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Original Article

Designing a Quantitative Model of Intellectual Capital Promotion with Social Capital Approach at Mashhad University of Medical Sciences

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Abstract

Introduction: With the advancement of science, the role of employees and human relations (human capital) in the development of the organization and society has become more apparent, drawing more attention to the discussion of social capital and intellectual capital, as well as their constructive role in the development and top organizational performance. As a result, the current study was designed at Mashhad University of Medical Sciences to create a quantitative model of intellectual capital promotion using a social capital approach.

Methods: This is a quantitative study in the form of a survey. The statistical population of the study included 15415 employees and faculty members of Mashhad University of Medical Sciences. The statistical sample was obtained from 416 subjects using a two-stage stratified sampling method (with proportional allocation). The study tool included a 91-item questionnaire made by the researcher. The data from this study were analyzed using SPSS software using Amos structural equations.

Results: The research findings in the quantitative model of intellectual capital promotion with social capital approach consisted of 7 dimensions and 17 components, of which 3 dimensions and 7 components related to social capital included structural, relational, and cognitive capital; also, 4 dimensions of intellectual capital included human capital, structural capital, client's reverence, and innovative capital, which had 10 components. Given that the coefficients of all the dimensions and components of the model (t>1.96) were significant and because in the structural model, almost all the fit indices were within the desired range, the appropriateness of the model was confirmed.

Conclusion: The analysis of the data revealed that the quantitative model of intellectual capital promotion at Mashhad University of Medical Sciences through using a social capital approach was designed successfully, and all the fit indices were within the desired range.

Keywords: Humans, Social capital, Surveys and questionnaires, Research design, Intellectual capital

Introduction

Today's world is the age of unbridled transformations, and according to Toffler, it is a period of power transfer; the management of intellectual capital and intangible assets of organizations, following the issues of re-engineering in the 1980s and comprehensive quality management in the 1990s, is regarded as an important phenomenon that has profoundly influenced the horizon of management developments (1). Meanwhile, intellectual capital management is the most recent model that addresses the aforementioned issue in organizational management. The focus of organizations has shifted from investing in tangible resources to intangible ones to achieve greater performance and competitive advantages (2). A collection of intangible assets is represented by intellectual capital, which is sometimes called knowledge assets. Intellectual capital is that portion of the total capital or assets of a company that is based on knowledge, and the company is considered to be its owner (3). Ignorance of intellectual capital causes the management to pay insufficient attention to it, resulting in a failure to fully exploit the added

value of capabilities. This intangible resource is one of the most valuable assets of organizations. Therefore, nowadays, building and managing intellectual capital has become a critical requirement in the organizational field (4). Intellectual capital is utilized to produce value for the business in the knowledge-based economy, and in today's world, the capacity to manage these types of assets is critical to the success of any organization (5). The management of these assets will be achievable with the cooperation and participation of all members of the organization, which provides the foundation for accomplishment of intellectual capital enhancement (6). Organizations can acquire a better understanding of the pattern of individual and group interactions by knowing the dimensions of their social capital and using it to better manage their organizational systems (7). In other words, social and intellectual capital are prerequisites for the growth of organizational performance. Social capital increases people's willingness to collaborate in groups, which creates a thriving network of volunteer events in a variety of social and professional contexts and, in turn, motivates employees to work hard (8). In any organization, the lack of attention to, or a deficit in, social capital deprives that organization of the benefit of using the strength of the groups inside the organization and creates an atmosphere devoid of trust and collaboration. Since intellectual capital is inextricably linked to social capital, it will undoubtedly be affected by this event (9). As mentioned in the literature, various types of research were conducted on intellectual capital and social capital, both domestically and internationally; however, no quantitative model of intellectual capital improvement using the social capital approach was designed at Mashhad University of Medical Sciences. For instance, Ozgun et al. emphasized the mediating role of innovative activities and intellectual capital, in which intellectual capital was the essential link between social capital and organizational performance (10). Sabrang et al. found that a higher level of intellectual capital strengthened honesty and mutual trust among employees and leaders, which led to higher social capital and customer satisfaction (11).

