Frontiers in Dentistry

Validation of a Questionnaire on COVID-19 Knowledge and Attitude for Dental Patients

Mohammad Reza Khami[1,2], Mahsa Karimi[1,3]*, Morenike Oluwatoyin Folayan[4], Ahmad Reza Shamshiri[1,2], Prathip Phantumvanit[5], Armando E Soto-Rojas[6], Seyed Hossein Bassir[7], Heikki Murtomaa[8]

1. Research Center for Caries Prevention, Dentistry Research Institute, Tehran University of Medical Sciences, Tehran, Iran
2. Department of Community Oral Health, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
3. Scientific Research Center, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
4. Department of Child Dental Health, Obafemi Awolowo University, Ile-Ife, Nigeria
5. Faculty of Dentistry, Thammasat University, Pathum Thani, 12120, Thailand
6. Department of Public Health and Dental Informatics, Indiana University School of Dentistry, Indianapolis, IN, USA
7. Department of Periodontology, School of Dental Medicine, Stony Brook University, New York, USA
8. Department of Oral Public Health, Institute of Dentistry, University of Helsinki, Helsinki, Finland

Article Info

Article type:
Original Article

Article History:
Received: 01 Dec 2023
Accepted: 20 May 2024
Published: 12 Dec 2024

**** Corresponding author:***
Research Centre for Caries Prevention, Dentistry Research Institute, Tehran University of Medical Sciences, Tehran, Iran

Email: mk778898@gmail.com

A B S T R A C T

Objectives: The current study aimed to develop a valid and reliable questionnaire in both English and Persian to assess dental patients' knowledge and attitude during the COVID-19 outbreak.

Materials and Methods: Through a comprehensive literature review, we designed the primary questionnaire in English and then translated it into Persian. The questionnaire consisted of six sections covering background information, knowledge of emergency dental treatments, transmission routes of disease, required preparation, source of information, and attitude. To evaluate the validity of the questionnaire, the researchers obtained expert opinions using the Item Content Validity Index (I-CVI) and Scale Content Validity Index (S-CVI/Ave). They distributed online versions of the questionnaire to a total of 60 English-speaking adults in Nigeria and the United States, and 60 Persian-speaking adults in Iran to measure its reliability using Cronbach's alpha.

Results: I-CVI score, S-CVI/Ave, and Cronbach's alpha of the questionnaire ranged from 0.29-1, 0.62-0.99, and 41.1-87.6%, respectively. After reviewing the scores and comments received on each item, taking into account the opinions of the research team, a decision was made to remove, merge, modify, or retain certain items. This led to a final version of the questionnaire consisting of nine questions in the background section and 46 items in the remaining five sections.

Conclusion: Overall, the developed questionnaire appears to be valid and reliable for assessing the knowledge and attitude of dental patients toward COVID-19 in dental settings. It can potentially serve as an appropriate scale in future infectious disease epidemics across diverse populations.

Keywords: Attitude; Fear; Knowledge; Surveys and Questionnaires; Reproducibility of Results

➢ **Cite this article as:** Khami MR, Karimi M, Oluwatoyin Folayan M, Shamshiri AR, Phantumvanit P, E Soto-Rojas A, et al. Validation of a Questionnaire on COVID-19 Knowledge and Attitude for Dental Patients. *Front Dent*. 2024:21:48.

INTRODUCTION

In December 2019, an outbreak of a highly infectious respiratory disease, initially identified in Wuhan, China, occurred. The pathogen and the resulting disease were named Corona Virus Disease 2019 (COVID-19) [1,2].

As of October 2023, over 690 million people had been infected with COVID-19, leading to

the deaths of over 6.9 million individuals worldwide [3]. The virus is primarily transmitted through respiratory droplets generated when an infected person talks, coughs, or sneezes. Other modes of transmission include contact with contaminated surfaces and objects and close personal contact [4].

As the World Health Organization (WHO) declared, during the first wave of the COVID-19 pandemic, many dental clinics were shut down, and those that opened limited service delivery to emergency treatment due to concerns that dental procedures generate droplets and aerosols that could transmit the COVID-19 pathogen [1,5,6].

Many patients avoided dental clinics and hospitals due to fear of contracting COVID-19 [7,8]. These actions resulted in the worsening of oral health conditions, especially for many who were receiving oral health rehabilitation services [9].

While many dental clinics have resumed the delivery of full dental services, in some countries dental clinics continue to provide only emergency dental care [10]. There are now multiple references available that promote infection-transmission-free dental care delivery since COVID-19 is likely going to become an endemic disease [1,4,11,12].

