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Construction and Validation of Online Teaching Literacy Questionnaire in Online Teachers

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ABSTRACT

Objective: Given the absence of standardized tools for assessing online teaching literacy, this study aimed to validate an Online Teaching Literacy Questionnaire (OTLQ) designed for online educators. The primary objective was to examine the reliability and validity of the OTLQ as an instrument to measure online teaching literacy among online teachers.

Methods: This descriptive-survey and evaluative research followed an instrument-development approach. The study sample consisted of 345 online professors, selected through random sampling. Participants completed the Online Teaching Literacy Questionnaire. The instrument's validity was evaluated through content validity, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA). Reliability was assessed using Cronbach's alpha and test–retest methods.

Results: Findings from factor analysis indicated that the factor structure demonstrated an acceptable fit with the data, and all goodness-of-fit indices supported the proposed model. Reliability analyses revealed Cronbach's alpha and test–retest coefficients above 0.70, indicating strong internal and external consistency.

Conclusions: The results confirm that the Online Teaching Literacy Questionnaire possesses satisfactory psychometric properties. It can therefore be considered a valid and reliable instrument for measuring online teaching literacy among online teachers.

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Introduction

Teaching methods refer to a set of activities carried out according to existing conditions and available resources in order to create the most favorable environment for effective and desirable learning and education (Saif, 2000). One of the most important stages in instructional design is the selection of the teaching method. After choosing the content and before determining the teaching aids, the teacher must select an appropriate teaching strategy and method. The term "teaching method" refers to a set of systematic measures adopted to achieve a goal based on certain conditions and possibilities.

With the rapid advancements in digital technologies and their implications for learning and education, teachers, students, lecturers, and university learners are required to continuously update and enhance their knowledge base and skills (Dashtestani, 2014). However, are these groups prepared to keep pace with such progress? In teacher professional training programs, a lack of computer-assisted and information and communication technology (ICT)-based instruction has been reported (Hubbard, 2008; Kessler, 2007). In fact, learning how to use digital technology has become an important step in developing online teaching literacy in the 21st century (Godwin-Jones, 2000). Online teaching literacy is now recognized as an essential competency alongside traditional literacies such as reading and writing.

Among all the responsibilities of higher education, teaching can be considered one of the most fundamental tasks, which is interactively related to other responsibilities and, in fact, serves as the foundation for them. Considering the importance of teaching and its pivotal role in achieving educational objectives in both theoretical and practical domains, emphasizing teaching literacy — in both face-to-face and online forms — is essential for achieving university goals.

While traditional literacy has been defined as the ability to read and write, establishing a clear and precise definition of online teaching literacy remains a moving target. Online teaching literacy is subject to rapid changes in technology and evolving social trends in online communication. Learners must be able to function effectively in society (Healey et al., 2008). Teachers are therefore encouraged to consider how they can effectively prepare students to practice, develop, and learn science in online classrooms, as this can lead to better career prospects, increased community engagement, greater support for online and independent learning, and broader entertainment options (Healey et al., 2008; Korbel & Gruba, 2004).

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Online classroom skills are just as important for teaching as language skills are for success in the 21st century. Learners need computer skills to: communicate effectively in class, interact with peers, perform efficiently in academic environments, and learn new ideas for enjoyment and personal growth. Researchers believe that if students must possess these skills, it is equally important to ensure that teachers are capable of demonstrating them and confident in teaching them when necessary.

The U.S. Department of Education (1996) defined online teaching literacy as possessing computer skills and the ability to use computers and other technologies to enhance learning, productivity, and performance in virtual classrooms. Barrett (2001), along with Korbel and Gruba (2004), stated that online teaching literacy consists of two main components: (1) the ability to control basic computer operations and (2) the use of one's understanding of computers to solve problems, think critically, and teach effectively. More recently, Son et al. have defined this concept as "the ability to use computers at a sufficient level to create, communicate, collaborate, and present and teach in a literate community," while Dudeney, Healey, and colleagues (2008) refer to online teaching literacy as the ability to use available technologies for online teaching and to understand the social practices surrounding the use of new media.

