



Development and Validation of a Clinical Decision-Making Scale for Medical Students

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*Aydin Adnan Menderes University, Aydin Vocational School, Department of Child Care and Youth Services, Aydin, Turkey

**Aydin Adnan Menderes University Faculty of Education, Department of Curriculum and Instruction, Aydin, Turkey

Abstract

Aim: No scale has been found in the literature that allows for determining the clinical decision-making level of medical school students in Turkey. We aimed to develop a valid and reliable scale to determine the clinical decision-making levels of medical students.

Methods: This descriptive study was conducted between October and November 2021. Interviews were conducted with 12 clinician faculty members through semi-structured interview forms created by considering expert opinions, and an item pool was created through content analysis with support from the literature. The item pool was piloted with 20 medical students, and their feedback was used to revise the scale items. The final version of the scale was administered to 332 fourth, fifth, and sixth-grade medical students undergoing clinical training. Data were analyzed using exploratory and confirmatory factor analysis, reliability analysis, and descriptive statistics.

Results: The results of the explanatory factor analysis indicated that the scale had 27 items and a three-factor structure, which explained 67,905% of the total variance. The three factors were identified as "1-defining the problem and determining its causes", "2-evaluating alternatives", and "3-individual and institutional factors". Confirmatory factor analysis results confirmed the three-factor model, and fit indices indicated a good fit between the model and data. The reliability analysis showed that the scale had high internal consistency, with a Cronbach's alpha coefficient of 0.94.

Conclusion: The study suggests that the Clinical Decision-Making Scale is a valid and reliable tool for assessing medical students' clinical decision-making competence in Turkey.

Keywords: Clinical decision-making, scale development, medical student

Introduction

Clinical decision-making, which is a type of medical decision-making, is to choose and apply the most appropriate, useful, and acceptable option among the options for solving the patient's problem (1,2). The clinical decision-making process, which is quite complex, has cognitive dimensions such as observation, interpretation, explanation, questioning, analysis, evaluation, and experience (3). Numerous factors affect the clinical decision-making process. Many factors, such as the patient's current condition, urgency, risks, existence of alternative options, chance of success, and the doctor's individual opinion, affect the clinical decision-making process. However, individual factors such as the

patient's personality, values, wishes, knowledge and understanding capacity, competencies, and costs, legal and political situations, and society's perspective also affect this process (4). It is effective on decision-making personality characteristics such as the physician's self-perception, psychological state, personality structure such as emotional, shy, and excited (5), and the physician's self-confidence, autonomy, professionalism, creativity, critical and analytical thinking, problem-solving ability, and ethical values (6). Although there are many factors affecting this process, when clinical decision-making is done appropriately, the quality of patient care increases, medical errors decrease, costs decrease because resources are used effectively, and patient satisfaction increases (7).

Address for Correspondence: Hilal Hatice Ulku, Aydin Adnan Menderes University, Aydin Vocational School, Department of Child Care and Youth Services, Aydin, Turkey

Phone: +90 530 080 44 96 **E-mail:** hilal.gulludere@adu.edu.tr **ORCID:** orcid.org/0000-0003-1780-3531

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Undoubtedly, experience is one of the most important factors in clinical decision-making. Students' clinical decision-making skills can be acquired at every stage of their education and increase with clinical experience (8). Some studies have revealed that the perception of clinical decision-making increases with education (9,10). From this perspective, it is important to determine the clinical decision-making level of medical students and plan the necessary interventions before graduation.

No scale has been found in the literature that allows for determining the clinical decision-making level of medical school students in Turkey. Therefore, we designed this study to develop a valid and reliable scale to assess the clinical decision-making level of medical school students in Turkey.

Methods

Compliance with Ethical Standards

Ethical approval was received by Aydin Adnan Menderes University Education Research Ethics Committee decision number 2021/20-IV, and dated 06.09.2021. To collect data, written consent was obtained from the institution where the research was conducted, and verbal consent was obtained from the participants after informing them about the research. Volunteer participants were included in the study.