The knowledge of the public about infection control and the risk of transmission of infectious diseases such as Human Immunodeficiency Virus (HIV), hepatitis, and Severe Acute Respiratory Syndrome (SARS) in dentistry settings is generally poor, and the attitudes are negative [8,13] with many people choosing to stay away from the dental clinics because of concerns about nosocomial infection [8]. However, there is a lack of information regarding the public's knowledge and attitudes toward COVID-19 and its impact on dental clinic attendance. To address this gap, the present study aimed to design and validate a questionnaire that assesses patients' knowledge about dental emergencies, COVID-19 transmission routes, COVID-19 preventive measures in dental practice, and patients' fear of infection in dental settings.

MATERIALS AND METHODS

Study Design and Ethical Aspects

This questionnaire development and analysis study was conducted in September 2021, after approval of the Research Ethics Committee of the Tehran University of Medical Sciences (IR.TUMS.DENTISTRY.REC.1400.117). All research methods were performed following the Declaration of Helsinki [14].

The study questionnaire was initially developed in English and subsequently translated into Persian using a standardized translation process. A bilingual translator back-translated the Persian version into English, and the researchers compared and edited the Persian version accordingly. This process helped to ensure the accuracy and cultural appropriateness of the translated survey.

Questionnaire Development Procedure

The questionnaire development in this study was conducted based on Boateng et al. [15] study, in the following phases and steps:

Phase 1: Item Development

Step 1: Domain Identification and Item Generation

A group of experts in dental public health and epidemiology collaborated to create a questionnaire comprising four domains: knowledge of dental emergency treatments, knowledge of transmission routes of COVID-19 in dental settings, knowledge of required preparation in dental settings, and fear of getting infected in dental settings.

Once domains were outlined, we utilized both deductive and inductive approaches to identify an item pool.

We conducted an extensive search in PubMed/MEDLINE, Google Scholar, Scopus, and Web of Science using following keywords; “fear”, “airborne disease”, “COVID-19”, “SARS”, “SARS-CoV-2”, “SARS Virus”, “COVID-19”, “Aerosols”, “Disease Transmission, Infectious”, and “Dental Anxiety” Mesh Terms. Furthermore, they searched for related guidelines in the Centers for Disease Control and Prevention (CDC), World Health Organization (WHO), and American Dental Association (ADA). We included articles and guidelines related to patients' knowledge about dental emergencies, COVID-19

transmission routes, COVID-19 preventive measures in dental practice, and patients' fear of infection in dental settings.

This thorough search yielded nine articles [1,4, 8,12,13,16-19], which served as references for creating the closed-ended study questionnaire, following the Stehr-Green scale [20]. Consequently, a questionnaire containing eight to fifteen questions per domain was developed, drawing upon similar surveys and a comprehensive literature review.

Step 2: content validation

A content validation form was prepared excluding the background and sources of information sections. Eight experts in community dentistry, including six bilingual experts and two native English speakers with experience in designing questionnaire, determined whether each item represent the domain of interest or not, by rating them on a scale of 1-3 for essentiality and 1-4 for relevance, clarity, and simplicity. Additionally, a box was provided for "comments and suggestions" to assess the face validity of the survey. Seven out of the eight experts completed and returned the content validation form. One expert only provided comments and suggestions.

To ensure the content validity of the questionnaire, both quantitative and qualitative perspectives were taken into account. The Item Content Validity Index (I-CVI) was used to assess the relevance of each item in the questionnaire. The calculation involved dividing the number of experts assigning a rating of "very relevant" by the total number of experts. Scores ranged from 0 to 1, with values above 0.79 indicating high relevance, scores between 0.70 and 0.79 indicating the need for revisions, and values below 0.70 suggesting elimination of the item [21]. In addition to calculating the I-CVI based on relevance, we also assessed the essentiality, clarity, and simplicity of the items using similar approach (the number of experts rated an item 3 or 4 was divided by the total number of experts).

Additionally, the Scale Content Validity Index/average (S-CVI/Ave) was calculated as an overall measure of content validity for each section of the scale. This involved averaging the I-CVI scores for all items within each section [22]. The ideal value for S-CVI/Ave was set at 0.90. Any section with a score below this threshold was revised until a satisfactory level of content validity was achieved [23].

The source of information section was a checklist, and its items were not scored, though the comments were gathered in order to make revisions. In consultation with an epidemiologist, the wording of some items was modified. According to the number of experts judging items, an I-CVI score of less than 86% was considered a threshold for removing items from the questionnaire [24]. After reviewing the scores and comments on each item, the research team decided to remove, merge, modify, or keep the original items based on the experts' opinions.

