

Translation, Validity, and Reliability of Disability Rating Scale in Iranian Patients with Traumatic Brain Injury

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Abstract

Background: The Disability Rating Scale (DRS) is a short, efficient, and rapid instrument for assessing levels of functional disability, but little information is available on the translation and psychometric properties of its Persian version, especially for traumatic brain injury (TBI) patients. The aim of this study was to translate and adapt the Persian version of DRS and to determine the psychometric properties of the Persian version of this scale in patients with TBI. **Materials and Methods:** In this analytical cross-sectional study, 191 TBI patients (age range, 16–86 years) referred to the physiotherapy Center of PourSina Hospital in Rasht, Iran, were selected through census sampling. First, the DRS was translated into Persian, and then, the validity, reliability, and repeatability of DRS scores were evaluated. All patients were evaluated on admission and at discharge through the Glasgow Coma Scale (GCS) and Functional Independence Measure (FIM). **Results:** According to the reports of the translators, translation of the DRS into Persian language was easy. The quality of translation (including translation clarity, common language usage, conceptual equivalence, and overall quality of translation) was generally favorable. Inter-raters' reliability on admission and at discharge stages was excellent (intraclass correlation coefficient = 0.93–0.94). Cronbach's alpha values for the internal consistency of DRS on admission and at discharge stages were 0.96 and 0.97, respectively. The results showed a strong inverse relationship of DRS scores on admission and at discharge with GCS and FIM scores (in all cases more than 0.70, $P < 0.0001$). **Conclusion:** The validity, reliability, and repeatability of the DRS scores for the Persian version were confirmed. These results reflect that DRS can be used to determine the effects of therapeutic/rehabilitation interventions on levels of functional disability in Iranian patients with TBI.

Keywords: Disability assessment, psychometric, traumatic brain injury

INTRODUCTION

The lifelong costs of caring for traumatic brain injury (TBI) patients are high, and the impact of an effective treatment for this devastating disorder is economically significant not only for the patient's family but also for the community and health system.^[1,2] Therefore, the main goal of the new treatments and interventions is to reduce the physical disability of TBI patients, and it is clear that health-care professionals, researchers, and planners need valid, reliable, and repeatable tools which are simple to operate and sensitive to a variety of defects that generally cause functional disability in patients

with TBI to assess the effectiveness of care interventions in patients.^[2] The Disability Rating Scale (DRS) is one of the most commonly used tools for outcome measurement in TBI.^[3]

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How to cite this article: 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;9:166-72.

Received: 13-03-2020, **Revised:** 28-06-2020

Accepted: 03-08-2020, **Published:** 26-12-2020.

Access this article online

Quick Response Code:



Website:
www.archtrauma.com

DOI:
10.4103/atr.atr_14_20

The DRS was developed and tested in patients with moderate-to-severe TBI admitted to rehabilitation centers. One advantage of DRS is the ability to record a person's changes from the coma stage to the community. This scale can also cover a wide range of recovery stages for patients with brain injury because of the variety of items included in it. This scale covers all the three measurement categories of the WHO including impairment, disability, and participation.^[4] The first three items of DRS include eye opening, ability to communicate, and motor response; it is based on a model with little modifications to the Glasgow Coma Scale (GCS) and reflects the rate of impairment. Furthermore, the three items of feeding, toileting, and grooming show the level of disability. The level of functioning is a modified item from a scale used by Scranton in 1970; this item together with the employability item shows the level of handicap.^[3]

The highest score a patient can obtain from the DRS is 29 (severe vegetative state). A patient without a disability can score 0. DRS scoring should be reliable, and the patient should not be under the influence of anesthesia or other drugs altering brain activity.^[1] The purpose of designing this scale is to accurately measure overall functional changes during patient recovery.^[5]

The validity and reliability of DRS have been confirmed in various studies.^[3,5-8] DRS can be completed by the patient or by interviewing his or her family. The main reasons for the generality of this scale are its ease of scoring and shortness. The DRS scoring time ranges from 30 s (for anyone who is familiar with the scale) for up to 15 min, assuming that the examiner has to interview the individual and his/her family and ask for extra information from available personnel.^[9]