Ghaen (2000) also stated that teaching is a purposeful, interactive process designed, implemented, and evaluated by the teacher, and teaching literacy involves mastery of such objectives. In fact, teaching includes a set of skills performed before, during, and after the teaching process, enabling student learning. It helps students, based on the conditions provided and their learning styles and goals, to achieve effective learning outcomes. No teaching method is inherently good or bad; rather, the way and conditions under which it is applied determine its effectiveness. One of the most important factors in using any teaching method is the quality of delivery — and online teaching is no exception.

Major transformations are taking place in the higher education system, with particular emphasis on the relationship between teacher and student and the effort to distinguish online teaching literacy from offline literacy (Salehi, 2001). Acheson and Gall believe that a teacher possessing online teaching literacy is one who performs each of the teaching tasks at a satisfactory level. These tasks include: providing instruction for knowledge and academic skills; creating a positive educational environment that fosters favorable attitudes toward learning and self; adapting

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teaching to individual, cultural, and familial differences; engaging learners actively in the teaching–learning process; making sound decisions and instructional plans; and implementing desirable changes in curriculum design and programs.

The university — and higher education in general — is the most valuable resource a society possesses for progress and development. Universities and research institutions have gained considerable credibility due to their knowledge and are regarded as the pioneers of science and advancement. Teaching refers to a set of purposeful and deliberate activities that do not occur by chance, and online teaching literacy involves developing awareness of these goals and teaching methods (Mohammadi, 2015).

One of the fundamental problems in university education is the lack of indicators for *online teaching literacy*. Teaching literacy refers to a set of instructor behaviors and characteristics that lead to the achievement of educational objectives and student learning. Of course, learning also depends on various other factors such as student behavior, learning motivation, curriculum content, and the physical environment and resources. However, researchers have shown that teaching literacy plays a more significant role in students' academic achievement and learning than other factors.

On the other hand, evaluating instructors' teaching literacy without having access to clear teaching indicators not only fails to improve the quality of education but may also lead to its decline. Various methods exist for determining effective teaching indicators, including collecting opinions from administrators, colleagues, instructors themselves, and students (Zohur & Eslaminejad, 2002). Defining the main indicators and components of teaching literacy at the desired level requires identifying the current status and then improving and designing systems to ensure teaching literacy.

It can be said that the main indicators determining online teaching literacy are based on professional teaching skills, the ability to communicate effectively with students, mastery of course materials and content, and evaluation skills. Examining these indicators from the perspective of faculty members and prioritizing the aforementioned components reflects the current level of teaching literacy. Comparing these indicators with the expected level can help formulate essential strategies for improving and designing a model for online teaching literacy in universities (Mohammadi Khaneqahi & Hosseinzadeh, 2015).

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Classroom teaching requires many elements such as mastery of teaching skills and specialized knowledge. These two components complement each other. Effective faculty members must not only possess specialized knowledge but also have the ability to deliver lessons, organize, and evaluate effectively. Mastery of professional teaching skills, scholarship, communication ability, and evaluation competence can be considered the main features of teaching literacy.

In terms of *scholarship*, characteristics include scientific knowledge and presenting new content. In *professional teaching skills*, features include clear and transparent delivery of material and preparing the class for thinking and discussion, as well as organizing and sequencing content. In *communication ability*, features include encouraging student participation in discussions and maintaining friendly interactions with students. In *evaluation competence*, features include appropriate assessment methods, accurate judgment, and fairness—these are recognized as key indicators of teaching literacy (Mohammadi Khaneqahi & Hosseinzadeh, 2015).

Given the significant expansion of online education worldwide—including in Iran—and the increasing use of this method during the COVID-19 pandemic in Iranian universities, and considering the central role of instructors in educational systems, the necessity for further research on the level of online teaching literacy becomes evident. Although it is clear that online teaching techniques have well-known advantages, their successful implementation depends on several factors, including instructors' acceptance and literacy in using such methods.

