDI-S total score ($r = 0.328$, $P = .008$), which could be due to a low level of disability in patients, in relation to personal care. All participants marked the first 2 statements in the section “personal care” (“I can look after myself normally, without causing extra pain,” and “I can look after myself normally, but it causes extra pain”).

Only a single person marked the third statement (“It is painful to look after myself, and I am slow and careful”). No one marked the fifth statement that described complete disability (“I do not get dressed; I wash with difficulty and stay in bed”) (Table 3).

Limitations

This study did not assess responsiveness of the NDI-S (eg, sensitivity to changes after rehabilitative interventions)

that should be recommended in future research studies for the complete evaluation of psychometric properties.¹³

CONCLUSIONS

The results of this study suggest that NDI-S is a valid questionnaire to measure neck and arm pain-related disability in Serbian patients with CR.

FUNDING SOURCES AND CONFLICTS OF INTEREST

No funding sources or conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): M.D.J., L.M.K.

Design (planned the methods to generate the results): M.D.J., L.M.K., A.D.G.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): L.M.K., A.D.G., N.D.M., S.M.D.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): M.D.J., N.D.M., V.Z.J., S.I.K.D., M.K.H., S.M.D.

Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): M.D.J., L.M.K., A.D.G., G.T.

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Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): M.D.J., V.Z.J., M.K.H.

Practical Applications

- No specific disease questionnaire that assesses disability in patients with neck pain and CR has been validated in Serbia.
- The results of the study show that the NDI-S is a valid questionnaire to measure neck and arm pain-related disability in Serbian patients with CR.

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