The original DRS version is English and has been translated into five other languages.^[6] The tools used to evaluate outcomes in rehabilitation should have acceptable repeatability and validity.^[10] One of the problems in cross-cultural research today is that most tools are developed in English-speaking countries, and there are relatively few tools that have been adequately translated and adapted in non-English-speaking cultures.^[11]

On the other hand, the accepted validity and repeatability of a tool in one language does not guarantee that these features remain unchanged following translation of the tool to another. Therefore, it is necessary to examine the psychometric properties of the tool in the new language before using it in scientific works.^[12]

Considering that when a tool is used in an environment different from the environment where it is developed, culture, language, and geographical location must be taken into account; when a tool is used cross-culturally, there is a standardized approach to translate, adapt, and review its psychometric properties. In other words, in order to use this tool in non-English-speaking communities, it must be adapted and the psychometric properties of the new version were examined.^[13]

According to what was stated, translation of the DRS into Persian language is necessary in order to create a common

language among rehabilitation professionals in Iran as well as to record data and conduct outcome-based studies in TBI patients. So far, no research has been performed on evaluating the psychometric properties of DRS in Iran. The aim of this study was to translate and adapt the Persian version of the DRS and to determine the psychometric properties of the Persian version of this scale in patients with TBI.

MATERIALS AND METHODS

This analytical cross-sectional study was performed on 191 patients (age range, 16–86 years), diagnosed with mild-to-severe TBI. These patients were admitted to the Trauma and Internal Neurosurgery and Intensive Care Units of PourSina Hospital in Rasht (North of Iran) during 2019–2020 and were referred to the same hospital for rehabilitation. Eligible patients were selected through census sampling.

The inclusion criterion for all patients with mild-to-severe TBI in both stages was 16 years of age and older. The exclusion criteria were patients with clinical or radiologic findings indicating spinal cord injury, any pre-TBI neurological disease, or non-TBI lesions (such as brain tumors, arterial aneurysms, stroke, and other cerebrovascular accidents), patients with vegetative status or severe lack of consciousness who were unable to respond to tests; presence of motor or balance disorders, arthritis, knee or joint fractures prior to TBI, and patients who were not willing to participate in the study for any reason.

It should be noted that patients who had been hospitalized for more than 7 days were evaluated. Demographic data were collected after obtaining informed consent from the patients or their families. The next step was to extract clinical information (such as the exact length of hospital stay), the results of neurosurgery examinations, and the findings of neurosurgical imaging (CT scans) until the same day of their hospital information records. DRS and Functional Independence Measure (FIM) were completed simultaneously by two physiotherapists on admission and at discharge. The research proposal was accepted by the Ethics Committee of Guilan University of Medical Sciences under a code of IR.GUMS.REC.1397.184.

Instruments

Functional Independence Measure

The FIM is a multidimensional measure that assesses self-care, sphincter control, moving objects, motor displacement, communication, and social cognition along with cognitive (5 items) and motor (13 items) subscales. Each FIM dimension has a score ranging from a minimum of 1 (complete help needed to complete the task) to a maximum of 7 (complete independence). Then, the scores for each dimension are summed, yielding a probable total score ranging from 18 (complete dependency) to 126 (complete independence).^[6] FIM has shown desirable construct validity,^[14] repeatability (intraclass correlation coefficient [ICC] = 0.779–0.895), and internal consistency ($\alpha \geq 0.97$) in TBI patients.^[15]

Glasgow Coma Scale

It was introduced in 1974 as a tool for assessing the depth and duration of impaired consciousness and coma.^[2] GCS has also been developed to measure the severity or improvement of early stages of injury or brain lesion and to predict the final outcome.^[16] The GCS is a 15-point scale that measures the depth of coma and the duration of posttraumatic amnesia.^[2] In addition, GCS has been able to predict the motor and cognitive abilities of TBI patients at the time of admission and discharge.^[17]

Statistical analysis

Data were analyzed using ICC and Spearman's correlation coefficient by the SPSS software version 24 (SPSS 24, IBM, Armonk, NY, United States of America). The level of significance was set at $P < 0.05$.

