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The effect of education based on health belief model on hand hygiene behavior in the staff of Tehran dentistry centers: A quasi-experimental intervention study

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Abstract

Background and Aims: Considering the increasing prevalence of dental services in the community and the impossibility of identifying each infected patient, hand sanitation is the most critical factor in controlling infection in these centers. Therefore, this study aimed to determine the effect of educational intervention on the hand health behavior of the staff of Tehran dentistry clinics based on the health belief model (HBM).

Methods: In this quasi-experimental study in 2017, 128 employees of the health centers were selected through a multistage sampling method and they were placed in two groups of intervention and control (each 64 people). The data was collected using a questionnaire devised by the researcher. The validity and reliability of the questionnaire were determined. The questionnaire consisted of demographics, knowledge, structures of the HBM, and behavior variables. Then, the intervention was administered based on HBM-based education. Data were analyzed by SPSS16 and independent t test, χ^2, and repeated measurement analysis of variance.

Results: Before the intervention, the two intervention and control groups did not differ significantly in terms of demographic variables, mean scores of knowledge, constructs of HBM, and hand hygiene behavior ($p > 0.05$), while the intervention group was scored higher significantly compared to the control one after the intervention ($p < 0.001$).

Conclusion: According to the findings, the HBM can be used as a framework for designing educational interventions to improve hand hygiene behavior to control infection in health centers.

KEYWORDS

behavior, education, hand hygiene, health belief model

1 | INTRODUCTION

Nosocomial infection is one of the common problems in intensive care units, and hospital staff hand hygiene behavior is the most important factor in the transmission of nosocomial pathogens. The healthcare-associated infection might cause prolonged hospital stay, long-term disability, increased resistance of microorganisms to antimicrobials, massive additional financial burden, high costs for patients and their families, and excess deaths.[1]

The mouth and throat in the gastrointestinal tract, as well as the respiratory system and skin, are the main sources of pathogenic species for hospital infections.[2] The use of rotating dentistry instruments and maxillofacial surgery produces visible droplets that mainly contain droplets of saliva, blood, microorganisms, and other infectious substances. In dentistry clinics, the staff and patients are exposed to a wide variety of microorganisms among which blood-oriented viruses and Mycobacterium tuberculosis are more important because they can cause severe and in some cases fatal diseases.[3]

All patients should be considered potentially infectious because of progressively increasing dentistry services that are generally outpatient,[4] and infectious diseases that cannot be diagnosed based on history, physical examination, or simple laboratory tests[5]—for example, 75% of people with hepatitis C and 66% of people with hepatitis B are asymptomatic patients—and AIDS which is not diagnosed easily and the patients do not know or do not provide information about their diseases. Therefore, infection control has a special place in dentistry.[6]

The possibility of transmitting pathogens to patients through dentists which could cause clinical infections were confirmed from the beginning of the last century,[7] and in addition, it was proved that the staff could transmit these pathogens from the environment to the patients while caring for other patients.[8]

According to the World Health Organization, 1.7 million hospital infections occur annually—1 in 20 people is infected—which kills 99,000 people a year and costs $26–$32 billion.[9] In developing countries, the risk of these infections is 2–20 times more than in developed ones and its incidence is up to 25%.[10] The results of the study of Ranjbar et al. in Iran showed that the rate of nosocomial infection in medical units varies between 24% and 38%.[11]

Among these, hand hygiene is a simple way to reduce hospital infections, prevent the spread of antimicrobial resistance, and increase patients' security,[12] and was emphasized by many studies[13,14] showing that hand hygiene in the staff could reduce infections by about 15%–30%.[15] Some studies showed poor hand hygiene in healthcare workers.[13,14] Although most health centers run many programs to provide training on hand hygiene behavior, its effect on the staff is low[1]; however, factors such as family education, workplace rules and regulations, and the habit of hand hygiene can help promote this behavior. On the other hand, to have long-lasting impacts, this behavior must become a habit.[16] The following were found to be the main obstacles to performing hand hygiene behavior: formal/informal control, improper spatial design, and insufficient facilities and equipment.[17]

