Assessing Prevention Protocols by a Brief Questionnaire in the Infectious Respiratory Diseases Pandemics: An Application in Pedestrian Population in COVID-19 Pandemic

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Abstract- To perform effective prevention programs, we need to know how well people follow prevention protocols, like mask use and social distancing, measuring using standard tools. This study aims to develop and validate a brief questionnaire to assess the compliance with prevention protocols against infectious respiratory diseases pandemics including COVID-19 in pedestrians. This cross-sectional study was conducted using convenience sampling method in May and June 2021. Construct validity of the questionnaire was assessed using Exploratory Factor Analysis (EFA). Content validity was evaluated by quantitative method, thus, Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated. For reliability of the questionnaire, the internal consistency using Cronbach's alpha, and test-retest reliability using Spearman-Brown correlation coefficient were assessed. A total of 324 persons from three provinces of Iran participated in this study. The mean age (SD) of participants was 41.5 (16.7). The CVR values resulted in the elimination of two questions. The Scale level CVI/Average (S-CVI/Ave) was equal to 0.992; and Scale level CVI/Universal Agreement (S-CVI/UA) was 0.889. One factor with five items emerged from principal component factor analysis accounting for 51.99% of the variance. Cronbach's alpha coefficient equal to 0.76 indicated an acceptable internal consistency and the Spearman-Brown correlation coefficient of 0.939 depicted stability of the questionnaire. This questionnaire is a brief

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tool with acceptable validity and reliability to evaluate the compliance with preventive protocols during infectious respiratory diseases outbreaks in order for policy-makers to make effective interventions to slow down the spread of disease.

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Introduction

People face infectious respiratory diseases epidemics every few years in different regions of the world and confront more extensive pandemics less frequently than epidemics. However, pandemics arise more frequently in recent decades than in previous ones and cause major problems for countries and people. Pandemics of SARS (2002), Influenza H1N1 (2009), MERS (2015), and COVID-19 (2019) are recent examples (1,2).

COVID-19 shocked the world with its prompt spread, morbidity, and mortality (3-5). By the end of September 2022, more than 614 million people have infected with the virus, and more than 6.52 million deaths occurred due to disease worldwide (6). It also led to an overload of healthcare systems, resulting in burnout among healthcare workers. Therefore, it was crucial for health systems to immediately control the pandemic (7-9).

Owing to the lack of effective treatments, the main strategy to control the COVID-19 pandemic and hinder its rapid spread at the early stages was to prevent virus transmission by compliance with prevention protocols, such as social distancing, wearing masks, avoiding crowds, ventilating indoor places, and washing hands (10,11). Along with health behavior, vaccination provided being available, was one of the most effective ways to control the pandemic (12,13).

To perform successful prevention programs, we need to know how well people follow prevention protocols, and to know that, we need to measure it using standard tools. In the case of the recent COVID-19 pandemic, the lack of standard measuring tools was obvious and most studies used non-standard instruments (14-16), especially at the earlier phases of the pandemic. Then, knowing the importance of an instrument's validity, researchers started to develop and validate tools to precisely measure the preventive protocols of COVID-19 (17-21). Consequently, it is essential to have a validated tool to measure the health behavior of people to provide accurate information about the extent of that behavior and poorly followed parts of the protocols to be able to undertake effective health-promoting interventions. In the meantime, it is important for the tool to be concise so that it can be completed outdoors, in the shortest possible time, and with the least contact with participants, in order to comply with prevention protocols.

Therefore, the aim of this study was to develop and validate a brief questionnaire to assess the compliance with prevention protocols against infectious respiratory diseases pandemics including COVID-19 in the passer-by and pedestrian population.

Materials and Methods

This cross-sectional study was part of a greater study conducted in three provinces of Iran to develop and assess the validity and reliability of a questionnaire for evaluating people's behavior during respiratory diseases epidemics, focusing on COVID-19.

