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Design and Psychometrics of a Questionnaire on COVID-19 Preventive Behaviors Evaluation based on Health Behavior Model

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ABSTRACT

Aims This study aimed to design and psychometric a tool for measuring the knowledge, beliefs, and behavior of teachers regarding COVID-19 preventive behaviors.

Instrument & Methods The goal was to create a tool that may be used to create an educational intervention that promotes preventive behaviors. A 60-item scale regarding COVID-19 preventive behaviors was developed upon literature review. Then, face and content validity were evaluated using quantitative and qualitative methods, through the involvement of the participants and expert panel. The internal consistency and reliability were assessed and approved using Cronbach's alpha index and test-retest.

Findings The face and content validity of the primarily developed scale was confirmed by item impacts of 1.5, 0.49 CVR, and 0.79 CVI, and the number of items dropped to 60. The reliability of the instrument was approved by Cronbach's alpha of 0.67 to 0.95 and a correlation coefficient of 0.65 to 0.93.

Conclusion Based on the results, the scale that was developed using the constructs of the HBM for COVID-19 preventive behaviors among teachers had appropriate validity and reliability.

Keywords Behavior; COVID-19; Health Belief Model; Prevention; Psychometrics; Questionnaire

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Introduction

An outbreak of an unexplained respiratory infection was first reported in Wuhan, China, on December 31st, 2019, to the World Health Organization. The causative agent of the disease has been attributed to a new virus belonging to the coronavirus family, which causes diseases ranging from the common cold to more severe illnesses that lead to death [1].

On February 11th, 2020, the World Health Organization announced that the disease caused by the new coronavirus is called COVID-19, which stands for 'Coronavirus 2019'. On the same day, the International Committee for the Classification of Viruses named the virus SARS-CoV-2, originally called nCoV 2019 [2].

In the past 20 years, two other coronavirus epidemics have occurred. The SARS epidemic, which began in China and affected 29 countries and caused more than 8,000 cases and more than 800 deaths (9.6% mortality rate), and the MERS epidemic, which began in Saudi Arabia and caused about 2,500 cases and 800 deaths (35% mortality rate) [3, 4]. Despite the higher mortality rate of SARS and MERS, due to the high number of COVID-19 patients, the total number of deaths due to this disease was higher [5].

Since the beginning of 2020, the new coronavirus has spread rapidly around the world [1]. According to the latest statistics, more than 202 million cases and more than 4 million deaths due to COVID-19 have been reported worldwide [6]. In the Eastern Mediterranean region, Iran had the highest COVID-19 incidence and mortality [7-9]. On February 19th, 2020, the first case of death from COVID-19 was reported in Iran, and the disease rapidly spread across the country [10, 11].

The incubation period of COVID-19 is between 2 and 14 days [12]. The most common clinical symptoms of COVID-19 are fever, cough, muscle aches, sputum, shortness of breath, sore throat, headache, diarrhea, nausea or vomiting, loss of sense of smell and taste, nasal congestion, and bloody sputum [13, 14]. More than 80% of COVID-19 patients experience a mild illness and 20% of them experience severe illness and suffer from shortness of breath, septic shock, and failure of various organs of the body [15]. The main routes of transmission of the novel coronavirus are inhalation of respiratory droplets from an infected person and close contact with the infected person or their secretions [16]. Given the lack of medications and universal vaccination in society, prevention is the best way to reduce the number of cases of disease [17]. COVID-19 preventive behaviors include using a mask, frequent hand-washing with soap and water, covering the mouth and nose with a handkerchief when coughing and sneezing, avoiding contact with the eyes, mouth, and nose with a dirty hand, avoiding close contact with affected people and social distancing [18-20].