Today, it is clear that prevention is much more important than treatment, and education has an important role in the prevention, it has a close and lasting relationship with health. In educational planning, the first step, and one of the most important ones is to choose a model or theory based on the existing conditions, to recognize the problem and purpose of the desired educational program.[18] Studies showed that structured, model-based learning was more successful than traditional teaching. Theory can serve as a unifying framework and a roadmap for the questions we are going to answer.[19]

There is no dominant theory or training program in health education today.[20] Based on the results of the studies on behavior change, the health belief model (HBM) in the prevention of diseases and behavioral problems is acceptable and effective.[21,22] The HBM is especially useful for designing programs to prevent disease and change behavior in the short term.[23] In this model, the probability of the adoption of preventive behaviors is influenced by a perceived threat, self-efficacy, perceived barriers and benefits, and cues to action.[21] On the other hand, the effectiveness of this model in predicting hand hygiene behavior was studied and proved; therefore, its use in educational programs to adopt hand hygiene behavior was suggested.[6]

Hand hygiene is the first step to control nosocomial infections.[24] Hence, considering the importance and role of hand hygiene in the health of patients and care providers, interventions should be implemented for healthcare personnel and all hospital staff to reemphasize the importance of adherence to hand hygiene protocols.[1] Although the studies based on the HBM to prevent nosocomial infections are rare, in most studies the model was effective in promoting health behaviors, and its effect on planning health education interventions and prevention and promotion of health care was significant.[25,26] Since we couldn't find a study using the model of hand hygiene in dentistry centers, this study was designed to determine the effect of education on the hand hygiene behavior of dentistry center staff based on the HBM.

2 | MATERIALS AND METHODS

This was a quasi-experimental interventional study conducted on the staff of selected dentistry centers in Tehran in 2017. To determine the sample size, according to a similar study in Iran[27] in which the mean score of hand hygiene behavior after the intervention in the intervention and control groups were 20.42 ± 2.66 and 19.54 ± 2.90, respectively, considering 95% confidence interval and statistical power of 80%, and using the Kappa Pokak formula, the sample size was estimated to be 53, which was increased to 64 considering the 20% of the participants might leave the study

$$n \geq \frac{(z_{1-\alpha/2} + z_{1-\beta})^2\left(s_1^2 + s_2^2\right)}{(\bar{x}_1 - \bar{x}_2)^2}.$$

Participants were selected by multistage sampling. First, two centers were selected from the dental centers of the Armed Forces in Tehran (Chamran, Imam Khomeini, Imam Ali, and Center 600) by

simple random method. In the second stage, one center was randomly allocated to the intervention and the other one to the control group. In the third step, the participants were randomly allocated to both groups by equal distribution. Inclusion criteria were: Official employment in dental centers of the Armed Forces of Tehran as a general dentist, specialist dentist, health worker, and dental assistant, written consent to participate in the study, and 1 year of continuous work experience. The exclusion criteria were: not willing to continue participating in the study, retirement, or any reason that the employees were not present at work (leave, mission, illness, dismissal, etc.), not attending the training classes (even one session).