The Type of Research

This research is a descriptive cross-sectional study conducted between October and November 2021.

Data Collection Instrument

For the interviews to be held and the research to be applied to students, opinions were received from a measurement and evaluation specialist and a medical education specialist. After the corrections were suggested in line with expert opinion, one-on-one interviews were conducted with 12 clinician faculty members working at the Faculty of Medicine to create the item pool. Interviews were held in an appropriate time frame by making an appointment with the faculty members and lasted an average of 10 minutes. The data obtained from one-on-one interviews with faculty members was subjected to content analysis using the line-by-line reading technique, and a draft item pool of 42 items was created with the support of the literature. The draft item pool was subjected to the opinions of 10 faculty members working at the Faculty of Medicine to calculate the expert opinion score. The expert opinion method was used to determine the validity of the content. After the content validity index (CVI) and content validity ratio (CVR) coefficients were calculated after the opinions, it was determined that an additional specialist was needed, and three more medical faculty members

were asked for their opinions. After the opinions, the CVR was recalculated, and six items were removed from the scale (CVR=0.778). With this 36-item version of the scale, a pilot study was conducted with 20 medical students in the fourth, fifth, and sixth grades who were not included in the study. The scale items were revised according to the feedback provided after the pilot application. Responses to the scale items (5-point Likert) were formed as "strongly disagree", "disagree", "neither agree nor disagree", "agree", "strongly agree". There is no reverse item in the scale, and a high score indicates a high level of clinical decision-making competence, whereas a low score indicates a low level of clinical decision-making competence.

Research Group

With the scale created, data were collected from 332 students studying in the 4th, 5th, and 6th grades at the same university in October-November 2021. Considering the necessity for the sample to represent the universe, Nunnally (11) stated that 300 people were sufficient, and Comrey and Lee (12) stated that the level of representation was good for 300 people. Because these classes began clinical training, we decided to select them as the research group. The minimum number of participants for factor analysis was calculated by taking at least five times the number of items on the scale (13).

Study Inclusion and Exclusion Criteria

In determining the participants in the study, attention was paid to the faculty members being clinicians and volunteering to participate in the study. In determining the students, care was taken to ensure that they were in the clinical teaching period and volunteered to participate in the study. Participants who did not volunteer and provided incomplete responses to the study data were excluded from the study.

Statistical Analysis

SPSS version 22 was used for the explanatory factor analysis (EFA) and reliability analyses of the scale, and the Lisrel 8.80 program was used to verify the factor structure. In EFA, the scale was able to separate items that do not measure the desired structure and load more than one dimension (14) and make the relevant variables some meaningful and independent factors (15). In the CFA, fit indices were examined. Factor analysis of the data was performed by the Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity tests. Possible factorizations that may occur in factor analysis are determined by the Varimax rotation of the axes. The model fit was evaluated using CFA fit indices. Cronbach's alpha coefficients were calculated for reliability analysis. A Cronbach's alpha coefficient of 0.70 or higher is considered sufficient for scale and factor scores (16).

Results

Findings on Validity

Explanatory factor analysis was performed to determine how many dimensions and which items the factor structure included with the collected data. First, the KMO sampling adequacy measurement and the Bartlett sphericity test were performed to assess the support of the data for EFA. The KMO and Bartlett tests are frequently used in factor analysis of study data. The KMO measure of sampling adequacy ranges from 0 to 1, with higher values indicating better suitability for factor analysis (16). In this case, the KMO value of 0.951 suggests that the data are highly suitable for factor analysis. A significant result

($p < 0.05$) suggests that the variables are correlated and suitable for factor analysis. In this case, the test statistic is very large (7872.412) with 351 degrees of freedom, and the p -value is very small (0.000), indicating that the variables are significantly correlated and suitable for factor analysis.

In Table 1, the scale items, factors, item factor loads, explained variance, and reliability coefficients are presented. In determining the number of factors, eigenvalues, scree plots, and variances explained by the factors were examined. When the slope graph in Figure 1 is examined, it is seen that the slope plot has turned horizontal starting from the third factor.

