Caspian Journal of Neurological Sciences
"Caspian J Neurol Sci"

Journal Homepage: http://cjns.gums.ac.ir

Research Paper

Psychometrics and Validation of the Intensive Care Unit Memory Assessment Tool in the Iranian Population

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Citation Ghafouri S, Sayadi N, Jahani S, Maraghi E, Biparva Haghighi S. Psychometrics and Validation of the Intensive Care Unit Memory Assessment Tool in the Iranian Population. Caspian J Neurol Sci. 2023; 9(1):30-38. https://doi.org/10.32598/CJNS.9.32.391.1

Running Title Validation of the Intensive Care Unit Memory Assessment Tool

https://doi.org/10.32598/CJNS.9.32.391.1

Article info:
Received: 28 Aug 2022
First Revision: 22 Oct 2022
Accepted: 11 Nov 2022
Published: 01 Jan 2023

ABSTRACT

Background: The intensive care unit memory (ICUM) assessment tool is a practical tool for memory monitoring after the discharge from ICU.

Objectives: This psychometric study purported to validate ICUM for a sample population of Iranian patients hospitalized in ICU.

Materials & Methods: This research was a descriptive-analytical study that was conducted at Ahvaz University of Medical Sciences in 2022. A total of 96 patients were selected through the convenience sampling method and were asked to complete the questionnaire 2 weeks and 8 weeks after their discharge from the hospital. Exploratory factor analysis was run to validate the tool's structure. The reliability of the ICUM tool was checked by the test-retest method and the Cronbach alpha coefficient for memory subscales.

Results: To increase the qualitative face and content validity of the tool in Persian, some vague items were modified according to the suggestions of the participants, language, and nursing experts. For the quantitative face validity, the item coefficient was calculated, and the minimum score obtained was 4.4. For the quantitative content validity, the content validity ratio (CVR) and content validity index (CVI) were calculated. The minimum obtained scores were CVI=0.7 and CVR=0.6. Thus, all the items were confirmed. The implementation of the factor analysis was confirmed with KMO=0.65. The highest Cronbach alpha coefficient for delusional memory was 0.62 and the highest test-retest correlation for factual memory was 0.95.

Conclusion: The Persian version of ICUM has strong test-retest reliability, but weak internal consistency reliability. It is recommended that future studies evaluate the tool's reliability over an extended period.

Keywords: Memory, Intensive care, Critical care

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Highlights

- The intensive care memory assessment tool (ICUM) has acceptable psychometric properties in the Iranian population.
- The ICUM tool does not have acceptable reliability in the Iranian population.
- The validity of the ICUM tool varies in different cultures and languages.

Introduction

Special care includes all sensitive care associated with the patient's life provided to patients with acute life-threatening diseases under the supervision of highly experienced personnel who have the skills to run advanced equipment and facilities [1]. In the United States, almost 5.7 million patients are admitted to the intensive care unit (ICU) every year, of whom 4.85 million survive and are discharged from the hospital [2]. Considering the studies on Iranian populations, the prevalence of depression in 30% of ICU patients and post-traumatic stress disorder has been reported in 10% to 50% of patients rescued from critical illness in the ICU [3]. Survivors of critical illnesses, in addition to their pre-existing medical condition, may suffer from physical, mental, and cognitive disorders following the treatments they received during their stay in ICU. This condition has been termed post-intensive care syndrome by the Society of Critical Care Medicine [4]. Post-intensive care syndrome occurs in 50% to 70% of ICU survivors and can persist for 5-15 years after hospital discharge [5].

The feature common among patients hospitalized in ICU is their life-threatening conditions. Hallucinations, paranoid delusions, sleep disorders, drug use, physical limitation, and metabolic disorder which affect the patients' memory, have been widely reported in patients treated in ICU [6-10]. The ICU environment is not normal due to the lack of a clear day-night cycle, intense light, infusion pump alarms, constant noises of monitors, and the personnel sounds for twenty-four-hour staffing. Overall, these conditions may lead to psychiatric disorders during the recovery period and after discharge. They also affect the way patients recall ICU memories [11-16]. ICU patients remember factual events very poorly but recall nightmares, hallucinations, and delusions instantly in great detail [8, 17]. The majority of ICU patients falsely see light sources, complex patterns, and illusions; few of them recall childhood memories or images of familiar people [18].