To enhance the face validity of the survey after obtaining approval from the expert panel, we administered the questionnaire to a small sample of the target population. The pilot participants provided feedback on the clarity and understanding of the items in the questionnaire.

Phase 2: Scale Development

Step 3: Pre-testing Questions

In this step, we conducted interviews with five laypeople to gather information on their thought processes when answering questionnaire items. We used this data to assess how well the items met our study objectives and identified areas for improvement. Based on our findings, we made revisions to the items to ensure clarity and accuracy.

Step 4: Survey Administration and Sample Size

In order to accommodate the challenges posed by the COVID-19 pandemic, the research team opted to create an online version of the survey. This allowed for greater accessibility and ease of completion for participants who may have been unable to attend in-person sessions. Additionally, most of the development and validation processes were conducted remotely through online platforms such as video conferencing and messaging applications,

due to the lock-down.

Given the difficulties posed by the COVID-19 pandemic, we utilized a convenience sample for the initial stages of the survey's development. We aimed to maximize the diversity of the participants by including individuals from various age groups, socioeconomic backgrounds, and levels of education.

Step 5: Item Reduction Analysis

In our questionnaire design procedure, we utilized the technique of estimating item-total correlations to support the deletion or modification of items. This method falls under classical test theory (CTT) and involves examining the relationships between individual items in a pool through a correlation matrix. By calculating these correlations, we were able to identify redundancies or overlaps among items and potentially delete or modify those items that did not contribute significantly to the measurement of the intended constructs.

The English and Persian versions of the questionnaire were uploaded into two separate Google Forms. The survey links were sent to different convenient samples of 18 years old and older adults via WhatsApp. The Persian version was sent to native Persian-speaking residents in Iran, while the English survey link was sent to English-speaking residents in Nigeria and the US. A total of 60 Persian- and 60 English-speaking individuals participated.

Prior to filling out the questionnaire, participants provided informed consent. Respondents filled out the questionnaire. Participants were required to select only one option per item and had to respond to all items before submitting their responses. Reminders were sent separately to study participants. The survey was closed once 60 respondents each for the Persian and English questionnaires had been reached.

All responses were downloaded into a Microsoft Excel 2019 file, cleaned, coded, and transferred to IBM SPSS Statistics version 21 for windows (IBM Corp., Armonk, N.Y., USA). Descriptive statistics including mean (Standard Deviation or SD) and percentages were calculated for the background characteristics of the respondents. Item-total correlation was calculated for items of each section separately.

Step 6: Factor Extraction

Given that our questionnaire was developed through a process of defining domains and then creating items within each domain, it was not necessary to perform factor analysis or factor extraction on the instrument.

Phase 3: Scale Evaluation

Step 7: Dimensionality Test

Due to the specific circumstances of our study, which involved developing the questionnaire during the early phase of the COVID-19 pandemic using online platforms, we decided to skip conducting dimensionality tests or test-retest reliability assessments.

Step 8: Reliability Test

Cronbach's alpha was used to assess the reliability of four of the six sections of the questionnaire, excluding the section on background and source of information. The average completion time was also recorded. In addition, comments and suggestions from the pilot study participants were discussed by the research team, and relevant comments were incorporated into the questionnaire after computing Cronbach's alpha, as mentioned before in Step 2.

Questionnaire Content

The first page of the questionnaire included the full title and the primary objective of the study. Informed consent was also provided to participants, informing them that their participation was voluntary and unpaid, and that their responses would remain anonymous and confidential.

The questionnaire consisted of 52 items organized into six sections [25]. It assessed various aspects such as background information (including five short answer and multiple choice questions about age, sex, level of education, living status, and whether participants had attended a dental visit in the past year and their reasons), awareness of dental emergency or urgent treatment needs (eight yes/no items about different situations requiring emergency care), knowledge of COVID-19 transmission

routes in dental settings (eight yes/no items about situations that could lead to COVID-19 transmission), awareness of required preparations in dental practice settings (15 yes/no items about protective measures expected in dental settings), sources of information about COVID-19 (five yes/no items exploring sources of information on COVID-19 including mass media, internet websites, social media, and friends and relatives), and fear of becoming infected with COVID-19 in dental settings (11 statements scored from 0 to 10 describing feelings in different situations). Some items included in the knowledge sections lack a specific scientific justification but were intentionally included to evaluate the reasoning behind the selected answers. The questionnaire is available in Supplementary File 1.