Since there was not a valid questionnaire, one was developed by the researchers which included 59 items in 9 sections using the sources and reference books[3] and the opinion of technical professors. The first part was the questions related to demographic and general characteristics (eight items). The second part was the items related to the assessment of awareness (seven items, e.g., "In what cases should you wash your hands?") the answers were presented in three choices in which the correct answers were given 5, the wrong answers were given 1, and this choice (I do not know) was given 3 scores. The range of changes in awareness scores was from 7 to 35. The third part was related to measuring the constructs of the HBM, which included the structures of perceived susceptibility (five items, e.g., "The possibility of transmitting pathogens through the hands of dental staff to the devices used in the treatment and mouth of patients is low"), perceived severity (four items, e.g., "Infections that are transmitted due to poor hand hygiene in dentistry are not very dangerous"), perceived benefits (five items, e.g., "Adopting hand hygiene is an important step in maintaining the health of patients"), perceived barriers (five items, e.g., "Due to the busy schedule, there is no opportunity to wash and disinfect the hands"), and self-efficacy (nine items, e.g., "I can apply the correct principles of hand washing and disinfection") for which a Likert scale with five options (strongly agree, agree, have no opinion, disagree and strongly disagree) was used. The range of the scores for perceived severity, perceived benefit, perceived barrier, and self-efficacy scores was between 4 and 20, 5 and 25, 5 and 25, and 9 and 45, respectively. The items related to measuring cues to action (three items, e.g., "To what extent does referring to a hand hygiene poster play an effective role on your hand hygiene?") were based on a Likert scale with five options (very much, much, little, very little, and not at all) which were between 3 and 15. The fourth part was the behavior assessment items (13 items, e.g., "Before wearing gloves, I take care of my hand hygiene") based on a Likert scale with 4 options "always, most of the time, rarely and never" which ranged from 13 to 52.

To evaluate the validity of the content, a panel consisting of 10 professors was formed. The panel consisted of experts in the fields of health education and health promotion, dentistry, infectious disease specialists, microbiologists, and epidemiologists who examined the content validity in qualitative and quantitative ways. Qualitatively, experts were asked to review the tool based on the criteria of grammar, use of appropriate words, placing the items in the right place, and proper scoring, and they provided the necessary feedback. For content validity, the content validity ratio (CVR) and content validity index (CVI) were determined quantitatively. Experts were consulted to determine the necessity or nonnecessity of each item to determine the CVR. The CVR values above 62% were considered acceptable.[28] At this stage, one item of knowledge assessment, one for perceived intensity, two for cues to action, and one for self-efficacy were removed from the questionnaire. In the CVI review, experts evaluated each item in terms of relevance, clarity, and simplicity, and values above 0.79 were considered acceptable.[28] None of the items were omitted in the CVI review, and the CVR to the total number of items was 0.95.

In the second stage, a modified questionnaire was given to 10 members of the target group to assess its face validity. According to the suggestions of the target group and their understanding of the simplicity and ability to understand the items, the final necessary changes were made to the questionnaire. It is worth noting that these individuals were not included in the study.

To evaluate the reliability of the questionnaire, Cronbach's α coefficient was used to determine the internal consistency of the subscales of the HBM questionnaire, and values of 0.70 and above were accepted.[28] Therefore, the questionnaire was completed by 15 participants who met the criteria of the present study and had similar demographic characteristics to the study population. Cronbach's α values for knowledge, perceived susceptibility, perceived severity, perceived benefit, perceived barriers, cues to action, self-efficacy, and behavior components were 0.85, 0.75, 0.73, 0.91, 75 0.0, 0.86, and 0.87, respectively.

Also, to measure reliability over time, the questionnaire was completed again after 2 weeks by 15 participants from the target population, and the correlation coefficient and intraclass correlation coefficient were measured, which was 0.94 for knowledge, 0.96 for perceived susceptibility, 0.97 for perceived severity, 0.97 for perceived benefits, 0.85 for perceived barriers, 0.87 for cues to action, 0.96 for self-efficacy, and 0.89 for behavior assessment. It is worth noting that these individuals were not included in the study. Moreover, after carefully studying reliable and relevant sources, the initial educational content was designed based on the HBM and the data from the pretest results based on which the most effective structures predicting hand health behavior were identified. In fact, perceived barriers and knowledge significantly predicted health behavior,[6] and the lesson plan and teaching content were revised and adjusted based on all structures and with emphasis on these effective structures. Finally, it was given to the panel of experts to evaluate and give their comments. After correcting some parts, general goals, specific goals, and related behavioral goals were formulated based on the training program of each session. The training program was held in three 90-min sessions by the researcher and training expert in the conference hall of selected dental centers. The interval between each session was 10 days. Participants were also divided into three groups (two groups of 22 dentists and assistants, and a group of 20 dentists). The content of the training sessions was summarized in Table 1. In each session in addition to training; items such as questions and answers and bug fixes and

TABLE 1 Training sessions.