The intensive care unit memory (ICUM) assessment tool was designed and validated by Jones et al. [19] in 2000 at the University of Liverpool, England. The Italian version of this tool was validated in a study by Maurizia Capuzzo [20]. The tool classifies the patients' memory admitted in ICU and helps to identify relationships between memories and clinical information. The ICUM examines the patients' memory before ICU admission.

A review of the available literature reveals that there is no assessment tool to check ICU patients' memory except for the ICUM. In Iran, many studies have been conducted in the field of sleep disorder and delirium in patients hospitalized in ICU but there is no appropriate tool for monitoring the memory of these patients. Due to the lack of such tools in Iran, the researchers decided to check the psychometrics and validate the ICUM. The results of this study can provide scientific implications and new dimensions of the issue for researchers who investigate this field.

Materials and Methods

This research was a descriptive-analytical cross-sectional study. To run the assessment tool, written permission was obtained from the expert who devised the assessment tool via email.

Study participants

The research population included all adult patients hospitalized in the ICU of teaching hospitals affiliated with Ahvaz University of Medical Sciences (Imam, Golestan, and Razi). The sample size was determined based on the prerequisites of factor analysis. The size encompassed ten persons per item (8 items multiplied by 10 equaled 80 persons). Considering a 20% dropout, the final sample size was extended to 100 people. These people were selected through easy sampling from adults admitted to ICU in compliance with the inclusion criteria.

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The inclusion criteria required the population to be adult patients hospitalized in ICU, aged between 17-82 years (both male and female), willing to participate in the study, hospitalized for more than 24 hours in ICU with mechanical ventilation, discharged from the ICU 2 weeks or 8 weeks ago, able to communicate in writing or verbally, and have learning ability. The exclusion criteria encompassed partial completion of the ICUM tool, transfer of the patient to another hospital, discharge with a mechanical ventilation device, history of psychological illness and suicide, history of Alzheimer's before being admitted to the ICU, history of head trauma, stroke, and death of patients during hospitalization. Also, patients who were in coma and had hearing and speech problems were excluded from the study.

Study procedure

ICU memory tool

The ICUM tool, administered in this study, includes 8 main items and 6 supplemental ones with a total of 14 items. The items aim to assess types of memory in patients and include the memory of factual events (sound, light, faces, family, tracheal tube, suction, time, and darkness), feeling memory (feelings of discomfort, confusion, anxiety, fear, and pain), and delusional memory (hallucinations, delusions, dreams, and nightmares). The stability of memory over time can also be monitored via this tool [20].

A checklist (item 4b) of possible memories namely, factual, feelings, and delusional, is used to increase the possibility of recall. Patients are also asked for a brief description of any delusional memories (item 4c). The ICUM test also examines the clarity of recall for admission to the hospital and ICU (items 1 to 4a), discharge from ICU (item 5), panic (item 6), and intrusive thoughts (item 7) relating to any type of memories of ICU after ICU discharge [19].

Scores for subscale of ICUM tool

- Score of 0, 1 is added to the factual memories.
- Score of 0, 1 totaled to score memories of feelings
- Score of 0, 1 totaled to score delusional memories+score of 1 for mention of nurse or doctor trying to kill the patient in description 4c [19].

Translation and back-translation of the ICUM tool

Subsequently, the translation processes and back-translation of the ICUM were completed according to the research article published by the department of the University of Liverpool, England [19]. This tool was translated from English to Farsi and from Farsi to English by 3 PhD. holders in English and 1 Master's in English). The translated version was sent to the designer of the tool. He was asked to compare and comment on the compatibility of the Persian version of this tool with the original version. This process ended with his approval. Upon these processes, the Persian version was finally approved.

Statistical analysis

Information related to the individual characteristics of the patients was analyzed using descriptive indices in SPSS v. 24 software. To analyze the data, after confirming the assumption of normality for each quantitative variable, the state of variance was checked by an independent t test and for pair-by-pair comparisons of more than two levels and Tukey's post hoc test. MPLUS.8.3.2 software was used for exploratory factor analysis (EFA).