RESULTS

Respondents' Characteristics

The mean (SD) age of the 60 Persian respondents was 36.3 (14.9) with ages ranging from 18-67, and 42 (70%) of the participants were female. The mean (SD) age of the 60 respondents for the English survey was 36.7 (12) with ages ranging from 20-79, and 35 (58.3%) of the participants were female (Table 1).

Validity and Reliability

Table 2 displays the computation of the I-CVI scores. The I-CVI score for the primary version of the questionnaire ranged from 0.29 to 1. Also, any items that were revised, added, or deleted are indicated in Table 2.

Five of the 47 items of the original questionnaire (excluding the background information section) were removed, due to the I-CVI score for the essentiality of less than 86%. Two items were merged into statements that were similar in interpretation based on the experts' comments. Comments also were used to modify 14 other items, and to add four new questions to the background section. The newly added questions requested information on participation method (online, phone interview), country, vaccine status, and COVID status. Moreover, we added one item to the knowledge of emergency and knowledge of transmission sections respectively, and four items to the source of information section.

Table 1. Characteristics of study participants (N=120)

Characteristics	Persian (N=60)	English (N=60)
Age (years), Mean ± Standard Deviation (range)	36.3±14.9 (18-67)	36.7±12 (20-79)
Gender, N (%)		
Female	42 (70)	35 (58.3)
Male	18 (30)	25 (41.7)
Education level, N (%)		
Academic	44 (73.3)	51 (85)
Non-academic	16 (26.7)	9 (15)
Living status, N (%)		
Live alone	1 (1.7)	12 (20)
Live with neither at high risk nor old people	35 (58.3)	38 (63.3)
Live with at high risk or old people	24 (40)	10 (16.7)
Dental visits, N (%)		
Yes, because of a none-emergent problem	13 (21.7)	15 (25)
Yes, because of an urgent problem	11 (18.3)	18 (30)
No, because of COVID-19, although I had some problems in my mouth	13 (21.7)	3 (5)
No, because I did not have any problem	23 (38.3)	23 (38.3)
Never visited a dentist	0 (0)	1 (1.7)

Table 2. Content validity index (CVI) rating of the individual questionnaire items based on the responses by experts (N=7)

Item	I-CVI			
	Essentiality	Relevance	Clarity	Simplicity
Awareness of emergency dental treatments				
1. Painful swelling in or around your mouth*	0.86	0.86	0.86	0.57
2. Regular visits for braces*	0.29	0.57	0.71	0.86
3. Treatment of cavities that aren't painful	0.43	0.57	0.71	0.71
4. Regular visits for exams, cleanings, and x-rays	0.43	0.57	0.86	0.86
5. Denture adjustment for people receiving radiation or other treatment for cancer*	0.86	0.86	0.57	0.43
6. Broken or knocked out tooth	0.71	0.71	0.86	0.71
7. Gum infection with pain or swelling	0.71	0.71	0.71	0.86
8. Pain in a tooth, teeth, or jaw bone	0.71	0.86	0.71	0.86
9. Any lesion (painful or not) in the mouth persisting for two weeks or more†				
Knowledge on COVID-19 transmission routes in dentistry				
1. Inhaling respiratory droplets produced when an infected person coughs, sneezes, or talks.	1	1	1	0.86
2. Through intact skin*	0.71	0.71	1	1
3. Indirect contact with contaminated instruments and/or environmental surfaces‡	0.86	1	1	1
4. Talking without a mask	0.86	1	1	1
5. Contact with asymptomatic patients*	0.71	1	0.86	0.86
6. Inhaling aerosols formed during dental procedures*	1	1	1	1
7. Direct contact with blood, oral fluids or other patient materials*	0.86	0.86	0.86	0.86
8. Contact with oral, nasal, and eye mucous membrane‡	0.71	0.86	0.86	0.71
9. Being in close contact (less than 2 meters or 6 feet distance) with an infected person (patients, dentist, staff) for more than 15 minutes in a closed space without mask†				
Awareness of required preparations in dental practice settings				
1. Adequate air conditioning*	0.86	1	1	1
2. Screen staff and patients for flu-like symptoms, respiratory distress or fever as daily routine before their entering to the office/clinic	1	1	1	1
3. Ensuring a spatial sitting distance of at least 3 feet (1 meter) among patients in the waiting area*	1	1	1	1
4. Enforce isolation of patients infected with/suspected of COVID-19 infection in the waiting area	0.71	0.71	0.86	0.86
5. Deny non-emergency or elective procedures to patients infected with/ suspected of COVID-19 infection*	0.86	1	0.86	1
6. Use pre-procedural antimicrobial mouthwash.	0.86	1	1	1
7. Clean and disinfect public areas frequently, including door handles, chairs, and bathrooms	1	1	1	1
8. Post visual alerts/ signs of instructions for hand and respiratory hygiene, and cough etiquette	0.86	1	1	1
9. Cover full personal protective equipment including masks, gloves, gowns, and goggles or face shields by dentists and nurses*	1	0.86	0.86	0.86
10. Dedicate instruments to treat only suspected or infected patients‡	0.43	0.71	0.71	0.71
11. Dedicate dental units or areas in the operatory to treat only suspected or infected patients‡	0.43	0.71	0.86	0.86