Number sessions	Educational content	Time sessions, min
Session 1	Introducing the researcher and colleagues and expressing the educational goals, starting the training about the concept of hand hygiene, the role of hand hygiene in the prevention and control of nosocomial infections, the high risk of hand infection with viruses of blood origin, benefits and barriers to control and prevention of nosocomial infections in staff, other staff and patients through the adoption of hand hygiene.	90
Session 2	Solutions to overcome modifiable and nonmodifiable barriers to the adoption of hand hygiene, self-efficacy in following the practical principles of hand hygiene by breaking it into small and successive stages, and the role of practical hand hygiene skills in preventing and controlling nosocomial infections.	90
Session 3	Summarizing all the training materials and reviewing them and answering patients' questions.	90

improvements were also provided. Methods such as lectures with public discussion, group discussion, brainstorming, role-playing, and practical demonstration were used. Researchers were present at these meetings to monitor and conduct training sessions. The control group only completed the questionnaire at the same time as the intervention group; however, they did not receive any training.

The questionnaire was completed in three stages before, immediately, and 3 months after the intervention, and it was self-reported for 30 min. After explaining the study and its objectives, all participants were asked to complete the questionnaire with complete honesty, and they were assured that all the information requested in the questionnaire would be used confidentially. Before the study, written informed consent was obtained from all participants. The questionnaires were completed at the employees' workplace. Also, before starting the study, the ethics code was received from the research ethics committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.PHNS.REC.1396.3).

2.1 | Statistical analysis

We reported descriptive statistics for qualitative variables by frequency (percentage) and for quantitative variables by means and standard deviations because the degree of departure from normality was not large by the Q–Q plot. The distribution of quantitative and qualitative variables between the intervention and control groups were compared by independent t test and χ^2 test, respectively. In addition, repeated measurement analysis of variance was used to detect the effect of education on knowledge and components of the HBM and behavior. The significance level was considered less than 0.05 and all tests were two-sided.

3 | RESULTS

A total of 128 healthcare staff—64 in the intervention and 64 in the control group—were included in the study and the response rate was equal to 100%. So, the final analysis was performed on 128 cases (Figure 1). The mean age of the intervention and control groups were 34.57 ± 7.66 and 33.93 ± 6.28, respectively, and the independent t test did not show a significant difference between the two ($p = 0.606$). Also, the mean years of work experience in the intervention and control groups were 10.46 ± 6.22 and 10.26 ± 4.94, respectively, and the independent t test did not show a significant difference between the two groups either ($p = 0.707$).

A comparison of the frequency and percentage of people in the intervention and control groups at the education level with the Mann–Whitney test showed that there was no significant difference between the two groups ($p = 0.373$). Also, comparing the qualitative demographic information of the two groups, which has been reported in frequency and percentage, and the results of the χ^2 test indicated that the two groups were not significantly different in sex ($p = 0.845$), marital status ($p = 0.052$), type of employment ($p = 0.253$), type of job ($p = 0.961$), and the unit they worked in ($p = 0.961$) (Table 2).

The results of Mann–Whitney and independent t tests showed that the two groups were not significantly different in their knowledge scores, HBM constructs mean scores (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy), and behavior mean scores before the intervention (Table 3).

Results of analysis of variance with repeated measures to test subjects' scores at intervals immediately and 2 months after the intervention in two groups by controlling the effect of pretest scores showed that knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, self-efficacy, and behavior mean scores significantly improved in the intervention group ($p < 0.001$) (Table 3).

