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Checking the Validity and Reliability of the Delirium-O-Meter Questionnaire in the Persian Language

Saeideh Ghaffarifar[1], Reza Naghdi Sadeh[2*], Mehrdad Ghaemmaghami[3], Mohammad Hossein Parchehbaf Mohseni[3]

Abstract

Objective: Compiling and designing short and practical psychometric tools are among the benefits and strengths of a good standard test. The Delirium-O-Meter questionnaire measures patients' delirium status. Accordingly, the main aim of this research was to check the reliability and validity of the Persian version of this questionnaire.

Method: This exploratory psychometric study was conducted from 2021 to 2022 at the therapeutic research training centers of Tabriz University of Medical Sciences. The study population included patients diagnosed with delirium. Content and construct validity were assessed using exploratory factor analysis and confirmatory factor analysis. Exploratory factor analysis was performed using SPSS 18, which helped identify the underlying factor structure, while confirmatory factor analysis in Smart PLS was employed to confirm the structure's fit. Pearson correlation was used to evaluate the consistency between different raters, and Cronbach's alpha was calculated to assess internal consistency. These methods were selected for their robustness in evaluating the instrument's psychometric properties, ensuring the reliability and validity of the Persian version of the Delirium-O-Meter questionnaire.

Results: The Persian version of the Delirium-O-Meter questionnaire, consisting of 11 items, demonstrated strong psychometric properties. The average impact factor was 3.24, indicating a high relevance of the items. The content validity ratio was 0.78, and the content validity index was 0.87, both above the acceptable thresholds, confirming the content validity of the questionnaire. Cronbach's alpha coefficient for the entire questionnaire was 0.77, reflecting good internal consistency. The Kaiser-Meyer-Olkin index was 0.88, and Bartlett's sphericity test was significant ($\chi^2 = 278.45$, $P < 0.001$), indicating the appropriateness of the data for factor analysis. Exploratory factor analysis revealed two factors that explained 76.09% of the total variance, supporting the questionnaire's construct validity. Additionally, Pearson's correlation coefficient between the assessments of two nurses was 0.91, signifying inter-rater solid reliability.

Conclusion: The Persian version of the Delirium-O-Meter questionnaire demonstrates acceptable reliability and validity, as confirmed by the comprehensive psychometric evaluation conducted in this study. The strong internal consistency, significant content and construct validity, and high inter-rater reliability underscore its effectiveness in assessing delirium in Persian-speaking patients. These findings highlight the questionnaire's suitability for clinical use, providing a reliable and valid instrument for accurately diagnosing and managing delirium in diverse healthcare settings.

Key words: *Delirium; Diagnosis; Factor Analysis; Questionnaire; Validity and Reliability*

1. Medical Education Research Center, Health Management and Safety Promotion Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran.
2. Research Center of Psychiatry and Behavioral Sciences, Tabriz University of Medical Sciences, Tabriz, Iran.
3. Department of Psychiatry, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran.

*Corresponding Author:
Address: Research Center of Psychiatry and Behavioral Sciences, Tabriz University of Medical Sciences, Tabriz, Iran, Postal Code: 5167846184.
Tel: 98-914 3327077, Fax: 98-413 3826512, Email: Naghdir@tbzmed.ac.ir

Nowadays, one of the most common psychiatric diagnoses among hospitalized patients, especially among older adults, is delirium (1). The term 'delirium' originates from the Latin word "delirare", which means "to go out of the furrow," signifying a deviation from a straight path or a state of mental disturbance. Delirium is a serious neuropsychiatric condition marked by the sudden onset of impaired attention and other cognitive functions. Patients may experience altered levels of arousal, ranging from near-comatose unresponsiveness to extreme alertness and agitation. They may also suffer from severe and distressing psychotic symptoms, such as delusions and hallucinations, as well as mood changes. The symptoms of delirium typically vary in intensity and duration. This condition causes significant distress for both patients and their caregivers (2). Over 65 years of age, impairment of the five senses, particularly vision and hearing, immobility, and dependency, increase the incidence of this disorder and susceptibility to underlying problems (3).

Delirium is characterized by inattention, disorientation, disorganized thinking, cognitive deficits, and changes in consciousness and sleep patterns. It typically develops suddenly and fluctuates, with a prodromal phase of restlessness, anxiety, and sleep disturbances. There are five distinct clinical types of delirium, with three classic motoric forms: hyperactive, hypoactive, and mixed, the latter being most common in older, medically ill patients. Subsyndromal delirium, an incomplete form, results in longer hospital stays and poorer outcomes. Newer variants include the "catatonic variant" (extreme hypoactive) and the "excited variant" (extreme hyperactive), the latter often associated with stimulant drug abuse and severe consequences if untreated (4).

Various factors, including metabolic encephalopathy, drug poisoning, hypoglycemia, preoperative hypoxemia, and hypotension, can trigger delirium (5). Additionally, there are some causes of post-surgery, including surgical stress, pain, insomnia, painkillers, electrolyte imbalances, fever, and bleeding that lead to delirium (6). Additional risk factors are lower plasma albumin, hypertension, mechanical ventilation, and antipsychotic drug use (7).