Due to the importance of COVID-19 preventive behaviors, the availability of a specific and standard tool is necessary to conduct the study. Health Belief Model is one of the suitable models to teach preventive behaviors. The Health belief model emphasizes how a person's perception causes an Increase motivation to adopt preventive behaviors [21]. HBM is widely used to comprehensively understand people's health-related behaviors, plays an important role in predicting preventive measures compliance, and has been used in many previous studies [22, 23]. According to the Health Belief Model (HBM), people react appropriately to disease prevention when they believe they are at risk (perceived susceptibility) and that the risk is serious to them (perceived severity). Also, when they feel that behavior change has many benefits for them (perceived benefits) and they can remove the obstacles to performing the recommended behavior (perceived barriers), they are more likely to engage in that behavior. Self-efficacy is likewise the belief in one's ability to perform the recommended behavior. Cues to action are internal and external stimuli that lead a person to perform healthy behaviors.

In their search, the research team did not find a specific tool based on the HBM measuring knowledge, beliefs, and behavior of individuals regarding COVID-19. Therefore, this study aimed to design and psychometric a tool for measuring the knowledge, beliefs, and behavior of teachers regarding COVID-19 preventive behaviors.

Instrument and Methods

To develop and psychometric an instrument to assess the COVID-19 preventive behaviors of Iranian teachers, the items required in this study were extracted from other COVID-19 tools available in the world, and a literature review of relevant texts measuring knowledge, attitude, and practice in individuals with regards to COVID-19, based on the HBM model and concerning two main following stages had been done: Development of the questionnaire, and Psychometric characteristics of the questionnaire.

Development of the questionnaire

Conceptual framework and Item generation

Due to the high incidence and mortality of COVID-19 in Iran and the lack of specific treatment for it, it seems to be necessary to promote knowledge, attitudes, and preventive behaviors toward the disease. Because of relationships with many students, and playing an effective role in them and their parents' attitudes, it seems essential to consider the health of teachers and their health behaviors. Promoting COVID-19 preventive behaviors based on theoretical frameworks of behavior change can be useful. The review of the literature suggests that the Health Belief Model may be effective in promoting COVID-19 preventive

behaviors. The Health Belief Model was one of the first theories to be developed exclusively for health-related behaviors.

Contextual item generation based on HBM constructs

Items of the questionnaire were generated through the deductive-inductive approach. This approach helps to find appropriate items based on literature review and World Health Organization and CDC guidelines. This combination resulted in a 101-item draft scale designed on concept labels that accurately reflected the content of each dimension.

Psychometric properties of the questionnaire

In this stage, the psychometric properties of the developed instrument were assessed.

The current instrument consists of four parts;

-A demographic information including gender, age, educational status, Marital status, and history of COVID-19 infection.

-Assessment of teacher's knowledge regarding COVID-19: This part of the questionnaire aimed to assess knowledge. It contains 10 questions including COVID-19 signs and symptoms, mode of transmission, and prevention. knowledge questions were weighed with three options: "True", "False" and "I do not know".

-Health belief model structures: This part of the questionnaire was developed to examine perceived susceptibility (8 items), perceived severity (5 items), perceived benefits (5 items), perceived barriers (6 items), cues to action (4 items) and self-efficacy (11 items). Responses for each item ranged from "strongly disagree" to "strongly agree".

-COVID-19 preventive behaviors: This part of the questionnaire aimed to assess COVID-19 preventive behaviors. It contains 11 items with response ranging from "never" to "always". It contains 11 items.The scale's score ranges from 50 to 270.

The face validity of an index was used to determine if it is a reasonable measure of word order, structure order, and evaluation form [24]. In contrast, content validity is used to assess the relevance, clarity, simplicity, and completeness of the tool [25]. Fifteen people including health education specialists (N=12) and health care providers (N=3) as experts on issues related to COVID-19 prevention were asked to review the initial draft of the instrument. Both quantitatively and qualitatively content validity was assessed. They were asked to present their corrective views in writing after carefully studying the items and their final opinion was received and analyzed through a qualitative approach. It was also emphasized that the qualitative evaluation of content validity in terms of grammar criteria should assess the use of appropriate words and the necessity, importance, and placement of phrases in their proper places. After collecting the experts' opinions, the necessary changes were applied to the questionnaire. Content Validity Ratio (CVR) and Content Validity Index (CVI) were used to evaluate the content validity quantitatively. In calculating the CVR, experts were asked to choose one of the options "necessary", "not necessary but useful" and "not necessary" for the items in each of the scales. Responses were calculated using the following formula and adapted to the Lawshe table. According to this table, items with a CVR above 0.49 were considered acceptable.