Face validity

Face validity was measured using quantitative and qualitative approaches. To determine qualitative face validity, 10 patients hospitalized in ICU (who complied with the inclusion criteria) and 10 nurses working in the ICU were selected and invited to check the items and examine the questions in terms of comprehensibility, simplicity, and clarity. In this process, some items were marked as not sufficiently clear or comprehensible to the patients. These items were re-examined and revised by the research team as far as the content of the item did not change. The items were again presented to the patients and they were asked to express the phrases with more simplicity and clarity. This stage continued until the intended meaning was not changed. In quantitative face validity, the questionnaire was given to 10 patients and 10 nurses of the target group, and they were asked to rate each item in terms of importance based on the Likert scale, completely important [5], moderately important [4], somewhat important [3], slightly important [2], and not at all important [1]. Finally, the coefficient of the expressions was calculated.

Content validity

To check the qualitative content validity, expert opinions and judgments were sought. In this research, the tool was presented to 10 nursing and research experts who were asked to rate the items in terms of grammar, use of appropriate words, the importance of items, appropriate placement of items, and the time to complete the tool. They were expected to announce their opinions within one week. Accordingly, the research team agreed to modify some items to the extent that the content was maintained intact. In terms of content validity, experts' opinions were evaluated quantitatively by calculating two indices of content validity ratio (CVR) to ensure that the most important and the best content (item necessity) was selected and the content validity index (CVI) was examined to ensure the items were best designed to measure the intended content.

Construct validity

Construct validity shows the correlation between variables. At this stage, according to Anderson's recommendations [21], a sample size of 10 patients per item (80 patients) plus a 20% dropout rate resulted in the selection of 100 patients, of whom 4 patients left the study. In this study, EFA was performed to determine the sample size and the existence of an appropriate correlation between variables. The KMO test was run to confirm the implementation of the factor analysis. According to the KMO test, if the numerical values are greater than 0.6, the factor analysis is confirmed and data clustering can be done. MPLUS.8.3.2 software was used to perform EFA.

Reliability and stability

To evaluate the internal consistency of the ICUM tool, the Cronbach alpha coefficient was calculated for the factual, feeling, and delusional memory subscales. The Cronbach alpha coefficient above 0.7 indicates an acceptable level of internal consistency. The internal correlation was checked by the test-retest method. To analyze the data, after confirming the assumption of normality for each of the quantitative variables, independent t tests, analysis of variance, and for pairwise comparisons with more than two levels, and Tukey's post hoc test were conducted using SPSS software, version 24, IBM Corporation, Armonk, New York, USA.

Results

To our research aim, 43 men and 52 women were included in the study. Men and women with the age range of 19-78 years and APACHE II scores of 37-3 were hospitalized in ICU for 1-10 days (Table 1).

Face validity and content validity were evaluated using a qualitative and quantitative approach. While measuring face validity and qualitative content, minor changes were made in the content of the items based on the judgments of the participants and experts. The items were then re-examined and finally were approved by

Table 1. Types of patients and diagnoses

Variables		No.
Types of patients	Emergency patients	48
	Emergency surgery	48
Diagnoses	ARDS	17
	AKI	2
	GIB	6
	Trauma	10
	HF	8
	Pneumonia	3
	Septicemia	3
	COPD	4
	Other diagnoses	43

Table 2. Internal consistency and correlation coefficient

Types of Memory	Internal Consistency	Infraclass Correlation Coefficient		P
	Cronbach Alpha	Correlation	(95% confidence interval) ICC	
Factual memory	0.428	0.950	0.92 (0.88-0.94)	<0.0001
Feeling memory	0.611	0.874	0.80 (0.72-0.86)	<0.0001
Delusional memory	0.627	0.874	0.86 (0.79-0.90)	<0.0001

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the research team. For quantitative face validity, the minimum score was calculated as 4.4. Accordingly, all items were approved. For quantitative content validity, CVR and CVI were calculated. The minimum score for CVI was 0.7 and for CVR was 0.6. Thus, all cases were confirmed.

To check the construct validity, 100 patients entered the study of whom 96 answered the questionnaire in 2 weeks and 8 weeks after their discharge from ICU (for more information (Tables 1 and 2). EFA was used to check the construct validity and the KMO test was used to ensure sample size adequacy and sphericity in the variables. The value obtained from the KMO test, which was conducted to confirm the factor analysis, was 0.653. As the value was above 0.6, sample adequacy for factor analysis was confirmed.

The Cronbach alpha coefficient was run to check the internal consistency. In the current study, the alpha coefficient was less than 0.7. This indicates that the tool does not have acceptable reliability. Next, the stability of the instrument was checked via the retest method. For the memory subscales (factual, feeling, and delusional), the value was above 0.8. Concerning the similarity of the results of this study with the original version and the psychometric version of the memory evaluation tool (ICUM), the obtained value confirms that the tool has good stability (Table 2).

