

Transcultural adaptation and validation of the DASH questionnaire in Mexican healthy volunteers and patients with neurogenic disorders of the upper extremity

Adaptación transcultural y validación de la versión mexicana del cuestionario DASH en individuos sanos y pacientes con trastornos neurogénicos del miembro superior

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Abstract

Objective: To conduct a cultural adaptation and validation of the DASH questionnaire to evaluate the perspective of patients with neurogenic disorders of the upper extremity regarding the impact on their quality of life. **Method:** We performed an adaptation of the Spanish version of the DASH questionnaire to the Mexican vocabulary and applied it to 478 volunteers. Ceiling effect, floor effect, item-total correlation, descriptive statistics of items and total score, internal consistency, precision, cross-sectional and longitudinal validity were estimated by comparing healthy controls and affected individuals with different disability levels. **Results:** Our DASH questionnaire version was equivalent to those previously approved and showed homogeneity of the items with respect to the total value of the questionnaire (Cronbach's alpha > 0.96). In addition, it showed an accuracy of 7.25 points and the cross-sectional and longitudinal validity was documented with significant differences between groups and subgroups with distinct disability levels. **Conclusions:** The DASH questionnaire can be used with a high level of confidence in the Mexican population.

Keywords: DASH questionnaire. Upper limb disability. Cultural adaptation. Questionnaire validation.

Resumen

Objetivo: Realizar la adaptación cultural y validación del cuestionario DASH para conocer la perspectiva de pacientes con trastornos neurogénicos del miembro superior respecto al impacto en su calidad de vida. **Método:** Se realizó una adaptación al vocabulario mexicano de la versión española del cuestionario DASH y se aplicó en 478 voluntarios. Se estimaron el efecto techo, el efecto suelo, la correlación ítem-total, las medidas de tendencia central de ítems y el puntaje total, la consistencia

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interna, la precisión y la validez transversal y longitudinal mediante la comparación de individuos sanos y enfermos con diferente nivel de discapacidad. **Resultados:** Nuestra versión del cuestionario DASH resultó equivalente a las previamente aprobadas y mostró homogeneidad de los ítems respecto al valor total del cuestionario (alfa de Cronbach > 0.96). Además, tuvo una precisión de 7.25 puntos y se documentó la validez transversal y longitudinal con diferencias significativas entre grupos y subgrupos con diferente nivel de discapacidad. **Conclusiones:** El cuestionario DASH puede ser empleado con un nivel de confianza alto en la población mexicana.

Palabras clave: Cuestionario DASH. Discapacidad del miembro superior. Adaptación cultural. Validación de cuestionarios.

Introduction

Various neurological disorders affect the upper limb, including degenerative alterations of the cervical spine with nerve component involvement (radiculopathy/myelopathy)¹, as well as peripheral neuropathies of various etiologies, including, due to their clinical and functional importance, thoracic outlet syndrome (TOS), carpal tunnel syndrome, and traumatic neuropathies².

Currently, the functional impact of these conditions is assessed using validated scales for medical use, such as the modified Japanese Orthopaedic Association scale (mJOA)³ or the Neck Disability Index (NDI)⁴, just to name a few. However, these tools require anatomical, functional, and clinical knowledge to allow an objective determination of the degree of limb involvement. Furthermore, they have been used for alterations with a generally orthopedic-specific etiology and do not consider the upper limb as a complete functional entity. Additionally, there are few validated tools that allow understanding the patients' perspective on the function of their upper limbs and the impact of different neurogenic disorders on the patients' quality of life and daily activities.

The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire is a clinical metric tool created by the American Academy of Orthopedic Surgeons in 1996 to measure the impact of upper limb diseases on people's quality of life, focusing on their symptoms, physical condition, and difficulty performing activities of daily living⁵. This self-administered tool consists of 30 items that grade the involvement in different activities on a scale of 1 to 5, resulting in a final score that is converted into a scale using the formula described in its original version^{5,6}. The final result of this questionnaire quantitatively expresses the degree of overall disability of the upper limb as perceived by the patient.