Moreover, Ebrahimian et al. investigated the relationship between intellectual capital, social capital, and performance in the Tehran Stock Exchange under the conditions of environmental instability and the existence of business relationships. They also demonstrated that human capital and organizational capital, as mediating variables, had a positive effect on customer and social capital. Besides, social capital, as a mediating variable, had a positive effect on the

components of intellectual capital and performance (12). In addition, Danesh et al. found a significant positive association between social capital and intellectual capital, and knowledge management in an Iranian insurance company (9). According to Shihaki Tash et al., social capital had a positive and significant effect on the psychological empowerment of nurses at Khatam-Al-Anbia Hospital in Zahedan through the mediating variable of intellectual capital (13).

In this regard, the universities, and educational and research centers of the country, particularly Mashhad University of Medical Sciences, as a pole of the main centers of medical education and healthcare services, like other organizations and even more, require intellectual capital management. Therefore, with the assistance of intellectual capital management, it may continue to achieve growth and excellence, and fulfill its main mission in the field of health as well as raise the citizens' quality of life indicators through education, prevention, and treatment. Moreover, to set the groundwork and provide the required conditions for social capital strengthening, the organization should take fundamental actions to promote, nurture, and train intellectual capital, particularly the human capital component.

Finally, the objective of the current study is described in this research question: "What is the quantitative model of intellectual capital enhancement with the social capital approach at Mashhad University of Medical Sciences?" Accordingly, the current study was designed at Mashhad University of Medical Sciences to create a quantitative model of intellectual capital promotion using a social capital approach.

Materials and Methods
Sampling Method Procedure

The objective of this study was to design a quantitative model of intellectual capital promotion at Mashhad University of Medical Sciences using a social capital approach. The research method was descriptive and survey type. In the current research, a stratified (two-stage) random sampling method with proportional allocation was used to select the required sample. The sample size was determined according to the preliminary sample of 16 people, who were selected as the pre-test plan as well as the required parameters; the minimum sample size was estimated. Therefore, according to the size of the statistical population of 15415 members, the error coefficient of 0.1, and the confidence coefficient of 95%, and placing these values in the following formula, the minimum required sample size was determined to be 416 people.

$$n = \frac{N z^2 s^2}{Nd^2 + z^2 s^2}$$

In this formula, n is the required sample size, and N is the population size. Moreover, according to the standard normal distribution, z is the z-score associated with a level of confidence, s is the sample proportion, expressed as a decimal, and d is the tolerated margin of error, expressed as a decimal.

In this regard, a two-stage classification sampling procedure was adopted depending on the goals of the study. In the first stage, in accordance with the type and structure of the society and based on the characteristics of the sampling method, the statistical population was divided into seven classes or seven vice-chancellors of Mashhad University of Medical Sciences. The required sample was then determined based on the percentage of each class or vice-chancellor. Then, as the second stage of the sampling procedure, the target population was split into two groups of employees, comprising faculty members and staff members, which was almost the most homogeneous classification in this area of study. Then, several professors and staff members were chosen at random from each class (within each vice-chancellor), and their perspectives on the research topic were evaluated. It should be noted that to have a satisfactory and representative sample, the researcher distributed a larger number of questionnaires. Finally, 416 accurate and complete questionnaires were returned, of which about 25 questionnaires belonged to academic faculty members and 391 to working employees.

A researcher-made questionnaire with 91 questions scored using a five-point Likert scale was included in the study tool. This questionnaire assessed both social and intellectual capital. Social capital was divided into three categories: structural dimensions (13 questions), relational dimensions (11 questions), and cognitive dimensions (9 questions). Besides, there were four parts to intellectual capital: human capital (22 questions), structural capital (18 questions), client reverence (10 questions), and innovation capital (8 questions).

The face and content validity of the questionnaires were confirmed by professors and experts in this field; as to reliability, the reliability coefficient of each category was determined using Cronbach's alpha test. Cronbach's alpha coefficient was estimated in a sample of 16 managers and employees, i.e., faculty and non-faculty members of Mashhad University of Medical Sciences. The obtained coefficient value for the intellectual capital dimension of this questionnaire was 0.971, and for the social capital dimension was 0.964, which indicated the high reliability of this questionnaire.