Delirium's fluctuating symptoms pose significant challenges for diagnosis, and nurses, who spend the most time with patients, are well-positioned to identify these changes (8). Thus, nurses' observations are crucial for early delirium diagnosis, and their effectiveness increases significantly when these observations are systematically organized (9). A qualitative study conducted in 2021 highlighted a significant knowledge gap among community care nurses regarding delirium. Many nurses were found to be unfamiliar with the condition, often misdiagnosing it as dementia or depression. Although tools such as the Confusion Assessment Method (10) and the 4AT effectively identify delirium, their usage is not yet widespread among nurses. Enhancing nurses' observational skills through these tools can improve the

accuracy of delirium detection. Therefore, nurse-led assessments are vital, as nurses' close and continuous contact with patients places them in a key position for the early identification and intervention of delirium (11). Delaying the diagnosis of delirium can lead to treatment delays and cognitive impairment. Therefore, regular delirium assessments should be conducted in intensive care units, and healthcare providers should be trained in using assessment tools. Early diagnosis and management of the underlying medical causes and targeted interventions can reduce delirium's severity, duration, and consequences (12-14).

Delirium is prevalent in various patient groups and settings, with higher rates among hospitalized older adults. A 2020 meta-analysis reported a 23% prevalence among medical inpatients (15). Other studies showed delirium occurs in 7.2% to 24% of patients after cardiovascular surgery (16, 17) and 25% following acute stroke (17). In palliative care, prevalence ranges from 4–12% in community settings to 35% in inpatient units, increasing to 59–88% among patients nearing death (17). Also, in nursing homes, delirium prevalence ranges from 4.3–38%, while it is generally ≤2% in non-institutional community settings (12, 13). The presence of delirium significantly impacts patient outcomes, including increased mortality rates, prolonged hospitalization, higher costs, greater nursing demands, and worsened cognitive function. Delirium also heightens the risk of dementia, falls, and reduced quality of life, with mortality rates reaching 23% at three months and 50% with annual episodes (18, 19). The consequences extend to patients' families and caregivers, with nurses facing challenges in managing unpredictable behaviors and providing additional care, further exacerbating the burden of delirium (14).

Due to these challenges, a tool is needed to quickly assess the severity of delirium symptoms and provide appropriate treatment. So far, several delirium assessment tools have been provided (9). In Iran, some scales, including the Intensive Care Delirium Screening Checklist (ICDSC) (14), the Pediatric Delirium Scale (19), and 4AT (18), have been validated in Persian. There are several challenges associated with these delirium assessment tools. Delirium manifests differently across patient populations, making it difficult to design a tool that suits all cases. For example, hypoactive delirium is often underdiagnosed because its symptoms are more subtle. Additionally, effective use of these tools requires proper training, but inconsistencies in training practices and resource availability can impede consistent implementation across various settings. Regarding limitations, while tools like ICDSC have been widely validated, their sensitivity and specificity can vary based on the patient population and clinical environment, potentially leading to misdiagnosis or under-diagnosis of delirium. The use of sedation in ICU settings further complicates delirium assessment, as sedated patients may not display the full range of delirium symptoms, making

it challenging even for the most advanced tools to provide accurate assessments. Moreover, implementing these tools requires considerable resources, including staff training, time for assessment, and integration into clinical workflows (14, 18, 19).

Based on DSM-IV criteria, the Delirium-O-Meter (DOM) questionnaire offers a consistent and reliable tool for diagnosing delirium across various clinical settings. Unlike other tools, the DOM aligns closely with updated delirium definitions and provides a sensitive measure of severity, allowing even minimally trained nurses to make quick, accurate assessments in 3-5 minutes (20-22). This is particularly valuable for detecting subsyndromal delirium, which other tools might miss (23). Due to the worth of the DOM and the comprehensive coverage that suits clinical environments, standardizing this tool in Iran is crucial for enabling nurses to perform their duties more efficiently and accurately. This study marks the first effort to accomplish this standardization. The present study introduces the Persian version of the DOM questionnaire and assesses its psychometric properties, aiming to improve delirium assessment in Iran and enhance nursing efficiency and accuracy.

Materials and Methods

Study Design
This exploratory psychometric study was conducted at Tabriz University of Medical Sciences between 2021 and 2022.

Population and Sample
The population studied in this research were patients, including men and women, over the age of 18 who were admitted to medical research centers at Tabriz University of Medical Sciences. These patients were diagnosed with delirium caused by lung infections, post-surgery, Covid-19, urinary tract infection, cerebrovascular accidents, fracture, etc. Regarding the changes in the number of patients in different periods, accurate statistics of the number of patients were not available. The inclusion criteria included the consent of the patient or family to participate in the study and the diagnosis of delirium. This diagnosis based on the DSM identifies delirium as a disturbance in attention (i.e., reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment) (26). The diagnosis was made by a psychiatrist fluent in Persian. Patients and experts who did not have the necessary cooperation and consent to participate in the research were excluded from the study.

40 patients were selected to determine the reliability of the questionnaire, while 110 patients were chosen to determine its construct validity. Furthermore, the questionnaire's face and content validity were determined with the participation of 10 nurses and 10 psychiatric experts. Patients were selected as they became available during their hospital admission or stay. The research team collaborated closely with attending psychiatrists and

nurses to identify eligible patients diagnosed with delirium based on DSM criteria. Patients or their families were approached for consent, and those who agreed were included in the study. Efforts were made to include a diverse patient population across different hospital wards and varying levels of delirium severity. For the validation process, 10 psychiatric experts and 10 nurses were selected using a targeted sampling method. These individuals were chosen based on their psychiatry expertise and experience working with delirium patients in teaching hospitals in Tabriz. Their participation was crucial in determining the face and content validity of the Persian version of the Delirium-O-Meter questionnaire.