The DASH questionnaire has been translated and culturally adapted into about 54 languages, including

its original English version⁷, as well as French⁸, German⁹, Italian¹⁰, Portuguese¹¹, Russian¹², Japanese¹³, and Spanish^{14,15}, among others, and in different Spanish-speaking countries, including Mexico, all approved by the Institute for Work and Health¹⁶. However, besides translation and cultural adaptation, the metric properties of this tool must be verified in the population for which it has been re-adapted. In this regard, the use of the DASH questionnaire to determine the degree of upper limb disability still needs to be validated in the Mexican context. Additionally, the ability of this tool to identify individuals with upper limb dysfunction due to various neurological etiologies has not been formally analyzed in Mexico.

The objective of this study was to verify the usefulness of the Mexican version of the DASH questionnaire previously translated by the Institute for Work and Health¹⁶ through a cultural re-adaptation from its Spanish version¹⁵, as well as to validate its utility to understand the perception and degree of upper limb disability in the general population of Mexico. A secondary endpoint was to evaluate this tool in a group of individuals with known upper limb neurological disorders.

Method

Translation and cultural adaptation

Since the DASH questionnaire had previously been translated into Spanish by the Institute for Work and Health¹⁶, a verification of this cultural adaptation was performed based on the validated Spanish version by Hervás et al.¹⁵ in 2006. For this purpose, a professional in philosophy and letters, as well as a specialist in neurology, conducted a linguistic analysis of this tool and adapted it to the popular vocabulary of the Mexican population. The changes made consisted of adaptations to some terms whose use is more colloquial in the sociocultural context of Mexico compared to that of Spain, following established best practices for translation and cultural adaptation¹⁷⁻¹⁹. Upon

completion of this process, the resulting version of this work was compared with that proposed by the Institute for Work and Health.

Study population

To validate the Mexican version of the DASH questionnaire resulting from the cultural adaptation process, a pilot study was conducted in the outpatient service of a center for neurological and neurosurgical disorders from northern Mexico City, with an open invitation to regular patients of that center and their relatives or companions, including in the analysis all individuals who voluntarily agreed to complete the questionnaire over a period of 6 months. Illiterate individuals or those with movement disorders, as well as those with conditions compromising higher mental functions, including cerebrovascular, oncological, and autoimmune diseases, mild cognitive impairment, and dementia of various causes, among others, were excluded from the study due to the self-administered design of the evaluated tool.

Therefore, the questionnaire was administered to a pilot group of 478 healthy volunteers and individuals with neurogenic upper limb disorders, including patients with cervical radiculopathy diagnosed through clinical criteria and magnetic resonance imaging of the cervical spine, as well as subjects with upper limb peripheral neuropathy due to TOS, carpal tunnel syndrome, or traumatic neuropathy evaluated through clinical interrogation, physical examination, upper limb magnetic resonance imaging, and electromyography.

All participants gave their prior written informed consent before being included in the study. The study was reviewed by an internal scientific committee and exempted from approval by an ethics committee due to its nature as non-interventional and low-risk research. Data were processed and safeguarded based on the national personal data protection laws, and the study was conducted in accordance with the Mexican Official Standard NOM-012-SSA3-2012, which sets criteria for conducting health research projects involving human subjects.

Metric properties and validation of the DASH questionnaire

To evaluate the metric properties of the Mexican version of the DASH questionnaire, ceiling and floor effects, item-total correlation, and central tendency measures for each item and total score in the tool were estimated in all participants and study groups.

The internal consistency of the scale, that is, the homogeneity of the items concerning the entire tool, was evaluated by calculating Cronbach's alpha²⁰, applied to the total sample and the different groups within it. The precision of the questionnaire was determined by the standard error of measurement (SEM) and the 95% confidence interval of the SEM (SEM₉₅), both estimated as previously described by other authors¹⁹. To determine the validity of using the questionnaire to evaluate upper limb disability due to neurogenic disorders, scores from healthy patients were compared with those with some condition, as well as between cases grouped according to the specific upper limb disorder (TOS vs peripheral neuropathy). Additionally, comparisons were drawn among all study participants categorized by age, sex, education level, and comorbidity presence. The longitudinal validity of the questionnaire regarding its ability to estimate the response to change was analyzed by comparing baseline and post-treatment scores in a subgroup of individuals with TOS undergoing anterior scalenotomy.