The questionnaire initially consisted of two sections: demographic and behavioral. The behavioral section included 11 items, four of which were open-ended and the other seven on five-point Likert scale. Nine items were about the behavior of the individual during respiratory diseases epidemics, and two were about the behavior of other people. The items of the questionnaire and choices are indicated in Table 1.

Sampling and data collection

The convenience sampling method was used for sampling in the capitals of three provinces of Iran, including East Azerbaijan, West Azerbaijan, and Fars provinces. In each city, areas with high, medium, and low Socio-Economic Status (SES) were identified, and sampling was conducted in each area by convenience sampling method. 324 people were included in the study. As in the nature of the questionnaire, data collection was performed in sidewalks, pavements, and similar places using pedestrians and passers-by in the two-month period between May and June 2021, by two trained interviewers in each city. The survey area population was around 4 million people.

At the time of the survey (May and June 2021), the country was in the middle of the 4th wave of the epidemic

with an average daily death of about 300 people. Most of the cities were situated at very dangerous (red) or dangerous (orange) positions. The public vaccination had newly been started and only a very low percentage of people had been vaccinated with two doses.

This study has been registered in the ethics committee in the research of the National Institute for Medical Research Development (NIMAD) with the approval ID "IR.NIMAD.REC.1399.120". Before questioning, the objectives of the study were explained to the participants and informed consent was obtained from all of them. They were assured that the information acquired would remain confidential with the research team and would be used for research purposes only.

Table 1. The items and relevant choices of the initial questionnaire

Question No.	Questions	Choices				
Q1	How many recreational trips or trips aiming to visit relatives have you taken during the last month?	The number of trips within the province: …	The number of trips to destinations outside the province: …			
Q2	How many times did it happen to you during the last week that you were in closed and crowded places (without full and standard ventilation, with the gathering of more than 10 people) for at least 10 minutes?	Open ended				
Q3	How many members of your first-degree family have been infected with covid-19 disease during the epidemic period?	Open ended				
Q4	How often do you use a mask when you are at work, in public spaces, shopping centers, stores, etc?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q5	How often did you use only one mask continuously or for more than 5 hours?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q6	How often do you throw a used mask in a lidded trash can?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q7	How often do you use the mask correctly (it covers your mouth, nose, and chin)?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q8	During the last week, when you were in various places, how often did you observe the physical distance of at least 1.5 meters?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q9	During the last week, how often did you use soap and water or alcohol-based disinfectants to wash your hands after touching the surrounding environment and objects?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q10	In what percentage of your recent visits to public places, did you see a public place not following the health protocols related to Covid-19?	More than 80%	60% to 80%	40% to 60%	20% to 40%	Less than 20%, never
Q11	If you have seen public places that do not follow health protocols, please report them.	Name: …		Address: …		

Questionnaire development

For the preliminary questionnaire development, a literature review was done by the research team on non-pharmacological interventions against the Covid-19 pandemic. Then, primary information was extracted, the key domains were identified, and items were recorded for each. Subsequently, by conducting a group discussion in the expert panel with six experts in the fields of epidemiology, health education and promotion, psychology, transportation, and mechanics, experts suggested complementary items for each domain. The initial questionnaire was designed with 11 items, seven of which were on the Likert scale. Then, the wording of the item questions and answer choices were improved and finalized.

Construct validity

Construct validity was evaluated using Exploratory Factor Analysis (EFA) with principal component factor in the extraction method. To determine each factor, the lower limit eigenvalue was fixed to 1, and the uniqueness was considered under 0.7 as a criterion to select items with sufficient communality.

Content validity

Using the comments of 14 external experts in the fields of epidemiology, health education and promotion, health in emergencies, and biostatistics, the content validity of the questionnaire was evaluated by quantitative method. The Content Validity Ratio (CVR) was calculated using a three-point scale (1=not necessary, 2=useful but not essential, 3=essential), for assessing the necessity of the questions. The Content Validity Index (CVI) in both Item level (I-CVI) and scale level (S-CVI)

was computed to assess the relevancy of questions using a four-point scale (1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant).

