ORIGINAL PAPER

Physiotherapy Quarterly (ISSN 2544-4395)
2024, 32(2), 54–61

Cross-cultural adaptation of the Arabic version of the Disability Rating Scale among caregivers of patients with traumatic brain injury

DOI: https://doi.org/10.5114/pq/161722

Abdulaziz Alqahtani[1], Mohamed K. Seyam[2], Faizan Kashoo[2], Mazen Alqahtani[2,3], Mohammad Abu Shaphe[4], Ezzat Moubarak[5], Ghada Shawky[2], Gopal Nambi[6], Aksh Chahal[7], Mehrunnisha Ahmad[8]

[1] General Administration of Health Affairs, Ministry of Health Department, Riyadh, Saudi Arabia
[2] Department of Physical Therapy and Health Rehabilitation, College of Applied Medical Sciences, Majmaah University, Al Majmaah, Saudi Arabia
[3] College of Applied Sciences, Almaarefa University, Riyadh, Saudi Arabia
[4] Department of Physical Therapy, College of Applied Medical Science, Jazan University, Saudi Arabia
[5] Department of Rheumatology and Rehabilitation, College of Physical Therapy, Zagazig University Hospital, Al-Sharqia Governorate, Egypt
[6] Department of Health and Rehabilitation Sciences, College of Applied Medical Sciences, Prince Sattam bin Abdulaziz University, Al Kharj, Saudi Arabia
[7] Department of Physiotherapy, School of Allied Health Sciences, Galgotias University, Greater Noida, Uttar Pradesh, India
[8] College of Nursing, Majmaah University, Al Majmaah, Saudi Arabia

Abstract

Introduction. The Disability Rating Scale (DRS) is a short, efficient, rapid instrument for monitoring general functional recovery from moderate to severe traumatic brain injury (TBI). The 8-item DRS is a published and validated assessment instrument but has not yet been adapted to native Arabic-speaking caregivers of patients with TBI. This study aimed to translate, cross-culturally adapt, and test the reliability of the Arabic version of the DRS.

Methods. Cross-cultural adaptation and translation were performed according to the recommended guidelines: translation, back-translation, expert review, and pretesting. Reliability was assessed via a test-retest procedure at 2-week intervals using the Kappa coefficient among 42 caregivers of patients with TBI.

Results. The agreement among the raters was excellent, varying from 0.88 to 1. Translating the DRS into Arabic was easy based on the translators' information. The test-retest reliability was excellent (interclass correlation coefficient = 0.99 with a 95% CI 0.998 to 0.999 [$F(41) = 1100.7$, $p < 0.001$]. The Cronbach's alpha for the internal consistency of the DRS was 0.917. There was good agreement (convergent validity) between the DRS scores with the Short Form 36 Health Survey Questionnaire [$rs(42) = 0.895$, $p = 0.001$].

Conclusions. The Arabic version of the DRS can be used among Arabic-speaking caregivers of patients with TBI. The Arabic translated version of the DRS can be used among caregivers of patients with TBI telephonically by expert professional. The translated questionnaire was easy to comprehend among caregivers of patients with TBI, with excellent test re-test reliability and good convergent validity.

Key words: traumatic brain injury, translation, Arabic, reliability, cultural adaptation, questionnaire, validation

Introduction

Traumatic brain injury (TBI) is a physical injury to the brain tissue that results in temporary or permanent impairment of brain function. TBI remains the leading cause of morbidity and mortality among all age groups worldwide [1]. The most common causes of TBI are falls, violence, and vehicle accidents [2]. It is estimated that 69 million (95% CI 64–74 million) individuals experience TBI annually worldwide [3], particularly in Arab countries [4]. The rate of incidence of TBI in Saudi Arabia has been estimated to be 116 per 100,000 people [5]. Patients treated for TBI incur an average annual cost of 77,657 Saudi Riyal [6]. Despite this, there is a paucity of data on the epidemiology, social characteristics, and factors influencing TBI rehabilitation outcomes.

The National Institute of Neurological Disorders and Stroke (NINDS) recommended four scales/surveys to assess global outcomes (domains) in adults with TBI. These four scales/surveys are the Glasgow outcome scale/Extended, Short Form-12 Health Survey (SF-12), Short Form-36 Medical Outcome (SF-36), and Disability Rating Scale (DRS). The global outcome domain measures the overall impact of TBI on functional status, independence, and role participation. The Glasgow Outcome Scale Extended is an eight-item scale used primarily by researchers in clinical trials. The outcome is evaluated through a structured interview with the patient alone or together with a caretaker. Moreover, there are scales that are self-reported by patients or caregivers to determine the progress and treatment efficacy [7]. In Arabic-speaking countries, the use of English-validated scales is limited due to the language barrier. There is an increasing demand for cross-culturally adapted and validated tools in Arabic-speaking countries for research purposes and for clinicians [8]. A review conducted in 2012 reported that cross culturally adapted and validated tools such as health related quality of life measures are scarce in Arabic countries [9].