Also, the results showed that the interaction of group and time on the mean scores of knowledge ($p = 0.214$), perceived susceptibility scores ($p = 0.561$), perceived severity ($p = 0.252$), perceived benefits ($p = 0.991$), cues to action ($p = 0.827$), self-efficacy ($p = 0.705$), and behavior ($p = 0.062$), at intervals immediately and 2 months after the intervention did not differ significantly in both groups and only the mean scores of perceived barriers ($p = 0.030$) differed significantly due to the interaction of the group and time at the two times after the intervention in both groups. Also, the results showed the mean scores of knowledge ($p = 0.427$), perceived severity ($p = 0.214$), perceived benefits ($p = 0.219$), perceived barriers ($p = 0.208$), cues to action ($p = 0.984$), self-efficacy ($p = 0.353$), and behavior ($p = 0.396$) did not differ significantly between the periods immediately and 2

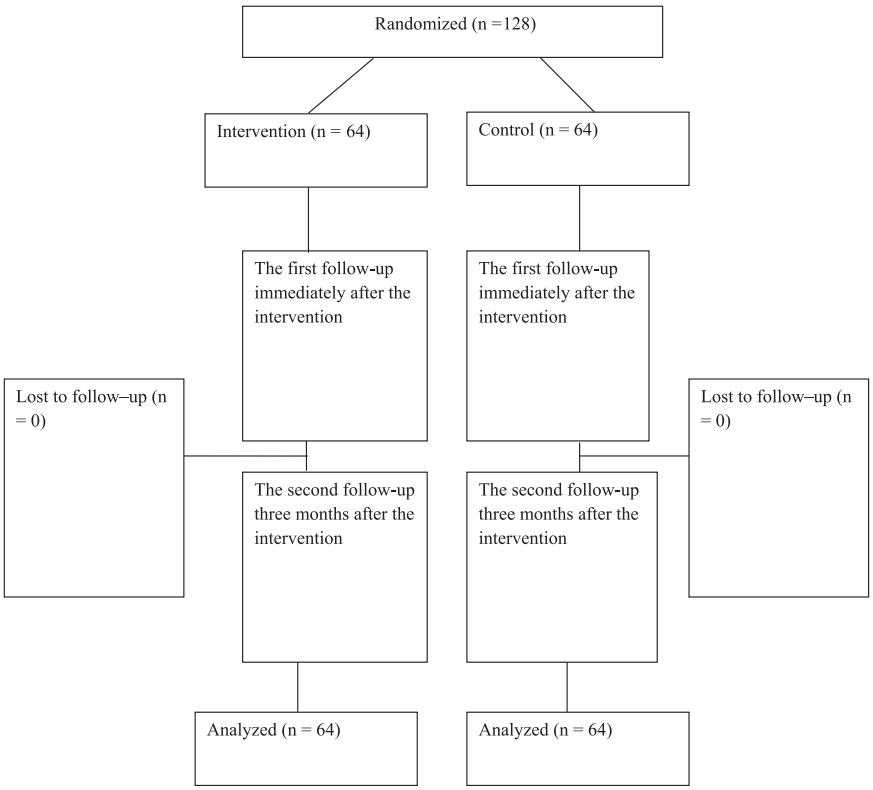

FIGURE 1 Flowchart of the study Like Consort.

months after the intervention, and only perceived susceptibility mean score ($p = 0.003$) showed a significant difference in these two times after the intervention (Table 3).

4 | DISCUSSION

The results of the present study on measuring the effect of HBM-based education on hand hygiene behavior showed a significant change in the mean scores of knowledge, all model constructs (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy), and behavior. Consistent with this finding, the study of Zeigheimat et al., after performing an educational intervention based on the HBM, showed a statistically significant difference between the mean scores of knowledge and all model components and the adoption of behavior in the intervention and control groups.[27] Also in the study of Jeihooni et al., immediately and 4 months after the intervention, there was a significant difference in the mean scores of knowledge, all model components, and the performance in the intervention group compared to the control one,[29] which is consistent with the results of the present study. Zeigheimat et al.[27] confirmed the tendency of nurses to adopt the principles of infection control and preventive behaviors after being aware of the risks of infection transmission, which is consistent with the results of Kaewchana et al.[30] Although education can always increase the level of knowledge, changing attitudes is crucial to improve people's behavior. According to the HBM, improving attitude factors (perceived susceptibility and perceived severity) will increase people's motivation to adopt and maintain preventive health behaviors such as hand hygiene.[31]

