



Original Research

Cite this article: Sharififar S, Hamidi Farahani R, Khoshvaghti A, Ahmadi Marzaleh M. Designing and validation of the nurses' preparedness to response to COVID-19 questionnaire in Iran. *Disaster Med Public Health Prep*. doi: <https://doi.org/10.1017/dmp.2021.233>.

Keywords: coronavirus; COVID-19; Iran; nurses; preparedness

Corresponding author: Milad Ahmadi Marzaleh, Email miladahmadimarzaleh@yahoo.com

Designing and Validation of the Nurses' Preparedness to Response to COVID-19 Questionnaire in Iran

Simintaj Sharififar PhD¹ , Ramin Hamidi Farahani², Amir Khoshvaghti³  and Milad Ahmadi Marzaleh⁴

¹Department of Health in Disasters and Emergencies, Nursing Faculty of AJA University of Medical Sciences, Tehran, Iran; ²Department of Infectious Diseases, Faculty of Medicine, AJA University of Medical Sciences, Tehran, Iran; ³Aerospace Medicine Research Center, Aerospace and Subaquatic Medicine Faculty, AJA University of Medical Sciences, Tehran, Iran and ⁴Department of Health in Disasters and Emergencies, School of Management and Medical Informatics, Shiraz University of Medical Sciences, Shiraz, Iran

Abstract

Objective: Nurses are considered key members to respond to incidents and disasters. As many patients are hospitalized during the coronavirus disease (COVID-19) pandemic, and nurses are directly in contact with these patients; their preparedness enables them to respond to this situation more effectively and protects their health. Therefore, the present study aimed to design and validate a questionnaire to measure the nurses' preparedness in response to COVID-19 in Iran in 2020.

Methods: This study was a mixed research aiming to develop and validate a psychometric research instrument in 2020. Based on the review of the literature regarding COVID-19 and other viral respiratory infections, the items were extracted, rewritten, and validated. In the quantitative phase, the validity of the questionnaire was evaluated in terms of face, content, and construct validity, and its reliability was evaluated based on internal consistency and stability (Cronbach's alpha and Intra-class Correlation Coefficient [ICC]). To fill out the questionnaire, the nurses were selected by random sampling. Data analysis was done by the SPSS software, version 23 (IBM Corp, Armonk, NY).

Results: The designed questionnaire included 9 dimensions and 50 items. The dimensions included (1) Incident Command System (ICS); (2) risk assessment and management; (3) information and communication management; (4) psychological approaches; (5) personal protective equipment; (6) prevention of contamination, isolation, and quarantine; (7) education and training; (8) patient management; and (9) features of the new coronavirus. The content and face validity of the questionnaire were approved by the specialists and experts of nursing and health in disasters and emergencies. The content validity ratio was > 0.7 for all items. The content validity index was also approved for all items. The Cronbach's alpha coefficient and ICC were respectively 0.71 and 0.72 for the total questionnaire. The total score was determined based on 5 ranges, including 50–89 (very low preparedness), 90–129 (low preparedness), 130–170 (medium-level preparedness), 171–210 (high preparedness), and 211–250 (very high preparedness).

Conclusion: Nurses' preparedness to respond to this pandemic requires multilateral measures. Measuring the nurses' preparedness can clarify the challenges in hospital measures taken to respond to this crisis. Evaluating the nurses, determining the challenges and priorities, and finding solutions to resolve them can improve the nurses' performance in providing health care services. Preparation of nurses during pandemics can reduce the damages to this group and maximize their efforts to protect the patients. Thus, health planners and policy-makers should try to promote the nurses' awareness and preparedness.

