

## RESEARCH ARTICLE

## The Persian Version of Constant-murley Score in Patients with Rotator Cuff Tears: Reliability and Validity

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## Abstract

**Objectives:** Shoulder pain is a prevalent reason in orthopedic clinic patients, with rotator cuff disorders being the most common cause. The Constant-murley Score (CMS) questionnaire is a practical and reliable tool for the assessment of shoulder joint function.

**Methods:** The CMS questionnaire was translated into Persian and completed by 57 patients with persistent shoulder pain due to rotator cuff tears (case group) and 50 healthy controls. The case group refilled the questionnaire after 7-10 days without receiving any special treatment. The reliability and validity of the questionnaire were measured via the test-retest method and known-groups validity with the t-test, respectively. The intraclass correlation coefficient (ICC) was calculated to estimate the agreement as a measure of test-retest reliability.

**Results:** The mean ages of the case ( $51.8 \pm 14.2$ ) and control groups ( $52.0 \pm 10.0$ ) were similar ( $P=0.94$ ). No significant difference was found between the groups regarding co-existing clinical conditions ( $P=0.74$ ). The mean CMS values of the case and control groups were  $46.2 (\pm 22.3)$  and  $87.4 (\pm 5.7)$ , respectively, showing a statistically significant difference ( $P<0.001$ ). Moreover, the ICC was 0.95.

**Conclusion:** The findings indicated that the Persian version of the CMS questionnaire was reliable ( $ICC=0.95$ ) and valid ( $P<0.001$ ) for the assessment of shoulder pain and functional status in the Southern Iranian population with rotator cuff tear disorders.

**Level of evidence:** V

**Keywords:** CMS questionnaire, Culture adaptation, Shoulder pain, Translation

## Introduction

Shoulder pain is among the most common reasons for musculoskeletal pain and orthopedic clinic referrals. Various studies have indicated that 5-30% of musculoskeletal pain in the general population is related to the shoulder.<sup>1-6</sup> A meta-analysis has reported work-related shoulder pain as the second most prevalent upper limb pain (36.8%) among younger Iranian employees, with upper back pain ranking first.<sup>7</sup> These patients often experience pain and stiffness around the shoulder, which can disrupt and restrict shoulder movements in daily and occupational activities.<sup>8,9</sup>

Most diseases causing shoulder pain are not self-limited and often require surgical interventions. The primary objective of treatment of such patients is to restore the proper function of the shoulder joint and reduce the pain

intensity.<sup>9</sup> One of the most common causes of shoulder pain is rotator cuff disorders, which can lead to a frozen shoulder and often necessitate cuff tear repair surgeries. Shoulder function and pain intensity need to be precisely evaluated before making any decision for surgical intervention.<sup>10</sup>

Shoulder joint function and treatment outcome can be assessed using various patient-based questionnaires, including the disability of arm, shoulder, and hand (DASH), Oxford Shoulder Score,<sup>11</sup> Shoulder Disability Questionnaire, Shoulder Pain and Disability Index (SPADI), and Constant-murley Score (CMS).<sup>4,9,12,13</sup> The CMS questionnaire, originally developed in English, is one of the most practical and reliable tools for the assessment of shoulder pain intensity, muscle strength, and the ability to perform daily and occupational tasks before and after treatment.<sup>9,10</sup>

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European medical societies recognize this questionnaire as a gold standard tool for the evaluation of shoulder functionality. It facilitates the collection of valid data in clinical settings without requiring advanced diagnostic tests or radiology. However, for effective use across different languages and cultures, the questionnaire must be accurately translated, localized based on regional and social contexts, and tested for validity and reliability.<sup>8,9,12</sup>

The CMS questionnaire effectively evaluates shoulder function for therapeutic decision-making and treatment outcomes.<sup>12,14,15</sup> Given the prevalence of shoulder disorders in the Iranian population,<sup>7</sup> it is crucial to customize and localize the questionnaire to make its parameters more practical and comprehensible for users.<sup>14</sup>

To ensure the effectiveness of a questionnaire in orthopedic clinics and scientific studies, it is essential to have a culturally adapted questionnaire that is both reliable and valid. Due to the lack of a similar study evaluating both validity and reliability in an appropriate sample size, the present study was conducted to assess the validity and reliability of the Persian translation of the CMS questionnaire for patients with rotator cuff tears, the most common cause of upper limb pain.

## Materials and Methods

### Translation

To determine the validity and reliability of the CMS questionnaire, it was translated into Persian. After obtaining permission from the designers and authorities, the translation was conducted using the forward-backward method. Two independent native Persian speakers, experts in both orthopedics and English, translated the original questionnaire into Persian. The draft was reviewed and edited by experienced colleagues to incorporate cultural adaptations and necessary changes.