Correspondence address: Faizan Kashoo, Department of Physical Therapy and Health Rehabilitation, College of Applied Medical Sciences, Majmaah University, Al Majmaah 11952, Saudi Arabia, e-mail: f.kashoo@mu.edu.sa; https://orcid.org/0000-0002-8272-674X

Received: 07.10.2022
Accepted: 27.02.2023

Citation: Alqahtani A, Seyam MK, Kashoo F, Alqahtani M, Shaphe MA, Moubarak E, Shawky G, Nambi G, Chahal A, Ahmad M. Cross-cultural adaptation of the Arabic version of the Disability Rating Scale among caregivers of patients with traumatic brain injury. Physiother Quart. 2024;32(2):54–61; doi: https://doi.org/10.5114/pq/161722.

The DRS is an 8-item outcome measure that was developed to evaluate functional disability in patients with moderate-to-severe TBI [10–12]. The questionnaire was used to monitor the patient's recovery from being in a coma to returning to the community [13]. It measures recovery in terms of three constructs: impairment, disability, and handicap. Impairment is assessed through three items: eye-opening, communication ability, and motor response. Disability is evaluated via the ability to perform feeding, toileting, and personal hygiene. Handicap is evaluated by assessing the individual's functional ability. The lowest score is 0, which represents no disability. The highest score is 29 and represents an extreme vegetative state. The advantage of this scale is that it can be self-administered or evaluated through an interview with the participant or caregivers by telephone. During the COVID-19 pandemic, this scale could have been given over the phone as part of telerehabilitation [14]. It is short and easy to use, making it a popular rating scale among clinicians for assessing the outcome of TBI. The average time required to complete the questionnaire was approximately 10 min [15]. Many newly developed scales have been validated through the DRS, such as the Coma Recovery Scale [16], the Mayo Portland Adaptability Inventory [17], the Supervision Rating Scale [18], and the Community Integration Questionnaire [19]. The Disability Rating Scale (DRS) is a commonly preferred scale among clinicians to evaluate functional recovery among patients with TBI from the hospital to the community. However, its usage in Arabic-speaking countries is limited because of the lack of availability of a cross-culturally adapted and validated Arabic version of the DRS.

Translation and cultural adaptation are essential to validate its consistency with the original version and to address linguistic barriers in non-English-speaking nations. This study aimed to translate and adapt the English version of the DRS into Arabic and determine its psychometric properties (reliability, internal consistency, convergent validity) with Arabic-speaking caregivers of patients with TBI.

Subjects and methods

Study design and settings

A cross-sectional approach was used in the present study. The study was reviewed by the Institutional Review Board of Majmaah University and approved on 28-02-2021, with approval no. MUREC-Feb. 28/COM-2021124-3. The study was conducted in accordance with the principles of the Declaration of Helsinki and in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The retrospective medical records in King Khalid Hospital for 2010–2021 were searched in March 2021. A total of 204 traumatic brain injury cases at King Khalid Hospital, Riyadh, Saudi Arabia were identified from the medical records at the King Khalid Hospital. The invitation to participate was sent through email and a direct telephone invitation to 204 caregivers and patients. Out of 204, 104 responded (50.9% response rate) (Figure 1). Out of 104, 59 caregivers met the inclusion criteria. Consent forms, questionnaires and a detailed description of each item of the questionnaire (Appendix) were sent through email to 59 caregivers of patients with TBI. A telephone interview was scheduled with the caregivers of the patients with TBI as per their convenience. Non-respondents were given three consecutive reminders (1-week interval) until all communication was stopped. There were 42 complete responses from caregivers of patients with TBI.

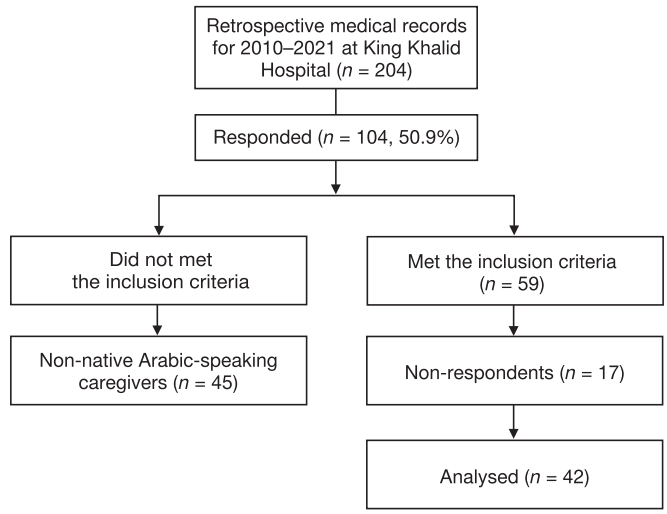

Figure 1. Flowchart of the sample population, respondents, inclusion, and analysis

Participants

Forty-two native Arabic speakers who were involved in caring for patients with TBI were invited to participate in the study. The caregivers and patients who agreed and consented to participate were requested to answer questions from the DRS-Ar and SF-36 via telephone. A brief introduction about the DRS-Ar was provided to the caregivers by the first author of this study, who has more than 10 years of experience with TBI. A telephone interview was conducted based on the recommended guidelines from previous research [15]. A detailed description of each item of the DRS was provided to each participant through email. Caregivers were advised to read the documents before the commencement of the telephone interview (Appendix). All patients were diagnosed by neurological physicians based on clinical and radiological findings. The inclusion criteria were as follows: native Arabic-speaking caregivers who were actively involved in taking care of the day-to-day activity of patients with TBI. The caregivers were required to read, write, and comprehend a simple dialect and vocabulary of Arabic that was easily understood by all Arabic speakers, regardless of the country. The exclusion criteria were patients with clinical or radiological findings suggestive of spinal cord injury, patients with neurological disease before TBI or lesions not due to TBI, and patients with orthopaedic deformities, such as arthritis of joints, fractures, or dislocations of joints. The general characteristics of the participants are presented in Table 1.