Introduction

The first coronavirus disease (COVID-19) case was reported in Wuhan (Hubei Province, China) in December 2019.¹ COVID-19 is a highly infective disease with a high prevalence. It rapidly spread throughout the world, so the World Health Organization declared it an emergency situation on January 30, 2020.^{1–3} Almost 20% of the cases reported severe symptoms and the death rate caused by this virus was reported to be about 3%.⁴ This virus may have been transmitted from bats to humans. Human-to-human transmission was found to occur by means of respiratory particles or direct contact. The average incubation period was 6.4 days. The most prevalent symptoms were fever, cough, and shortness of breath. Pulmonary involvement and ground-glass opacity in lung computed tomography scan were also significant symptoms for diagnosis.⁵

To properly respond to pandemics, employees' awareness should be promoted in all affected organizations. The front lines of responding to such incidents is the health sector.⁶ Studies have suggested the lack of preparedness of health care staff, especially the hospital personnel, in response to COVID-19.⁷⁻⁹ To achieve an appropriate performance in health care centers and promote that under critical conditions, hospitals need to recognize these conditions and become prepared to respond to pandemics. In addition, the managers of health care institutions and other involved organizations should recognize the risks and promote the capabilities of their personnel with respect to the standards.^{7,10} They can properly respond to such incidents as pandemics by developing preparation and educational programs.¹¹⁻¹³ Promotion of the nurses' awareness leads to their higher willingness to work under such conditions. However, studies have suggested the nurses' inadequate knowledge and skills in responding to COVID-19.¹⁴ Studies performed before the occurrence of the COVID-19 pandemic indicated that nurses did not pay enough attention to personal protective equipment and had negative attitudes toward risk acceptance. In fact, wide educational gaps have been reported in universities, preventing nurses' preparedness in the course of pandemics.¹⁵ Since many nurses work in military hospitals, evaluation of their preparedness can promote their responsiveness.

Nurses are considered key members to respond to incidents and disasters. As many patients are hospitalized during the COVID-19 pandemic and nurses are directly in contact with these patients, their preparedness enables them to respond to this situation more effectively and protects their health. Regarding the lack of a comprehensive questionnaire for evaluation of nurses' response to COVID-19 in Iran and considering the nurses' significant role in this pandemic as well as the risks threatening them, the present study aims to design and validate a questionnaire to measure the nurses' preparedness in response to COVID-19 in Iran in 2020.

Method

This study was a mixed research aiming to develop and validate a psychometric research instrument in 2020. In the qualitative phase, review of the literature was done to extract the factors involved in nurses' preparedness in response to COVID-19, design the items, and find the similar questionnaires. The questionnaire was prepared on the basis of the one designed by Worrall et al. to investigate nurses' preparedness to respond to disasters with an approach to all types of disaster.¹⁶ Based on the review of the literature regarding COVID-19 and other viral respiratory infections, the items were extracted, rewritten, and validated.

In the quantitative phase, the validity of the questionnaire was evaluated in terms of face, content, and construct validity, and its reliability was evaluated based on internal consistency and stability (Cronbach's alpha and Intra-class Correlation Coefficient [ICC]). To investigate the qualitative face validity, the designed items were reviewed by 20 specialists of infective diseases, board members, nursing managers, and experts in health in disasters and emergencies, passive defense, and crisis management. After evaluation of the qualitative face validity and modification of the deficiencies, the impact score (IS) was assessed to reduce and eliminate the inappropriate items and to determine the importance of each item.¹⁷ Each of the items was scored based on a 5-point Likert scale ranging from "quite important" (5) to "not important at all" (1). Then, the IS of each item was calculated using the following formula¹⁸:

$$\text{Importance} * \text{Frequency} = \text{Impact Score (IS)}$$

In the qualitative method, the questionnaire was reviewed by 20 specialists of infectious diseases, nursing, health in disasters and emergencies, passive defense, and crisis management, and items overlapping were explored. In the quantitative method, validity was evaluated by Lawshe's technique. Content validity ratio (CVR) is one of the widely accepted quantitative methods of determining the CVR.¹⁹ The questionnaire was reviewed by 20 specialists with sufficient experience in the aforementioned areas.^{20,21} Then, the CVR was calculated to determine the importance of each item. The acceptable CVR value for each item varied depending on the number of experts assessing the content validity.²² To calculate the content validity index (CVI), the experts were required to evaluate each item in terms of "relevance," "clarity," and "simplicity," using a 4-point scale. In case relevance scores above 75% were obtained for the items, they were studied in terms of clarity and simplicity, too. The items with CVIs above 80% were accepted.²³ In the next step, the items were analyzed by a sample of 30 participants. Item analysis was done by determining the Cronbach's alpha coefficient for the primary reliability, identifying the items that affected the reliability, and studying the correlations between the items. The items with correlation coefficients less than 0.3 or more than 0.7 were omitted.²⁴