Table 2 cont'd

12. Instruct patients to call before their appointment if they have respiratory symptoms so that staff can be prepared to care for them when they arrive	0.71	0.86	0.86	0.86
13. Dedicate personnel to treat only suspected or infected patients‡	0.29	0.71	0.71	0.71
14. Encourage home isolation of suspected/ infected staff or those who have been travelling abroad‡	0.43	0.86	0.86	0.86
15. Tele/online patient evaluation*	0.57	0.71	0.86	0.86
Attitude toward COVID-19 infection in dental settings				
1. In COVID-19 pandemic all dental offices and clinics should be closed‡	0.71	0.86	1	1
2. In COVID-19 pandemic due to the high risk of infection with COVID-19, I will not go to dentistry even when I have an emergent dental problem (e. g. pain, bleeding, and swelling)*	1	1	1	0.86
3. In COVID-19 pandemic the risk of infection with COVID-19 is high in dentistry even when all necessary preparations are in place*	0.86	1	1	1
4. I am worried about contracting COVID-19 and avoiding dental visits as a consequence‡	0.71	1	1	1
5. I am worried about contracting COVID-19 from my dentist	0.86	1	1	1
6. I am worried COVID-19 would be a long-term health issue	0.86	1	1	1
7. I am worried about transmitting COVID-19 to my dentist in case I am infected and asymptomatic	0.71	0.86	1	1
8. I avoid/delay dental visits because of the risk of infection from dental equipment	0.86	1	1	1
9. I am worried about catching COVID-19 infection from previous patients of the office	0.86	1	1	1
10. I am worried about transmitting COVID-19 to my loved ones after being infected in dental setting	0.71	0.86	1	0.86
11. I am worried about catching COVID-19 infection from public area of dental office	0.57	0.71	0.86	0.86
Sources of information				
1. Mass media (TV, Radio, Newspapers)				
2. Internet websites				
3. Friends, relatives, neighbors, and co-workers				
4. Social networks (Telegram, WhatsApp, Instagram, Twitter, Facebook, ...)				
5. Physicians or other health care professionals (nurses, health visitors, etc.)†				
6. Dentists or dental staff†				
7. Associations or organizations (CDC, WHO, ADA, etc.)†				
8. School announcement and human resources department from your work team†				
9. Other sources (please specify)				

CDC: Centers for disease control and prevention; WHO: world health organization; ADA: American dental association
* Item revised in the final version
† Item added to the final version
‡ Item deleted in the final version

Five of the 47 items of the original questionnaire (excluding the background information section) were removed, due to the I-CVI score for the essentiality of less than 86%. Two items were merged into statements that were similar in interpretation based on the experts' comments. Comments also were used to modify 14 other items, and to add four new questions to the background section. The newly added questions requested information on participation method

(online, phone interview), country, vaccine status, and COVID status. Moreover, we added one item to the knowledge of emergency and knowledge of transmission sections respectively, and four items to the source of information section. Table 3 represents the S-CVI/Ave of the questionnaire. The S-CVI/Ave ranged from 0.63 to 0.99.

Tables 4 to 7 display the Item-total correlation for each item of the questionnaire, organized by section. Items with negative correlation in knowledge domains were retained with modifications to enhance clarity, since they are less likely to be correlated.

The overall Cronbach's alpha coefficient for the knowledge sections (awareness of emergency dental treatments, knowledge of Coronavirus transmission routes, and awareness of required preparations in dental practice settings) was 87.7% and 89% in the Persian and English versions of the questionnaire, respectively; and 84.7% and 85.1% for the attitude section in the Persian and English questionnaires, respectively. The reliability for each section of the questionnaire ranged from 41.1% to 87.6%, as shown in Table 8.