Translation of questionnaire

Cross-cultural adaptation was carried out in two stages, as per the standard procedures [20]: translation and cross-cultural adaptation, and assessment of the psychometric properties. The first stage was conducted following published recommendations for cross-cultural adaptation of the questionnaire [20]. The second stage involved testing the reliability and validity of the translated questionnaire. The steps followed to perform the cross-cultural translation and reliability testing were (1) forward translation, (2) synthesis, (3) backward translation, (4) expert committee evaluation, (5) pretesting, and (6) psychometric evaluation (Figure 2).

(1) Forward translation: The adaptation began with a forward translation by two bilingual independent translators who were proficient in English and were native Arabic speakers. The first translator was a clinical physiotherapist who was

Table 1. Sociodemographic characteristics of participants

Variables	Caregivers	Patient with TBI
Sex		
Male [*n* (%)]	25 (59.5)	33 (78.6)
Female [*n* (%)]	17 (40.5)	9 (21.4)
Age (years) (mean ± *SD*)	30.7 ± 6.7	36.1 ± 13.0
BMI (kg/m^2) (mean ± *SD*)	NA	25.5 ± 5.3
Year of head injury		
2010–2013 [*n* (%)]	NA	6 (14.2)
2014–2016 [*n* (%)]	NA	10 (23.8)
2017–2020 [*n* (%)]	NA	26 (61.9)
Cause of injury		
Road traffic accident [*n* (%)]	NA	31 (73.8)
Sports injury [*n* (%)]	NA	4 (9.5)
Fall [*n* (%)]	NA	5 (11.9)
Assault [*n* (%)]	NA	2 (4.8)
Type of injury		
Concussion [*n* (%)]	NA	1 (2.4)
Diffused axonal injury [*n* (%)]	NA	5 (11.9)
Epidural hematoma [*n* (%)]	NA	4 (9.5)
Subdural hematoma [*n* (%)]	NA	10 (23.8)
Intracerebral hematoma [*n* (%)]	NA	9 (21.4)
Intraventricular hematoma [*n* (%)]	NA	7 (16.7)
Subarachnoid hematoma [*n* (%)]	NA	6 (14.3)
Education level of caregivers		
Primary [*n* (%)]	4 (9.5)	NA
Secondary [*n* (%)]	20 (47.6)	NA
Bachelor [*n* (%)]	18 (42.9)	NA
DRS level of disability		
Mild [*n* (%)]	NA	1 (2.4)
Moderate [*n* (%)]	NA	4 (9.5)
Moderately severe [*n* (%)]	NA	9 (21.4)
Severe [*n* (%)]	NA	9 (21.4)
Extreme severe [*n* (%)]	NA	8 (19.0)
Vegetative [*n* (%)]	NA	2 (4.8)
Extremely vegetative [*n* (%)]	NA	9 (21.4)
SF-36 scores (mean ± *SD*)	NA	21.2 ± 9.7
DRS baseline scores (mean ± *SD*)	NA	16.2 ± 8.2

BMI – body mass index, DRS – Disability Rating Scale, SF-36 – Short Form Survey 36-item, NA – not applicable

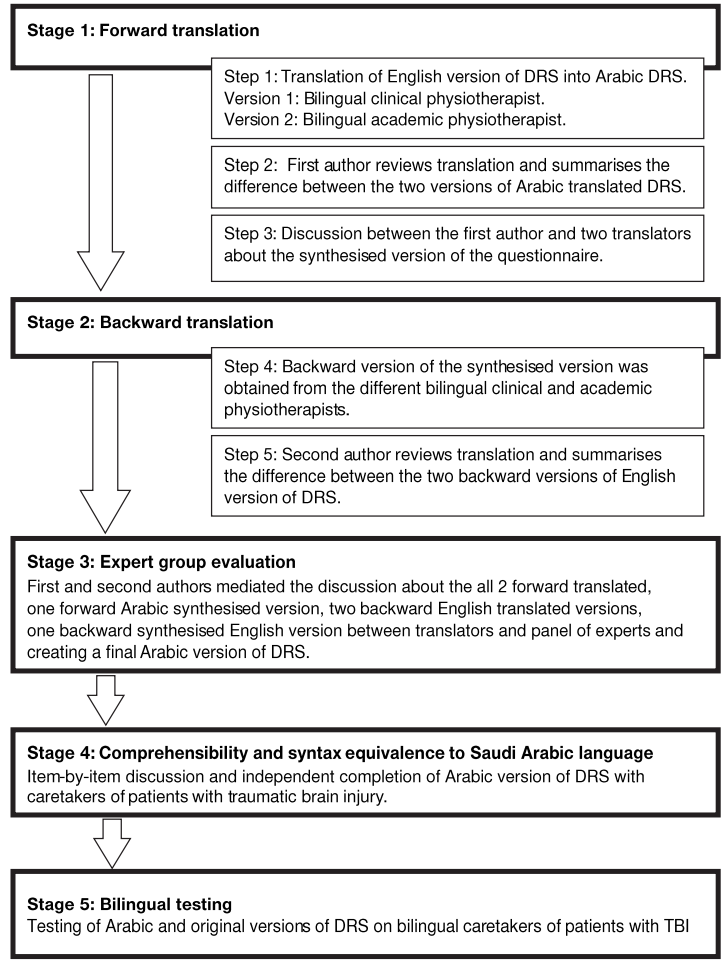

Figure 2. Translation and pilot testing of the Arabic version of Disability Rating Scale

aware of the concept and purpose of the questionnaire, while the second translator was an academic staff member teaching computer science who had no knowledge of the questionnaire. Two Arabic-translated versions of the DRS were obtained from the translators (T1 and T2).