To assess the construct validity of the questionnaire based on exploratory factor analysis, the sample adequacy was examined using the Kaiser-Meyer-Olkin (KMO) method. If the KMO value was more than 0.6, the sample adequacy was acceptable.²⁵ To determine the construct validity, the questionnaire was distributed among 20 people. In the next step, Bartlett's sphericity test was used to determine whether the obtained matrix was significantly different from zero. Based on the results, using the factor analysis was justified. After making sure about the possibility of factor analysis, the constructs of the questionnaire were specified by Eigenvalues (Kaiser values) and scree plots.

The reliability of the questionnaire was evaluated based on internal consistency and stability. Stability was evaluated by the test-retest method. In this method, a test was given to a group of subjects more than once under the same conditions. To evaluate the reliability by this method, first the questionnaire was distributed among 30 nurses and then the retest was done in the same group after 7 days. The ICC value was obtained based on the scores of the 2 tests,²⁶ which indicated the reliability of the tool. The ICC above 0.8 was considered optimal.^{27,28}

The most common method of evaluating the internal consistency of a tool is Cronbach's alpha coefficient. Cronbach's alpha indicates the proportion of a set of items that measure a construct. Cronbach's alpha values above 0.7 are considered optimal.^{29,30} To evaluate Cronbach's alpha coefficient in this study, the questionnaire was distributed among 200 nurses. Then, a data analysis was done using the SPSS software, version 23 (IBM Corp, Armonk, NY).

This study was approved by the Committee of Ethics in Biomedical Studies (IR.AJAUMS.REC.1399.027). The participants were informed that they could attend the study in case they were willing to, and they were ensured about the confidentiality of their information. After getting the necessary permissions from the Research Deputy of the Nursing Faculty and the approval letter of AJA University of Medical Sciences, the researchers presented the approval letter to the participants. They also introduced themselves and explained the research goals. Then, the individuals who were willing to participate in the study were selected and were

informed that they could leave the study at any stage. Other ethical considerations included obtaining written consent forms from the specialists, ensuring the participants that they could receive the research results if they desired, appreciating all the people cooperating in the study, and gaining permission from the Ethics Committee.

Results

The extracted questionnaire included 9 dimensions and 50 items. The psychometric properties of this questionnaire were determined by studying its validity (face, content, and construct validity) and reliability (based on Cronbach's alpha and test-retest method). The 9 dimensions of the questionnaire included (1) Incident Command System (ICS); (2) risk assessment and management; (3) information and communication management; (4) psychological approaches; (5) personal protective equipment; (6) prevention of contamination, isolation, and quarantine; (7) education and training; (8) patient management; and (9) features of the new coronavirus. The results of item analysis regarding the correlation between the items did not lead to the removal of any items and all the items remained in the questionnaire. Each item had a correlation of 0.3 with at least 1 of the other items. The results of face and content validity and item analysis were approved, as presented in [Table 1](#).

The final questionnaire included 50 items scored based on a 5-point Likert scale (ranging from "completely" [5] to "not at all" [1]) and was tested for construct validity.

To determine the construct validity by exploratory factor analysis, first the sample adequacy was investigated based on KMO statistic whose value was 0.71. The value of Bartlett's sphericity test was also 3140.80, which was significant at $P < 0.001$. Based on the resulted correlation matrix, factor analysis could be done in the study sample. The 2 abovementioned criteria were significant indicators to approve the sample adequacy and the possibility of factor analysis. The results of KMO statistic and Bartlett's sphericity test have been presented in [Table 2](#).