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

n_E: The number of experts by whom the "necessary" option was selected.

N: Total number of experts (panel members)

The Waltz and Basel index was used to evaluate the validity index. For this purpose, scales were presented to the experts to calculate the CVI and they were asked to comment on each of the items with the following three criteria based on the quadratic Likert scale (1: irrelevant, 2: somewhat relevant, 3: relevant, and 4: completely relevant): relevance, simplicity, and clarity. To calculate CVI scores, the total number of "agreeing" scores for each item that scored 3 or 4 (highest score) was calculated for the total number of voters. The minimum acceptable value for the CVI index was 0.8 and if the CVI index for an item was less than 0.7, that item was removed and if it was between 0.7 and 0.79, it was corrected.

Cronbach's alpha was used to evaluate the reliability (internal correlation) [26]. And intra-cluster homogeneity of the questionnaire based on the ICC coefficient was calculated. If ICC (Intraclass coefficient correlation) values are 0.8 or higher, there is excellent reliability; if it is between 0.6 and 0.79, there is moderate reliability, and if it is less than 0.6, there is poor reliability [27]. To evaluate the reliability of the scale at test-retest, which indicates the reproducibility of an index, the questionnaire was given to 30 people with similar characteristics in the target group. Ten days later, they were asked to complete the questionnaire again.

Findings

The mean age of participants was 39.11±9.76 years. The demographic characteristics of the target group were presented in Table 1.

Table 1) Demographic characteristics of the target group

Characteristics		N (%)
Gender	Female	20 (66.7)
	Male	10 (33.3)
Education	High school graduate	1 (3.3)
	Associate degree	2 (6.7)
	Undergraduate	21 (70.0)
	Masters	6 (20.0)
	PhD	0
Marital status	Single	9 (30.0)
	Married	21 (70.0)
History of COVID-19 infection	Yes	7 (23.3)
	No	21 (70.0)
	Not sure	2 (6.7)

Table 2) Final questionnaire with Content Validity Ratio and Content Validity Index scores