(2) Synthesis: The first author, acting as a recording observer, summarised the results of the two versions (T1 and T2) of the DRS. Discrepancies were discussed and resolved through mutual consensus with the translators. Finally, a consolidated Arabic version of the DRS (T12) was generated.

(3) Backward translation: T12 was back-translated into English by two native English translators (a professor at the Department of Epidemiology and a professor at the Medical Laboratory Technology) who were also proficient in the Arabic language. Both translators were blinded to the original version of the questionnaire and were unaware of the questionnaire's purpose and concept. The two back-translated English versions (BT1, BT2) were combined into one document by the second author of this paper, who acted as a recording observer, and any discrepancies were resolved through consensus between both translators (BT12).

(4) Review by an expert committee: The expert committee comprised ten members who had knowledge and expertise in the field of study of the questionnaire. The expert committee consisted of one head trauma specialist, one general physician, two senior clinical therapists, one language professional, and all five authors of this study. Each expert committee member reviewed and compared all versions of the questionnaire (T1, T2, T12, BT1, BT2, and BT12) to develop a pre-final version. Expert committee members used item-

objective congruence (IOC) ratings to independently evaluate each item on the scale. A score of +1 indicates clear, 0 indicates slightly unclear, and -1 indicates unclear. The final IOC score was obtained by dividing the total score from each expert by the number of experts. Any item below 0.5, was modified and re-evaluated until the item reached a minimum of 0.5.

The committee members also analysed the semantic, idiomatic, experiential, and conceptual equivalence of the Arabic version of the DRS to the original DRS. When a non-equivalent item was discovered, the committee reviewed it before a decision was made, and the final version of the instrument was tailored to Arabic culture.

(5) Pretesting: The third author conducted face-to-face interviews [21] with 30 native Arabic speakers who were currently involved in taking care of patients with TBI. The participants could read, write, and understand the Saudi Arabic language. The participants were permitted to indicate whether there was anything on the questionnaire that was unclear to them, and these were then reviewed by the expert panel to arrive at the final version. The outcome of this process is the final Arabic DRS (Appendix). The translation followed the most common Arabic dialect used in Saudi Arabia. Therefore, countries having a similar Arabic dialect will find the translated version of the questionnaire easy to comprehend in countries such as Bahrain, Kuwait, Iraq, Oman, Qatar, and the United Arab Emirates [22]. However, countries such as Chad, Algeria, Comoros, Eritrea, Djibouti, Egypt, Palestine, Lebanon, Jordan, Mauritania, Morocco, Somalia, Sudan, Syria, Tanzania, and Tunisia may find the translation difficult to comprehend [22].

Psychometric testing of the Arabic DRS

The Arabic DRS was evaluated for internal consistency, test-retest reliability, and convergent validity among caregivers of patients recruited prospectively at the Department of Physiotherapy at King Khalid Hospital from March 2021 to August 2021.

Reliability testing of the questionnaire: test-retest reliability was assessed with a recommended time gap of 3 weeks between the first and second evaluations [23]. Convergent validity was evaluated by correlating the questionnaire scores with the Arabic RAND 36-Item Health Survey.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 20 was used to analyse the data (SPSS 20, IBM, Armonk, NY, USA). Based on sample size calculations, a sample size of 42 subjects was required to perform this analysis with an alpha of 0.5 and a power of 80%. The characteristics and observations of the quantitative and qualitative variables were summed using the mean, standard deviation (*SD*), and frequencies or relative frequencies. The normality of the scores from the different instruments was examined using the one-sample Kolmogorov–Smirnov test. The internal accuracy, test-retest reliability, and convergent validity of the two scales used in the analysis were examined. We were able to determine the internal consistency of the Arabic DRS using Cronbach's alpha index, with values between 0.70 and 0.90 considered satisfactory [24]. For test-retest reliability, interclass correlation coefficients (ICCs) and 95% confidence intervals (CIs) were determined. ICCs below 0.40 were considered low, those in the range of 0.4–0.70 were considered moderate, those in the range of 0.70–0.90 were considered significant, and values above 0.9 were considered exceptional [24]. The degree of correlation between the Arabic DRS and the SF 36-item subscales at baseline was determined using Spearman's rho correlation. We looked at ceiling and floor results by measuring the number of participants who scored the highest or lowest possible score for each of the 42 responses. Upper and lower bound results were verified if more than 15% of all respondents received the lowest or highest potential score [24]. The significance level was set at $p < 0.05$.

Results

Translation

The Arabic version of the DRS (DRS-Ar; Appendix) was produced after following a standard protocol for cross-cultural adaptation of the questionnaire [20]. Pretesting and recommendations from the expert committee confirmed the face validity of the DRS-Ar.