Two additional expert colleagues translated it back into English, and this version was compared and matched with the original by two shoulder surgeons to ensure eloquence, consistency, accuracy, and efficacy. The Persian version of the CMS questionnaire was piloted with a group of 10 patients to assess its content simplicity, comprehensibility, and user-friendliness. It was subsequently used in a study with a sample size determined by the statistician (as detailed in the Statistical Methods section).

### Participants

Informed written consent was obtained from all participants and they were reassured of the confidentiality of their personal information and data protection. In total, 107 participants were enrolled, comprising 57 patients with persistent shoulder pain secondary to rotator cuff tears (case group) and 50 healthy individuals without shoulder disorders (control group). All participants were over 18 years of age. The case group was selected from individuals who referred to the Shoulder Orthopedic Clinic at Shiraz University of Medical Sciences, Shiraz, Iran from April to July 2022.

Exclusion criteria were language barriers, inability to cooperate or complete the questionnaire (due to poor mental or emotional status, communication issues, or reading/writing difficulties), shoulder instability, a history of radiotherapy, fracture or previous shoulder surgery, and

any traumatic or non-traumatic disorders affecting the distal part of the same limb. Control participants were healthy individuals without any pain complaints recruited from the visitors of patients scheduled for surgery at Shiraz Nemazi Hospital, Shiraz, Iran.

### Constant-murley Score Questionnaire Application

The CMS addresses pain intensity (15 points), the ability to perform daily activities (20 points), shoulder range of motion (40 points), and shoulder muscle strength (25 points).<sup>11</sup> The first and second sections are subjectively completed by the patient (35 points), while the third and fourth sections are objectively completed by the examiner (65 points). Its total score is 100 points, and a higher score indicates better shoulder performance.<sup>15</sup> Completion of the questionnaire took about 5-7 min.<sup>16</sup> The section completed by the patient evaluated shoulder pain intensity during ordinary activities, sleep disturbance, performance of normal and recreational activities, and subjective ease of arm raising.

Pain intensity was scored by the Visual Analog Scale (VAS), where the patients marked their pain intensity on a 15-cm line ranging from "no pain" to "the greatest imaginable pain". The distance from the beginning of the line to the marked point was measured with a ruler, and pain intensity was calculated using the formula mentioned in the questionnaire. Limitations in performing daily activities were scored using the same method.

To complete the objective section, a therapist objectively examined the motion limitations and muscle strength of the shoulder joint. The acceptable range of motion was defined as that achieved effortlessly and painlessly. To measure shoulder movement limitations, the degrees of arm raising from the front and side of the body were measured with a goniometer and recorded. [Figure 1]

Outward and inward rotational movements of the arm were also recorded, and shoulder muscle isometric strength was measured by a dynamometer. Strength was defined as the ability of a muscle to contract and make force. The dynamometric test evaluated the relationship between muscle length and tension. The patient grasped the instrument handpiece, applied an upward tensile force, and held it for 5 sec. The strength was displayed in kg on the digital screen. [Figure 2] Three attempts were made for each movement and the maximum score was recorded.



Figure1. Measuring the shoulder range of motion by using a goniometer



**Figure 2.** Measuring the shoulder muscles' strength with a dynamometer

#### **Test-retest method**

Since there was no valid and appropriate questionnaire available for comparison, it was decided to assess validity using the test-retest method. Only Quick DASH was assessed in Persian, which was not an appropriate test for comparison with CMS due to its brevity and incompleteness.

To assess the reliability of the questionnaire through the test-retest method, the case group completed the questionnaire twice, once at the initial clinic visit and again after 7-10 days, without receiving any special treatment during this interval. The control group completed the questionnaire just once.

#### **Study Size**

Considering 90% power for the study, a 5% type I error, and a minimum intraclass correlation coefficient (ICC) of 0.75, at least 50 patients were required to ensure reliable outcomes

with the test-retest method. With 80% power, a 5% type I error, and a minimum effect size of 0.6, two groups of 45 participants were needed. To balance the sample size, 50 participants were allocated to each group. Additional participants were enrolled in the case group to account for potential attrition.

#### **Statistical methods**

Continuous variables were presented as mean  $\pm$  standard deviation (SD), and categorical variables as frequency and percentage. The Chi-square test or Fisher's exact test was used as appropriate to assess the association between categorical variables. The independent sample t-test and paired t-test were employed to compare mean values between two groups and between two occasions, respectively. The test-retest reliability of the questionnaire over time was evaluated using the ICC.

Validity of the questionnaire was assessed using the known-groups validity method, which measured the ability of the questionnaire to distinguish among distinct groups.<sup>17-23</sup> Content validity was assessed by examination of ceiling and floor effects. The floor effect represents the lowest percentage score (0), while the ceiling effect indicates the highest percentage score (100). A questionnaire is considered relevant if more than 30% of respondents exhibit ceiling or floor effects (1).