This study was conducted in 2021 with the aim of validating a tool for assessing online teaching literacy among university instructors in Iran. Therefore, the present research, through standardization of the questionnaire for measuring online teaching literacy among Iranian instructors, seeks to answer the following two questions:

1. Does the questionnaire for measuring online teaching literacy among Iranian university instructors have validity?
2. Does the questionnaire for measuring online teaching literacy among Iranian university instructors have reliability?

Material and Methods

The present study is of an instrument-development type with an analytical approach. This psychometric study was conducted in 2021 (1400 in the Iranian calendar) with the aim of

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validating the Online Teaching Literacy Scale among online instructors at universities across the country. In terms of purpose, the research is applied, and in terms of data collection, it is a quantitative study based on a correlational approach using path analysis.

The statistical population included all faculty members of Payame Noor University who, according to self-report, had participated in one or more online or electronic training courses during the 2020–2021 academic year (1399–1400). Table 1 presents demographic information of the research population categorized by academic rank.

Table 1. Distribution of the demographic characteristics of the study population

Demographic Variable	Category	Frequency	Percentage
Age	30–40 years	179	51.14
	41–60 years	151	43.14
	61 years and above	20	5.71
Gender	Female	190	54.28
	Male	160	45.71

For model-based studies, the following rule of thumb is suggested for sample selection: the minimum sample size per estimated parameter is 5, a 10:1 ratio is considered acceptable, and a 15:1 ratio is considered desirable (Kline, 2011). Given that this study included 24 observed parameters, approximately a 15:1 ratio was used, resulting in a sample size of 350 participants (considering potential attrition, incomplete questionnaires, and outliers). Participants were selected using a convenience sampling method. After data screening and removal of incomplete or outlier responses, a total of 341 valid questionnaires remained for analysis.

To ensure the proper distribution, completion, and collection of the final questionnaire, a one-day training workshop was held for the provincial coordinators, during which they were briefed on the procedures. The questionnaires were then distributed nationwide by these coordinators. Questionnaires were administered online through email and messaging applications such as WhatsApp, Telegram, and I Gap. No further explanations were provided to respondents, as all necessary instructions were included at the beginning of the questionnaire. Moreover, no time limit was imposed for completion. After excluding incomplete or invalid responses, 345 questionnaires were retained for statistical analysis. Data analysis was performed using SPSS version 24 and AMOS version 24.

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The validity of the data collection instrument was evaluated using quantitative content validity methods, including the Content Validity Ratio (CVR) and Content Validity Index (CVI). To assess construct validity, Exploratory Factor Analysis (EFA) was conducted using the Bartlett's Test of Sphericity, eigenvalues, and Varimax rotation. The Varimax method was applied to simplify and clarify the extracted factor structure, and items with factor loadings of at least 0.40 were retained. Furthermore, Confirmatory Factor Analysis (CFA) was used to assess construct validity and determine model fit indices, including the Chi-square (χ^2), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Adjusted Goodness of Fit Index (AGFI).

Results

As shown in Table 1, all Cronbach's alpha coefficients for the subscales were above 0.70, indicating satisfactory internal consistency and confirming external reliability. Furthermore, the test–retest reliability assessed through the Pearson correlation coefficient with a 15-day interval demonstrated high temporal stability across all subscales of the instrument.

Table 1. Reliability indices of the Online Teaching Literacy Questionnaire for Online Instructors

Scale	Cronbach's Alpha	Mean ± SD	Test–retest reliability coefficient
Time management	0.88	10.87 ± 4.31	0.80
Technical competence	0.81	15.91 ± 6.51	0.83
Pedagogical skill	0.87	11.24 ± 2.41	0.86
Technological skill	0.89	16.88 ± 5.12	0.88

Table 2. Results of CVI and CVR for the questionnaire items

Dimension	Item	CVR	CVI
Time management	1	0.89	0.88
	2	0.84	1
	3	0.91	0.82
	4	0.84	0.81
	5	0.86	0.85
	6	0.84	0.88
	7	0.87	1
	8	0.89	0.85
	9	0.85	0.88
	10	0.86	0.87
	11	0.86	0.84
	12	0.93	0.88
Technical Competence	13	0.96	1
	14	0.80	0.91
	15	0.81	0.88
	16	0.88	0.84