To evaluate the content validity of the questionnaire, we used the content validity coefficient (CVR) by considering the opinions of 16 experts.

$$CVR = \frac{n_E - \frac{N}{2}}{\frac{N}{2}}$$

In this formula, nE represents the number of experts who evaluated the question as useful, and N represents the total number of experts. To judge the estimated CVR indicators for the questions, we used the Lawshe table. Because there were only 16 experts in the final stage, questions with a content validity coefficient greater than 0.42 were approved. In the second stage, to calculate the content validity quantitatively, we used the content validity index (CVI). The content validity index of expert opinions is questioned in four scales and three categories of relevancy, clarity, and simplicity. As the final content validity increases, the content validity index value approaches 0.99.

Statistical Analysis

Finally, for the analysis of the data, descriptive statistics and inferential statistical methods were used simultaneously. All the analyses were performed using SPSS software for Windows (SPSS Inc., Version.20. Chicago, USA). After gathering, reviewing, coding, entering the data, and creating an information bank, the data and observations were described using statistical methods such as frequency distribution tables, descriptive charts, and central and dispersion indicators such as mean, standard deviation, etc. In the inferential statistics section, AMOS software was applied. After forming the research variables and measuring the normality of their main variables, we utilized various statistical inference tests such as factor analysis, structural equation modeling (SEM), and path analysis to achieve the research objectives and answer the research questions as well as generalize them to the studied population.

Results

As previously stated, this research included two main concepts or variables. Intellectual capital and social capital, which itself included dimensions and components that would be discussed and explained more in the following section.

Prior to performing any statistical analysis, the

Table 1: Results of normality of research variables

Main variables	Components	Normality indices	
		Skewness	Kurtosis
Intellectual Capital	Individual competencies	0.197	0.688
	Group competencies	0.171	0.077
	Intellectual property	-0.096	-0.266
	Technology Management	-0.113	0.057
	Process capital	-0.086	0.310
	Strategic management	0.233	0.341
	knowledge management	0.260	0.672
	direct stakeholders	0.057	0.329
	Indirect stakeholders	-0.148	0.655
	Innovation in technology	-0.070	-0.061
	Distinctive innovation	-0.024	-0.167
Social Capital	Network structure	0.532	2.089
	Network relationships	-0.036	-0.021
	Organizational suitability	0.349	-0.153
	Social participation	0.455	0.399
	Political participation	-0.053	0.137
	Consciousness/Awareness	0.320	0.268
	Social trust	0.166	0.518

Table 2: Descriptive statistics related to intellectual capital and social capital variables at Mashhad University of Medical Sciences

Intellectual Capital Variable	Mean±SD	Minimum	Maximum
Individual competencies	3.09±0.66	1.00	5.00
Group competencies	2.95±0.80	1.00	5.00
Intellectual property	3.58±0.70	1.00	5.00
Human capital	3.16±0.65	1.00	5.00
Technology management	3.26±0.76	1.00	5.00
Process capital	3.18±0.72	1.00	5.00
Strategic management	3.03±0.76	1.00	5.00
Knowledge management	2.94±0.74	1.00	5.00
Structural capital	3.09±0.66	1.00	5.00
Direct stakeholders	3.19±0.61	1.00	5.00
Indirect stakeholders	3.20±0.74	1.00	5.00
Clients reverence	3.20±0.62	1.00	5.00
Innovation in technology	3.09±0.80	1.00	5.00
Distinctive innovation	2.98±0.81	1.00	5.00
Innovation capital	3.02±0.77	1.00	5.00
Intellectual capital	3.12±0.62	1.00	5.00
Social Capital Variable			
Network structure	3.10±0.53	1.00	5.00
Network relationships	3.11±0.76	1.33	5.00
Organizational suitability	3.08±0.74	1.00	5.00
Structural capital	3.10±0.55	1.74	5.00
Social participation	2.91±0.68	1.00	5.00
Political participation	3.08±0.81	1.00	5.00
Relational capital	2.96±0.67	1.00	5.00
Consciousness/Awareness	2.87±0.74	1.17	5.00
Social trust	2.85±0.71	1.00	5.00
Cognitive Capital	2.86±0.69	1.09	5.00
Social Capital	2.99±0.59	1.40	5.00

normality of the data of the research variables was investigated using Skewness and Kurtosis indices. The data distribution was said to be normal if the Skewness and Kurtosis values were in the range of 2 and -2. The Skewness and Kurtosis values related to the research variables and their components arepresented in Table 1.

It was noted that most of the computed values were in the range of 2 and -2, and even typically they were between 0.5 and -0.5. Therefore, it can be concluded that the data distribution of these variables was normal.