Exploratory factor analysis using the principal component analysis was performed to confirm the uni-dimensional structure. Internal consistency was assessed with Cronbach's alpha, with a value greater than 0.80 considered ideal. All analyses were performed in SPSS software for Windows (version 16.0, SPSS Inc.; Chicago, IL, USA). A P value of <0.05 was considered statistically significant.

#### **Results**

In total, this study was performed on 107 participants, including 57 patients with rotator cuff tears (case group) and 50 healthy individuals without known pain syndromes (control group). [Table 1] illustrates the demographic data and medical background of the participants.

<b>Table 1. Demographic characteristics of participants</b>			
	<b>Case (n=57)</b>	<b>Control (n=50)</b>	<b>P value</b>
<b>Age (years)</b>	51.8 $\pm$ 14.2	52.0 $\pm$ 9.9	0.94
<b>Gender</b>			
Male	33 (57.9%)	27 (54)	0.69 <sup>a</sup>
Female	24 (42.1%)	23 (46)	---
<b>History</b>			
None	48 (84.2%)	39 (78)	0.74 <sup>b</sup>
Thyroid	4 (7)	7 (14)	---
Smoking	2 (3.5)	2 (4)	---
Diabetes	2 (3.5)	2 (4)	---
Opium consumption	1 (1.8)	0 (0)	---

The values indicate mean  $\pm$ SD or frequency (percentage); a Chi-squared test; b Fisher's exact test

**Validity (Factor analysis)**

Results of the factor analysis indicated that all assumptions for the analysis were met. The one-factor extraction explained 53.07% of the variance, confirming that the Persian CMS met the criterion for unidimensionality [Table 2]

**Known-group Validity**

Validity of the questionnaire was assessed by using known-groups validity with a t-test. The mean CMS score was  $46.2 \pm 22.3$  in the case and  $87.4 \pm 5.7$  in the control group, showing a significant difference between the two groups ( $P < 0.001$ ) and indicating acceptable known-groups validity. [Table 3]

**Reliability**

The CMS reliability, as measured by the calculation of Cronbach's alpha, was found to be 0.86. Both subscales,

activities of daily living and range of motion, demonstrated acceptable internal consistency, with Cronbach's alpha values of 0.70 and 0.82, respectively. No ceiling or floor effects were observed for any of the items.

**Test-retest Reliability**

Table 2 summarizes the results of the t-test. The ICC was used to estimate test-retest reliability, yielding a value of 0.95, which indicated good reliability for the questionnaire. The CMS was higher at the retest stage (mean:  $48.5 \pm 21.2$ ), compared to the initial test stage (mean:  $46.2 \pm 22.3$ ), with a significant difference on both occasions ( $P = 0.01$ ). Table 3 shows the test-retest analyses and ICC for each CMS item separately. All items showed high ICC values, except for the pain item.

**Table 2. Descriptive statistics and explanatory factor analysis with factor loadings of the Constant-Murley Score items**

	Min	Max	Mean $\pm$ SD	Cronbach's $\alpha$	Principal Component Coefficients $\geq$ 0.4
<b>Pain</b>	1	14	7.7 $\pm$ 3.4		0.68
<b>Daily activities</b>	---	---	---	0.70	---
Work	0	4	2.2 $\pm$ 1.3	---	0.66
Leisure	0	4	2.2 $\pm$ 1.3	---	0.67
Sleep	0	2	0.9 $\pm$ 0.7	---	0.32
Positioning	0	10	6.7 $\pm$ 2.9	---	0.86
<b>Range of motion</b>	---	---	---	0.82	---
Forward elevation	2	10	5.9 $\pm$ 2.2	---	0.85
Lateral elevation	0	10	5.3 $\pm$ 2.7	---	0.87
External rotation	0	10	7.0 $\pm$ 4.1	---	0.75
Internal rotation	0	10	5.4 $\pm$ 3.0	---	0.67
<b>Strength</b>	0	25	5.8 $\pm$ 6.8	---	0.78
<b>Total Score</b>	9	89.9	48.5 $\pm$ 21.1	0.86	---

**Table 3. Results of test-retest analyses for the Constant-Murley score**

	Case (n=57)	Control (n=50)	Effect size	P value
<b>CMS<sup>c</sup> <math>\pm</math>SD (test)</b>	46.2 $\pm$ 22.3	87.4 $\pm$ 5.7	2.5	<0.001 <sup>a*</sup>
<b>CMS<math>\pm</math>SD (retest)</b>	48.5 $\pm$ 21.2	---	---	---
<b>P-value</b>	0.01 <sup>b*</sup>	---	---	---
<b>Effect size</b>	0.35	---	---	---
<b>ICC</b>	0.95	---	---	---

\*indicates significant P value; <sup>a</sup>Independent t-test; <sup>b</sup>Paired t-test; <sup>c</sup>Minimum CMS=0, Maximum CMS=100

**Discussion**

Translation and cultural adaptation of the CMS questionnaire into Persian were successful, with no specific issues encountered. This success may be attributed to the similarities in cultural habits and lifestyles between the Iranian population and the communities for which the CMS was originally developed. The Persian version of the CMS

was found to be a valid tool for the assessment of shoulder function in patients with rotator cuff tears.