Sample Size
To assess the reliability of the Persian version of the Delirium-O-Meter questionnaire, a sample of 40 patients was used. This sample size is consistent with standard psychometric practices, where reliability coefficients are typically estimated with sample sizes ranging from 30 to 50 participants (24). This allowed for a robust analysis of internal consistency using Cronbach's alpha. 110 patients were included in the evaluation of construct validity. This sample size aligns with recommendations for exploratory factor analysis and validity assessments, where a minimum of 100 participants is generally suggested to ensure stable and reliable factor solutions (25). This sample size provided adequate power for a thorough validity testing of the questionnaire in the Persian language.

Measures
The Delirium-O-Meter (DOM) questionnaire was used to collect data. This scale was developed by de Jonghe *et al*. (2005) (20). The DOM is an abbreviated rating scale for diagnosing and assessing the severity of delirium that nurses with limited training in geriatric care can use. The content of the scale was designed to reflect both hyperactive and hypoactive symptoms as per DSM-IV-TR criteria, and other critical aspects of rating scales. Thus, items measuring sustained attention, shifting attention, and impaired attention are included in the DOM. An expert panel of Dutch and Belgian clinicians/researchers in geriatrics, geriatric psychiatry, and psychology reviewed the content of the Delirium-O-Meter items. They made several specific recommendations regarding face and content validity. This resulted in a final 12-item behavioral observation scale consisting of the following categories: Sustained Attention, Shifting Attention, Orientation, Consciousness, Apathy, Hypokinesia/Psychomotor Retardation, Incoherence, Fluctuating Performance (Diurnal Variation/Sleep-Wake Cycle), Restlessness (psychomotor agitation), Delusions, Hallucinations, and Anxiety. Each item is scored on a four-point scale (0 = no symptoms, 1 = mild impairment, 2 = moderate impairment, 3 = severe impairment). Total scores range from 0 to 36. The Delirium-O-Meter score form is printed on one page and provides a quick overview of the

symptom profile. It takes about 4-5 minutes for the DOM to complete (20).

Method

The Delirium-O-Meter questionnaire was translated from English to Persian by a psychiatric expert fluent in both languages. Permission to translate the questionnaire was obtained via email from Dr. de Jonghe, one of the leading authors from the Department of Clinical Psychology, Alkmaar Medical Center, Netherlands. To ensure the accuracy and cultural appropriateness of the Persian version of the DOM questionnaire, we followed a rigorous translation process that included several vital steps. Starting with forward translation, the original English version of the DOM was translated into Persian by a bilingual psychiatric expert fluent in English and Persian. This expert was familiar with the questionnaire's content and ensured that the translation accurately reflected the meaning of the original items while considering the cultural context. Subsequently, backward translation was used to verify its accuracy. A second bilingual individual, fluent in English and Persian, independently translated the Persian version back into English. This person needed to be made aware of the original version of the questionnaire to avoid bias. The backward translation was then compared to the original English version to identify discrepancies or deviations. Next, the research team, consisting of experts in psychiatry and psychometrics, reviewed the translations (both forward and backward) to reconcile any differences between the translated versions. This step involved discussing and resolving discrepancies to ensure the final Persian version was conceptually equivalent to the original version and culturally appropriate. Finally, a panel of ten nurses from the Razi and Imam Reza Hospital departments and ten psychiatric experts reviewed the revised Persian version of the DOM. Their feedback was incorporated to ensure the content validity of the translated questionnaire and confirmed that it met the standards of clinical and psychometric practice. For cultural adaptation during the forward translation, the bilingual psychiatric expert ensured that the terminology and phrases used in the DOM were adapted to align with cultural norms and expressions commonly understood by Persian-speaking patients. This involved modifying specific items to reflect culturally relevant concepts related to delirium and its symptoms, ensuring that the language was appropriate for the Persian context. Also, certain items were adjusted to be sensitive to cultural differences in the expression and interpretation of symptoms. For example, items related to emotional experiences or behavioral symptoms were reviewed and adapted to avoid cultural misunderstandings or misinterpretations. This was done to ensure that the questions were perceived as intended and resonated with the experiences of Persian-speaking patients. Regarding the criteria for item importance, items were evaluated based on relevance to key delirium symptoms, frequency of symptom occurrence, clarity and understandability,

and cultural relevance. Based on expert ratings, an impact score was calculated for each item, with higher scores indicating more significant importance. Items with lower scores were reviewed for potential modification or removal. Expert feedback was utilized to refine items and ensure the final questionnaire met the standards for face validity. Discrepancies were identified through feedback analysis and thematic analysis. Items were revised and re-reviewed to address any issues. Consensus meetings were held to ensure final revisions met clarity and relevance standards.

After undergoing required literary and scientific editing and determining its validity and reliability, the questionnaire was distributed among nurses, who were asked to complete the questionnaire for patients with delirium. The validity of the questionnaire was examined in the sections of face validity, content validity, and construct validity. To check construct validity, the questionnaire was completed by five nurses for 110 patients. Reliability was checked by determining the internal correlation of the items using Cronbach's alpha. Since delirium changes over time, for the stability of the attained results, the questionnaire was completed for 40 patients, two nurses were dedicated for each patient, and the intraclass correlation coefficient was calculated. Lastly, the data were entered into SPSS18 and analyzed.