Internal consistency

Cronbach's alpha was ($\alpha = 0.917$) for the DRS-Ar, which indicates that the test in the Arabic language had excellent reliability. The item-to-total correlations ranged from 0.625 to 0.858, with the highest correlation between Item 5 (toileting; cognitive ability) and Item 6 (grooming) (0.935, $p < 0.001$) and the lowest correlation between Item 1 (eye-opening) and Item 8 (employability) (0.375, $p < 0.005$). The item-total statistics showed that the removal of any item from the questionnaire would lead to a insignificant change in Cronbach's alpha. The deletion of item 3 (motor response) would improve the Cronbach's alpha to 0.925 and deletion of item 7 (level of functioning) would decrease Cronbach's alpha to 0.895.

The Cronbach's alpha for the three-factor structure of the DRS-Ar was 0.830. The inter-item correlation was highest between disability (factor 2) and handicap (factor 3) (0.853, $p < 0.001$) and lowest between impairment (factor 1) and handicap (factor 3) (0.739, $p < 0.001$). The results of the internal consistency assessments for the DRS-Ar are reported in Table 2.

Test-retest reliability

The test-retest reliability was assessed among caregivers of patients with TBI. The questionnaire was initially introduced and repeated after 2 weeks. The 2-week interval was chosen to avoid memorisation of answers and because it was assumed that a 2-week interval may not lead to clinically significant improvement among TBI patients. The mean ± *SD* of the DRS-Ar-1(test) and DRS-Ar-2 (retest) were 16.45 ± 8.05 and 16.29 ± 8.200, respectively. A Kolmogorov-Smirnov test indicates that the DRS-Ar-1(test) and DRS-Ar-2 (re-test) follow a normal distribution, $D\ (42) = 0.119$, $p = 0.146$ and $D\ (42) = 0.119$, $p = 0.150$, respectively. The average ICC was 0.999 with a 95% confidence interval from 0.998 to 0.999 ($F\ (41) = 1100.7$, $p < 0.001$).

The test-retest reliability between the factor structure of the DSR-Ar1 and DSR-Ar-2 was assessed for impairment, disability, and handicap. For impairment, the average ICC was 0.999, with a 95% confidence interval (CI) from 0.998 to 1.00 ($F\ (41) = 3040.8$, $p < 0.001$). For disability, the average ICC was 0.995, with a 95% confidence interval from 0.991 to 0.997 ($F\ (41) = 217.8$, $p < 0.001$). For handicap, the average ICC was 0.998, with a 95% confidence interval from 0.997 to 0.999 ($F\ (41) = 594.9$, $p < 0.001$).

Table 2. Internal Consistency of Arabic Version of Disability Rating Scale (DRS) (N = 42)

Items in DRS	Item-total statistics			
	scale mean if item deleted	scale variance if item deleted	corrected item-total correlation	Cronbach's alpha if item deleted
Eye opening	15.74	52.44	0.752	0.905
Communication	15.19	46.74	0.745	0.906
Motor response	14.19	39.96	0.751	0.925
Feeding	14.38	52.24	0.858	0.900
Toileting	14.40	52.34	0.835	0.901
Grooming	14.33	53.05	0.852	0.901
Level of functioning	12.98	48.70	0.851	0.895
Employability	13.95	56.68	0.625	0.915

Table 3. Spearman correlations matrix between factor structures of DRS-Ar and SF-36

Scale	Factor structure	Impairment	Disability	Handicap	Physical functioning	Limitation due to physical health	Social functioning	Pain	Emotional well-being	Energy/fatigue
DRS-Ar	total impairment									
	total disability	0.771**								
	total handicap	0.797**	0.864**							
SF-36	physical functioning	–0.456**	–0.645**	–0.643**						
	limitation due to physical health	–0.092	–0.273	–0.273	0.354*					
	limitation due to emotional problem	ND	ND	ND	ND	ND	.	.	.	.
	social functioning	–0.815**	–0.792**	–0.783**	0.430**	0.164				
	pain	–0.773**	–0.697**	–0.737**	0.371*	0.24	0.824**			
	emotional well-being	–0.705**	–0.569**	–0.706**	0.275	0.129	0.751**	0.680**		
	energy/fatigue	–0.773**	–0.794**	–0.825**	0.454**	0.221	0.753**	0.756**	0.782**	
	general health	–0.547**	–0.624**	–0.753**	0.462**	0.254	0.648**	0.668**	0.643**	0.736**

DRS-Ar – Disability Rating Scale (Arabic version), SF-36 – Short Health Survey (36 items)
* correlation is significant at the 0.05 level (2-tailed) and because both values equal zero
** correlation is significant at the 0.01 level (2-tailed)

Convergent validity

The Arabic Short Form 36 Health Survey Questionnaire (SF-36) is a scale used to evaluate health-related quality of life. The instrument was used to evaluate perceived health change among patients with TBI [25]. The scale was cross-culturally validated and tested in a native Saudi population [26]. The instrument has eight subscales to measure a person's physical and mental fitness. The physical dimension (PCS) includes physical functionality, functioning in physical tasks, physical discomfort, and general well-being, which may be compared to a similar construct assessed by the DRS. The mental aspect (MCS) consists of the following elements: vitality, social functioning, emotional state, and mental well-being, which can be compared to the disability construct of the DRS. The scores of this scale range from 0 to 100 (higher scores indicate better health status).

