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# The use of medicinal plants in the prevention of COVID-19 using the Health Belief Model: A survey based on the Iranian population

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## Abstract:

**BACKGROUND:** Because of the spread of coronavirus disease 2019 (COVID-19), the preventive measures have increased, such as focusing on the use of medicinal plants in most communities, including Iran. The purpose of this study was to identify the knowledge, attitude, and performance of individuals toward the use of medicinal plants and to identify the predictors of the use of medicinal plants in the prevention of COVID-19.

**MATERIALS AND METHODS:** This descriptive-analytical study (February–April 2021) was performed on 3840 Iranian men and women aged 20–70 years selected as a multi-stage cluster study. At the first stage, all provinces were divided into five regions: North, South, East, West, and Center. In the second stage, a provincial center and a city were randomly selected from each region (North: Sari, Babol; South: Bushehr, Bandar Genaveh; East: Mashhad, Sabzevar; West: Hamedan, Toisarkan; Center: Yazd, Ardakan). Data were collected by a researcher-made scale based on the Health Belief Model (HBM). Data analysis was performed applying Pearson correlation coefficient, logistic regression, and linear regression.

**RESULTS:** The results showed that people have relatively high knowledge and positive attitude toward the use of medicinal plants in prevention of COVID-19. The most important reason for positive attitude was the perceived benefits with the mean of 75.06%. Also, half of the people had poor performance. Correlation coefficient showed that the use of medicinal plants with perceived sensitivity ( $p = 0.000$ ,  $r = 0.3$ ), perceived benefits ( $p = 0.012$ ,  $r = 0.126$ ), perceived barriers ( $p = 0.000$ ,  $r = 0.179$ ), and perceived self-efficacy ( $p = 0.000$ ,  $r = 0.305$ ) had a significant correlation. The strongest correlation between perceived self-efficacy was observed with the use of herbs in prevention of COVID-19. The HBM constructs can predict 26% of the variance for the use of medicinal plants in the prevention of COVID-19, among which perceived self-efficacy ( $\beta = 0.230$ ) was the most powerful predictor.

**CONCLUSION:** Based on the results, the predictive role of self-efficacy constructs for the use of medicinal plants in prevention of COVID-19 has been confirmed according to the HBM. Therefore, methods of increasing self-efficacy such as training programs and providing appropriate intervention models can be used not only as promoters of using medicinal plants in prevention of COVID-19 but also for improving people's performance in the proper use of medicinal plants.

## Keywords:

COVID-19, medicinal, plants, prevention

## Introduction

The coronavirus with an unknown etiology has spread worldwide since

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December 31, 2019,<sup>[1]</sup> and the speed of rapid transmission has prompted the World Health Organization (WHO), the International Health Organization (IHR), and the Emergency Committee to raise this issue as an international concern and as a public health emergency (PHEIC).<sup>[2,3]</sup> On February 19, 2020, Iran reported the first case of coronavirus disease 2019 (COVID-19) in Qom, and this disease became increasingly widespread throughout the country.<sup>[4]</sup> As a result, to prevent the rapid transmission of the infection, the Iranian government imposed a number of measures, including restrictions on the education sector and extensive restrictions on the transportation sector (nationally and internationally). Subsequently, to prevent the spread of the virus, Iranian residents and citizens imposed a ban on public travel.<sup>[5]</sup> However, the transmission of the disease has increased significantly, and by November 25, it has reached more than 5,518,741 approved COVID-19 cases in Iran.<sup>[6]</sup>

The slow pace of vaccination and mutated forms of the virus has raised many concerns among Iranians, which has led to many efforts to find alternatives to prevent transmission or reduce the progression of the infection,<sup>[7]</sup> including more focus on preventive measures (to prevent transmission to other people), the use of natural products, and extracts of medicinal plants to improve the immune system and reduce the risk of infection.<sup>[8,9]</sup>

Medicinal plants are herbs with one or more organs containing active ingredients. These substances, which constitute less than 1% of the dry weight of the plant, have medicinal properties affecting living organisms.<sup>[10]</sup> The use of these plants, which are used to treat diseases and eliminate their symptoms, has historically a special place in the beliefs and culture of people around the world, and there is a growing global tendency to use them with the least harmful side effects compared to drugs. They are considered as the strengths and opportunities for the advancement of medicinal plants.<sup>[11,12]</sup>