Data Analysis

Two qualitative and quantitative methods were employed to determine face validity. In the qualitative determination of face validity, the level of difficulty (difficulty in understanding phrases and words), the degree of disproportion (the appropriateness and relationship of phrases with the dimensions of the questionnaire), and ambiguity (the possibility of misperceptions of phrases or the existence of inadequacies in the meanings of words) were examined and corrected. For the quantitative assessment of face validity, the quantitative method of the impact of items was used. The impact score of each item is calculated based on the following formula:

Impact score = Frequency (%) * Importance

The content validity ratio (CVR) and content validity index (CVI) were utilized to determine the questionnaire's content validity. The CVR is calculated to assess the necessity of each item in the questionnaire. The panel of ten experts evaluated each item and rated it on a three-point scale: "essential," "useful but not essential," or "not necessary." Items rated as "essential" were used to compute the CVR. According to Lawshe's (1975) (27) recommendations, the cutoff value for CVR to indicate adequate content validity depends on the number of experts. The CVR cutoff value is approximately 0.62 for a panel of ten experts. Items with a CVR below this threshold were considered for revision or removal. Items with a CVR below 0.62 were reviewed for potential revision. For instance, if an item had a CVR of 0.40, indicating that fewer than the majority of experts considered it essential, it was scrutinized for possible

modification to better reflect the critical aspects of delirium.

CVI was used to evaluate the relevance of each item. Two types of CVI were calculated: Item-CVI (I-CVI), which is the proportion of experts who rated each item as "relevant" or "highly relevant," and Scale-CVI/Ave (S-CVI/Ave), which is the average of all Item-CVI scores. Each item was rated on a four-point scale: "not relevant," "somewhat relevant," "quite relevant," and "highly relevant." Items with an I-CVI of 0.80 or higher were considered to have adequate relevance. The S-CVI/Ave is calculated by averaging all I-CVI scores, with a recommended cutoff of 0.90 for the scale to ensure overall content validity. Items with an I-CVI below 0.80 were reviewed for revision. For example, if an item had an I-CVI of 0.70, indicating that fewer than most experts deemed it highly relevant, it was re-evaluated and revised based on expert feedback to improve its relevance and clarity. Items with low CVR or I-CVI scores were revised based on expert feedback to improve their relevance and clarity.

Initially, the research questionnaire was completed for 40 patients and subsequently analyzed with SPSS18 software. Cronbach's Alpha was calculated to assess internal consistency, with values below 0.70 indicating potential issues. Items contributing to low alpha were reviewed or removed. The Intraclass Correlation Coefficient was used to evaluate test-retest reliability. Values below 0.70 suggested instability, which led to further review of the questionnaire. Items with low-reliability coefficients were considered for removal or revision based on their impact on overall reliability (28). The factor analysis methods (exploratory factor analysis and confirmatory factor analysis) were used to determine construct validity and check the construct validity of 110 questionnaires.

Second-order confirmatory factor analysis, performed in the Smart PLS software, was used to check the structural validity of the extracted factors.

To evaluate the applicability of this questionnaire, a quantitative criterion and several qualitative criteria were considered. The average time required for nurses to the questionnaire, the amount of cost and human resources needed to complete the questionnaire from the nurses' point of view, and their agreement on the utility of the questionnaire were considered both quantitative and qualitative criteria to evaluate the applicability of the questionnaire respectively.

Results

Descriptive findings of the demographic variables of patients and nurses are presented in Table 1. The mean age of the participants was 67.63 ± 14.88 years, and 63.6% of patients were male and 36.4% female. 17.3% of the nurses who cooperated in completing the questionnaire were on the morning shift, 42.7% in the evening shift, and 40% on the night shift. The highest frequency of patients was in the corona section with 21.8%.

Table 1. Baseline Characteristics of Patients (110) and Nurses (n = 110), Who Participated in Psychometric Evaluation of the Persian Version of the Delirium-O-Meter Questionnaire

Variable	Options	Frequency	Percentage
Patient's gender	Male	70	63.6
	Female	40	36.4
Nurses' shift	Morning	19	17.3
	Evening	47	42.7
	Night	44	40.0
Inpatient department	General inpatient department	8	7.3
	Corona	24	21.8
	Thorax	4	3.6
	ICU	9	8.2
	Lung	14	12.7
	Digestion	2	1.8
	Infectious	9	8.2
	Trauma	2	1.8
	Surgery	7	6.4
	Neurology	5	4.5
	Urology	2	1.8
	ENT	2	1.8
	Rheumatology	2	1.8

Kidney	6	5.5
SCU	2	1.8
Orthopedics	2	1.8
Oncology	4	3.6
CCU	6	5.5

First, the Delirium-O-Meter questionnaire was translated from English to Persian. It was then back-translated into English by another fluent person and compared with the original questionnaire. There was no significant difference between the two English questionnaires. After matching them, the opinions of ten nurses from the Razi and Imam Reza Hospital departments and ten psychiatrists and professors about the required changes regarding the clarity and transparency of the questionnaire items were reviewed and applied.