In the descriptive section of the research dimensions and components, the obtained scores for the research variables (dimensions and components of intellectual capital and social capital) are presented.

Examining the descriptive findings of each of the dimensions and components of intellectual capital, presented in Table 2, we found that the standard deviation of all dimensions was less than 1, indicating an approximate agreement in the views of the respondents regarding the questions and different dimensions of the evaluation of the current state of intellectual capital in Mashhad University of Medical Sciences.

In addition, Figure 1 shows a comparison chart of the studied dimensions with the total mean of intellectual capital and social capital.

This graph displays the evaluation of each of the dimensions of the mentioned variable from the point of view of the selected employees of Mashhad University of Medical Sciences.
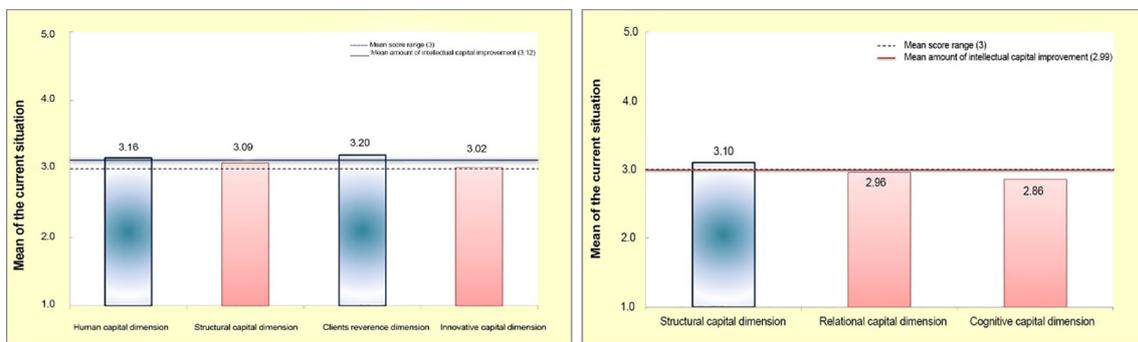

Figure 1: The mean comparison chart of the current state of intellectual capital dimensions and social capital dimensions at Mashhad University of Medical Sciences
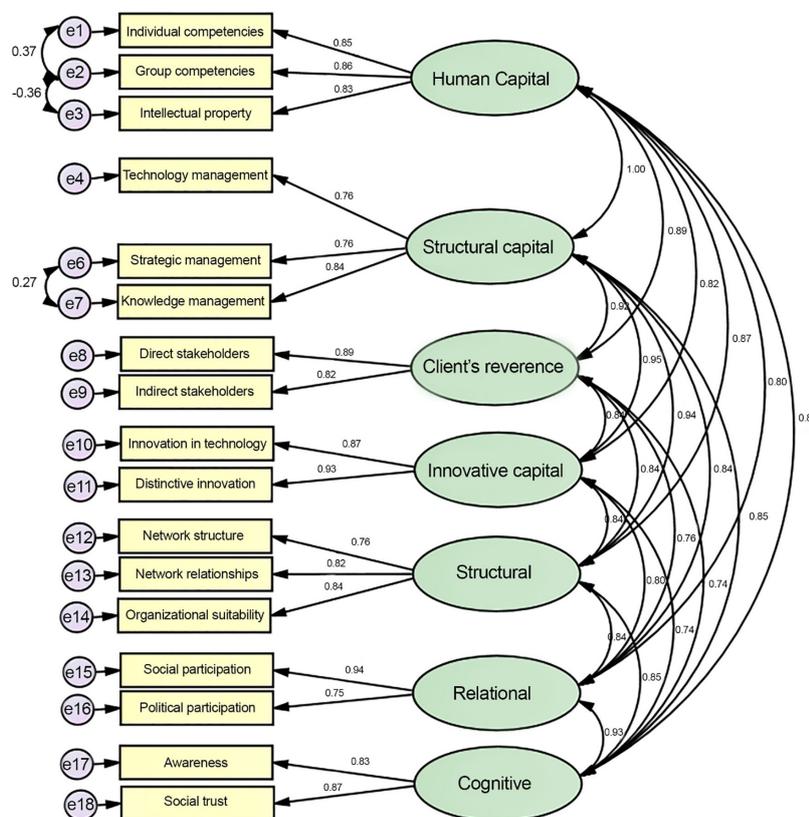

Figure 2: First-order measurement model after applying corrections along with standardized coefficients

As shown in Figure 1, the mean of the current status of all the analyzed dimensions of intellectual capital was slightly higher than the mean of the studied period, indicating that they were in an average state. However, the mean dimensions of structural capital and innovation capital, which were marked in red, were less than that of the total intellectual capital. Moreover, the dimensions of structural capital variables were illustrated. Hence, the mean value of these dimensions could be compared with each other.