Research has shown that the use of medicinal plants has increased simultaneously with the outbreak of corona, and several studies have quantitatively and qualitatively examined the consequences and potential value of the use of medicinal plants in the prevention of COVID-19,<sup>[13,14]</sup> the ability of medicinal plants in the pharmaceutical industry and production of anti-viral drugs for COVID-19,<sup>[15,16]</sup> motivation of people to use medicinal plants during the pandemic,<sup>[17]</sup> the challenges of self-medication with medicinal plants during the pandemic,<sup>[18]</sup> knowledge and attitude of people using medicinal plants,<sup>[19,20]</sup> and people's knowledge about the healing properties of different species of medicinal plants.<sup>[14,21]</sup> The results of some studies evaluated the effect of medicinal plants as one of the counter-measures

and preventive methods against infectious diseases such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), and COVID-19 positively.<sup>[16,22,23]</sup>

Some studies also suggest that the most important reason for using herbs is the lack of new and effective drug treatments to fight viral infections and the resistance of the coronavirus to some chemical drugs,<sup>[21]</sup> prevention of the epidemic of COVID-19,<sup>[23]</sup> the lack of vaccination or effective treatment for COVID-19,<sup>[24]</sup> family traditions and habits,<sup>[25]</sup> good experiences of using medicinal plants in the treatment of MERS and SARS infectious patients,<sup>[26,27]</sup> better quality and fewer side effects of medicinal plants, and ease of access and its cost-effectiveness,<sup>[17,24]</sup> However, regardless of the benefits of using herbs, there is a significant disadvantage: arbitrary use and possible interactions of herbal products and chemical drugs, which can be classified as minor, moderate, and severe. In some cases, the combination of herbs and chemicals can be life-threatening.<sup>[28]</sup> Unfortunately, a recent report found that about 80% of the population in developed countries, without any control or study, trust the effects of herbs and use them arbitrarily.<sup>[29]</sup> Also, among people who are afraid of COVID-19, the use of herbs has been significantly increased, regardless of its possible harmful effects.<sup>[30]</sup>

Therefore, considering the climate and culture of the Iranian people in the strong history of traditional medicine and the special place of consumption of these plants during the pandemic, the diversity of species of medicinal plants<sup>[12]</sup> doubles the need for this study. The findings of this study can not only be a way to increase awareness, correct attitude, and proper performance during the pandemic but also have global implications for health and be used as an important factor in the decision-making process in this area.

## Materials and Methods

### Study design

This descriptive-analytical cross-sectional study was conducted from February to April 2021.

### Data collection tool

Data were collected using an online questionnaire extracted from the HBM. The first part was related to demographic characteristics (age, gender, education, occupation, place of living, history of using medicinal plants in the family or first-degree relatives, history of COVID-19 in the first-degree family or relatives, specific drug use, and history of underlying disease). The second part included ten questions related to people's awareness about medicinal plants in terms of cognition and use, which were answered by Yes and No.

For the answer Yes, the score was 1, and for the answer No, the score was 0. After calculating the percentage of knowledge of individuals, scores of less than 66.6 were assessed as ignorance, and scores above 66.6 were assessed as awareness. Section 3 consisted of 20 questions related to people's attitude toward the use of herbs, which included five components. The HBM has been used to identify attitude;<sup>[31]</sup> this model includes perceived sensitivity (four questions), perceived severity (five questions), perceived benefits (five questions), perceived barriers (three questions), and perceived self-efficacy (three questions). The answers to these questions were measured with the Likert scale in a five-choice range from score 5 (strongly agree) to score 1 (strongly disagree). Then, the percentage of attitude score of each person was calculated, and people with a score of less than 33.3 were in the negative attitude group, people with scores of 33.3 to 66.6 were in the neutral attitude group, and people with a score above 66.6 were in the positive attitude group.

Section 4 has three questions related to measuring the performance of individuals, and four options [always, most of the time, sometimes, and never (scoring from 1 to 4)] were considered. Then, the percentage of performance score of each person was calculated, and people with a score of less than 33.3 were in the unfavorable status group, a score of 33.3–66.6 was assigned to the relatively favorable status group, and people with a score of more than 66.6 were in the favorable condition group.