The scree plot has been depicted in [Figure 1](#). Accordingly, the 9 constructs of the questionnaire were efficient. The Eigenvalues of the extracted factors have also been shown in the figure.

In this research, the factor loading of 0.41 was considered the minimum acceptable correlation between each item and the extracted factors. The 9 constructs of the questionnaire could explain the variance by 54.87%.

After having 200 questionnaires filled, the Cronbach's alpha coefficient of the total questionnaire was obtained as 0.715. The ICC of the questionnaire was also obtained as 0.723. The Cronbach's alpha coefficients and ICCs for the 9 constructs of the questionnaire have been presented in [Table 3](#).

In the study questionnaire, items 1–10 measured the ICS, items 11–16 measured the risk assessment and management, items 17–22 measured the information and communication management, items 23–27 measured the psychological approach, items 28–33 measured the equipment dimension, items 33–36 measured the prevention of contamination, isolation, and quarantine, items 37–39 measured education and training, items 40–45 measured patient management, and items 46–50 measured the features of the new coronavirus. Overall, the questionnaire consisted of 50 items, including 10 items in the ICS, 6 items in risk assessment and management, 6 items in information and communication management, 5 items in psychological approaches, 5 items in the equipment dimension, 4 items in contamination prevention,

isolation, and quarantine, 3 items in education and training, 6 items in patient management, and 5 items in features of the new coronavirus. The total score of the questionnaire was determined based on the 5 ranges of 50–89 (very low preparedness), 90–129 (low preparedness), 130–170 (medium-level preparedness), 171–210 (high preparedness), and 211–250 (very high preparedness).

Discussion

This is one of the first researches to investigate nursing preparedness for COVID-19 in the world. According to the results, the study questionnaire was both reliable and valid and could be used to measure the nurses' preparedness to respond to COVID-19. The questionnaire included 9 dimensions and 50 items that clearly addressed the factors required for the nurses' preparedness to respond to the new coronavirus. These dimensions included (1) ICS; (2) risk assessment and management; (3) information and communication management; (4) psychological approaches; (5) personal protective equipment; (6) prevention of contamination, isolation, and quarantine; (7) education and training; (8) patient management; and (9) features of the new coronavirus. Although there are several tools to investigate biological incidents, no questionnaire was found to investigate COVID-19 specifically. Thus, the research aimed to design a comprehensive tool with all the required dimensions.

Terri Reb et al. performed a study to measure the nurses' preparedness to respond to bioterrorism in Missouri. They used a tool including the dimensions of risk perception, vulnerability, seriousness, acquired education, participation in training, and individual response program.³⁰ Some of their criteria were similar to those of the present study. Nevertheless, the questionnaire designed in the present study was more comprehensive and could measure more clearly the nurses' preparedness in response to COVID-19.

Yang et al. performed a study to measure the nurses' preparedness in response to nucleus, chemical, and biological terrorism.³¹ They used a questionnaire including 19 dimensions about demographic properties, perception, concern about preparedness, willingness to work, expectation about the future terrorist incidents, impact on lifestyle, fear of terrorism, and terrorism victims. The Cronbach's alpha coefficient for the items of that questionnaire was obtained as 0.745.³¹

Huang et al. investigated the emotional responses and coping strategies of nurses and nursing students during the COVID-19 pandemic.³² They found that females experienced severer anxiety and fear in this condition. They also reported that the participants in cities expressed higher levels of fear and anxiety compared to those in villages. In addition, the nurses caring for patients with COVID-19 reported high levels of anxiety and anger. Compared to nursing students, nurses expressed more appropriate emotional responses to this problem.³² Furthermore, the nurses taking care of female patients were more prone to depression and stress due to their mental and physiological conditions.^{24,33}

Nurses should be aware of the activation and function of the ICS. They should also know the components of the ICS chart and be aware of the responsibilities of different ICS components to preserve their performance in response to pandemics.³⁴ Besides, nurses should pay attention to the preservation of their communications chain, identification of their colleagues' abilities in operational programs, documentation, access to medical equipment warehouses, provision of information for patients, and use of different communication tools.³⁵ Triage is one of the most vital measures in response to the new coronavirus. Some of the professional competencies of