The scores for the memory subscales (factual, feeling, and delusional) were calculated for the patients 2 and 8 weeks after discharge from ICU. The results showed that the average score of the memory subscales in the second and eighth weeks in the female group was higher than the average score in the male group (except for delusional memory in the second week). The results obtained by gender also showed

Table 3. Comparison of factual, feeling, and delusional memories in the second and eighth weeks by gender

Variables	Mean±SD		
	Female	Male	Total
Factual memory of the second week	6.19±2.29	5.25±1.96	5.76±2.19
Factual memory of the eighth week	6.25±2.02	5.66±1.76	6.12±1.95
P	0.002	0.003	<0.0001
Feeling memory of the second week	4.32±1.63	3.91±2.03	4.13±1.83
Feeling memory of the eighth week	4.92±1.35	4.61±1.92	4.78±1.63
P	<0.0001	<0.0001	<0.0001
Delusional memory of the second week	2.25±1.64	2.43±1.66	2.33±1.64
Delusional memory of the eighth week	2.65±1.71	2.57±1.57	2.61±1.64
P	0.002	0.200	<0.001

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that the average score of all types of memories in the eighth week was higher than the average score in the second week (except for delusional memory) in the male group (Table 3).

Discussion

The purpose of this study was to determine the psychometrics and validity of the ICUM tool in a selected sample population in Iran. Overall, the research confirmed the translation, face validity, content validity, construct validity, and stability of the tool. However, in comparison with the original version of the tool, the reliability of the tool was not confirmed. The results obtained from the comparison of the Persian translation of the ICUM tool for patients hospitalized in the ICU with the original version of the tool showed that the Persian version of the tool was identical to the original version devised by Jones et al. (2000) [19] in terms of content and concept.

Furthermore, the comparison of face validity and content validity (quantitative and qualitative) of the Persian ICUM tool with the original tool for patients in the ICU showed that the Persian version of the ICUM tool ensured face validity and an acceptable level of content validity (quantitative and qualitative). Jones et al. (2000) [19] designed and validated the tool in terms of construct validity. Next, the tool was utilized in the study by Maurizia Capuzzo [20] et al. (2004) but was not assessed psychometrically. The Italian and English version of the ICUM tool was not validated in terms of quantitative and qualitative face/content validity. Therefore, the psychometric evaluation performed in this research can distinguish this research from others.

In this research, due to the lack of correlation between the variables and ICUM tool items, EFA was used to check the construct validity. Two categories of items with factor load were also determined and the KMO test confirmed the factor analysis of the tool. On the other hand, in the studies by Jones et al. [19] and Capuzzo et al. [20], the relationship between the presence of severe infections and amnesia for factual events in ICU was used to check the construct validity.

Concerning the reliability of the memory assessment tool (ICUM) for patients admitted to the ICU, it was perceived that the tool did not have acceptable reliability but had good internal stability. This result specified that the validity of this tool can vary in different cultures and languages. Compared to the study of Jones et al. (2000) [19], it was clear that the reliability of the original version of the tool did not agree with the value obtained in the present study. However, the internal correlation of ICUM in the study by Jones et al. was consistent with the results obtained in this study [19].

In contrast to this research, the study by Capuzzo et al. showed that the Italian version of the ICUM tool did not use the Cronbach alpha coefficient test to check the internal consistency of the instrument, and instead of the internal correlation coefficient, the Kappa (K) test was used to check the stability of the memory types [20]. This was because the ICUM tool items do not follow an accurate hierarchy and encompass several scales and dimensions that may not be rational [20].

The current study uncovered five facts; firstly, the recall of factual, feeling and, delusional memories increased in women over time while for men the recall of only factual and feeling memories increased. Secondly, most of the memories recalled in the eighth week were related to feeling memories in both groups of women and men. Third, the recall of factual and delusional memories in women was equal in the eighth week. Fourthly, there was a difference in the recall of delusional memories between the second and eighth weeks in the men's group in the eighth week. Fifth, the recollection of all three factual, feeling and delusional memories increased in all men and women after the second and eighth weeks. Conversely, the study by Capuzzo et al. showed that patients who did not have a clear memory of their stay in ICU and the patients with an infection had more delusional memories than those who had vivid memories. It has been reported that delusional memories are the most durable memories over time, and feeling memories have been proven to be more stable while fewer factual memories can recall over time [20]. In contrast to this research, Samuelson et al. [22], Burry et al. [23], Yamaguchi et al. [24], Fukuda et al., [25], and Sanson et al., [26] concluded that delusional memories have been the most common memories after ICU discharge. They also maintained that patients' memory types may differ if their memories are monitored over a longer period after discharge from ICU and if they have more critical conditions during their stay in ICU.