In the following stage, research measurement models are examined. As previously stated, the model of this research at Mashhad University of Medical Sciences included the two main variables of intellectual capital and social capital. Each of these variables contains several dimensions and components. The first-order measurement model and second-order measurement model were investigated for these dimensions. Finally, the research structural model was developed based on these models. After the appropriateness of this model was confirmed, the findings from the structural model were used to answer the research questions.

Evaluation of the First-order Measurement Model of the Research

The first-order measurement model included obvious variables such as the constituent components of each dimension of intellectual capital and social capital variables as well as hidden variables (e.g., research dimensions). This model is shown in Figure 2.

In the illustrated model, the numbers written on the arrows represent standardized coefficients (Figure 2). Standardized coefficients were the same model coefficients that have been transferred to the range of -1 to 1, allowing them to be compared for different variables. According to the results of this model, the t values for all the components of the fitted model were greater than the critical region value (t>1.96), indicating that all of these coefficients were significant. Therefore, all components played a significant role in explaining their respective dimensions. The fit indices of the first-order measurement model are reported in Table 3. If the fit indices were in the desired range, it indicated that the model was appropriate for the collected data.

The following fit indices were used to fit the model:

the Chi-square ratio to the degree of freedom (X^2/df), comparative fit index (CFI), Tucker-Lewis Index (TLI), root mean square error of approximation (RMSEA), and Standardized root means square residual (SRMSR). Ho and Bentler proposed that an RMSEA value less than 0.08 indicated an appropriate fit, while one smaller than 0.05 indicated a good fit. The CFI, TLI, and NFI indices should be greater than 0.95, but a value greater than 0.90 was also acceptable. SRMR index with values smaller than 0.08 indicated a good fit. Marsh considered values between 2 and 5 for the X^2/df index to indicate a good fit. As a result, the appropriateness of the first-order measurement model was confirmed because all the fit indices were almost within the desired range.

Evaluation of the Measurement Model of the Second Order of Research

The second-order measurement model of the research includes its dimensions as first-order hidden variables and the components of each as obvious variables. In this model, there were also two hidden variables of the second order including intellectual capital and social capital of Mashhad University of Medical Sciences. Figure 3 displays the measurement model for the second order of the present study.

Figure 3 shows that the coefficients of all components and dimensions were t>1.96, indicating that they were significant. Table 4 shows the fit indices of this model.

As explained in Table 1, practically all the fit indices in the second-order measurement model were in the intended range, proving the suitability of the model.

Evaluating the Structural Model of Research and the Relationships between Variables

The final research model, based on which the research questions can be answered, is presented in Figure 4. This model includes dimensions and components for both the dependent variable, intellectual capital, and the independent variable, social capital.

In the structural model in this research, for all dimensions and components, t was greater than 1.96, indicating that they were significant. Table 4 presents the fit indices of the final model.

Table 3: Fit indices of the first-order measurement model

Comparative Fit Index (CFI)	Tucker-Lewis Index (TLI)	Root Mean Square Error of Approximation (RMSEA)	Standardized Root Mean Square Residual(SRMSR)	Chi-Square/ degree of freedom
0.95	0.93	0.089	0.031	4.30

According to Figure 4 and Table 4, the set of fit indicators shows that the model has a good fit for the data. Moreover, it indicated the relationship between the variables of "human" and "structural". Since almost all the fit indices in the structural model were in the desired range, the appropriateness of this model was also confirmed.

Finally, based on the findings of this model, which are presented in Figure 4, it can be stated that the quantitative model of intellectual capital promotion with social capital approach in Mashhad University of Medical Sciences included social capital as well as structural dimensions (including network structure components, network relationships and organizational suitability), relational (including the components of social participation and political participation), and cognitive (including the components of awareness and social trust), and intellectual capital along with the dimensions of human capital (including

the components of individual competencies, group competencies and Intellectual property), structural capital (including the components of technology management, strategic management and knowledge management), client's reverence (including the components of direct stakeholders and indirect stakeholders), and innovation capital (including the components of innovation in technology and distinctive innovation).