Construct	Questions	CVI	CVR
Knowledge	The main symptoms of COVID-19 are fever, dry cough, and shortness of breath.	0.93	0.73
	A person infected with COVID-19 may have no symptoms.	0.93	0.86
	People infected with COVID-19 who are asymptomatic can also transmit the disease to other individuals.	0.93	0.73
	COVID-19 is transmitted through droplets in coughs and sneezes.	0.93	0.86
	COVID-19 is transmitted through an infected hand's contact with the mouth, nose, and eyes.	0.93	0.73
	COVID-19 is transmitted through close contact with an infected individual.	0.93	0.73
	Closed spaces (without ventilation) increase the possibility of COVID-19 transmission.	0.93	0.86
	Repeated hand washing with soap and water is one of the most important principles of COVID-19 prevention.	0.93	0.86
	Keeping a one-meter distance from others is effective in preventing COVID-19.	0.93	0.86
	Objects and surfaces that are constantly touched, such as doorknobs, cell phones, and their likes should be routinely cleaned and disinfected.	0.93	0.73
Perceived susceptibility	Given the high contagiousness of COVID-19, I might be affected by it.	1	0.86
	I may contract COVID-19 if I shake hands with or kiss others when greeting others.	1	0.86
	I may contract COVID-19 if I don't routinely wash my hands.	1	0.86
	I may contract COVID-19 if I don't routinely disinfect objects and surfaces at home and the office.	0.93	0.86
	I may contract COVID-19 if I don't wear a mask in crowded spaces (such as a taxi, the subway, office, or shop).	1	0.86
	I may contract COVID-19 if I don't keep 1-2 meters distance from others outdoors.	1	1
	I may contract COVID-19 if I travel during the COVID-19 pandemic	1	0.86
	I may contract COVID-19 if I attend family or friendly gatherings or parties.	1	1
Perceived severity	COVID-19 can affect many people in a short period.	1	0.86
	COVID-19 is a dangerous disease and can damage my lungs, kidneys, and/or heart if I am affected by it.	1	0.86
	If I contract COVID-19, I might get severe shortness of breath and chest pain.	0.93	1
	I may die if I contract COVID-19.	0.93	0.86
	Being affected by COVID-19 will have negative effects on my social relations.	1	0.73
Perceived benefits	I won't contract COVID-19 if I wear a mask outdoors.	1	0.86
	If I regularly wash my hands during the day, I won't contract COVID-19.	1	0.73
	The use of alcohol or hand sanitizers in places where I don't have access to soap and water will lower the risk of my contracting COVID-19.	0.93	0.86
	It is easier to prevent than to cure COVID-19.	1	0.86
	If I stay home and avoid contact with people, I will not contract COVID-19.	0.86	0.86
Perceived barriers	It is difficult for me to constantly wash my hands with soap and water.	0.93	1
	It is difficult for me to breathe with a mask on.	1	1
	Not shaking hands with my friends and acquaintances reduces the intimacy between us.	1	0.73
	Not traveling during the COVID-19 pandemic negatively affects my spirits.	0.93	1
	I don't disinfect surfaces and objects out of fear of the disinfectants' side effects.	0.93	0.86
	I don't buy personal hygienic equipment such as masks, gloves, and gel sanitizers due to their expensive prices.	0.93	1
Cues to action	Social media (like Instagram, WhatsApp, Telegram, etc.) play an important role in my learning of COVID-19 preventive health measures.	0.93	1
	The Health Ministry's National COVID-19 Control Committee is my most important source of information and COVID-19-related news.	0.93	1
	Social media (like Instagram, WhatsApp, Telegram, etc.) play an important role in encouraging people to adhere to COVID-19 preventive health measures.	0.93	1
	Employers, chief directors, and managers of organizations play a significant role in observing appropriate physical distancing and mask-wearing by their employees.	0.93	1
Self-efficacy	I can regularly wash my hands with soap and water during the day.	0.86	1
	I can wash my hands correctly.	0.93	0.73
	I can wear the mask properly.	0.93	1
	I can wear a mask when leaving the house.	0.93	0.86
	I can avoid handshaking and others when greeting them.	1	1
	I can avoid touching my eyes, nose, and mouth with my unwashed hands.	0.86	1
	I can cover my mouth and nose with a tissue or my bent elbow whenever I cough or sneeze.	0.93	0.73
	I can use hand sanitizers whenever necessary.	0.93	1
	I can keep a 1–2-meter distance between myself and others when socializing with them.	0.93	0.73
	I can receive valid COVID-19-related information and news.	0.93	0.73
	During the COVID-19 pandemic, I can limit my socialization to virtual meetings (audio-visual contact).	0.93	1
Behavior	I regularly wash my hands with soap and water.	0.86	1
	Whenever I don't have access to soap and water, I use hand sanitizer to clean my hands.	1	1
	I avoid handshaking and others when greeting them.	1	1
	I cover my mouth and nose with a tissue or my bent elbow whenever I cough or sneeze.	1	1
	I keep a 1–2-meter distance from others.	1	1
	I stay home as much as possible and only leave when necessary.	1	1
	I disinfect the surfaces that come in contact with my hands daily at home and the office.	1	1
	I wear a mask outdoors.	1	1
	I don't touch my eyes, nose, and mouth with dirty hands.	1	1
	By intermittently opening windows at work or home, I allow the air to ventilate.	1	1
	I will visit a physician or clinic if I have symptoms of fever, dry cough, or shortness of breath.	1	0.86

The results of the validity ratio for all items except 4 items were larger than the number specified in the standard Lawshe table (0.49). This suggests that essential and relevant items were present in this tool. The results of the content validity index showed that all items except one item scored higher than 0.79 (Table 2).

Upon assessing the reliability of items on the perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, self-efficacy, and behavior scales, Cronbach's alpha ranged from 0.669 to 0.950 and ICC ranged between 0.652 and 0.938 (Table 3).