Statistical analysis

Descriptive statistics with central tendency measures was used to characterize the study population. Categorical variables were expressed as absolute and relative frequencies (percentages), while the continuous ones were analyzed using the Kolmogorov-Smirnov test to determine the normality of their distribution. Quantitative variables with normal distribution are described in terms of means with standard deviation or range, and median with interquartile range for non-normally distributed data. Differences between the 2 groups were estimated using Fisher's exact test or the chi-square test for qualitative variables, while quantitative variables were analyzed using the Mann-Whitney U test, the Kruskal-Wallis test with Dunn's test, or Wilcoxon test, as appropriate. All analyses were conducted using GraphPad Prism version 8 (La Jolla, CA, United States). Specific statistical tests are also mentioned in the table footnotes. P-values < 0.05 (two-tailed) were considered statistically significant.

Results

Study population

A total of 478 participants were considered in the validation cohort and completed the Mexican version

of the DASH questionnaire. Of these, 35.7% were men and 64.2% were women, with a median age of 37 years and a range of 15-91 years. Most participants were of mixed race (96.23%). This population was divided into 442 volunteers considered controls for the validation of the tool use in the general Mexican population due to the absence of an objectively diagnosed neurogenic upper limb disorder, being 36.65% men and 63.34% women, with a median age of 35 years and a range from 15 to 91 years. On the other hand, the second group consisted of 36 individuals considered cases due to a demonstrated upper limb neurogenic disorder. This group included a total of 25% men and 75% women, with a median age of 55 years and a range from 23 to 78 years. In both groups, the predominant education level in our population was college level at 42.40%, followed by high school education at 37.34%. The primary place of origin was Mexico City, at 53.97%, followed by the State of Mexico at 23.64%. Regarding participant comorbidity, alcoholism predominated at 44.56%, followed by anxiety at 35.84% and depression at 34.10%. Anthropometric data and other demographic characteristics of the study population are summarized in table 1. It is worth mentioning that statistically significant differences were found in age, height, body mass index, and the proportion of individuals with primary hypothyroidism between the study groups, while the rest of their demographic and anthropometric characteristics were similar.

Metric properties and validity of the Mexican version of the DASH questionnaire

The cultural adaptation from the Spanish version of the DASH questionnaire to the Mexican population proved equivalent to the previously approved version by the Institute for Work and Health for Mexican Spanish (https://dash.iwh.on.ca/sites/dash/public/translations/DASH_Spanish_Mexico_2018.pdf). However, despite its previous approval and use in some small case series of Mexican patients with rheumatological hand disorders²¹, the metric properties and validity of this version had not been formally evaluated in a clinical study with a large sample size. As shown in table 2, the application of the adapted questionnaire to our total study population demonstrated acceptable metric properties, with 100% of computable data, meaning no eligible patient omitted or refused to

complete the questionnaire. Furthermore, the ceiling and floor effects were within optimal parameters in the total sample and its groups. Regarding internal consistency, Cronbach's alpha result was determined at a value > 0.96 in the total number of study participants, with this parameter being 0.95 in controls and 0.96 in cases; both values indicating item homogeneity concerning the total questionnaire score and being similar to the consistency of the original version⁵. This means that the version applied to our population is equivalent in both the general population and subjects with a prior diagnosis of neurogenic disorder, despite the limited number of cases included in the study.

The mean, median, and central tendency measures of the questionnaire score in the overall sample showed a low level of upper limb disability. However, as expected, the scores were higher in cases vs controls. Tables 3 and 4 show the descriptive statistics of each item in the total study population and cases with neurogenic upper limb disorders, respectively. Finally, the precision in terms of SEM₉₅ was 7.25 points overall, meaning that for a given questionnaire application at a specific time, the real value could be 7.25 points above or below the obtained value, with a 95% confidence. Table 5 shows the correlation between the demographic characteristics of the study participants and their questionnaire scores. As shown, the score presented significant differences between sexes, some age groups, and segments of the population with different education levels. Finally, table 6 illustrates the results of the questionnaire's validity evaluation. Significant differences in scores were documented between controls and cases, as well as between cases grouped by the specific etiology of their disorder. Additionally, a significant decrease in the questionnaire score was observed post-treatment in a group of TOS patients compared to their baseline level. Together, these results provide preliminary data on the usefulness of the DASH questionnaire adapted to the Mexican population as a sensitive tool for detecting changes in severity and response to treatment of neurogenic disorders affecting upper limb function, evaluated from the patient's perspective.