The present study showed that education has significantly improved the mean scores of perceived benefits in the intervention group, which is consistent with the results of Zeigheimat et al.,[27] Khani Jeihooni et al.,[29] Efstathiou et al.,[32] and Javaheri Tehrani et al.[33] Zeigheimat et al.[27] also stated the improvement of perceived benefits and the reduction in perceived barriers as important factors influencing infection control. Shalansky et al.[34] also showed that perceived barriers were the most important barriers to adopting a new behavior and could be emphasized more in education programs. It seemed that the mean scores of knowledge and perceived barriers were less than other constructs before the intervention which needs more attention in promoting healthy behavior.

Moreover, Efstathiou et al. showed that education was able to affect the perceived barriers of individuals,[32] which is consistent with Zeigheimat et al.,[27] Khani Jeihooni et al.,[29] and the results of our study. Osborne[35] emphasized that the most important factor influencing hand hygiene is perceived barriers. Simbar et al.[25] also showed that the HBM could improve the behavior of midwives to control infection by reducing perceived barriers. Javaheri Tehrani et al. showed that training was effective on all constructs of the model except perceived barriers.[33] A Korean study stated that due to the complexity of hand hygiene behavior and the role of various external factors in it, a delicate balance had to be between the evaluation of perceived barriers and benefits.[36]

However, the results of different studies on the perceived barriers were different and in some cases contradictory, which could be attributed

TABLE 2 Demographic characteristics in two groups.

Demographic information	Intervention group ($n = 64$), no. (%)	Control group ($n = 64$), no. (%)	p Value[a]
Gender			0.845
Male	19 (29.7)	18 (28.1)	
Female	45 (70.3)	46 (71.9)	
Marital status			0.052
Single	25 (39.1)	36 (56.3)	
Married	39 (60.9)	28 (43.7)	
Type of employment			0.253
Permanent	23 (35.9)	17 (26.6)	
Contract	41 (64.1)	47 (73.4)	
Job			0.961
Dentist	20 (31.3)	20 (31.3)	
Healthcare worker	8 (12.5)	7 (10.9)	
Dentist assistant	36 (56.2)	37 (57.8)	
Education status			0.373
Diploma	31 (48.4)	24 (37.5)	
Above diploma	10 (15.6)	11 (17.2)	
Bachelor	2 (3.2)	9 (14.1)	
Master of science	1 (1.6)	0 (0)	
General dentist	13 (20.3)	13 (20.3)	
Specialist dentist	7 (10.9)	7 (10.9)	
Work unit			0.961
Orthodontics	7 (10.9)	7 (10.9)	
Pediatrics	6 (9.4)	8 (12.5)	
Prosthesis	10 (15.6)	9 (14.1)	
Root canal treatment	11 (17.2)	11 (17.2)	
Gum surgery	8 (12.5)	8 (12.5)	
Restorative	9 (14.1)	9 (14.51	
Oral and maxillofacial	7 (10.9)	6 (9.4)	
Diagnosis	6 (9.4)	6 (9.4)	

[a]χ^2 test.

to the significant variety of perceived barriers (material, physical, psychological, environmental, and social barriers) and the different effects of education on these barriers in different communities.

The results also showed that the intervention significantly improved the mean scores of cues to action, which is consistent with Khani Jeihooni et al.,[29] Zeigheimat et al.,[27] Javaheri Tehrani et al.,[33] and Efstathiou et al.[32] Cues to action had an independent relationship with improving hand health adoption, and practical guidelines such as placing health posters on alcoholic solutions or next to toilets could have a significant impact on hand hygiene behavior.[31] Also, in the present study, the mean scores related to the item "The effective role of referring to the hand hygiene poster in observing hand hygiene" significantly increased after the intervention. A study conducted in India on internal medicine guidelines showed that nothing could be as important as work commitment in preventing hospital infections.[37] Conscientiousness and commitment are effective in adopting health-related behaviors through a variety of mechanisms.[38] In our study, the role of employees' sense of responsibility in adopting hand hygiene behavior was reported to be more than other internal and external cues to action, and this was promoted in the individuals to adopt hand hygiene behavior after training in the present study.