Table 1. Clinical Decision-Making Scale items, factors, item factor loadings, explained variance, and reliability coefficients

Scale items	Rotated component matrix*		
	Factor 1 (Defining the problem and determining its causes)	Factor 2 (Evaluating alternatives)	Factor 3 (Individual and institutional factors)
I observe to describe the patient's problems in clinical decision making	0.862		
I make inquiries describe the patient's problems in clinical decision making	0.824		
I use the patient's prior knowledge to identify the problem in clinical decision making	0.796		
I interpret the data while identifying possible causes for clinical decision making	0.756		
I consider the urgency of the patient to define the problem in clinical decision making	0.751		
I analyze all the information at my disposal when identifying possible causes for clinical decision making	0.725		
I use my knowledge gained through experience when collecting and evaluating information for clinical decision making	0.638		
I think analytically when identifying possible causes in clinical decision making	0.632		
I consider the patient's current medical condition when determining possible causes in clinical decision making	0.623		
I use my evidence-based medical knowledge to collect and evaluate information for clinical decision making	0.621		
I use my professional experience to define problems in clinical decision making	0.610		
While defining the problem in clinical decision making, the time I can spare for the patient affects my decision	0.606		
I check the compliance of my decisions with the guidelines/algorithms determined by national and international organizations		0.717	
I consider the purpose of the treatment when evaluating clinical decision making		0.715	
I consider the risk of treatment in clinical decision making		0.695	
Multidisciplinary behavior while making a decision provides more accurate clinical decisions		0.690	
My constant research/literature reading enables me to make better clinical decisions		0.677	
I can change my decisions according to the patient's economic situation		0.672	
I consider the most likely diagnoses first in clinical decision making		0.602	
I conduct research to identify possible causes of clinical decision making		0.599	
I will look to determine if there is an alternative to treatment in clinical decision making		0.543	
I consider the patient's culture when collecting information and evaluating clinical decision making			0.824
I care about the patient's values/religious beliefs when collecting information and evaluating clinical decision making			0.786

Table 1. Continued			
Scale items	Rotated component matrix*		
	Factor 1 (Defining the problem and determining its causes)	Factor 2 (Evaluating alternatives)	Factor 3 (Individual and institutional factors)
The infrastructure/opportunities of the institution for which I work affect my clinical decision			0.723
I consider institution policy when evaluating clinical decision making			0.712
I consider the legal situation (malpractice, etc.) while making an evaluation in clinical decision making			0.676
I consider the patient's place of residence when collecting and evaluating information for clinical decision making			0.597
Variance explained	55,423	8,013	4,469
Cronbach's alpha	0.956	0.934	0.875
*Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. a. Rotation converged in four iterations			

In this case, the first factor explained 55.423% of the total variance, the second factor explained an additional 8.013%, and the third factor explained an additional 4.469%. Together, these three factors explain 67.905% of the total variance. The remaining PCs each explain smaller amounts of variance. It was determined that the amount of variance explained met the rule of 2/3 of the total variance proposed by Buyukozturk (16).

In factor analysis, the goal is to identify the underlying factors that explain the correlations among a set of observed variables. The matrix shows the loadings (i.e., the correlation between the variable and the factor) of each variable on each of the three identified components. The higher the loading, the stronger the association between the variable and the component. Based on this matrix, it appears that three components explain the correlations among the variables. The highest factor load of the scale,

whose three-factor structure was determined, was 0.862, and the lowest factor load was 0.543. When the factors were examined, the first factor was named "defining the problem and determining its causes", the second factor was named "evaluating alternatives", and the third factor was named "individual and institutional factors". The path diagram of the Clinical Decision-Making Scale is shown in Figure 1.

Cronbach's alpha coefficients were computed for the internal consistency of the scale whose factors were settled. Because of the analysis, $\alpha=0.965$ for the 27-item Clinical Decision-Making Scale, $\alpha=0.956$ for the first factor, $\alpha=0.934$ for the second factor, and $\alpha=0.875$ for the third factor (Table 1). Item-total statistics tables were examined, and no significant increase was observed in the Cronbach's alpha coefficients of the scales when any item was removed.