The face validity results of the questionnaire are presented in Table 2. Using the impact score method, the impact score was calculated by multiplying an item's frequency by its importance. An impact score greater than 1.5 indicated that the item was suitable for further analysis and would be retained. The significance of each item was determined using the expert judgment method. All items of the questionnaire had an impact score greater than 1.5, which designates the acceptable face validity. Considering that the CVI value of all the items is more significant than 0.79, it is concluded that each item's content validity index is at an acceptable level. Because the number of specialists was 10, the minimum acceptable CVR value, according to the relevant table, should be equal to 0.62. The CVR values for all questionnaire items are calculated in Table 2. Based on the results, the CVR value of the fifth question is equal to 0.2, which is less than the threshold value of 0.62, indicating it should have been removed from the questionnaire. However, the CVR value of other questionnaire questions is greater than 0.62, confirming that they have an acceptable content validity ratio. Therefore, the fifth question, titled "apathy", was removed from the questionnaire.

Table 2. Face and Content Validity of the Persian Version of the Delirium-O-Meter Questionnaire

Items	Impact score	Content Validity Index	Content Validity Ratio
Sustained attention	2.16	0.80	0.80
Shifting attention	2.28	0.80	1.00
Orientation	3.28	0.80	0.80
Consciousness	2.80	1.00	0.80
Apathy	2.80	0.80	0.20
Psychomotor retardation/Hypokinesia	3.87	0.80	0.80
Incoherence	3.78	0.90	0.80
Fluctuating	3.96	0.90	0.80
Restlessness	3.44	0.90	0.80
Delusions	3.87	1.00	0.80
Hallucinations	3.28	0.80	1.00
Anxiety	3.36	0.90	0.80
Entire questionnaire		0.87	0.78

Cronbach's alpha coefficient for the whole questionnaire was 0.77. Since the significance level of the Kolmogorov-Smirnov test was greater than 0.05 both in the first stage (p = 0.87) and in the second stage (p = 0.93), it was concluded that the distribution of the variables was normal. Pearson's correlation coefficient between the two stages (opinions of two groups of nurses) was calculated for an overall score equal to 0.91.

According to Table 3, the results show that the value of the KMO index is equal to 0.88 and the significance level of Bartlett's sphericity test is equal to 0.001.

Table 3. The Results Indicating the Suitability of the Data for Factor Analysis on the Persian Version of the Delirium-O-Meter Questionnaire

KMO* Index		0.881
Bartlett's Sphericity Test	Chi-Square	997.36
	df	55
	Sig.	0.001

*Kaiser–Meyer–Olkin test

Table 4 presents the eigenvalues and explanatory variance of the extracted factors. Two factors were extracted from the 11 questions in the questionnaire (the fifth question was removed because of low content validity). The eigenvalue of these two factors was greater than 1. These two factors explain 76.09% of the total variance.

Table 4. Eigenvalues and Explanatory Variance of the Extracted Factors of the Persian Version of the Delirium-O-Meter Questionnaire

Factor	Eigenvalues	Percentage of variance	Cumulative Percent Variance
1	6.088	40.637	40.637
2	2.282	35.453	76.090

Table 5 indicates the extracted factors after Varimax rotation. The extracted factors were sorted using Varimax rotation. Each question should have the highest factor loading in its respective factor. The first factor includes questions 2, 3, 4, 6, 7, and 8, which were named based on the main cognitive/motivational dimension questionnaire. The second factor includes questions 1, 9, 10, 11, and 12, which were named based on the main psychological/behavioral dimension questionnaire.

The results of construct validity are shown in Figures 1 and 2. According to Figure 1, the results demonstrate that the first-order factor loadings of questions related to cognitive/motivational dimensions and the second-order factor loadings related to psychological/behavioral dimensions are greater than 0.7. On the other hand, based on Figure 2, the significance test of the factor analysis model, the results indicate that all factor loadings are significant at the 95% level (t > 1.96).

Table 5. Factors Extracted after Varimax Rotation and Factor Loadings of the Items of the Persian Version of the Delirium-O-Meter Questionnaire