Moreover, O'Boyle et al. assessed the role of intrinsic motivational factors in important hand hygiene behavior and showed that people with high perceived self-efficacy had a greater commitment to taking appropriate action when a problem occurred and spent more time and effort on the desired behavior.[39] Also, the mean self-efficacy scores had a significant improvement after the educational intervention which was also consistent with Khani Jeihooni et al.,[29] Efstathiou et al.,[32] and Javaheri Tehrani et al.[33] although, in Zeigheimat et al.,[27] the educational intervention had no significant effect on self-efficacy.

The results also showed a significant improvement in the mean scores of hand hygiene behavior which was consistent with the results of Zeigheimat et al.,[27] Khani Jeihooni et al.,[29] and Barekati[40] which confirmed the positive of the intervention on hand health behavior.

The results of our study indicated that except for the perceived susceptibility, no significant difference was observed in the periods immediately and 2 months after the intervention in other constructs. In Bikmoradi et al.[41] study, the mean scores of knowledge and attitude in the first month after training increased significantly, but in the third month after the intervention, there was a slight decrease compared to the first month which was not consistent with our study. The mean knowledge scores in the period of 2 months after the intervention compared to them immediately after the intervention increased which was not significant, but the results of attitude scores were consistent with the results of our study in which there was a slight decrease in mean scores of perceived susceptibility and severity in 2 months after the intervention compared to immediately after it. Also, the rate of nurses' adherence to hand hygiene behavior in Bakmoradi et al.,[41] in the third month compared to the first month increased, which was not consistent with this study. In fact, the mean scores of hand hygiene behavior in the second month after the intervention compared to the time immediately after the intervention decreased slightly which was not significant. Such a decrease in the scores could be related to various reasons such as forgetfulness over time, and it seemed that the need for reminder training and retraining had an effective role in sustaining the effect of training. On the other

TABLE 3 Comparison of the mean scores of knowledge, health belief model constructs, and behavior in the periods before, immediately, and 2 months after the educational intervention in the intervention and control groups.

		Group				
		Intervention		Control		
Variables	Time	Mean	Standard deviation	Mean	Standard deviation	*p* Value
Knowledge	Before intervention	21.71	6.05	22.03	5.32	0.874[a]
	Immediately after the intervention	30.62	5.00	22.42	5.70	<0.001[b]
	3 months after the intervention	30.93	4.70	22.34	5.34	0.214[c]
						0.427[d]
Perceived susceptibility	Before intervention	20.70	2.72	20.57	2.75	0.764[a]
	Immediately after the intervention	23.48	1.82	21.00	2.48	<0.001[b]
	3 months after the intervention	23.23	1.78	20.60	2.76	0.561[c]
						0.003[d]
Perceived severity	Before intervention	16.39	2.20	16.20	3.42	0.543[a]
	Immediately after the intervention	18.29	1.71	16.48	3.23	<0.001[b]
						0.252[c]
	3 months after the intervention	18.25	1.55	16.25	3.41	0.214[d]
Perceived benefits	Before intervention	22.73	2.22	22.68	2.80	0.498[a]
	Immediately after the intervention	24.31	1.33	22.70	2.78	<0.001[b]
						0.991[c]
	3 months after the intervention	24.31	1.84	22.70	2.90	0.219[d]
Perceived barriers	Before intervention	19.51	4.20	19.31	4.68	0.797[a]
	Immediately after the intervention	21.39	3.77	19.29	4.65	<0.001[b]
						0.030[c]
	3 months after the intervention	21.31	3.68	19.50	4.66	0.984[d]
Cues to action	Before intervention	12.31	1.85	12.26	1.90	0.888[a]
	Immediately after the intervention	13.42	1.65	12.10	2.00	<0.001[b]
						0.827[c]
	3 months after the intervention	13.40	1.60	12.12	1.69	0.984[d]
Self-efficacy	Before intervention	38.85	4.15	38.50	4/50	0.639[a]
	Immediately after the intervention	42.06	2.97	38.96	4.25	<0.001[b]
						0.705[c]
	3 months after the intervention	41.92	3.21	38.70	4.46	0.353[d]
Behavior	Before intervention	38.03	3.56	38.37	7.31	0.736[a]
	Immediately after the intervention	46.31	2.92	38.65	7.40	<0.001[b]
						0.062[c]
	3 months after the intervention	45.39	2.86	38.17	7.25	0.396[d]