Reliability

In order to determine the inter-rater reliability of the DRS or to determine the correlation between the scores given by two examiners in the admission and discharge stages, the ICC with two-way random effects model (absolute agreement type) was used. ICC was used to evaluate the repeatability of the scores obtained from the total score of the Persian version of the DRS by two physiotherapists at twice measurement with at least 2-week interval. The classification of repeatability is as follows: excellent (0.99–0.90), good (0.89–0.80), moderate (0.790–0.70), and poor (≤ 0.69).^[18]

The internal consistency of the DRS was evaluated by examining the intercorrelation among the DRS items. The common technique for this purpose is the Cronbach's alpha coefficient. A Cronbach's alpha of 0.70 and above is acceptable, 0.80 and above is good, and 0.90 and above is excellent.^[19]

Validity

Spearman's correlation coefficient was run to evaluate the construct validity of the DRS (determining its relationship with FIM and GCS). Correlations between total scale scores on the admission and discharge stages were examined. Nonparametric Spearman's coefficient values were interpreted as excellent relationship ≥ 0.91 , good 0.90–0.71, fair 0.70–0.51, weak 0.5–0.31, and little or none ≤ 0.3 .^[20]

RESULTS

Translation and adaptation

After preparing the preliminary Persian version of DRS by the first and second translators, this initial version was evaluated and scored by two other translators (the third and fourth translators) for the quality and difficulty of translation [Table 1]. It should be noted that the concept of translation quality is based on four more detailed concepts: clarity or transparency (using simple and understandable terms), common language (nonuse of technical and specialized terms and expressions), conceptual equivalence (according to the concepts in the original version), and general quality (suitability and overall quality of translation). For each of these dimensions, each of the

third and fourth translators performed scoring on a 100-point scale, and the mean scores of these two translators are listed in Table 1.^[21,22]

The translators also scored the difficulty of translation and their meanings using the same method, the results of which are listed in Table 1. For the columns of agreement for each of these concepts, if the scores of the two translators exceeded 15 points, the negative sign was marked (meaning no agreement), and if the maximum difference was 15 points or less, a positive sign given (meaning agreement). In addition, in difficulty and quality of translation detail columns, it was determined as easy translation if the average difficulty score was maximum 25, and if the mean quality score was at least 90, desirable translation quality was specified. Finally, the words "relatively desirable" and "relatively easy" were used to indicate the quality and difficulty close to the cutoff points (for the mean quality between 80 and 90 and the mean difficulty between 25 and 30).^[23]

It should be noted that the results in Table 1 were calculated using the final version obtained from DRS, and during the translation and adaptation processes, preliminary versions were obtained, especially with regard to the quality of translation for some items, responses or recommendations had lower-than-desirable scores, and a percentage of undesirable translations were observed. These items had poor translation quality and were re-reviewed by the researchers and modified using the words and phrases and substitution sentences suggested by the first and second translators and provided to the third and fourth translators for evaluation. The above process was repeated until the quality of the translation of the Persian version obtained at this stage improved to a satisfactory and acceptable level and the mean scores reached over the desirable level.

As noted in the translation difficulty column, most of these items are identified by translators as having easy translation. Consequently, a satisfactory quality of translation was prepared, and the same version was used in the later stages of the translation and adaptation process to perform the "back translation" step, which consisted of translating the scale back to English by two translators whose mother tongue was English and had sufficient experience in translating texts from Farsi to English. This English version was originally from the Persian version, which should be conceptually identical to the English version. To this end, joint meetings were held with the participation of the third, fourth, fifth, sixth translators and researchers of the present study, and finally, the initial Persian version was prepared, finalized, and approved after resolving a few minor inconsistencies in translation quality. The final version of the "translation and adaptation" phase was completed with the completion of this Persian version, and the research entered the following stages.

Demographic characteristics

Of the 234 patients evaluated, 32 died and 11 could not be evaluated at discharge and were excluded. Therefore, the