| Question Number	Question Title	Factor 1	Factor 2
s2	Shifting attention	0.901	0.22
s3	Orientation	0.887	0.193
s6	Psychomotor retardation/Hypokinesia	0.838	0.174
s4	Consciousness	0.824	0.229
s8	Fluctuating	0.806	0.323
s7	Incoherence	0.8	0.093
s12	Anxiety	0.187	0.875
s11	Hallucinations	0.177	0.861
s9	Restlessness	0.203	0.859
s10	Delusions	0.169	0.838
s1	Sustained attention	0.256	0.819
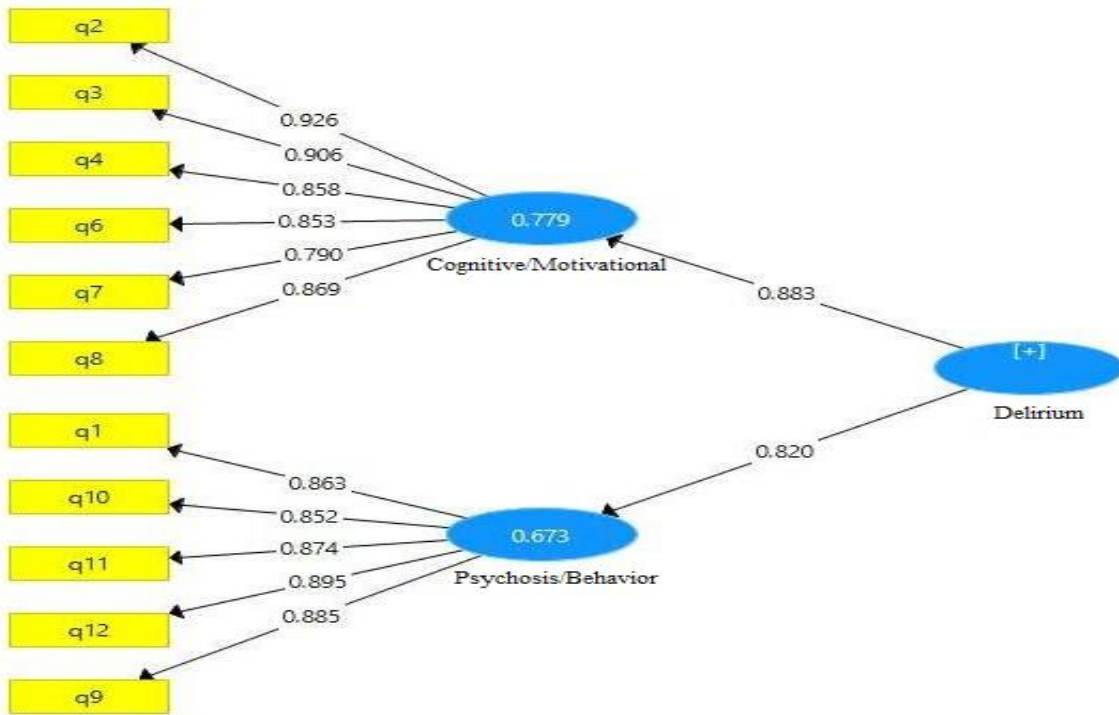
Figure 1. Factor Loadings of the Confirmatory Factor Analysis Model of the Delirium-O-Meter Questionnaire
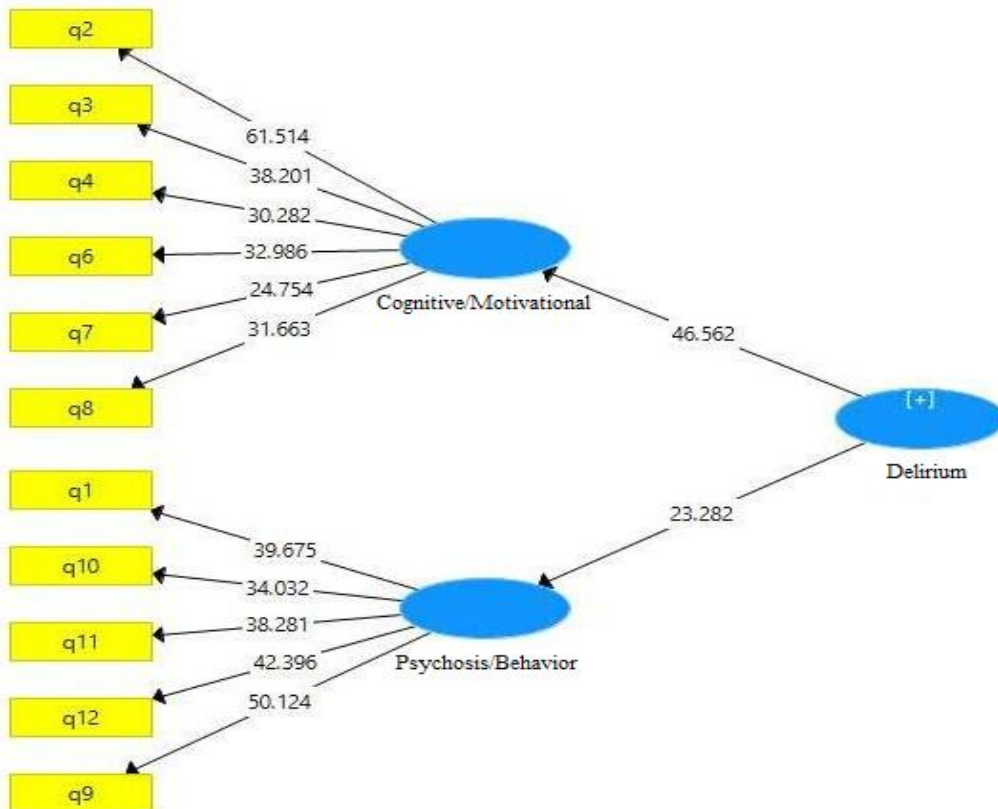

Figure 2. Significance Test of the Confirmatory Factor Analysis Model of the Delirium-O-Meter Questionnaire

After mastering the questionnaire, the average time required for its completion was between 4 and 5 minutes. Implementing it for at-risk patients costs as much as one sheet of printed paper per shift. The human resources required for the evaluation include the nurse on the patient's shift, who can perform this evaluation for each patient during the shift's delivery.

Discussion

The present study was conducted to provide the Persian version of the DOM questionnaire and assess its psychometric properties. Based on the evaluations, the impact score for all questionnaire items was greater than 1.5, indicating acceptable face validity. Additionally, all items in the questionnaire had a CVI value greater than 0.79, indicating an acceptable content validity index. The fifth question, however, had a CVR value of 0.2, less than the acceptable value of 0.62, leading to its removal from the questionnaire. This rigorous process ensures the questionnaire's reliability.