Internal consistency

The reliability of the questionnaire was assessed using internal consistency. The most commonly used method to evaluate internal consistency, Cronbach's alpha, was used and the alpha value of 0.7 or greater was considered acceptable.

Test-retest reliability

In order to assess the stability of the questionnaire by test-retest reliability, the questionnaire was completed by the same interviewers twice at a two-week interval for 21 participants, selected by the convenience sampling method from the same target population, and the Spearman-Brown correlation coefficient was computed.

Data analysis

The Content Validity Ratio (CVR) was calculated based on Lawshe's approach (22) using $CVR = \frac{n_e - \mathrm{N}/2}{\mathrm{N}/2}$ formula, in which ne is the number of experts indicating "essential", and N is the total number of experts. Since 13 experts were answered CVR questions, the CVR value of 0.54 or more was considered acceptable (22). The Item level Content Validity Index (I-CVI) was calculated by summing the number of experts giving point three (quite relevant) or four (highly relevant) to the relevancy of each question, divided by the total number of experts, and scores more than 0.79 were perceived acceptable. For the S-CVI/Ave, the average of I-CVIs was calculated, and for S-CVI/UA, the number of questions with I-CVIs equal to one is divided by the total number of questions (23).

The test-retest reliability was evaluated by the Spearman-Brown correlation coefficient using the $r_{SB} = \frac{2\mathrm{r}}{1+\mathrm{r}}$ formula, in which rSB indicates the Spearman-Brown correlation coefficient and r is the Pearson correlation coefficient of the average scores of the test phase and that of the retest phase.

Descriptive statistics like mean, standard deviation, frequency, and percent were applied to describe the study participants. Data analysis was performed using Microsoft Excel 2013, STATA 14, and SPSS 16.0 software.

Results

Participants

A total of 324 persons from three provinces of Iran participated in this study to check the internal consistency and construct validity of the tool. The mean age (SD) of participants was 41.5 (16.7), and 175 (54.0%) of them were male. In total, 133 participants (41%) had a university degree and 20 (6.2%) were illiterate, 93 individuals (28.7%) were self-employed, and 78 (24.1%) were housewives. Table 2 indicates the demographic characteristics of the study participants.

Table 2. Demographic characteristics of the participants

Variable		Frequency	Percent
Province (Capital)	East Azerbaijan (Tabriz)	221	68.2
	Fars (Shiraz)	78	24.1
	West Azerbaijan (Urmia)	25	7.7
Gender	Male	175	54.0
	Female	148	45.7
	Unspecified	1	0.3
Education	Illiterate	20	6.2
	Elementary school	35	10.8
	Middle school till Diploma	133	41.0
	Under graduate	103	31.8
	Post graduate	30	9.2
	Unspecified	3	0.9
Job	Self-employed	93	28.7
	Housewife	78	24.1
	Employee	51	15.7
	Retired	44	13.6
	Student	34	10.5
	Unemployed	17	5.2
	Laborer	6	1.9
	Unspecified	1	0.3

Content validity

The questionnaire consisted of a total of 11 questions. Due to a low CVR value (below 0.54), two questions (Q3 and Q11) were eliminated. The I-CVIs for remained items were acceptable. The S-CVI/Ave was equal to 0.992, the average of I-CVIs; and S-CVI/UA was 0.889. The results

of CVR and I-CVI calculations are indicated in Table 3.