Following the inclusion of layperson and experts' feedback, the questionnaire was finalized with nine questions in the background section and 46 items in the other five sections. Supplementary File 2 provides the final version of the questionnaire.

Table 3. Primary and revised questionnaire S-CVI/Ave* based on the responses by experts (n=7).

Domain	S-CVI/Ave*			
	Essentiality	Relevance	Clarity	Simplicity
Primary				
Awareness of emergency dental treatments	0.63	0.71	0.75	0.73
Knowledge on COVID-19 transmission routes in dentistry	0.84	0.93	0.95	0.91
Awareness of required preparations in dental practice settings	0.73	0.88	0.90	0.90
Fear of being infected with COVID-19 in dental settings	0.79	0.93	0.99	0.96
Revised				
Awareness of emergency dental treatments	0.63	0.71	0.75	0.73
Knowledge on COVID-19 transmission routes in dentistry	0.86	0.94	0.96	0.94
Awareness of required preparations in dental practice settings	0.86	0.92	0.94	0.95
Fear of being infected with COVID-19 in dental settings	0.73	0.84	0.99	0.96

* Scale content validity index/ average

Table 4. Item-total correlation of awareness of emergency dental treatment section of the COVID-19 questionnaire based on the responses by lay participants (N=120)

Items	Item-total correlation	
	Persian	English
Painful swelling in or around your mouth and cheek	0.34	0.40
Regular visits for braces and fixed orthodontic appliances	-0.27	0.15
Treatment of cavities that aren't painful	0.26	0.06
Regular visits for exams, cleanings, and x-rays	0.20	0.15
Denture adjustment for people under radiotherapy and/or chemotherapy	-0.20	0.35
Broken or knocked out tooth	0.33	0.36
Gum infection with pain or swelling	0.36	0.66
Pain in a tooth, teeth or jaw bone	0.18	0.50
Any lesion (painful or not) in the mouth persisting for two weeks or more	0.40	0.54

Table 5. Item-total correlation of knowledge of Coronavirus transmission routes section of the COVID-19 questionnaire based on the responses by lay participants (N=120)

Items	Item-total correlation	
	Persian	English
Inhaling respiratory droplets produced when an infected person coughs, sneezes, or talks	0.52	0.52
Through intact skin (healthy skin in which there are no breaks, scrapes, bruises etc.)	-0.13	0.26
Contact with contaminated dental instruments and/or environmental surfaces	0.22	-0.26
Talking without a mask	0.40	0.61
Close contact with other asymptomatic patients	0.49	0.52
Inhaling fine droplets formed during dental procedures	0.44	0.43
Contacts of oral, nasal, and eye mucous membrane with surfaces contaminated with oral fluids of other patients	0.49	0.62
Being in close contact (less than 2 meters or 6 feet distance) with an infected person (patients, dentist, staff) for more than 15 minutes in a closed space without mask	0.46	0.61

Table 6. Item-total correlation of awareness of required preparations in dental practice settings section of the COVID-19 questionnaire based on the responses by lay participants (N=120)

Items	Item-total correlation	
	Persian	English
Adequate air conditioning (air flow or air circulation) in both waiting rooms and treatment rooms	0.55	0.66
Screen staff and patients for flu-like symptoms, respiratory distress or fever as daily routine before they enter to the office/clinic	0.70	0.42
Ensuring a spatial sitting distance of at least 6 feet (2 meters) among patients in the waiting area	0.64	0.47
Enforce isolation of patients infected with/suspected of Corona virus infection in the waiting area	0.43	0.44
Limit (or restrict) dental treatments for those infected with/suspected of Corona virus to only emergency procedures	0.47	0.33
Use effective pre-procedural antimicrobial mouthwash	0.62	0.31
Clean and disinfect public areas frequently, including door handles, chairs, and bathrooms	0.52	0.56
Post visual alerts/ signs of instructions for hand and respiratory hygiene, and cough etiquette	0.67	0.51
Use of full personal protective equipment including masks, gloves, gowns, and goggles or face shields by dentists and nurses	0.53	0.60
Instruct patients to call before their appointment if they have respiratory symptoms so that staff can be prepared to care for them when they arrive	0.66	0.76
Complete tele/online evaluation before the first visit	0.62	0.52

Table 7. Item-total correlation of attitude section of the COVID-19 questionnaire based on the responses by lay participants (N=120)