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	17	0.85	1
	18	0.85	0.80
	19	0.83	0.85
	20	0.96	1
	21	0.93	0.83
	22	0.84	0.81
	23	0.86	0.85
	24	0.89	0.93
Pedagogical Skill	25	0.94	0.92
	26	0.88	0.86
	27	0.88	0.84
	28	0.84	1
	29	0.86	0.86
	30	0.89	0.88
	31	0.91	0.82
	32	0.88	1
	33	0.90	0.88
	34	0.89	0.80
	35	0.93	1
	0.36	0.86	0.88
Technological Skill	37	0.84	0.89
	38	0.86	0.90
	39	0.89	0.88
	40	0.91	1
	41	0.84	0.81
	42	0.88	0.82
	43	0.89	0.88
	44	0.88	0.81
	45	0.89	1
	46	0.91	0.87
	47	0.85	0.85
	48	0.84	0.89

The results of the Content Validity Ratio (CVR) and Content Validity Index (CVI) for the 48 items indicated that, according to experts, all items were appropriate for measuring online teaching literacy among instructors. Both indices confirmed the necessity and relevance of each item, and all items achieved acceptable values, warranting their inclusion in the final questionnaire. Subsequently, Exploratory Factor Analysis (EFA) was conducted.

Table 3. Assumptions for Exploratory Factor Analysis (EFA) of the Online Teaching Literacy Questionnaire

Index	Value
KMO Measure of Sampling Adequacy	0.91
Bartlett's Test of Sphericity (χ^2)	459,893.453
Significance Level	0.001

Items in the questionnaire must show a moderate level of inter-correlation—too little correlation prevents factor extraction, while excessive correlation leads to multicollinearity, which impedes

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the identification of distinct factors. The Bartlett's Test of Sphericity was significant ($p < 0.001$), indicating sufficient correlations among items for factor analysis. The KMO value of 0.91 confirmed the adequacy of the sample size (values above 0.70 are acceptable).

EFA extracted four factors, which together explained 57.87% of the total variance, as shown in table 4.

Table 4. Percentage of variance explained by each factor after Varimax rotation

Factor	Eigenvalue	Percentage of explained variance	Cumulative percentage of variance
Factor 1	10.61	19.98	19.98
Factor 2	8.78	15.45	35.43
Factor 3	6.71	12.54	47.97
Factor 4	4.31	9.90	57.87

As indicated in Table 4, 57.87% of the total variance in the Online Teaching Literacy Questionnaire was explained by these four factors. The factor analysis ran successfully in SPSS without computational errors, indicating that the determinant of the correlation matrix was near zero, signifying strong inter-variable relationships and the suitability of the data for factor analysis. The first column (eigenvalue) represents the factor loading strength of each dimension on the main construct—Online Teaching Literacy. The second column shows the percentage of variance explained by each dimension, with Factor 1 explaining 19.98% and Factor 4 explaining 9.90% of the total variance. The third column presents the cumulative variance, indicating that the four extracted factors collectively accounted for 57.87% of the total variance of the construct.

Table 5. Parameters of the Final Revised Measurement Model for the Construct of Online Teaching Literacy

Parameter / Item Component	Unstandardized Factor Loading	Standardized Factor Loading	Std. Error	T Value	Variance Explained by Latent Variable	P	Result
Time Management							
1	1	0.846	–	–	0.706	0.001	Item confirmed
2	0.942	0.862	0.05	17.55	0.747	0.001	Item confirmed
3	0.939	0.845	0.05	17.14	0.744	0.001	Item confirmed
4	0.943	0.851	0.07	17.32	0.698	0.001	Item confirmed
5	0.930	0.862	0.05	16.29	0.732	0.001	Item confirmed
6	0.929	0.845	0.09	17.98	0.744	0.001	Item confirmed