As reported, no ceiling or floor effects were observed for any of the items. Cronbach's alpha of 0.86 indicated high internal consistency. Furthermore, the ICC value of 0.95 demonstrated excellent reliability of the CMS questionnaire. The mean CMS in the retest was slightly higher than that in



the initial test ( $P=0.01$ ), with a significant difference observed only in the pain score ( $P<0.001$ ). This result was clinically reasonable as no treatment was administered between the test and retest stages, and could also reflect a better understanding of the questionnaire by the patients upon retesting.

Widespread use of the CMS questionnaire is evident from its culturally-adapted translations and implementation in several countries, such as Saudi Arabia, Brazil, China, Turkey, Denmark, and Greece, where this questionnaire has been translated into local languages to ensure simplicity, comprehensibility, applicability, and cultural compatibility while determining validity and reliability.<sup>2,6,12,14,19,24</sup> In studies conducted in Saudi Arabia,<sup>12</sup> Brazil,<sup>2</sup> China,<sup>19</sup> and Turkey,<sup>6</sup> patients completed both the CMS questionnaire and a previously validated shoulder questionnaire in their native languages. Based on the comparative analysis, the CMS met the validation criteria.

In Denmark<sup>14</sup> and Greece,<sup>24</sup> patients were re-examined with the same questionnaire a few days after the initial visit, without any treatment. In the Danish study, the test-retest method was performed with ICC=0.93 for rater A and 0.95 for rater B (with patients examined by two raters), while the Greek study reported an ICC value of 0.95.<sup>14,24</sup> In the present study, a similar method was used, as a single examiner was employed to minimize interpersonal rating bias, resulting in an identical ICC value of 0.95.

Greek version of the CMS questionnaire showed excellent reliability and validity within the community, using a numerical scale for pain and activity to simplify responses. The present study assessed pain intensity and activity using a VAS, which is more accurate, reliable, and scientifically validated, with no barrier for participants. Similarly, the Danish version also reported acceptable reliability and validity of the CMS questionnaire. However, the interval between the test and retest in the Danish study was shorter (2-4 days), compared to the present study (7-10 days), which might have affected the way participants recalled their initial responses. Likewise, the Arabic and Chinese versions of the CMS questionnaire demonstrated reliability and validity within their respective communities. These studies were notable for their larger sample sizes, similar to the present study, which also assessed a statistically sufficient sample size ( $n=107$ ).

The most recent Persian version of the CMS, published by Amroodi et al,<sup>17</sup> assessed only the reliability of the questionnaire through a test-retest method within a short time frame of 24 h, (potentially leading to recall bias). That study did not evaluate the validity of their translated CMS.

Strengths of the present study include the optimal sample size used to assess the reliability and validity of the questionnaire, the use of a VAS for the assessment of pain intensity and activity, a sufficient interval between the test and retest, and the employment of a single examiner for all participants.

However, the study was limited to patients with rotator cuff tears, which, although common, represent only one type of shoulder disorder. Further research is recommended to

assess the clinical value of this tool across a broader range of shoulder problems. Moreover, the single-center design of the study, despite being conducted at a major shoulder referral center in the South of Iran, covered only a limited region of the country. Therefore, multicenter investigations are needed to enhance generalizability.

### Conclusion

Given the limitations of this study, it can be concluded that the Persian version of the Constant-murley Score is both reliable and valid for the assessment of shoulder pain and functional status in the southern Iranian population with rotator cuff tears. The findings suggested that this version is suitable for use in orthopedic clinics to evaluate shoulder dysfunction. However, further research is required to address other shoulder pathologies and include diverse Iranian subcultures and subpopulations.

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**Authors Contribution:** O.M, M.A and A.F checked and approved the final translation of the CMS questionnaire. S.J did the literature review. S.J and O.M contributed to patient selection based on the inclusion criteria. S.J, A.Z and O.M led the clinical examinations and completed the objective section of the questionnaire for the case and control group, consent obtaining, and handing out the questionnaires. S.J and A.Z collected and curated the data; Dr Z.S participated in the data analysis. S.J led the drafting of the result section of the manuscript. A.F, M.A and O.M contributed to refining the overall manuscript and to production of the figures. All the authors participated in the conception and design of this study. S.J drafted the paper, and after being edited, A.F, M.A, and O.M were involved in reviewing and editing the writing part of the manuscript. In addition, they provided supervision during the whole process. All authors reviewed and approved the final manuscript.

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