Table 1: Descriptive findings from the evaluation of the quality and difficulty of translating the adapted Persian version of the Disability Rating Scale									
Subscale number	Subscales	Mean translation difficulty	Agreement in the translation difficulty	Translation difficulty	Mean translation clarity	Agreement in the translation clarity	Translation clarity	Mean common language	
Eye opening	0 - Spontaneous	34	-	Difficult	91.5	+	Desirable	89	
	1 - To speech	14	+	Easy	95.5	+	Desirable	89.5	
	2 - To pain	14	+	Easy	94.5	+	R d*	94.5	
	3 - None	15	+	Easy	96	+	Desirable	96.5	
Communication ability	0 - Oriented	14.5	+	Easy	98.5	+	R d*	98.5	
	1 - Confused	13.5	+	Easy	97.5	+	Desirable	98	
	2 - Inappropriate	13.5	+	Easy	97.5	+	Desirable	100	
	3 - Incomprehensible	17	+	Easy	96.5	+	Desirable	98.5	
Motor response	4 - None	20	+	Easy	98.5	+	Desirable	98.5	
	0 - Obeying	18	+	Easy	100	+	Desirable	100	
	1 - Localizing	16.5	+	Easy	96.5	+	Desirable	85	
	2 - Withdrawing	13.5	+	Easy	97.5	+	Desirable	97.5	
Feeding	3 - Flexing	14	+	Easy	93.5	+	Desirable	95.5	
	4 - Extending	14.5	+	Easy	96.5	+	Desirable	98.5	
	5 - None	13.5	+	Easy	96.5	+	Desirable	97	
	0 - Complete	14.5	+	Easy	95.5	+	Desirable	98	
	1 - Partial	14	+	Easy	94.5	+	Desirable	97.5	
Toileting	2 - Minimal	14	+	Easy	97.5	+	Desirable	96.5	
	3 - None	13	+	Easy	99	+	Desirable	92	
	0 - Complete	1.5	+	Easy	95	+	Desirable	91.5	
	1 - Partial	2.5	+	Easy	95	+	Desirable	93	
Grooming	2 - Minimal	2.5	+	Easy	85	+	Desirable	95	
	3 - None	3	+	Easy	95	+	Desirable	96	
	0 - Complete	2.5	+	Easy	85	+	Desirable	95	
	1 - Partial	2.5	+	Easy	96	+	Desirable	95	
Level of functioning (physical, mental, or emotional, or social function)	2 - Minimal	3	+	Easy	95	+	Desirable	97.5	
	3 - None	3	+	Easy	98	+	Desirable	97.5	
	0 - Completely independent	3	+	Easy	99	+	Desirable	92	
	1 - Independent in special environment	3	+	Easy	91	-	R d*	97.5	
	2 - Mildly dependent	3	+	Easy	97.5	+	Desirable	95	
Employability	3 - Moderately dependent	1	+	Easy	99	+	Desirable	99	
	4 - Markedly dependent	1	+	Easy	98.5	+	Desirable	99	
	5 - Totally dependent	1.5	+	Easy	96	+	Desirable	99	
	0 - Not restricted	15	+	Easy	96	+	Desirable	99	
	1 - Selected jobs, competitive	27	+	Relatively easy	89	-	Desirable	87	
2 - Sheltered workshop, noncompetitive	5	+	Easy	91	+	R d*	91		
	3 - Not employable	2	+	Easy	93	+	Desirable	95	

Contd....