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7	0.939	0.856	0.08	17.33	0.770	0.001	Item confirmed
8	0.917	0.871	0.05	16.55	0.747	0.001	Item confirmed
9	0.910	0.845	0.07	18.14	0.709	0.001	Item confirmed
10	0.913	0.865	0.09	17.91	0.717	0.001	Item confirmed
11	0.952	0.813	0.05	17.32	0.740	0.001	Item confirmed
12	0.943	0.862	0.04	16.55	0.769	0.001	Item confirmed
Technical Competence							
13	1	0.691	–	–	0.470	0.001	Item confirmed
14	0.929	0.662	0.07	13.05	0.438	0.001	Item confirmed
15	1.27	0.767	0.11	11.43	0.600	0.001	Item confirmed
16	1.05	0.709	0.08	12.77	0.540	0.001	Item confirmed
17	1.09	0.748	0.09	11.10	0.560	0.001	Item confirmed
18	0.998	0.678	0.07	13.05	0.600	0.001	Item confirmed
19	1.09	0.789	0.09	11.70	0.540	0.001	Item confirmed
20	1.14	0.569	0.06	12.22	0.560	0.001	Item confirmed
21	1.78	0.875	0.08	11.78	0.600	0.001	Item confirmed
22	0.897	0.765	0.07	13.98	0.540	0.001	Item confirmed
23	1.65	0.789	0.08	11.45	0.560	0.001	Item confirmed
24	1.49	0.609	0.08	12.90	0.600	0.001	Item confirmed
Pedagogical Skill							
25	1	0.870	–	–	0.750	0.001	Item confirmed
26	0.970	0.700	0.07	11.23	0.500	0.001	Item confirmed
27	0.910	0.690	0.07	12.42	0.470	0.001	Item confirmed
28	0.960	0.870	0.07	11.09	0.690	0.001	Item confirmed
29	0.930	0.800	0.06	13.67	0.520	0.001	Item confirmed
30	0.970	0.880	0.08	11.87	0.490	0.001	Item confirmed
31	0.950	0.880	0.09	12.33	0.770	0.001	Item confirmed
32	0.980	0.750	0.07	12.75	0.530	0.001	Item confirmed
33	0.910	0.690	0.06	12.90	0.460	0.001	Item confirmed

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34	0.920	0.870	0.05	11.46	0.750	0.001	Item confirmed
35	0.900	0.770	0.09	12.29	0.500	0.001	Item confirmed
36	0.970	0.800	0.07	11.03	0.570	0.001	Item confirmed
Technological Skill							
37	1	0.730	–	–	0.540	0.001	Item confirmed
38	1.09	0.750	0.08	12.73	0.590	0.001	Item confirmed
39	1.18	0.780	0.09	13.68	0.620	0.001	Item confirmed
40	1.03	0.680	0.08	12.77	0.460	0.001	Item confirmed
41	1.56	0.810	0.09	13.45	0.650	0.001	Item confirmed
42	0.970	0.770	0.09	14.26	0.660	0.001	Item confirmed
43	1.14	0.820	0.06	14.43	0.670	0.001	Item confirmed
44	1.67	0.780	0.07	12.77	0.580	0.001	Item confirmed
45	1.22	0.690	0.09	12.99	0.630	0.001	Item confirmed
46	1.13	0.820	0.08	12.04	0.500	0.001	Item confirmed
47	1.87	0.750	0.05	13.52	0.640	0.001	Item confirmed
48	0.960	0.830	0.06	12.68	0.610	0.001	Item confirmed

In Table 5, all questionnaire items are presented according to their subscales. The related parameters—including unstandardized and standardized factor loadings, t-values, standard errors, and squared multiple correlations (SMCs)—were examined to assess the adequacy of each subscale's items.

In the analysis of factor loadings, as the key component of Confirmatory Factor Analysis (CFA), the strength of each item's loading on its subscale factor and the extent to which it explains the variance of that subscale were determined.