Discussion

Various disorders of neurogenic origin cause signs and symptoms that directly affect upper limb function. For example, in individuals with structural alterations due to traumatic, degenerative, or idiopathic processes of the cervical spine that cause radiculopathy or

Table 1. Characteristics of the validation cohort

Characteristics	Total	Controls	Cases	p
Age, years (range)	37 (15-91)	35 (15-91)	55.5 (23-78)	< 0.0001
Sex, n (%):				
Male	171 (35.77)	162 (36.65)	9 (25)	0.20
Female	307 (64.22)	280 (63.34)	27 (75)	
Race, n (%):				
White	17 (3.55)	16 (3.61)	1 (2.77)	> 0.99
Mestizo	460 (96.23)	425 (96.15)	35 (97.22)	
Black	0	0	0	
Indigenous	0	0	0	
Asian	0	0	0	
Education level, n (%):				
Illiterate	11 (2.32)	11 (2.51)	0	0.99
Primary	30 (6.32)	27 (6.16)	3 (8.33)	0.48
Secondary	41 (8.64)	34 (7.76)	7 (19.44)	0.02
High School	177 (37.34)	165 (37.67)	12 (33.33)	0.72
University	201 (42.40)	188 (42.92)	13 (36.11)	0.48
Graduate	14 (2.95)	13 (2.96)	1 (2.77)	> 0.99
Origin, n (%):				
Mexico City	258 (53.97)	236 (53.39)	22 (61.11)	0.39
State of Mexico	113 (23.64)	104 (23.52)	9 (25)	0.83
Puebla	11 (2.30)	10 (2.26)	1 (2.77)	0.58
Oaxaca	53 (11.08)	51 (11.53)	2 (5.55)	0.40
Nuevo León	3 (0.62)	3 (0.67)	0	> 0.99
Hidalgo	6 (1.25)	6 (1.35)	0	> 0.99
Chiapas	21 (4.39)	19 (4.29)	2 (5.55)	0.66
Jalisco	2 (0.41)	2 (0.45)	0	> 0.99
Veracruz	2 (0.41)	2 (0.45)	0	> 0.99
Querétaro	2 (0.41)	2 (0.45)	0	> 0.99
San Luis Potosí	1 (0.20)	1 (0.22)	0	> 0.99
Morelos	1 (0.20)	1 (0.22)	0	> 0.99
Tlaxcala	1 (0.20)	1 (0.22)	0	> 0.99
Yucatán	1 (0.20)	1 (0.22)	0	> 0.99
Guanajuato	1 (0.20)	1 (0.22)	0	> 0.99
Sinaloa	1 (0.20)	1 (0.22)	0	> 0.99
Anthropometrics				
Height, m (range)	1.62 (1.56-1.71)	1.62 (1.56-1.71)	1.56 (1.50-1.64)	0.003
Weight, kg (range)	68.5 (61-80)	68.5 (60.55-80.0)	68.50 (62.78-76.75)	0.95
BMI, kg/m ² (range)	26 (23.3-28.8)	25.9 (23.26-28.72)	27.41 (25.04-30.51)	0.01
Comorbidities, n (%):				
Anxiety	171 (35.84)	162 (36.73)	9 (25)	0.20
Depression	163 (34.10)	153 (34.61)	10 (27.77)	0.46
Hypertension	39 (8.17)	34 (7.70)	5 (13.88)	0.20
Diabetes	25 (5.2)	25 (5.65)	00	0.24
SAHOS	1 (0.20)	1 (0.22)	0	> 0.99
Hypothyroidism	7 (1.46)	4 (0.90)	3 (8.33)	0.01
Alcoholism	213 (44.56)	199 (45.02)	14 (38.88)	0.49
Smoking	100 (20.92)	89 (20.13)	11 (30.55)	0.14

BMI: body mass index; OSAHS: obstructive sleep apnea-hypopnea syndrome.