Subscale number	Subscales	Agreement in the common language	Translation common language	Mean conceptual equivalence	Agreement in the conceptual equivalence	Translation conceptual equivalence	Mean general quality	Agreement in the general quality	Translation general quality
Eye opening	0 - Spontaneous	-	R d*	89	-	R d*	88	-	R d*
	1 - To speech	-	R d*	95.5	+	Desirable	94.5	+	Desirable
	2 - To pain	+	desirable	96	+	desirable	95.5	+	Desirable
Communication ability	3 - None	+	desirable	97	+	desirable	97	+	Desirable
	0 - Oriented	+	desirable	99	+	desirable	99	+	Desirable
	1 - Confused	+	desirable	99	+	desirable	98	+	Desirable
	2 - Inappropriate	+	desirable	98.5	+	desirable	98.5	+	Desirable
	3 - Incomprehensible	+	desirable	98.5	+	desirable	98	+	Desirable
Motor response	4 - None	+	Desirable	98	+	Desirable	98	+	Desirable
	0 - Obeying	+	Desirable	99	+	Desirable	100	+	Desirable
	1 - Localizing	-	R d*	96	+	Desirable	95.5	+	Desirable
	2 - Withdrawing	+	Desirable	97.5	+	Desirable	97.5	+	Desirable
	3 - Flexing	+	Desirable	96	+	Desirable	97	+	Desirable
Feeding	4 - Extending	+	Desirable	93	+	Desirable	93	+	Desirable
	5 - None	+	Desirable	96	+	Desirable	97	+	Desirable
	0 - Complete	+	Desirable	96.5	+	Desirable	96.5	+	Desirable
	1 - Partial	+	Desirable	96.5	+	Desirable	97	+	Desirable
	2 - Minimal	+	Desirable	95	+	Desirable	97	+	Desirable
Toileting	3 - None	+	Desirable	99	+	Desirable	100	+	Desirable
	0 - Complete	+	Desirable	95	+	Desirable	95	+	Desirable
	1 - Partial	+	Desirable	95	+	Desirable	95	+	Desirable
	2 - Minimal	-	Desirable	92.5	+	Desirable	95	+	Desirable
	3 - None	+	Desirable	93.5	+	Desirable	97	+	Desirable
Grooming	0 - Complete	+	Desirable	92.5	+	Desirable	94	+	Desirable
	1 - Partial	+	Desirable	95	+	Desirable	95	+	Desirable
	2 - Minimal	+	Desirable	98	+	Desirable	97	+	Desirable
	3 - None	+	Desirable	97.5	+	Desirable	98	+	Desirable
	0 - Completely independent	+	Desirable	98.5	+	Desirable	98	+	Desirable
Level of functioning (physical, mental, emotional, or social function)	1 - Independent in special environment	+	Desirable	99	+	Desirable	97.5	+	Desirable
	2 - Mildly dependent	+	Desirable	98.5	+	Desirable	97.5	+	Desirable
	3 - Moderately dependent	+	Desirable	98.5	+	Desirable	99	+	Desirable
	4 - Markedly dependent	+	Desirable	99	+	Desirable	99	+	Desirable
	5 - Totally dependent	+	Desirable	99	+	Desirable	99	+	Desirable
Employability	0 - Not restricted	+	Desirable	99	+	Desirable	99	+	Desirable
	1 - Selected jobs, competitive	-	R d*	91	+	Desirable	85	-	R d*
	2 - Sheltered workshop, noncompetitive	-	Desirable	99	+	Desirable	99	+	Desirable
	3 - Not employable	+	Desirable	99.5	+	Desirable	99	+	Desirable

*Relatively desirable. +: Agreement, -: No agreement

following information was obtained by administering the Persian version of DRS among 191 patients [Table 2]. In this study, 32 women (16.8%) and 159 men (89.3%) participated. The mean age of the patients was 46.30 ± 13 years, with the age range of 16–86 years. The average length of hospital stays ($n = 191$) was 13 ± 7 days, with a minimum of 7 and a maximum of 56 days. Furthermore, 26 patients (13.6%) had subdural hemorrhage, 71 (37.2%) had epidural hemorrhage, and 94 (49.2%) had intracerebral hemorrhage. Finally, 54 patients (28.3%) had multiple brain injuries.

Validation and correlation of tests

Due to the lack of a gold standard on the performance of patients with TBI, the purpose of this study was to evaluate the validity of the Persian version of DRS and to determine the correlation of GCS and FIM scores with DRS total score. The results of Spearman’s correlation analyses are presented in Table 3.

As shown in Table 3, the DRS scores on admission and at the time of discharge were strongly correlated with the GCS and FIM scores ($P < 0.0001$).

Reliability assessment

Repeatability in test times

In the present study, the calculated ICCs are well above the acceptable level of 0.70; therefore, a reliability/repeatability for the Persian version of DRS is deduced. The results of ICCs are shown in Table 4.

Internal consistency

DRS internal consistency was calculated by Cronbach’s alpha coefficients on admission and at the time of discharge, the results of which are shown in Table 4.

DISCUSSION

Scale developers and translators try to avoid using ambiguous and unusual terms with multiple meanings and thus facilitate the process of translating the text of the tool into another language as much as possible.^[24] In the present study, such an advantage is clearly observed. In other words, four contributors to the project, who had a good experience of translating texts from English to Persian, affirmed the ease and quality of the translation process quantitatively.

The existing literature on secondary versions of the DRS also confirms this issue.^[6,7] Therefore, the easy and high-quality translation of this scale into Persian, as well as the relatively numerous translations of this scale internationally, could be another evidence of one of the advantages of DRS.^[7]

There was a strong inverse correlation between total DRS score and GCS and FIM scores (more than 0.70 in all cases). These findings confirm the construct validity of the DRS. Consistent with the present study, Deepika *et al.*^[6] examined the predictive validity of the DRS in determining the functional outcome of severe TBI patients and found that DRS can predict patients’ 1-year performance on admission and at discharge.