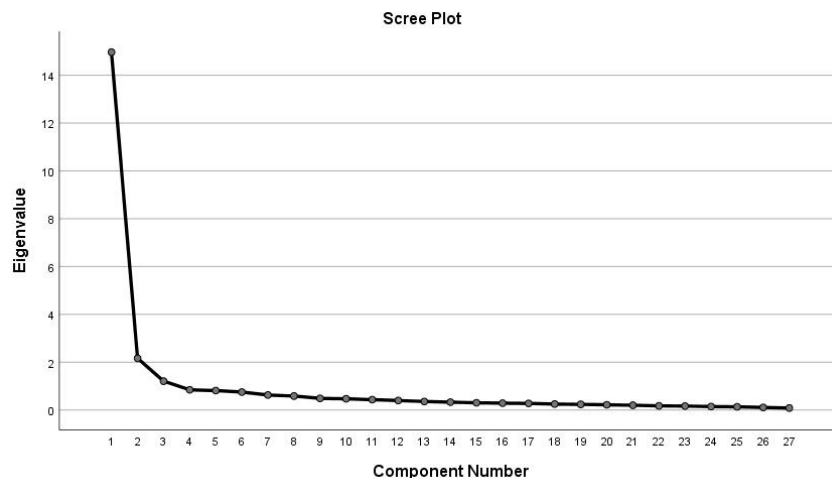


Figure 1. Scree plot of the three factors included in the Clinical Decision-Making Scale

Confirmatory Factor Analysis

Consequent to the CFA for the three-dimensional factor structure of the scale (Figure 2), the ratio of the chi-square statistic to the degrees of freedom (χ^2/df) was 3.64 ($\chi^2=1151.31$; $df=316$; $p=0.000$); Root Mean Square Error of Approximation=0.091; Goodness of Fit Index=0.79; Adjustment Goodness of Fit Index=0.75; Comparative Fit Index=0.97; Normed Fit Index=0.96; Tucker Lewis Index=0.97; Relative Fit Index=0.96; Incremental Fit Index=0.943; Root Mean Square Residual=0.065; and Parsimony Normed Fit Index=0.75 were found. The results show that the three-dimensional factor structure of the Clinical Decision-Making Scale provides acceptable fit values (17).

Discussion

The newly developed Clinical Decision-Making Scale for Medical Students has satisfactory psychometric properties. It was determined that the scale was valid and reliable for evaluating the clinical decision-making skills of medical students. It was observed that the developed scale consisted of three factors and 27 items and explained approximately 68% of the situation to be measured. The CVI and CVR scores of the scale were found to be at an

acceptable level. The internal consistency coefficient of the scale is satisfactory. The findings of the study showed that the scale is a valid tool for assessing medical students' clinical decision-making skills.

There are scales for similar purposes in the literature. The reliability of the "Clinical Decision-Making Scale in Nursing" developed by Jenkins and adapted into Turkish by Durmaz Edeer and Sarkaya (18), to determine the clinical decision-making status of nurses, was also found to be high. In addition, the four-factor structure of this scale is similar to that of the developed scale. Another scale developed with a high-level working group to determine nurses' clinical reasoning skills also has a high level of reliability, and the sub-dimensions of this scale are similar to the developed scale (19). Other studies aimed at determining the clinical decision-making status of nurses also show similar characteristics (20,21). Although the clinical decision-making situation of nurses and physicians in the field of health varies, there are common points in the decision-making process and factors affecting decision-making. There are also highly reliable studies that measure the clinical decision-making skills of physical therapy interns (22).