Differences between groups were estimated using Fisher's exact test for categorical variables and the Mann-Whitney U test for quantitative variables.

myelopathy, significant neurological signs, such as radicular pain, sensory alterations like paresthesias and dysesthesias, muscle weakness, and atrophy may occur, damaging the thoracic limb proximal and distal portions. Similarly, compressive or traumatic

changes to the peripheral nerves that innervate the upper limbs can cause a spectrum of similar signs, but with varying severity depending on the mechanism of damage to the neurovascular bundle, disease chronicity, and the level of damage^{1,2}. Importantly,

Table 2. Metric properties of the DASH questionnaire Spanish version for Mexico

Characteristics	Total	Controls	Cases
Computable data	100%	100%	100%
Mean	42.88	40.07	77.39
Standard deviation	18.59	14.7	25.8
Median	35	34	74
Interquartile range	31-46	31-43	56-95
Ceiling effect, n (%)	5 (1.05)	0	5 (13.88)
Floor effect, n (%)	94 (19.66)	94 (21.26)	0
Cronbach's alpha	0.9602	0.9512	0.9692
SEM	3.70	3.24	4.52
Cross-sectional precision (SEM95)	7.25	5.20	8.87

SEM: standard error of measurement; SEM₉₅: 95% confidence interval of the SEM.

some of these disorders can improve if they receive timely medical therapy and physical rehabilitation or definitive treatment through surgical decompression.

The ability to objectively measure the severity of upper limb involvement by the above-mentioned conditions, and the possibility to determine the benefit provided by therapeutic interventions, is crucial in decision-making and has the potential to impact the functional outcome of patients with upper limb disorders. However, currently there is a growing focus on improving the quality of health care in terms of the influence of interventions on restoring quality of life and reintegration into the patients' activities of daily living.

Despite this, regarding neurogenic upper limb disorders, and particularly during their evaluation and treatment by the neurosurgery area, there is a wide variety of objective methods such as clinical scales, imaging modalities, and neurophysiological studies to conduct initial assessments of clinical complexity and subsequently the effectiveness and resolution of each from the treating physician's perspective. Setback is that they omit the patient's perspective on their own disease. Therefore, it is ideal to consider both the medical perspective and the patient's subjective experience regarding the impact of the disease on their daily lives, as this integral consideration can also be decisive regarding medical/surgical approach and management, as it allows for a comprehensive evaluation of all aspects influencing the patient's prognosis. In particular, this becomes even more important since there

Table 3. Item-total correlation, mean score, median score, and range by item

Item	Item-total correlation	Mean (SD)	Median (IQR)	Range
Q1	0.67	1.6 (1.0)	1 (1-2)	1-5
Q2	0.57	1.2 (0.6)	1 (1-1)	1-5
Q3	0.65	1.2 (0.6)	1 (1-1)	1-5
Q4	0.65	1.2 (0.7)	1 (1-1)	1-5
Q5	0.74	1.5 (0.9)	1 (1-2)	1-5
Q6	0.79	1.4 (0.9)	1 (1-2)	1-5
Q7	0.80	1.5 (0.9)	1 (1-2)	1-5
Q8	0.55	1.2 (0.6)	1 (1-1)	1-5
Q9	0.72	1.2 (0.6)	1 (1-1)	1-5
Q10	0.76	1.4 (0.8)	1 (1-2)	1-5
Q11	0.76	1.7 (1.1)	1 (1-2)	1-5
Q12	0.78	1.5 (1.0)	1 (1-2)	1-5
Q13	0.68	1.2 (0.6)	1 (1-1)	1-5
Q14	0.73	1.4 (0.9)	1 (1-2)	1-5
Q15	0.70	1.1 (0.6)	1 (1-1)	1-5
Q16	0.72	1.1 (0.6)	1 (1-1)	1-5
Q17	0.57	1.1 (0.5)	1 (1-1)	1-5
Q18	0.71	1.5 (0.9)	1 (1-2)	1-5
Q19	0.78	1.5 (0.9)	1 (1-2)	1-5

SD: standard deviation; IQR: interquartile range.

is not always a correlation and equivalence between clinical-radiological findings and their actual impact on the functional performance of affected individuals²².