Table 2: Descriptive statistics indices and Shapiro-Wilk test results of Disability Rating Scale, Glasgow Coma Scale, and Functional Independence Measure instruments on admission and at discharge ($n=191$)

Test and time	Minimum	Maximum	Median	Shapiro-Wilk (P)
DRS on admission	7	28	19	0.006
DRS at discharge	0	22	14	0.0001
GCS on admission	4	15	8	0.0001
GCS at discharge	6	15	11	0.0001
FIM on admission	18	121	33	0.0001
FIM at discharge	18	129	78	0.004

DRS: Disability Rating Scale, GCS: Glasgow Coma Scale, FIM: Functional Independence Measure

Table 3: Spearman’s correlation of Disability Rating Scale with Glasgow Coma Scale and Functional Independence Measure scores in traumatic brain injury patients ($n=191$)

Test and time	GCS on admission	FIM on admission
DRS on admission	-0.81, $P < 0.0001$	-0.87, $P < 0.0001$
Test and time	GCS at discharge	FIM at discharge
DRS at discharge	-0.71, $P < 0.0001$	-0.77, $P < 0.0001$

DRS: Disability Rating Scale, GCS: Glasgow Coma Scale, FIM: Functional Independence Measure

Table 4: Intraclass correlation coefficient values and Cronbach’s alpha coefficients for the Persian version of Disability Rating Scale on admission and at discharge

Test and time	Mean \pm SD		ICC	Cronbach’s alpha
	Evaluator 1	Evaluator 2		
DRS on admission	19.08 \pm 4.65	19.20 \pm 4.45	0.93	0.96
DRS at discharge	13.30 \pm 4.65	13.38 \pm 4.72	0.94	0.97

SD: Standard deviation, ICC: Intraclass correlation coefficient, DRS: Disability Rating Scale

The results showed that DRS repeatability was excellent by ICC calculation of the Persian version in the two measurements during admission and discharge. The Persian version of DRS also had a satisfactory internal consistency. These results suggest that the Persian version of DRS provides researchers and therapists with a reliable assessment of disability/function in Iranian TBI patients.^[6,9] Consistent with the present study, Hall *et al.*^[5] found that DRS had excellent internal consistency (Cronbach’s alpha between 0.83 and 0.84). There was also an excellent inter-rater (0.97–0.98) and intra-rater reliability (0.95) for DRS. In patients with mild TBI (i.e., GCS above 12), the results of internal consistency and repeatability of DRS results were consistent with the present study.^[25] Considering the proximity of the calculated coefficients of the present study with previous studies,^[5,25] it can be concluded that there is a clear agreement in achieving high levels of score repeatability.

One of the study limitations was that the results of this study are only generalizable to those of TBI patients referred by

neurosurgery specialists for rehabilitation and physiotherapy. Therefore, caution should be exercised when generalizing these results to evaluate the performance and disability of other TBI patients. Moreover, although DRS has been translated into Persian with an acceptable agreement, the findings from the DRS psychometric characteristics are only limited to the admitted TBI patients in northern Iran. For future research, it is recommended that the validity of known groups or the differential validity of TBI clinical subgroups be examined.

CONCLUSION

The quality of translation (including translation clarity, common language usage, conceptual consistency, and overall quality of translation) of the DRS items in Persian was generally desirable. The inter-rater reliability between the evaluators and the reliability of the internal consistency for DRS were obtained excellent on admission and at discharge. There were strong correlations between total DRS scores on admission and at discharge with GCS and FIM scores, indicating the desired construct validity. These results reflect that DRS can be used to determine the effects of therapeutic/rehabilitation interventions on levels of functional disability in Iranian patients with TBI.

Acknowledgment

The authors gratefully acknowledged the staff of the physiotherapy, emergency, and neurosurgery wards at the PourSina Educational Hospital in Guilan University of Medical Sciences.

Financial support and sponsorship

This study was supported by Guilan University of Medical Sciences, Rasht, Iran.

Conflicts of interest

There are no conflicts of interest.

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