A highly reliable measurement tool has been developed to determine the clinical judgment competence of doctors and healthcare professionals in patients with acute asthma (23). The scale developed by urology doctors and medical students to determine differences in surgical decision-making also showed similar results to those of the research (24). Reliability analyses of the one-dimensional structure of the "Shared Decision-Making Questionnaire-Provider Version" developed by Scholl et al. (25) to determine doctors' shared decision-making behaviors also yielded similar results to the current study. Although the statistical analyses of the developed measurement tools are satisfactory, the results will be different in different study groups because of the variability of the job descriptions of medical students in the hospital. However, it is also important that the studies examined provide content aimed at understanding the clinical decision-making process of medical students. Considering the sub-dimensions of the current study, it not only determines the clinical decision-making level of medical students regarding this culture but also provides information about the clinical decision-making process.

The study showed that the scale could assess students' ability to observe, interpret, explain, inquire, analyze, evaluate, and apply clinical and biomedical knowledge. The scale also evaluated students' understanding of ethical principles and legal regulations in clinical decision-

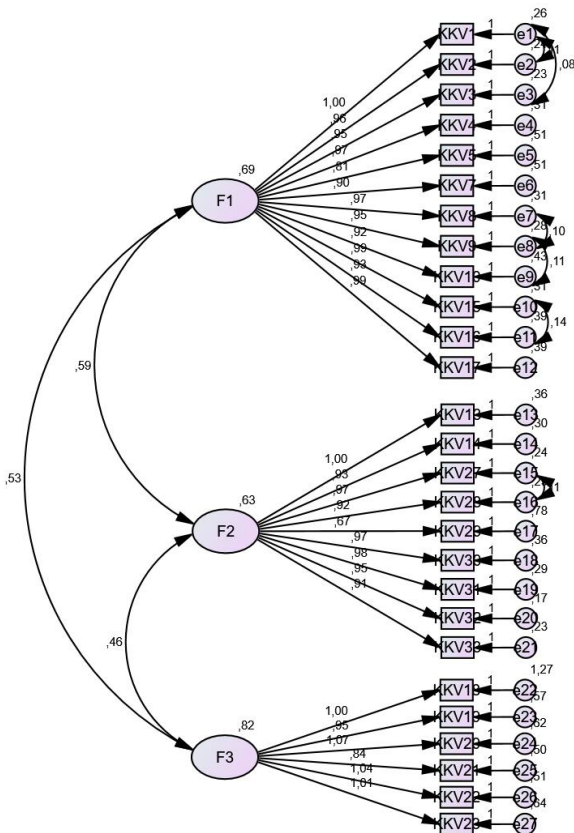


Figure 2. Clinical Decision-Making Scale path diagram

making. The results of the study indicated that the Clinical Decision-Making Scale could be used to evaluate students' competence in clinical decision-making and to identify areas for improvement in their training.

Study Limitations

This study was conducted with students from only one medical school. It can be repeated on different samples, considering regional, cultural, and educational differences, and the validity and reliability of the scale can be repeated by comparing the psychometric properties of the scale. Despite these limitations, the strengths of this study are the high number of participants, the inclusion of students at all stages of the clinical period, and the satisfactory statistical results.

Conclusion

The newly developed Clinical Decision-Making Scale for Medical Students is a valid and reliable scale that can be used to assess the clinical decision-making skills of medical students. The scale can be used to identify the strengths and weaknesses of students' clinical decision-making skills and to design educational interventions to improve their skills. These results were validated by our research group. It was thought that it would be beneficial to conduct a validity and reliability study by applying it to different cultures, societies, and research groups. It was concluded that the scale could be used in future studies.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Aydin Adnan Menderes University Educational Research Ethics Committee (approval no.: 2021/20-IV, date: 06.09.2021).

Informed Consent: Written permission was obtained from Aydin Adnan Menderes University Faculty of Medicine and verbal permission was obtained from the participants.

Authorship Contributions

Concept: H.H.U., A.S.S., Design: H.H.U., A.S.S., Data Collection or Processing: H.H.U., Analysis or Interpretation: H.H.U., A.S.S., Literature Search: H.H.U., Writing: H.H.U., A.S.S.

Conflict of Interest: No conflicts of interest were declared by the authors.

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