Items	Item-total correlation	
	Persian	English
During the Corona virus epidemic all dental offices and clinics should be closed	0.21	0.10
During the Corona virus epidemic, I will not go to the dentist even when I have an emergent dental problem (e.g. pain, bleeding, and swelling)	0.50	0.36
During the Corona virus epidemic, the risk of infection with Corona virus is high in the dental field regardless of necessary preparations	0.68	0.69
I am worried about getting Corona virus from my dentist	0.34	0.39
I am worried Corona virus would be a long-term public health issue for human beings	0.63	0.61
I am worried about transmitting Corona virus to my dentist in case I am infected and asymptomatic	0.70	0.63
I avoid/delay dental visits because of the risk of infection from dental equipment	0.66	0.81
I am worried about getting Corona virus infection from previous patients of the office	0.64	0.68
I am worried about transmitting Corona virus to my loved ones in the case that no safety precautions were taken at the dental office	0.70	0.83
I am worried about getting Corona virus from the waiting room of the dental office	0.21	0.10

Table 8. Cronbach's alpha of the various domains of the COVID-19 questionnaire based on the responses by lay participants (N=120)

Domain	Cronbach's alpha	
	Persian	English
Awareness of emergency dental treatments	41.1	67.5
Knowledge on COVID-19 transmission routes in dentistry	68.7	70.7
Awareness of required preparations in dental practice settings	87.6	83.3
Fear of being infected with COVID-19 in dental settings	84.7	85.1

DISCUSSION

The questionnaire developed to assess patients' knowledge about dental emergencies and COVID-19 transmission routes, COVID-19 preventive preparations in the dental practice, and the patients' attitudes towards contracting COVID-19 in dental settings exhibited moderate to high content validity across both the English and Persian versions, with the English version demonstrating greater overall validity.

A significant advantage of this research involves the creation of a valid tool for evaluating patient knowledge and concerns related to an infectious disease in a dental setting. During validation, we utilized three samples from three different populations to reduce cultural diversity impact. The validated English and Persian versions allow data collection in 67 countries and three countries respectively, where English or Persian is the primary language of communication. While this is useful, it is essential to conduct local context validation of the instrument.

The questionnaire has both an English and Persian version. It was designed specifically for use in dental settings and underwent validation by experts and laypersons from Iran, Nigeria, and the US. This process ensures that the questionnaire is applicable to a wide range of adults, with similar demographics to

those found in Iran, Nigeria, and the US. As far as we know, this is the first questionnaire focused on patients' knowledge of emergency dental treatments. Additionally, we aimed to make the questionnaire concise and comprehensive in covering major transmission and prevention routes.

Content validity is an important factor to consider when evaluating the relevance and representativeness of an assessment tool's items to their intended purpose [26, 27]. According to Haynes et al. [27], the overall medium to high content validity of the developed instruments suggests that the conclusions drawn from these assessments are satisfactory. In our study, the lowest S-CVI/Ave belonged to the knowledge of the emergency treatment domain. One expert believed that based on the objectives of the questionnaire, this section was unnecessary and could be omitted. However, from our perspective, although this domain was not directly related to knowledge and attitudes towards the COVID-19 pandemic, it highlights an important aspect of participants' awareness that could be useful in future studies using this tool. After consulting with other experts, we ultimately decided to retain this section in the questionnaire.

The notable difference in Cronbach's alpha values between the Persian and English versions in the knowledge of emergency treatment section may be attributed to several factors including the stage of COVID-19 in each country, financial constraints during pandemics, and cultural differences in self-medication practices. These factors may lead to biased choices and neglect of emergency dental care, emphasizing the importance of raising awareness about timely dental attention and providing accessible and affordable options.

An alpha coefficient of 70% is commonly considered as an acceptable threshold for reliability [15]. The internal consistency of the questionnaire was deemed acceptable in these sections: knowledge on COVID-19 transmission routes, awareness of required preparations in dental practice settings, and fear of being infected with COVID-19, in both sample groups. However, the knowledge of emergency dental treatments in the Persian and the English samples (Cronbach's alpha=41.1% and 67.5%, respectively) exhibited low internal consistency. This section was developed based on a list of emergencies published by the ADA, encompassing various orofacial conditions that we aimed to address. Consequently, a high level of consistency was not expected. In addition, the internal consistency of this section in the English version was not far from acceptable range and it can be viewed as more of a checklist. Thus, we decided not to make any change to it. Moreover, the knowledge of transmission routes of COVID-19 in dental settings in the Persian sample yielded a Cronbach's alpha of 68.7%. Further analysis of Cronbach's alpha value by removing each item showed that excluding the "through intact skin" item in the Persian questionnaire increased Cronbach's alpha to 71.9%. Given the significance of this item, we discussed this issue with several participants and decided to revise the Persian translation of this phrase.