Table 1. Evaluation of the face and content validity of the questionnaire

No.	Items	Impact Score	CVR	CVI	Correlation of Each Item With Other Items
1	I am aware of the incident command system of the hospital under crisis.	3	0.8	0.8	0.51
2	I know the relevant units to submit the necessary reports.	2.5	0.8	1	0.39
3	I am aware of the nurses' preparedness to respond to the new coronavirus.	2.4	0.9	1	0.45
4	I am aware of the hospital's preparedness to respond to the new coronavirus.	2.3	1	1	0.48
5	I am aware of the content of the emergency operation program in response to epidemics.	1.8	1	0.9	0.38
6	I am aware of the decision-making processes in the incident command system.	1.95	1	0.9	0.5
7	I am aware of the tasks not to be assigned to ordinary volunteers during the new coronavirus crisis.	3.3	1	0.8	0.43
8	I am aware of my colleagues' abilities in operational programs in response to the new coronavirus.	2.8	1	0.8	0.39
9	I know the symptoms needed to be quickly reported.	2.5	1	0.8	0.42
10	I am aware of the time of reporting the incident commander.	3.8	1	0.8	0.44
11	I am aware of the methods of evaluating the environmental security for myself.	3.5	0.8	0.8	0.52
12	I am aware of the methods of evaluating the environmental security for my colleagues.	2.5	0.8	0.8	0.61
13	I am aware of the methods of evaluating the environmental security for patients.	3.5	0.7	1	0.44
14	I am aware of the method of quick evaluation of patients' mental health.	3	0.7	1	0.54
15	I know how to evaluate the effectiveness of the measures taken for patients infected with the new coronavirus.	2	0.8	1	0.35
16	I know the process of quick physical evaluation of the patients.	3.2	0.8	1	0.32
17	I can quickly access the updated scientific resources about the new coronavirus.	2.2	0.8	1	0.48
18	I am aware of effective information provision about the degree of risk for different groups.	3.8	1	1	0.38
19	I know how to acquire reliable information and check its accuracy.	3.34	1	1	0.44
20	I know how to preserve the relationship between the intra-organizational and extra-organizational factors in response to the new coronavirus.	3	1	1	0.42
21	I know how to use different communication tools.	2.5	1	1	0.43
22	I know the documentation processes in caring areas.	3	1	1	0.52
23	I know the symptoms of posttraumatic stress disorder in the referring patients.	2.8	1	1	0.42
24	I know the process of diagnosis and evaluation of the symptoms of posttraumatic stress disorder or other health-related problems in a child or adolescent.	2.5	1	1	0.33
25	I am aware of the ways of providing psychological support for all people.	2.5	1	1	0.43
26	I know how to provide psychological counseling/health education for patients.	2.8	1	1	0.52
27	I know how to care for sensitive/vulnerable patients.	2.4	1	1	0.44
28	I know how to use personal protective equipment while caring for patients.	2.8	0.8	1	0.42
29	I know the proper use of personal protective equipment while caring for patients.	2.8	0.8	1	0.35
30	I know the proper ways of disposal of consumed personal protective equipment.	2.4	0.7	1	0.35
31	I know the process of accessing the strategic equipment warehouse in the hospital.	2.4	0.8	1	0.46
32	I know how to discharge the patients' wastes and wastewater.	2.6	1	1	0.4
33	I know the isolation methods after people's exposure.	3.5	1	1	0.42
34	I know the process of quarantine in the hospital.	3.5	1	1	0.54
35	I know the methods of elimination of pollutions in emergency operation programs.	4	1	1	0.48
36	I know the process of patient isolation.	2.3	0.8	1	0.42
37	I have been trained to provide care in epidemics.	2.5	1	1	0.38
38	I have participated in training programs to respond to epidemics and biological incidents.	2.4	1	1	0.36
39	I know different scenarios of responding to the new coronavirus.	3.4	1	1	0.42
40	I know the latest version of the clinical instruction of the Ministry of Health about the caring principles.	3.6	1	1	0.44
41	I know the methods of biological triage in the new coronavirus crisis.	3.8	1	0.8	0.46
42	I know the drugs needed by patients.	2.5	0.8	0.8	0.44
43	I have the necessary skills to fill out the patients' medical files and to perform physical examination for the patients who have been probably exposed to the new coronavirus agents.	2.8	1	0.9	0.46
44	I am aware of the considerations (ethical, legal, cultural, and safety-related) related to corpses.	3	0.8	1	0.42
45	I am able to identify the probability of the intensification of underlying diseases after being infected with the new coronavirus.	3.8	0.8	1	0.52
46	I know the transmission ways.	2.8	0.8	1	0.34
47	I know the symptoms of the coronavirus disease.	3.5	0.8	1	0.42
48	I know the probable side effects of the new coronavirus drugs.	2.4	1	1	0.36
49	I know the process of diagnostic sampling.	3.4	1	1	0.42
50	I know how to send the samples to the laboratory.	3.6	1	1	0.44