The total DSR-Ar score was compared to the SF-36 scores to determine the correlation with Spearman's rank-order correlation. There was a strong negative correlation between these scores that was statistically significant (r (42) = –0.895, p = 0.001).

The three-factor structure of the DRS-Ar was compared to the eight-factor structures of the SF-36. There was a weak, negative correlation between SF-36 item 2 (limitation due to physical health) and DRS-Ar item 1 (impairment; r_s (42) = –0.092, p = 0.564), item 2 (disability; r_s (42) = –0.273, p = 0.080),

and item 3 (handicap; r_s (42) = –0.273, p = 0.080). However, all other correlations between the factor structures of the two scales were statistically significant (Table 3).

Discussion

The DRS-Ar questionnaire measures caregivers' perspectives regarding the health and well-being of patients with TBI. Most of the questionnaires are developed in the English language, and their widespread use is limited due to language barriers and cultural differences. The present study was conducted to translate and adapt an Arabic version of the DRS among caregivers of the Arabic-speaking TBI population. Many research studies have highlighted the scarcity of volunteers participating in clinical trials, partly because of language barriers [27, 28]. The cross-cultural adaptation of questionnaires into Arabic will not only increase participation but can also be utilised to recruit participants in neighbouring Middle Eastern Arabic-speaking countries, such as Bahrain, Kuwait, Iraq, Oman, Qatar, and the United Arab Emirates.

Our study reported excellent internal consistency between the eight items and the three-factor structure (disability, impairment, and handicap) of the DRS-Ar. Similarly, the DRS was recently cross-culturally adapted into a Persian-language version and tested with 191 patients with TBI. The Persian version of the DRS reported excellent internal consistency (Cronbach's alpha 0.96–0.97) at admission and discharge, respectively. It was also reported to be strongly correlated with the GCS and the Functional Independence Measure [29]. These results signify that the 8-item DRS questionnaire, when translated using standard guidelines into other foreign languages, will retain the homogeneity among the items and measure the intended construct adequately.

A study reported that the three-factor structures of the DRS accounted for 82.1%, 58.4%, and 14.8% of the variance due to impairment, disability, and handicap among patients with TBI, respectively. The authors also reported that each factor may act as a clinical tool to predict recovery after TBI [30]. However, in our study, we could not conduct a factor analysis due to small sample size. The reliability (test-retest) of the DRS-Ar showed a very slight deviation between the two ratings from the caregivers separated by two weeks. The slight variation between the test-retest scoring could be due to participants being approached twice within a short span of time, consequently resulting in scoring casually during re-testing. Similarly, a study was conducted to evaluate the test-retest reliability of the DRS and the Levels of Cognitive Functioning Scale among 40 patients with TBI [11]. The study reported that the DRS was sensitive to changes in patients with TBI [11]. A study reported a positive correlation between caregivers' DRS ratings (n = 45) and assessment by healthcare professionals at admission (r = 0.95) and discharge (r = 0.93) [31].

Participation in the study was voluntary. The caregivers of patients with TBI were requested to fill out the two questionnaires online. This type of participation was more appropriate than a structured interview due to the COVID-19 pandemic. However, there was a moderate response rate (50.9%) from the eligible participants and a 100% retest response. These results infer that the translated version of the questionnaire was relatively simple, short and easy to comprehend by caregivers of patients with TBI. It is important to emphasise that the majority of the caregivers of patients with TBI had a high level of education (42.9% had a complete college-level education). Therefore, it would be intriguing to conduct telephone interviews or video conferencing among caregivers with a minimal level of education (able to read and write the Arabic language).

The convergent validity of the DRS scale was evaluated by comparing the SF-36 scores. There was strong agreement between the scores obtained from the DRS-Ar and those obtained from the SF-36. Similarly, a study reported a moderate-to-good correlation between scores on the DRS scale and abnormal evoked potential among patients with TBI [16]. There was a strong correlation (0.815) between scores on the impairment construct of the DRS with the social functioning construct of the SF-36, similarly to the handicap construct of the DRS with the energy/fatigue construct of the SF-36. This implies that the social functioning and energy/fatigue are severely affected with increasing severity in impairment and handicap, respectively. The results are supported by a systematic review that reports decline in social functioning with increasing impairment due to TBI [32]. Another study conducted among 223 community-dwelling individuals with mild to severe TBI reported that fatigue is severe and prevalent among individuals with TBI and significantly impacted well-being and quality of life [33].

A previous study suggested that the DRS may be used to predict outcomes in cases of severe TBI after 6 months [34]. The predictive validity of the DRS was established by a study reporting an association between a higher score on the DRS at the time of admission and a poor prognosis in terms of return to work and length of hospital stay [12]. The DRS scale was reported to be more sensitive in terms of overall improvement in patients with TBI than the Glasgow Outcome Scale [35], the Rancho Level of Cognitive Functioning Scale [11], and the Functional Independence Measure [36].

Limitations

The health status of the TBI patients was obtained from their caregivers, which may not truly represent their actual health status. Participation was limited because of the COVID-19 pandemic. The factorial structure analysis of the instrument by confirmatory factor analysis and a principal components analysis could not be performed due to the small sample size.