Table 3. Content validity ratio (CVR) and item-level content validity index (I-CVI) for the items of the questionnaire

Item	Content validity ratio (CVR)					Content validity index (CVI)			
	Number of experts	Acceptability value based on Lawshe's table	N_e*	CVR	Interpretations	Relevant (rating 3 or 4)	Not relevant (rating 1 or 2)	I-CVI**	Interpretations
Q1	13	0.54	13	1	Remained	14	0	1	Acceptable
Q2	13	0.54	13	1	Remained	14	0	1	Acceptable
Q3	13	0.54	10	0.538	Eliminated	-	-	-	-
Q4	13	0.54	13	1	Remained	14	0	1	Acceptable
Q5	13	0.54	12	0.846	Remained	14	0	1	Acceptable
Q6	13	0.54	11	0.692	Remained	14	0	1	Acceptable
Q7	13	0.54	13	1	Remained	14	0	1	Acceptable
Q8	13	0.54	13	1	Remained	14	0	1	Acceptable
Q9	13	0.54	12	0.846	Remained	13	1	0.929	Acceptable
Q10	12	0.56	10	0.667	Remained	14	0	1	Acceptable
Q11	12	0.56	6	0	Eliminated	-	-	-	-

*Ne: the number of experts indicating "essential" for each item's necessity; **I-CVI: Item-level Content Validity Index

Internal consistency

The questionnaire contained seven items with five-point Likert scale. Due to a different conceptual domain, one of the questions (Q10) was not included in the analysis of this section. All other six questions were included in the alpha model to determine if all items fit the scale. The alpha was 0.672 with an average inter-item covariance of 0.509. Since the item-test and item-retest correlations for one question (Q5) were lower than those of the others, it was excluded for better model fitting (Table 4). With this five-item scale, Cronbach's alpha coefficient increased from 0.672 to 0.757, indicating acceptable internal consistency, and the average inter-item covariance increased from 0.509 to 0.726 (Table 4).

Table 4. Cronbach's alpha for initial Likert scale items of the questionnaire and after removing an incompatible item

	Item	Item-test correlation	Item-retest correlation	Average inter-item covariance	Alpha
Initial likert scale items	Q4	0.738	0.591	0.438	0.569
	Q5	0.351	0.048	0.726	0.757
	Q6	0.628	0.376	0.495	0.643
	Q7	0.702	0.573	0.485	0.590
	Q8	0.662	0.471	0.477	0.606
	Q9	0.709	0.518	0.435	0.587
	Test scale			**0.509**	**0.672**
After removing an incompatible item	Q4	0.723	0.557	0.728	0.703
	Q6	0.720	0.488	0.695	0.734
	Q7	0.719	0.585	0.772	0.703
	Q8	0.699	0.507	0.741	0.719
	Q9	0.731	0.534	0.693	0.711
	Test scale (final)			**0.726**	**0.757**

Construct validity

One factor with five items emerged from Exploratory Factor Analysis accounting for 51.99% of the variance. The value of the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.77, indicating the adequacy of the model, and Bartlett's test of sphericity was significant (P<0.001) with the value of 381.3. The uniqueness for all items was below 0.7. Table 5 illustrates the factor loadings and uniqueness of five items.

Table 5. Factor loadings and uniqueness of items of the passers-by questionnaire

Variable	Factor 1: Individual's prevention behavior	Uniqueness
Eigenvalue	2.599	
Q4	0.755	0.430
Q6	0.674	0.546
Q7	0.763	0.417
Q8	0.691	0.523
Q9	0.718	0.485
Total Variance	51.99%	

Test-retest reliability

Twenty-one participants answered the questions twice at a two-week interval. The Spearman-Brown correlation coefficient was equal to 0.939 which verified the stability of the questionnaire at an excellent level (above 0.9).

Discussion

The present study aimed to develop and validate a brief questionnaire to assess the compliance with prevention protocols against infectious respiratory diseases pandemics including COVID-19 in the pedestrians and passers-by to obtain valid information about protocol adherence by people in order to make effective interventions.