There was a weak correlation between the first attitude statement and other items of this section in both versions of the questionnaire. Specifically, the statement assessed participants' attitudes towards attending dental clinics for emergency situations during the COVID-19 pandemic. Our findings suggest that people's opinions in this regard are more rational than based on fear or anxiety. Despite concerns about contracting illnesses in dental settings, individuals generally seek treatment for their emergent problems.

Previous studies have developed tools to assess public knowledge and attitudes towards the COVID-19 pandemic [28-33]. Kantor et al. [30] designed a tool that collects details on fear, anxiety, acute stress, and some other aspects of the attitude of the public regarding daily life issues. Doumani et al. [29] and Khattak et al. [31] designed questionnaires to assess the general knowledge of participants about COVID-19, the disease symptoms, and methods of prevention. Nazari et al. [33] conducted psychometric validation of a tool that combined five questionnaires in

Persian. However, these instruments were not specifically tailored to dental settings. Alam et al. [32] employed a self-designed questionnaire to evaluate COVID-19 related knowledge and learning attitudes among the public. This questionnaire was originally developed for healthcare workers and focused on general aspects of COVID-19.

There are also some tools designed to assess the knowledge and attitude of dental patients regarding infection control in dental practice. Ahmed et al. [34] performed their study based on a questionnaire that assesses the knowledge, attitude, and practice of COVID-19 cross-infection in dental settings. The Cronbach's alpha for the survey tool was 74%; a score lower than what we obtained for our survey tool. Meanwhile, the questionnaire only focused on transmission of COVID-19 in the dental operating room and did not consider transmission in the waiting area and other public spaces in clinics. Additionally, the section on attitude concentrated solely on cross-infection control without considering the fear of contracting the disease. Moffat et al. [35] utilized a questionnaire comprising items to evaluate patients' attitudes toward COVID-19 and the necessary conditions for returning to regular dental visits but did not examine knowledge and fear of contracting the virus in dental settings. Parvaie and Osmani [36] developed a questionnaire that partially overlapped with the survey we designed, focusing on evaluating dental patients' understanding of health protocols during the COVID-19 pandemic. Their questionnaire combined knowledge and attitude domains, whereas ours allows for individual evaluation of each domain. During a pilot study involving 30 participants, their questionnaire yielded a slightly lower Cronbach's alpha value (0.78) compared to the overall Cronbach's alpha score of our survey, tested in 60 participants per language group.

Despite its strengths, this study has certain limitations that should be considered when interpreting the results. One major limitation was the inability to conduct a test-retest reliability assessment due to the online data collection process during the COVID-19 pandemic. However, utilizing Cronbach's alpha served as an appropriate measure for reliability assessment in this type of survey [37]. Another limitation lies in the restricted scope of the study population to individuals with internet and smartphone access, resulting in self-selection bias. Although efforts were made to ensure diversity in the participant pool, the convenience sampling method employed in this study resulted in a limited age range and higher educational level among participants, potentially restricting the study's generalizability. Future validation studies of the translated questionnaire in various languages would enhance the generalizability of the findings.

CONCLUSION

Our newly designed questionnaire evaluates dental patients' knowledge and attitude towards COVID-19 in dental settings. We ensured its content validity through modification and achieved satisfactory scores in content validity indices and Cronbach's alpha. This valid and reliable tool can be employed as an appropriate scale in similar infectious disease outbreaks across diverse populations.

DATA AVAILABILITY

The datasets generated during and analyzed during the current study are available from the corresponding author on request.

Supplementary file 1.pdf: Primary version of the questionnaire

This file includes six sections on demographic information (5 items), awareness of emergency dental treatments (8 items), knowledge of COVID-19 transmission routes (8 items), required preparations in dental practice settings (15 items), sources of information about COVID-19 (5 items), and rating statements on their attitude (11 items), in four pages.

Supplementary file 2.pdf: Final version of the questionnaire

This file includes six sections on demographic information (9 items), awareness of emergency dental treatments (9 items), knowledge of COVID-19 transmission routes (8 items),

required preparations in dental practice settings (11 items), sources of information about COVID-19 (9 items), and rating statements on their attitude (9 items), in four pages.

ACKNOWLEDGMENTS

We would like to thank the expert panel for assisting us in the questionnaire development process and all volunteers who donated their time to participate in this study. This research was supported by Tehran University of Medical Sciences (TUMS) as a DDS-MDPH thesis; No. 6722.

CONFLICT OF INTEREST STATEMENT

None declared.

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