These results are consistent with the results of the original questionnaire of de Jonghe *et al.* (20), except for the fifth question; the CVR value of the fifth question was equal to 0.2 and less than the value of 0.62 and should have been removed from the questionnaire, and according to the experts in this field, removing it does not create a defect in the evaluation and diagnosis of delirium. The impact score, CVI, and CVR were reasonable in the original research. In de Jonghe *et al.*'s study, the overall findings strongly support the convergent and divergent validity of the DOM. Nurses agreed on total DOM scores (20).

The Persian version of the DOM questionnaire demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.77 for the whole questionnaire and 0.87 for the main questionnaire. The dimensions of the questionnaire varied between 0.87 and 0.92, indicating strong reliability. These findings align with the original questionnaire, confirming the Persian version's reliability. The Persian version of the DOM questionnaire was rigorously adapted to ensure its validity and reliability. This process included forward and backward translation, which was instrumental in maintaining conceptual and cultural alignment with the original English version. The face and content validity indices (CVR and CVI) were comparable to the original tools, further confirming the relevance of the Persian version. Construct validity was supported by factor analysis, which revealed a similar factor structure that explained 76.09% of the variance. The reliability indicators, including Cronbach's alpha (0.77) and intraclass correlation coefficient (ICC = 0.91), were consistent with the original version, confirming the Persian DOM's psychometric strengths.

The value of the KMO index was equal to 0.88 and the significance level of Bartlett's sphericity test was equal to 0.001. The value of the KMO index was greater than the standard value of 0.7, which designated the appropriateness of the obtained data for factor analysis and the adequacy of sampling (110 samples). The number of participants in the main study was 92. In total, two factors were extracted from 11 questions in the questionnaire. The eigenvalue of these two factors was greater than 1. These two factors explain 76.09% of the total variance. In the leading research, this number is 64.4 percent of the variance. The first factor included questions 2, 3, 4, 6, 7, and 8, which were named based on the main cognitive/motivational dimension questionnaire. This factor primarily encompasses symptoms of cognitive impairment and attentional disturbances, such as sustained attention, shifting attention, and orientation. This factor reflects delirium's core cognitive disruption characteristics, aligning with the DSM criteria emphasizing attention and awareness deficits. The second factor included questions 1, 9, 10, 11, and 12, which were named based on the original psychological/behavioral dimension questionnaire (same as the original research). This factor includes items related to psychomotor behavior and emotional disturbances, such as restlessness, hypokinesia, and anxiety. This factor captures the behavioral and emotional aspects of delirium, which are critical for distinguishing between hyperactive and hypoactive subtypes of the disorder. Together, these factors provide a comprehensive assessment framework, addressing both the cognitive and behavioral dimensions of delirium, essential for accurate diagnosis and tailored intervention strategies. The factor loadings of all questionnaire items in their respective dimensions were greater than 0.7, indicating a high level of explanatory power for each item. Also, all factor loadings are at the 95% significance level (t > 1.96). These results indicate that the extracted factors have satisfactory construct validity. Therefore, it can be concluded that the modified DOM questionnaire in the Persian language has the same construct validity as the original English version.

The two factors identified in the Persian version of the DOM align well with the hypoactive and hyperactive delirium subtypes. The first factor, which focuses on cognitive impairments like attention deficits and disorientation, is relevant to both subtypes, since these cognitive disturbances are central to delirium. The second factor, involving psychomotor and emotional symptoms such as restlessness and anxiety, corresponds with the hyperactive subtype, while hypokinesia captures the hypoactive subtype. This alignment underscores the tool's effectiveness in distinguishing delirium subtypes and reinforcing diagnosis and treatment customization.

The DOM is a homogeneous scale. However, two factors appeared in the analysis, the first factor (cognitive/motivational) explained around half of the variance. This factor is very similar to the concept of hypoactive delirium. The second and smaller factor included psychotic symptoms and behavior usually associated with hyperactive delirium (10). Our findings strongly suggest that the DOM is a suitable measure for hypoactive and hyperactive delirium.

The DOM was not only developed as a screening test for delirium, but also as a measure of severity. Nevertheless, in an interim analysis, it correctly classified almost all delirium patients (92.9%). Specificity was high in the non-delirium composite sample consisting of dementia patients (66.7%) as well as in the non-delirium sample consisting of psychiatric patients/normal controls (83.3%). Dementia is linked to changes in cognition (e.g., disorientation) and behavior. These symptoms are also measured by the DOM and this may account for why specificity was low in the combined sample. Notably, two-thirds of dementia patients had high scores on the disorientation DOM. Specificity was higher for the patient sample without cognitive impairment (29).

ICC value below 0.40 is interpreted as "poor", between 0.40 and 0.59 as "moderate", between 0.60 and 0.74 as "good," and between 0.75 and 1 as "excellent" (28).

The Pearson correlation coefficient for the overall score between the two stages was calculated to be 0.91. These coefficients were significant at the alpha level of 0.05 ($p < 0.05$). Since the Pearson correlation coefficient exceeds 0.7 and is significant, it can be concluded that the modified Persian version of the Delirium-O-Meter questionnaire has acceptable stability. In the original questionnaire, the ICC value was equal to 0.84, which indicates a similar level of intraclass stability for the two questionnaires.

The average time needed to complete the questionnaire was between 4-5 minutes after mastering it. The cost of implementing it for at-risk patients is as much as one sheet of printed paper per shift. The human resources essential for the evaluation is also the nurse of that patient's shift, who can perform this evaluation for each patient during the delivery of the shift. Among the nurses participating in the project, the questionnaire is acceptable and can be implemented in all hospitals. There was no need for special expertise and experience to complete the current questionnaire. Consequently, the Delirium-o-Meter questionnaire in the Persian language can be implemented by nurses.