[a]Independent *t* tests.
[b]The effect of education.
[c]The interaction of group and time.
[d]The effect of time in repeated measurement analysis of variance.

hand, several studies stated that improving adherence to hand hygiene after educational intervention by itself was temporary.[42,43]

The results of this study showed that education could sustainably improve hand hygiene behavior. Some of the known factors that were involved in studies on adherence to hand hygiene were: gender, hand-washing habits formed in childhood, the presence of a supervisor who monitors hand hygiene, appropriate patterns in medical wards, and the absence of environmental barriers.[44] Also, the

difference in time could be due to differences in educational content or methods used to perform interventions. The educational content designed in our study was modified according to the analysis of the results obtained from the pretest; therefore, it was appropriate for the participants. Also, the content was presented in simple and attractive language with recommended scientific methods. The result of this training significantly improved the mean scores of knowledge, HBM constructs, and intervention group behavior.

The following were some of the limitations of the present study:

1. Using the self-report method to measure the behavior of participants.
2. Due to the conditions in the study centers and high costs, it was not possible to directly observe hand hygiene behavior.
3. Not being able to check the continuity of hand hygiene behavior in other periods (e.g., 6 months).
4. The presence of nonsimilar cohorts in the control and experimental groups may have hindered the outcome as well as the interpretation of the outcome, and this was one of the most important limitations of the present study.
5. The last but not the least limitation was the lack of studies on hand hygiene and the HBM; we found no studies on educational interventions based on the HBM to promote health behavior which limited the power of comparing the findings and decisions in the field of educational effectiveness. This showed the need for further studies in this field.

5 | CONCLUSION

In general, the educational intervention based on the HBM was able to promote the level of knowledge and the HBM (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy) and hand health behavior in the intervention group.

According to these results and considering that today the old methods of teaching were replaced by new ones, it is possible to use the scientific principles of health education to design educational content appropriate to the audience, and to use appropriate educational methods based on a scientific model and framework, which is an important and effective step in promoting health concepts, and to replace these methods with traditional methods of education in health centers. Repetition of training at regular intervals can lead to the reliability of the effects after the intervention, and it could be done in medical centers with proper planning, and appropriate training methods to control the infection in dentistry centers and to maintain the health of staff and patients. It is suggested to do qualitative studies on hand hygiene behavior with an emphasis on barriers to hand hygiene. The target group was all medical staff working in the dental centers of the Armed Forces. Therefore, it is recommended to conduct other studies using this model and other models in nonarmed dental centers and also to evaluate the effects of such training in other periods.

AUTHOR CONTRIBUTIONS

Reza Kouhi: Conceptualization; formal analysis; project administration; supervision; writing—original draft; writing—review and editing. **Rahman Panahi**: Data curation; formal analysis; investigation; methodology; writing—original draft; writing—review and editing. **Ali Ramezankhani**: Data curation; investigation; methodology; software; validation; writing—original draft. **Mohsen Amin Sobhani**: Data curation; investigation; methodology; project administration; writing—original draft. **Soheila Khodakarim**: Formal analysis; investigation; project administration; software; validation; writing—original draft. **Mohiadin Amjadian**: Conceptualization; formal analysis; investigation; methodology; project administration; supervision; writing—original draft; writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

All authors have read and approved the final version of the manuscript. They had full access to all of the data and take complete responsibility for the integrity of the data and the accuracy of the data analysis. All data are available on logical request.

TRANSPARENCY STATEMENT

The lead author Mohiadin Amjadian affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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