Future studies

We recommend that future studies include more samples to evaluate other psychometric properties of the scale.

Conclusions

The study provides evidence supporting the use of the Arabic version of the DSR-Ar to be used by expert professionals to obtain responses to the DRS in the Arabic language from caregivers of patients with TBI. It is easy to comprehend and uses the popular Arabic dialect. Furthermore, according to our assessment, the Arabic edition of the DRS is sufficiently reliable and valid.

Availability of data and materials

Data are available upon reasonable request.

Acknowledgements

The authors thank all the patients who participated in this study.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the institutional Review Board of Majmaah University (HA-01-R-008) (approval No.: MUREC-Feb.28/COM-2021124-3).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

Funding

This research received no external funding.

References

[1] Roozenbeek B, Maas AIR, Menon DK. Changing patterns in the epidemiology of traumatic brain injury. Nat Rev Neurol. 2013;9(4):231–6; doi: 10.1038/nrneurol.2013.22.

[2] DeGrauw X, Thurman D, Xu L, Kancherla V, DeGrauw T. Epidemiology of traumatic brain injury-associated epilepsy and early use of anti-epilepsy drugs: an analysis of insurance claims data, 2004–2014. Epilepsy Res. 2018;146:41–9; doi: 10.1016/j.eplepsyres.2018.07.012.

[3] Dewan MC, Rattani A, Gupta S, Baticulon RE, Hung Y-C, Punchak M, Agrawal A, Adeleye AO, Shrime MG, Rubiano AM. Estimating the global incidence of traumatic brain injury. J Neurosurg. 2018;130(4):1080–97; doi: 10.3171/2017.10. JNS17352.

[4] El-Menyar A, Mekkodathil A, Al-Thani H, Consunji R, Latifi R. Incidence, demographics, and outcome of traumatic brain injury in the Middle East: a systematic review. World Neurosurg. 2017;107:6–21; doi: 10.1016/j.wneu.2017.07.070.

[5] Arabi YM, Haddad S, Tamim HM, Al-Dawood A, Al-Qahtani S, Ferayan A, Al-Abdulmughni I, Al-Oweis J, Rugaan A. Mortality reduction after implementing a clinical practice guidelines–based management protocol for severe traumatic brain injury. J Crit Care. 2010;25(2):190–5; doi: 10.1016/j.jcrc.2009.05.004.

[6] Alghnam S, Alkelya M, Aldahnim M, Aljerian N, Albabtain I, Alsayari A, Da'ar OB, Alsheikh K, Alghamdi A. Healthcare costs of road injuries in Saudi Arabia: a quantile regression analysis. Accid Anal Prev. 2021;159:106266; doi: 10.1016/j.aap.2021.106266.

[7] Mirhosseini S, Bazghaleh M, Basirinezhad MH, Abbasi A, Ebrahimi H. Health-related quality of life and caregiver's burden in patients with chronic diseases: a cross-sectional study. Fam Med Prim Care Rev. 2021;23(1):29–35; doi: 10.5114/fmpcr.2021.103184.

[8] Amri MI, Alzhrani MM, Alanazi AD, Alqahtani MM, Kashoo FZ. Cross-cultural adaptation and validation of the Arabic version of the foot function index in patients with chronic lateral ankle instability. J Foot Ankle Res. 2022;15(1):21; doi: 10.1186/s13047-022-00527-6.

[9] Al Sayah F, Ishaque S, Lau D, Johnson JA. Health related quality of life measures in Arabic speaking populations: a systematic review on cross-cultural adaptation and measurement properties. Qual Life Res. 2013;22(1):213–29; doi: 10.1007/s11136-012-0129-3.

[10] Neese LE, Caroselli JS, Klaas P, High WM, Becker LJ, Scheibel RS. Neuropsychological assessment and the Disability Rating Scale (DRS): a concurrent validity study. Brain Inj. 2000;14(8):719–24; doi: 10.1007/s11136-012-0129-3.

[11] Gouvier WD, Blanton PD, LaPorte KK, Nepomuceno C. Reliability and validity of the Disability Rating Scale and the Levels of Cognitive Functioning Scale in monitoring recovery from severe head injury. Arch Phys Med Rehabil. 1987;68(2):94–7.

[12] Eliason MR, Topp BW. Predictive validity of Rappaport's Disability Rating Scale in subjects with acute brain dysfunction. Phys Ther. 1984;64(9):1357–60; doi: 10.1093/ptj/64.9.1357.

[13] Shames J, Treger I, Ring H, Giaquinto S. Return to work following traumatic brain injury: trends and challenges. Disabil Rehabil. 2007;29(17):1387–95; doi: 10.1080/09638280701315011.

[14] Aloyuni S, Alharbi R, Kashoo F, Alqahtani M, Alanazi A, Alzhrani M, Ahmad M. Knowledge, attitude, and barriers to telerehabilitation-based physical therapy practice in Saudi Arabia. Healthcare. 2020;8(4):460; doi: 10.3390/healthcare8040460.

[15] Malec JF, Hammond FM, Giacino JT, Whyte J, Wright J. Structured interview to improve the reliability and psychometric integrity of the Disability Rating Scale. Arch Phys Med Rehabil. 2012;93(9):1603–8; doi: 10.1016/j.apmr.2012.04.003.