The findings show that all items had standardized factor loadings greater than the set criterion (≥ 0.40), indicating that each item has sufficient power to explain its corresponding subscale. Additionally, the squared multiple correlation indices revealed that all items explain a substantial proportion of their subscale variance, and none were identified as weak indicators. Moreover, the t-statistics for all items were significant at the $P < 0.001$ level, confirming the adequacy of the measurement parameters for the construct.

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Table 6. Goodness-of-Fit Indices for the Final Revised Measurement Model of Online Teaching Literacy

Index	Value	Acceptable Range
Chi-square Goodness-of-Fit Test (CMIN)	145.67	P > 0.05
Degrees of Freedom (df)	167	–
p-value	1.29	–
Chi-square/df Ratio (CMIN/DF)	1.78	< 5
Goodness-of-Fit Index (GFI)	0.96	> 0.90
Comparative Fit Index (CFI)	0.99	> 0.90
Root Mean Square Residual (RMR)	0.019	< 0.05
Root Mean Square Error of Approximation (RMSEA)	0.023	< 0.08

Based on Table 6, all model fit indices were evaluated at a desirable level. Overall, the findings indicate that this questionnaire demonstrates a strong ability to assess online teaching literacy among online instructors and possesses the necessary parameters to be recognized as a valid and reliable instrument with high construct validity and measurement adequacy.

Discussion

Today, in developed countries, fostering online teaching literacy among university instructors is considered one of the key goals of virtual and online education. The present study was conducted to address the lack of suitable and culturally adapted tools for examining or measuring online teaching literacy among Payame Noor University instructors across the country.

Online teaching literacy serves as a driving force in effective education and represents a unique competency in an individual's personal and social life. Based on various definitions of online teaching, it can be summarized that online teaching literacy refers to instructors' awareness of how to teach, present content, and, more broadly, how to provide optimal and effective learning experiences for students.

Given the importance and necessity of developing online teaching literacy skills—and the global and national (particularly Iranian) need to promote thinking based on logical principles and scientific findings—this study aimed to design and standardize a valid and reliable test for assessing online teaching literacy. Such a tool could serve as an alternative to tests developed in other countries with different cultural contexts. The required psychometric tests for validating this scale were examined and presented.

The questionnaire includes four subcomponents: Time Management, Technical Competence, Pedagogical Skill, and Technological Skill. In the present study, content validity of the Online

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Teaching Literacy Questionnaire was assessed qualitatively through expert review by 15 specialists in educational psychology from Payame Noor University, and it was confirmed. Moreover, reliability was measured using internal consistency (Cronbach's alpha) among 335 university instructors. The overall Cronbach's alpha coefficient for the Online Teaching Literacy Questionnaire was reported as 0.73, and for the subcomponents individually: Time Management (0.74), Technical Competence (0.78), Pedagogical Skill (0.80), and Technological Skill (0.83)—all indicating satisfactory reliability.

In addition, confirmatory factor analysis (CFA) results demonstrated that the data fit the proposed model well, and all goodness-of-fit indices were within acceptable ranges. This shows that the model has an appropriate fit with the data.

One possible interpretation of these findings aligns with Siemens' (2005) Connectivism Theory, which emphasizes the learner's effort to create positive and optimal conditions for new learning contexts. As the results of this study indicate, five key factors—self-efficacy and computer/internet skills, self-directed online teaching, learner control, motivation for online teaching environments, and self-efficacy in online communication—were confirmed as essential components of online teaching literacy.

According to the researcher, since this tool has been developed and psychometrically tested for the first time in Iran, it can serve as a foundation for further studies in this field, keeping pace with the progress of advanced countries. Based on the findings of this research, it is recommended that the instrument be validated separately for male and female instructors teaching online.

Another recommendation, given that this tool has been newly developed and standardized, is that it should be revalidated with larger samples by other researchers to confirm the present findings. The standardized Online Teaching Literacy Instrument developed in this study is a practical tool applicable at both micro and macro levels. Although it was designed to measure online teaching literacy among Payame Noor University instructors, it is not limited to this specific context and can be used in various educational settings. Therefore, it is also recommended that this instrument be standardized for use among students as well.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Payame Noor University (PNU). The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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