The Persian version of the DOM exhibits psychometric properties similar to the original English version, with solid reliability and construct validity. Both versions demonstrated high internal consistency, with Cronbach's alpha values above 0.75, and similar factor structures explaining significant variance. However, minor differences in individual item loadings and CVRs were noted, likely due to cultural differences in interpreting delirium symptoms. These differences highlight the need for cultural adaptation, suggesting that while the tool's overall reliability is preserved, some items may need refinement for full cultural equivalence.

The identified factors in the Persian version of the DOM hold substantial clinical significance for diagnosing and managing delirium. The first factor, centered on cognitive impairments like attention deficits and disorientation, is crucial for the early detection of delirium, enabling healthcare professionals to recognize the disorder even in its subtle forms. Understanding this factor allows clinicians to implement cognitively-focused interventions, such as environmental modifications or cognitive stimulation, to support patients' orientation and attention. The second factor, which encompasses psychomotor and emotional symptoms, is particularly relevant for distinguishing between hyperactive and hypoactive delirium subtypes. For example, patients exhibiting symptoms associated with the hyperactive subtype, such as restlessness and agitation, may benefit from calming strategies, including the use of antipsychotics or sedative environments. Conversely, those with hypoactive delirium, characterized by lethargy and reduced motor activity, may require interventions that promote mobility and social engagement. By understanding these factors, healthcare professionals can tailor their interventions more precisely, improving patient outcomes by addressing the specific symptoms and needs of different delirium presentations.

The factors identified in the Persian version of the DOM are clinically significant for diagnosing and managing delirium, particularly in distinguishing between hyperactive and hypoactive subtypes. The first factor, focused on cognitive impairments such as attention deficits and disorientation, aids early detection and supports cognitively-focused interventions. The second factor, related to psychomotor and emotional symptoms, guides appropriate interventions, such as calming strategies for hyperactive delirium or mobility promotion for hypoactive cases. The DOM's concise format and ease of administration make it practical for use in fast-paced clinical environments, with an average completion time of 4-5 minutes, allowing seamless integration into routine nursing assessments without a significant time burden. Its ability to register both hyperactive and hypoactive delirium symptoms enables comprehensive monitoring, early diagnosing, and timely intervention, particularly in settings like intensive care units or post-operative care. The straightforward scoring system of the DOM facilitates clear communication among healthcare teams, ensuring consistent documentation and management of delirium symptoms. Overall, the DOM allows healthcare professionals to implement the interventions more effectively, allocate resources efficiently, and improve the quality of care for patients experiencing delirium.

A notable point about delirium assessment is that the stability of symptoms, as assessed by the DOM, can be affected by patient characteristics and environmental factors. Factors such as age (30), baseline cognitive function, and comorbidities can influence the persistence of symptoms (31), with older adults and those with cognitive impairments potentially experiencing more prolonged delirium (30). Environmental elements, such as hospital settings, sensory stimulation, and sleep disruptions, can also impact symptom variability (2, 32). These influences suggest that while the DOM is reliable, its scores may fluctuate based on patient conditions and

environmental contexts. Clinicians should consider these factors when interpreting scores and managing delirium. Implementing the Persian version of the DOM in clinical settings encountered several challenges, including variability in nursing staff training and experience, which impacted the consistency of delirium assessments, particularly with hypoactive delirium. To address this, standardized training sessions are recommended to ensure accurate scoring of both hyperactive and hypoactive symptoms. Additionally, resistance to adopting the DOM in busy clinical environments and logistical issues like ensuring the questionnaire's availability during different shifts were noted. Implementing digital versions of the DOM could streamline its use and reduce problems with paper forms.

Limitation

The study also highlighted some limitations. Though sufficient for factor analysis, the sample size may only partially represent the broader population of delirium patients, potentially limiting the generalizability of the findings. Despite careful translation processes, cultural and linguistic nuances might affect the accuracy of the Persian version of the DOM, suggesting that some items may only partially capture delirium symptoms in the Persian context. Additionally, the tool's lower specificity in patients with dementia due to symptom overlap may impact diagnostic precision. Future research should focus on longitudinal studies for predictive validity, cross-cultural validation, expanding sample sizes, improving inter-rater reliability, and developing digital versions. Despite these challenges, the DOM's briefness and ease of use make it a valid and objective tool for diagnosing and assessing the severity of delirium, including hyperactive, hypoactive, and mixed subtypes.

Conclusion

To conclude, the Persian version of the Delirium-O-Meter questionnaire represents a significant advancement in delirium assessment within the Iranian healthcare context. Its robust psychometric properties and ease of use make it a valuable tool for nurses and clinicians to rapidly and accurately identify delirium, facilitating timely intervention, and improving patient outcomes. By integrating this tool into routine practice, healthcare professionals can enhance the early detection of delirium, thereby optimizing diagnostic and therapeutic strategies and potentially reducing adverse outcomes. This study underscores the importance of culturally adapted assessment tools in addressing the complexities of chronic diseases. It highlights the Persian DOM's potential to improve patient care, streamline clinical workflows, and contribute to the broader field of delirium research. Its adoption in various clinical settings will advance delirium management and support better overall patient care and treatment adherence in the Iranian healthcare system.

Conflict of Interest

None.

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