[16] Rappaport M, Hall KM, Hopkins K, Belleza T, Cope DN. Disability rating scale for severe head trauma: coma to community. Arch Phys Med Rehabil. 1982;63(3):118–23.

[17] Malec JF, Thompson JM. Relationship of the Mayo-Portland Adaptability Inventory to functional outcome and cognitive performance measures. J Head Trauma Rehabil. 1994;9(4):1–15; doi: 10.1097/00001199-199412000-00003.

[18] Boake C. Supervision Rating Scale: a measure of functional outcome from brain injury. Arch Phys Med Rehabil. 1996;77(8):765–72; doi: 10.1016/S0003-9993(96)90254-3.

[19] Turcotte S, Beaudoin M, Vallée C, Vincent C, Routhier F. Psychometric properties of the Community Integration Questionnaire: a systematic review of five populations. Clinical Rehabilitation. 2019;33(11):1775–87; doi: 10.1177/0269215519867998.

[20] Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine. 2000;25(24):3186–91.

[21] DeMuro CJ, Lewis SA, DiBenedetti DB, Price MA, Fehnel SE. Successful implementation of cognitive interviews in special populations. Expert Rev Pharmacoecon Outcomes Res. 2012;12(2):181–7; doi: 10.1586/erp.11.103.

[22] Alsudais A, Alotaibi W, Alomary F. Similarities between Arabic dialects: investigating geographical proximity. Inf Process Manag. 2022;59(1):102770; doi: 10.1016/j.ipm.2021.102770.

[23] Bogner JA, Whiteneck GG, MacDonald J, Juengst SB, Brown AW, Philippus AM, Marwitz JH, Lengenfelder J, Mellick D, Arenth P. Test-retest reliability of traumatic brain injury outcome measures: a traumatic brain injury model systems study. J Head Trauma Rehabil. 2017;32(5):1–16; doi: 10.1097/HTR.0000000000000291.

[24] Terwee CB, Bot SDM, de Boer MR, van der Windt DAWM, Knol DL, Dekker J, Bouter LM, de Vet HCW. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007;60(1):34–42; doi: 10.1016/j.jclinepi.2006.03.012.
[25] van Baalen B, Odding E, van Woensel MPC, van Kessel MA, Roebroeck ME, Stam HJ. Reliability and sensitivity to change of measurement instruments used in a traumatic brain injury population. Clin Rehabil. 2006; 20(8):686–700; doi: 10.1191/0269215506cre982oa.
[26] Coons SJ, Alabdulmohsin SA, Draugalis JR, Hays RD. Reliability of an Arabic version of the RAND-36 Health Survey and its equivalence to the US-English version. Med Care. 1998;428–32.
[27] Van Rosse F, de Bruijne M, Suurmond J, Essink-Bot M-L, Wagner C. Language barriers and patient safety risks in hospital care: a mixed methods study. Int J Nurs Stud. 2016;54:45–53; doi: 10.1016/j.ijnurstu.2015.03.012.
[28] Al-Amer R, Ramjan L, Glew P, Darwish M, Salamonson Y. Language translation challenges with Arabic speakers participating in qualitative research studies. Int J Nurs Stud. 2016;54:150–7; doi: 10.1016/j.ijnurstu.2015.04.010.
[29] Ezzati K, Yousefzadeh-Chabok S, Rezaei S, Reihanian Z. Translation, validity, and reliability of Disability Rating Scale in Iranian patients with traumatic brain injury. Arch Trauma Res. 2020;9(4):167.
[30] Krch D, Lequerica AH. The factor structure of the Disability Rating Scale in individuals with traumatic brain injury. Disabil Rehabil. 2019;41(1):98–103; doi: 10.1080/09638288.2017.1378388.
[31] Novack TA, Bergquist TF, Bennett G, Gouvier WD. Primary caregiver distress following severe head injury. J Head Trauma Rehabil. 1991;6(4): 69–76.
[32] Temkin NR, Corrigan JD, Dikmen SS, Machamer J. Social functioning after traumatic brain injury. J Head Trauma Rehabil. 2009;24(6):460–7; doi: 10.1097/HTR.0b013e3181c13413.
[33] Cantor JB, Ashman T, Gordon W, Ginsberg A, Engmann C, Egan M, Spielman L, Dijkers M, Flanagan S. Fatigue after traumatic brain injury and its impact on participation and quality of life. J Head Trauma Rehabil. 2008;23(1): 41–51; doi: 10.1097/01.HTR.0000308720.70288.af.
[34] Yamal J-M, Aisiku IP, Hannay HJ, Brito FA, Robertson CS. Disability rating scale in the first few weeks after a severe traumatic brain injury as a predictor of 6-month functional outcome. Neurosurgery. 2021;88(3):619–26; doi: 10.1093/neuros/nyaa474.
[35] Hall K, Cope DN, Rappaport M. Glasgow Outcome Scale and Disability Rating Scale: comparative usefulness in following recovery in traumatic head injury. Arch Phys Med Rehabil. 1985;66(1):35–7.
[36] Hammond FM, Grattan KD, Sasser H, Corrigan JD, Bushnik T, Zafonte RD. Long-term recovery course after traumatic brain injury: a comparison of the functional independence measure and disability rating scale. J Head Trauma Rehabil. 2001;16(4):318–29.