Table 2. KMO sampling adequacy index and Bartlett's sphericity test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.71
Bartlett's Test of Sphericity	Chi-square	3140.80
	Degree of freedom	199
	Sig	$P < 0.001$

the nurses in response to COVID-19 include differentiation among the susceptible, probable, and definite cases of COVID-19, biological triage, mental triage, and evaluation of the effectiveness of measures.³⁶ Since patients with COVID-19 and even the general public can be affected by the psychological impacts of this disease, nurses should be familiar with the symptoms, intervention and counseling methods, and support such vulnerable groups as children, elderly people, disabled individuals, and pregnant women to provide them with proper mental and social support.³⁷ Regarding the epidemic nature of COVID-19, nurses should contact the patients by using full personal protective equipment to ensure the maximum protection. Choosing the personal protective equipment, proper way of wearing them and taking them off, and the process of quarantine and isolation are some of the main factors of which nurses have to be aware.^{38,39}

Some trainings that should be provided for nurses include the information about the drugs needed by patients, filling the medical records, physical examination, identification of the patients with underlying diseases, and deciding about ethical, legal, cultural, and safety-related matters. Other necessary characteristics of nurses include their awareness of the relationship between the inside and outside of the organization, quick and on-time reporting to the upper and lower levels, and quick access to reliable information resources. Since COVID-19 is a new disease, nurses should be aware of the transmission ways, symptoms, side effects of drugs, quick evaluation of patients, isolation, sampling, and hospital waste and wastewater disposal.

The questionnaire designed in the present study provided a comprehensive tool for measuring the nurses' preparedness. Thus, it can be used as a standard tool for evaluation of nurses' preparedness to respond to the new coronavirus in future studies. This tool can also make health managers and policy-makers aware of the nurses' situations. Low preparedness of nurses can lead to their poor response to this epidemic. The higher their preparedness, the lower the death rates and the severity of complications in the patients and the hospital staff.

One of the advantages of this questionnaire was that it was almost comprehensive and investigated different dimensions of preparedness. The strengths of this study included the utilization of a large number of specialists in nursing and disasters to evaluate the reliability and validity of the questionnaire and lack of any questionnaires to measure the nurses' preparedness in response to COVID-19 in Iran. However, the weaknesses of the questionnaire included the lack of access to all experts. Hence, the researchers made their best attempts to interact with all available experts.

Conclusion

Nurses are considered one of the main groups responding to the COVID-19 crisis. Their preparedness to respond to this pandemic requires multilateral measures. Although there might be other latent factors to affect nurses' preparedness, evaluation of the factors extracted in this research can determine their preparedness. Lack of preparedness by nursing personnel can lead to deficiencies in performance, fear of working in the hospital wards, leaving service provision, infection, diseases, and death. These conditions can intensify the human force challenge under such crises. Measuring the nurses' preparedness is the first step toward their preparation. Determining the nurses' preparedness can specify the challenges, priorities, and necessary measures to improve their performance. Preparation of nurses during pandemics can reduce the damages to this group and maximize their efforts to protect the patients.