Unfortunately, there are still few valid tools to understand patients' views regarding the neurogenic disorders affecting their upper limbs. In fact, many known tools are aimed at evaluating only some anatomical segments of the thoracic limbs and are generally used in other specialties, particularly in orthopedic surgery^{3,4}. One of these tools is the DASH questionnaire, which has the particularity of being adaptable to different circumstances as it evaluates upper limb disability considering it as a unique functional entity⁷. This questionnaire was originally validated in English, and despite existing Spanish versions, its use in a different sociocultural context requires a new linguistic adaptation, even if it is the same language¹⁹, first in the general population, which allows evaluating the

Table 4. Item-total correlation, mean score, median score, and range by item in individuals with upper limb disorders

Item	Item-total correlation	Mean (SD)	Median (IQR)	Range
Q1	0.56	3.2 (0.8)	3 (3-4)	1-5
Q2	0.74	1.8 (1.2)	1 (1-3)	1-5
Q3	0.55	2.1 (1.2)	2 (1-3)	1-5
Q4	0.85	2.0 (1.4)	1 (1-3)	1-5
Q5	0.66	2.6 (1.4)	3 (1-4)	1-5
Q6	0.80	2.5 (1.5)	3 (1-4)	1-5
Q7	0.80	3.0 (1.4)	3 (2-4)	1-5
Q8	0.76	1.9 (1.3)	1 (1-3)	1-5
Q9	0.82	2.2 (1.2)	2 (1-3)	1-5
Q10	0.79	2.5 (1.4)	3 (1-3)	1-5
Q11	0.67	3.0 (1.2)	3 (2-4)	1-5
Q12	0.89	2.2 (1.5)	1 (1-3)	1-5
Q13	0.76	2.2 (1.4)	1 (1-3)	1-5
Q14	0.76	2.3 (1.5)	1 (1-4)	1-5
Q15	0.92	1.9 (1.3)	1 (1-3)	1-5
Q16	0.91	2.0 (1.4)	1 (1-3)	1-5
Q17	0.82	1.7 (1.3)	1 (1-2)	1-5
Q18	0.81	2.7 (1.5)	3 (1-4)	1-5
Q19	0.77	2.7 (1.5)	3 (1-4)	1-5
Q20	0.82	2.1 (1.3)	1 (1-3)	1-5
Q21	0.88	2.1 (1.5)	1 (1-3)	1-5
Q22	0.84	2.0 (1.2)	1 (1-3)	1-5
Q23	0.77	2.2 (1.4)	2 (1-3)	1-5
Q24	0.30	2.8 (1.2)	3 (1-4)	1-5
Q25	0.44	2.6 (1.3)	3 (1-4)	1-5
Q26	0.26	2.3 (1.2)	2 (1-3)	1-5
Q27	0.43	2.2 (1.3)	2 (1-3)	1-5
Q28	0.44	2.1 (1.3)	1 (1-3)	1-5
Q29	0.80	2.5 (1.5)	2 (1-4)	1-5
Q30	0.88	2.5 (1.4)	2 (1-4)	1-5

SD: standard deviation; IQR: interquartile range.

acceptance of textual adjustments in the sociocultural context to which the re-adaptation is directed, and then in individuals with confirmed upper limb disorders. Therefore, in this study, we applied a version suitable for the Mexican population and validated its

Table 5. Correlation between participants' characteristics and the score on the DASH scale in Spanish for Mexico

Characteristics	DASH	p
Age (years)		
< 20	36 (31-47)	0.0001*
20-30	34 (31-41)	
30-40	33 (30-37)	
40-50	34 (31-56)	
50-60	35 (31-51)	
> 60	43 (32-60)	
Sex		
Male	33 (30-39)	< 0.0001
Female	37 (32-49)	
Education level		
Illiterate	39 (33-43)	0.0003†
Primary	54 (37-78)	
Secondary	36 (31-68)	
High School	34 (31-44)	
University	34 (31-44)	
Graduate	34 (31-45)	
Comorbidities		
No	36 (31-45)	0.46
Yes	35 (31-46)	

*Significant differences were observed between the groups 20-30 years vs > 60 years (p = 0.0004) and 30-40 years vs > 60 years (p = 0.0001).

†Differences were observed between the groups primary vs high school (p = 0.0001) and primary vs university (p = 0.0001).