In this study, the content validity and the construct validity were assessed for the questionnaire's validity, and the internal consistency, as well as test-retest reliability, were evaluated for the questionnaire's reliability. The results of content validity showed acceptable S-CVI/Ave and S-CVI/UA confirming the validity of the questionnaire. Construct validity of the questionnaire was assessed using the EFA method. One factor emerged from factor analysis, justifying 51.99% of the variance, indicating the focus of the questionnaire on adherence to preventive protocols, related to infectious respiratory diseases. Agarwal *et al*., developed and validated a questionnaire to evaluate preventive practices against the Covid-19 pandemic in the general population. They assessed the validity of the questionnaire in two phases: 1. EFA technique for evaluating the construct validity, and 2. calculating CVR and CVI using the quantitative method for content validity (3). Rezaei *et al*., validated a questionnaire to measure travel behavior during the COVID-19 pandemic. In this questionnaire, content validity, construct validity, test-retest reliability, and internal consistency of the questionnaire were evaluated (20). In a study by Kose *et al*., the validity of a 20-item compliance scale for the COVID-19 outbreak prevention was measured using qualitative content validity and construct validity by both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). In this study two sub-dimensions were emerged in EFA stage and were confirmed in CFA stage with acceptable goodness of fit indices (18). Meneguin *et al*., conducted a study to create a scale and determine its content and face validity to assess the adherence to good practices for COVID-19. The content validity in that study with a CVI equal to 0.83 was satisfactory (19). In a study by Jafari-Khounigh *et al*., a questionnaire was developed and validated to measure the attitudes and behaviors about mask use during COVID-19. The researchers in this study assessed content and construct validity, and with a CVI equal to 0.95 confirmed the validity of the instrument (17).

In the current study, the Cronbach's alpha method was utilized to assess the internal consistency of the questionnaire. The alpha equal to 0.76 indicated acceptable internal consistency (24,25), and the Spearman-Brown correlation coefficient of 0.939 for the test-retest reliability, verified the stability of the questionnaire at an excellent level (26). Zhong *et al*., calculated Cronbach's alpha equal to 0.71 showing acceptable internal consistency for their questionnaire on the knowledge of Chinese residents towards Covid-19 during the rapid rise period of the outbreak (27). Agarwal *et al*., also used Cronbach's alpha method for internal consistency. The alpha equal to 0.82 indicated good internal consistency of their tool (3). In Rezaei *et al*., study to assess compliance with COVID-19 prevention protocols during travel, the reliability of a questionnaire was measured using internal consistency and test-retest reliability. The reliability was approved in that study by Cronbach's alpha and Spearman-Brown correlation coefficient equal to 0.83 and 0.911, respectively (20). Similarly, Kose *et al*., confirmed the reliability of their questionnaire using internal consistency and test-retest reliability and reported 0.95 for Cronbach's alpha and 0.928 for Spearman-Brown coefficient in an acceptable level (18). Also, Jafari-Khounigh *et al*., reported a satisfactory level for the reliability of their questionnaire about mask use during COVID-19 pandemic by Cronbach's alpha of 0.76 and Intraclass Correlation Coefficient (ICC) equal to 0.873 (17).

This questionnaire can be utilized to assess the health behaviors of the general population during an infectious respiratory disease outbreak, as in the case of the COVID-19 pandemic. Using the present questionnaire, the rate of obedience to preventive protocols and guidelines, and also vulnerable groups can be determined; as a result, useful information would be provided for policymakers to effectively make appropriate health-promoting interventions.

This questionnaire has some advantages and limitations. It is one of the first questionnaires assessing protocol adherence among the general population during an infectious respiratory disease outbreak. Furthermore, the briefness of the questionnaire allows researchers to conduct the questioning process outdoors, in a short period of time, having minimum contact with participants so that the preventive protocols would be obeyed in the questioning process, as well, which makes it suitable to be applied in pedestrians. On the other hand, a limitation of this questionnaire is that it is conducted in Iran and in order to be used in other countries with different cultures it may need some minor revisions.

This questionnaire is a brief tool with acceptable validity and reliability to evaluate the compliance with preventive protocols during infectious respiratory diseases outbreaks including COVID-19. Thus, it is an appropriate tool for policymakers to assess the extent of adherence to guidelines and make effective interventions to manage and slow down the spread of disease.

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