Discussion

The present study showed that the quantitative model of intellectual capital promotion with the social capital approach at Mashhad University of Medical Sciences included social capital as well as structural dimensions (including network structure components, network relationships, and organizational suitability), relational (including the components of social participation and political participation), and

Figure 3: Second-order measurement model

Table 4: Structural model fit indices

Comparative Fit Index (CFI)	Tucker-Lewis Index (TLI)	Root Mean Square Error of Approximation (RMSEA)	Standardized Root Mean Square Residual (SRMSR)	Chi-Square/ degree of freedom
0.93	0.92	0.096	0.038	4.84

Figure 4: Structural model of the research

cognitive (including the components of awareness and social trust), and intellectual capital along with the dimensions of human capital (including the components of individual competencies, group competencies, and Intellectual property), structural capital (including the components of technology management, strategic management, and knowledge management), client's reverence (including the components of direct stakeholders and indirect stakeholders), and innovation capital (including the components of innovation in technology and distinctive innovation).

In addition, the findings of the quantitative model of intellectual capital promotion with the social capital approach at Mashhad University of Medical Sciences indicated that this model included two variables of social capital and intellectual capital. Social capital consisted of four dimensions of human capital, structural capital, client's reverence, and innovation capital. Besides, intellectual capital had three dimensions including structural capital, relational capital, and cognitive capital. This model included 17 components in total, and all the studied paths are significant. In this study, all test statistics were more than 1.96, so they can be confirmed at a 95% confidence level, indicating the significance and appropriateness of the model. Besides, the coefficients related to intellectual capital to human capital (0.96), intellectual capital to structural capital (0.99), and

social capital to relational capital (0.91) show the significance of the path and the appropriateness of the model.

The findings of this study support those of Edvinson, Bontis, and Pirozzi's studies (14-16), which found a significant association between the components of intellectual capital.

Similarly, Khaliq et al. (2018) discovered a direct association between intellectual capital and human capital (0.913), structural capital (0.903), and relational capital (0.980), which is similar to the findings of the current study (17).

Furthermore, Peng and colleagues found that in the Taiwanese health sector, human capital, structural capital, and relational capital all had an impact on the organizational performance of the hospitals, with a coefficient of 0.23 for human capital, 0.46 for structural capital, and 0.25 for relational capital (18), which is consistent with this study in terms of the importance of intellectual capital along with the dimensions of human capital (including the components of individual competencies, group competencies, and Intellectual property).

Martínez-Torres et al. designed a model for measuring intellectual capital and found that human, structural, and relational capital had a positive impact on one another (19), which is consistent with the reported findings of the current study. In addition, the results of the study by Nejat et al. showed that human,

structural, and relational capitals all had a beneficial impact on intellectual capital, with relational capital having the greatest impact (0.399), followed by structural capital (0.359), and then human capital (0.358) (20).

Conclusion

Conducting this research at Mashhad University of Medical Sciences revealed aspects of intellectual capital with the social capital approach. Moreover, the analysis of the data revealed that the quantitative model of intellectual capital promotion at Mashhad University of Medical Sciences through using a social capital approach was designed successfully, and all the fit indices were within the desired range. This implied that investing in the social capital of the organization, i.e., in the cognitive, structural, and relational dimensions, would increase intellectual capital, including human capital, structural capital, client reverence, and innovation capital. Finally, it can be claimed that social capital and intellectual capital, in general, were the foundations of economic development and performance. It is suggested that in future studies, the current situation of each dimension of the intellectual capital model in Iran should be investigated and then compared with similar situations and experiences of other countries. Moreover, the researchers could conduct similar research in other organizations and compare the results with the current research.

Authors' Contribution
All authors equally contributed to preparing this article.

Ethics Approval and Consent to Participate
This study was approved by the Vice-chancellor of research and technology of Mashhad Azad University, as well as the local ethics committee of Mashhad University of Medical Sciences (IR.IAU.MSHD.REC.1399.204). Written informed consent was obtained from all the participants of the study.

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