Differences between groups were estimated using the Mann-Whitney U test and the Kruskal-Wallis/Dunn test as appropriate.

use as a useful tool to understand, first, the linguistic equivalence of this tool for use in the Mexican population, and second, the validity to estimate the impact of neurogenic disorders (such as cervical radiculopathy, TOS, carpal tunnel syndrome, and traumatic peripheral neuropathy) on quality of life.

When applying the DASH questionnaire, we identified that some concepts were not suitable for our Mexican population, so an adaptation of concepts to more common words in our country's context was made. For this purpose, we ensured that the words changed did not affect the concept of the question in the existing Spanish version of the DASH, using synonyms appropriate to our culture so that the items were equivalent¹⁹. This avoids language bias, facilitates its application, makes the results of this tool more reliable, and positions the DASH questionnaire as a valuable option for evaluating upper limb disability from the patient's perspective in the neurosurgery area.

Results indicate equivalence of the version resulting from our study with the previously proposed one¹⁶, which, when applied to our population, has similar properties vs the Spanish and original English

Table 6. Validity of the DASH scale in Spanish for Mexico

Validity Criterion	DASH	Difference	Cohen's d	Effect Size	p
Validity by severity					
Controls	34 (31-43)	40	-	-	< 0.0001
Cases	74 (56-94)				
Validity by severity					
Radiculopathy	57 (47-89)	34	-	-	0.04
TOS	91 (69-97)				
Longitudinal validity*					
Pretreatment	93 (73-97)	60	4.32	0.9	< 0.0001
Posttreatment	32 (30-34)				

TOS: thoracic outlet syndrome.

*Evaluated in patients with TOS undergoing surgical treatment.

Differences between groups were estimated using the Mann-Whitney U test. Differences between pre- and post-treatment scores were estimated with the Wilcoxon test.

versions^{5,14,15}, which is backed by the measurements of the questionnaire metric properties, including item-total correlation determinations, floor effect, ceiling effect, cross-sectional precision, and internal consistency between its items and total score. Therefore, our observations indicate that this questionnaire can be self-administered with a high level of confidence in the Mexican population. It is interesting that when comparing the questionnaire scores in our entire validation cohort, we found significant differences between sexes, with the baseline degree of disability being higher in women than in men. This had previously been observed in observational studies²³, although it may also be due to a higher proportion of women with TOS in the case group in our study.

We also identified differences between people of different age groups, with the highest degree of baseline disability in participants older 60 years old, which had also been documented in an arm disability study in German workers²⁴. Finally, we observed a higher degree of disability in people with primary education compared to those with high school and university levels, which could be related to the different jobs performed by people with different education levels. It is worth mentioning that our study includes a wide range of age, education, and comorbidity groups, so some parameters observed in our research could have epidemiological application.

Finally, we could validate the use of the questionnaire to detect changes in the severity of upper limb disability from the patient's perspective. Thus, we demonstrated that the Mexican version of the DASH questionnaire is useful for identifying a change in the severity of disability between healthy individuals and those with

neurogenic upper limb disorders, as well as between groups with different disability etiologies. Finally, the version validated in this study proved sensitive to detecting a change in the perspective of patients with TOS when comparing scores obtained before and after surgical treatment of this condition, corroborating what our group had previously documented²⁵. However, of note that a significant limitation of the study was the limited number of individuals with demonstrated upper limb disorders, which must be considered when interpreting the results. Despite this, our results should not be disregarded as they constitute useful preliminary evidence for future studies, in addition to demonstrating more than acceptable internal consistency in cases and controls, which showed comparable Cronbach's alpha values. Therefore, this study sets a precedent for conducting further studies aimed at understanding the degree of disability specifically in Mexican individuals with various upper limb disorders.

Conclusions

A cultural adaptation and validation of the Spanish version of the DASH questionnaire for the Mexican population were carried out. Our results show that this tool can be used with a high level of confidence, proving its utility in evaluating various neurogenic upper limb disorders and their influence and impact on quality of life from the patients' perspective. Therefore, the DASH questionnaire should be considered among the useful clinical-metric tools in research studies aimed at assessing the impact of these disorders on quality of life, as well as in their monitoring and post-treatment follow-up.

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Conflicts of interest

None declared.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained approval from the Ethics Committee for analysis and publication of routinely acquired clinical data and informed consent was not required for this retrospective observational study.

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