Table 3) Average values of validity and reliability indices of items in each scale

Variables	Number of items	CVI	CVR	Cronbach's alpha	Intra-class correlation
Knowledge	10	0.93	0.79	0.75	0.71
Perceived susceptibility	8	0.99	0.87	0.78	0.69
Perceived severity	5	0.97	0.86	0.71	0.69
Perceived benefits	5	0.96	0.83	0.69	0.65
Perceived barriers	6	0.95	0.93	0.88	0.82
Cues to action	4	0.93	1	0.67	0.67
Self-efficacy	11	0.92	0.88	0.87	0.86
Behavior	11	0.98	0.98	0.95	0.93

The impact score for all variables was >1.5.

Discussion

Based on our results, the psychometric evaluation of the COVID-19 prevention scales showed good content validity, such that the average validity index for all items of the eight scales of knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, self-efficacy and behavior was higher than 0.93 and its average validity ratio was calculated above 0.72.

Upon assessing the reliability of items in the knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, self-efficacy, and behavior scales, the degree of internal correlation (Cronbach's alpha coefficient) was, respectively, 0.75, 0.78, 0.71, 0.69, 0.88, 0.67, 0.87, and 0.95. The measurement tool in Tong *et al.*'s 2020 study contains 24 items. In this tool, only one item was used for perceived susceptibility, and Cronbach's alpha for perceived severity, perceived benefits, perceived barriers, and cues to action was reported at 0.79, 0.89, 0.74, and 0.68, respectively [28]. Fathian-Dastgerdi *et al.* conducted a study to assess adolescents' perceptions of COVID-19 preventive behaviors based on the Health Belief Model. They designed 4, 4, 4, 4, 3, 2, and 5 questions for perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and behavior, respectively, and reported Cronbach's alpha for these scales at 0.66, 0.74, 0.71, 0.72, 0.58, and 0.82, respectively [29]. In a study aimed at measuring the predictive power of the HBM for COVID-19 preventive behaviors regarding perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, cues to action and behavior, 4, 9, 9, 4, 7, 6 and 20 questions were considered, respectively. Cronbach's alpha for perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and behavior scales in this study was reported at 0.79, 0. 87, 0.84, 0.66, 0.92, and 0.91, respectively [30]. In a study to measure ophthalmologists' perception of COVID-19 using the Health Belief Model for perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, cues to action and behavior, 9, 5, 4, 5, 4, 5 and 8 questions were designed and Cronbach's alpha for these scales was reported at 0.78, 0.69, 0.73, 0.76, 0.71, 0.67, and 0.79, respectively [31].

The results of the abovementioned studies are consistent with the findings of the present study and in all three studies, the reliability of the 'cues to action' construct was lower than the others. This could be due to receiving information from various sources to prevent COVID-19. The audience may also be exposed to pseudo-knowledge about COVID-19 preventive behaviors.

Tong *et al.*'s questionnaire was not designed for knowledge, self-efficacy, and behavior scales [28]. In Fathian-Dastgerdi *et al.*'s questionnaire, there were no questions on knowledge and 'cues to action' scales [29]. Similarly, the questionnaires designed by Mirzaei *et al.* [30] and Almazyad EM *et al.* [31] had no knowledge scale questions.

Therefore, it was necessary to design a valid and reliable questionnaire that covered all these scales. The psychometric instrument designed in the present study has considered all the constructs of the Health Belief Model, although some constructs, such as self-efficacy, behavior [28], and cues to action [29] have not been assessed in similar studies.

Comparing the results of this study with other tools based on the Health Belief Model that are designed for COVID-19 preventive behaviors indicated that the Cronbach alpha values obtained for the scales used in the present tool were lower in some cases and higher in some others compared to those calculated for those tools.

Conclusion

In the present study, the tool "Measuring COVID-19 Preventive Behaviors" was developed to assess knowledge, Health Belief Model constructs, and behavior. During this psychometric study, the content validity, content reliability, and internal correlation of the tool were calculated. The COVID-19 Preventive Behaviors tool is an objective tool for assessing knowledge, Health Belief Model

constructs, and behavior. It is also a suitable tool for research in educational fields.

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