In most of the mentioned studies, many patients had severe infections and traumas, and consequently, their results do not concur with the present study. In agreement with this study, the study by Zetterlund et al. showed that the memories of patients who had been hospitalized in the ICU were more stable over time, and the patients remembered more feeling memories such as anxiety and panic [27]. Johnsson et al. present similar findings. Also, they argue that women remember more feeling memo-

ries from their stay in ICU than men, and patients without head injuries remember more memories from the time of hospitalization in the ICU [28]. However, gender has not been recognized to influence recalling previous memories before, during, and after discharge from ICU.

In the present study, according to the patients' answers, it was shown that the female and male patients mostly had disturbing memories from the time of admission to the ICU. The women's reactions in these situations were aggression, anger, and crying, but the men's reaction was mainly agitation. For both genders, most of these disturbing memories were related to the connections with ICU devices (including the breathing tube, nose tube, ventilators, etc.). The study by Rundshagan et al. suggested that the nasal tube and chest tube are the most stressful factors in critically ill patients hospitalized in ICU [29]. Similarly, Sanson et al. also state that all ICU experiences are recounted with strong emotions and the ICU environment is identified as a hostile and stressful environment [26]. It has been found that positive experiences are mainly associated with a sense of safety promoted by nurses and negative experiences are related to violations of patients' privacy and dignity, lack of empathy, not being understood, delayed support or even service failure, and being fully controlled by health care personnel [26].

One of the limitations of this study is the lack of generalizability of the tool (ICUM) to all patients who are hospitalized in different ICU departments because this tool is used by adult patients who are between 18 and 82 years old and the ones who do not suffer from neurological and psychological problems. According to the original version of the tool, the items are completed after 8 weeks and 6 months after discharge from the ICU, but in the present study, due to the time limit in conducting the research, the questionnaire was presented to the patients in 2 and 8 weeks after the discharge from ICU. This study has some merits and can help to better inform us about the factors that cause memory disorders in patients after discharge from ICU. Further, this research can aid develop future studies in the field of memory disorders in ICU patients in Iran.

Conclusion

According to the obtained results, the Persian version of the ICUM tool has acceptable internal stability, but not adequate internal consistency. It is concluded that Persian ICUM has good psychometric properties, however, it fails to provide acceptable reliability which indicates that the validity of this tool can be different in different cultures and languages. Concerning the time limit in this study and its plausible influences, it is recommended that future studies evaluate the tool's validity and reliability over a longer period.

Ethical Considerations

Compliance with ethical guidelines

All study procedures complied with the ethical guidelines of the Declaration of Helsinki 2013. This study was approved by the Ethics Committee of Jundishapur University of Medical Sciences, Ahvaz (Code: IR.AJUMS.REC.1400.159). Written informed consent was obtained from all the patients before participating in the study

Funding

This research is an extract of the master's thesis of the first author, entitled "Psychometrics and validation of the memory assessment tool for patients with a history of hospitalization in intensive care units (ICU) in the Iranian population" (U-00098).

Authors' contributions

Conceptualization: Sara Ghafouri, Nada Sayadi, Simin Jahani; Methodology,:all authors; Investigation: Sara Ghafouri, Nada Sayadi, Simin Jahani, Elham Maraghi; Writing the original draft: Sara Ghafouri, Nada Sayadi, Simin Jahani, Elham Maraghi; Writing, review, and editing: all author; Funding acquisition: Nada Sayadi; Resources: all authors; Supervision: Nada Sayadi; Project administration: Nada Sayadi; Software: Elham Maraghi; Validation: Elham Maraghi; Formal analysis: Elham Maraghi; Visualization: Sara Ghafouri, Data curation: Elham Maraghi; Translation and back-translation of ICUM assessment tool: Somayeh Biparva Haghighi.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The research team would like to express their deepest gratitude to the management, personnel, and patients of ICU departments of Golestan, Imam, and Razi Hospitals, and the Office of Deputy Vice-chancellor for Research at Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.

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