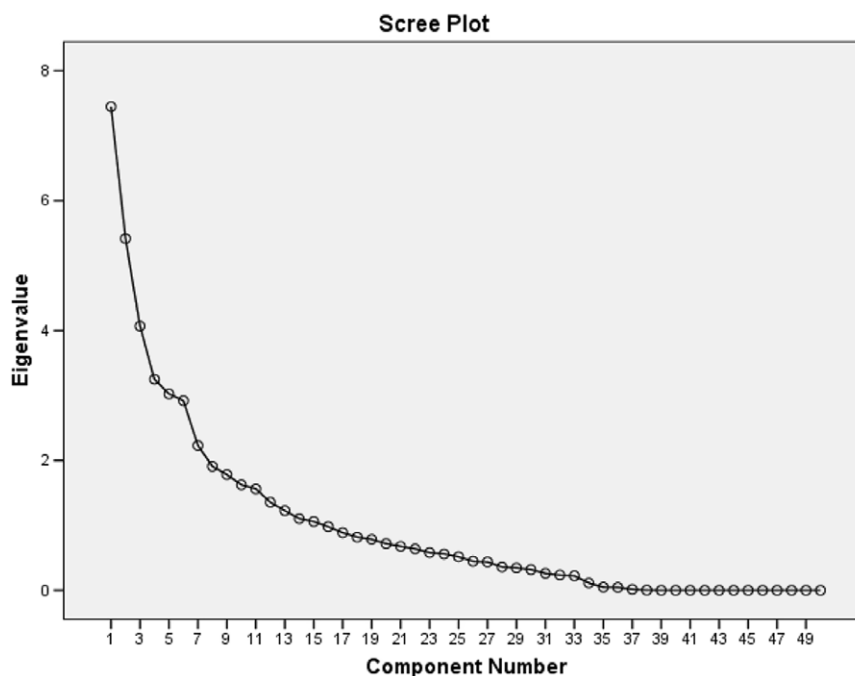
**Figure 1.** The scree plot specifying the number of constructs of the nurses' preparedness to respond to the COVID-19 questionnaire in Iran.

Table 3. Evaluation of the reliability based on Cronbach's alpha and ICC

No	Dimension	Cronbach's alpha	ICC
1	Incident command system	0.720	0.712
2	Risk assessment and management	0.704	0.7001
3	Information and communication management	0.710	0.719
4	Psychological approaches	0.711	0.720
5	Personal protective equipment	0.715	0.731
6	Contamination prevention, isolation, and quarantine	0.720	0.711
7	Education and training	0.732	0.730
8	Patient management	0.719	0.740
9	Features of the new coronavirus	0.7001	0.705

Hence, health planners and policy-makers should try to promote the nurses' awareness and preparedness. In this context, the developed questionnaire is suggested to be used in order to measure the nurses' preparedness to respond to COVID-19 in Iran and other countries. Other tools are also recommended to be designed in order to measure the preparedness of other health care providers, such as doctors and service staff.

Acknowledgments. Hereby, the authorities and personnel of AJA University of Medical Sciences are greatly appreciated for paving the way for conducting this study. Our thanks also go to Ms A. Keivanshekouh at the Research Improvement Center of Shiraz University of Medical Sciences for improving the use of English in the manuscript.

Author Contributions. SS and MAM were responsible for the conception and design of the study. SS, RHF, AK, and MAM supervised the whole study. SS, RHF, AK, and MAM prepared the first draft of the manuscript. SS, RHF, AK, and MAM did the analysis of the results and supervised the study. All authors have read and approved the final manuscript. SS and AK contributed equally as co-first authors.

Funding Statement. This project has partly been supported by a grant from AJA University of Medical Sciences with the code IR.AJAUMS.REC.1399.027.

Conflict(s) of Interest. The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this paper.

Ethical Standards. Informed consent was obtained from all individual participants in the study.

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