The content validity of the assessment tool was calculated according to the content validity ratio (CVR), which indicates the extent to which the tool (questionnaire) measures all aspects of the structure. With a survey of 5 PhDs in traditional pharmacy and 5 PhDs in health education and health promotion, the content validity for HBM was 0.89, which according to the Lawshe table is acceptable. The CVR for 10 specialists is 0.62. Structural validity assessment was performed using factor analysis methods and a measure of sampling adequacy (MSA) of 0.962, which showed the correlation of scale items. A questionnaire was given to 30 target groups (final sample) to determine face validity. After completing the questionnaire by the target group, using the formula impact of the item method, a face validity of 0.83 was calculated according to the following formula:

1. Impact of items = Frequency (%) × Importance

Instrument reliability using Cronbach's alpha was determined as knowledge questions:  $\alpha = 0.79$ , perceived sensitivity questions:  $\alpha = 0.80$ , perceived intensity:  $\alpha = 0.82$ , perceived benefits:  $\alpha = 0.78$ , perceived barriers:  $\alpha = 0.79$ , perceived self-efficacy:  $\alpha = 0.83$ , and finally performance:  $\alpha = 0.80$ .

### Sampling strategy and sample size

The statistical population was all Iranian men and women aged 20–70 years. Sampling was performed by the multi-stage cluster sampling method. At the first stage, all provinces were divided into five regions: North, South, East, West, and Center. In the second stage, a provincial center and a city were randomly selected from each region (North: Sari, Babol; South: Bushehr, Bandar Genaveh; East: Mashhad, Sabzevar; West: Hamedan, Toisarkan; Center: Yazd, Ardakan). The researcher-made questionnaire was provided online through social media (WhatsApp, Telegram, Instagram). It should be noted that in order to ensure that all participants are from selected provinces and cities, the first question was based on self-declaration and if they were not residents in selected provinces and cities, the questionnaire would not be displayed. According to this strategy, a total of 3840 people participated in this study from February to April 2021.

### Statistical analysis

Data were analyzed using SPSS software version 23, and the normality of the data was assessed using Smirnov Kolmogoroff test, t-test, Chi-square test, analysis of variance, Pearson correlation coefficient, logistic regression, and linear regression. The significance level considered was  $P$  value  $\leq 0.05$ .

### Ethical considerations

Ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed. In order to conduct the research, the consent of the ethics committee of Hormozgan University of Medical Sciences was obtained (IR.HUMS.REC.2021.139).

### Results

The results showed that the majority of participants were female (52.4%) and most of them (36.2%) belonged to the age group of 30–40 years; 46.9% of people have reported the history of COVID-19 in the family or their first-degree relatives, 53.8% had underlying disease, and 42.5% use a specific drug. Most of them (31.2%) had a master's degree or higher, and a majority of them (31.3%) were employees. Also, most of the participants lived in the west of Iran (0.28%) [Table 1].

The study of people's knowledge in terms of demographic characteristics showed that women with a mean score of 62.7% had more knowledge than men and this difference was statistically significant ( $P = 0.000$ ). Also, the group of 40–50 years old had the most knowledge. In this study, the relationship between age and level of knowledge was not significant ( $P = 0.632$ ). Among the occupations,

**Table 1: Summary of demographic characteristics of people and their state of knowledge and attitude**

	Knowledge (%)				Attitude (%)					
	Relative frequency (%)	Yes	No	P	Test statistics	Positive	Neutral	Negative	P	Test statistics
Gender*				0/006	2/7				0/082	1/7
Female	52/4	62/7	37/3			74/1	21/3	4/6		
Male	47/6	49/3	50/7			54/8	38/9	6/3		
Age**				0/632	-				0/300	-
20-30	28/1	58/3	41/7			69/1	21/1	9/8		
30-40	36/2	72/8	27/2			76/3	13/2	10/5		
40-50	12/4	75/9	24/1			88/4	9/5	2/1		
50-60	17/1	70/9	29/1			76/8	14/8	8/4		
More than 60	11/2	51/2	48/8			65/2	22/1	2/7		
Education**				0/000	21/9				0/704	0/544
Under diploma	10/1	37/2	42/8			64/2	32/2	3/5		
Diploma	11/9	53/8	42/2			59/8	35/6	4/6		
AD	18/1	66/2	33/8			68/7	29/2	2/1		
BA	28/7	71/5	28/5			73/4	19/9	6/7		
MA and higher	31/2	72/7	27/3			76/1	13/0	7/9		
Occupation**				0/013	3/2				0/277	1/2
Housewife	13/2	59/4	50/6			77/3	21/2	1/5		
Self-employment	27/9	34/8	65/2			53/4	32/9	2/7		
Employee	31/3	66/7	33/3			81/5	27/4	1/1		
Worker	15/7	21/2	78/8			51/2	25/3	22/5		
Retired	11/9	31/9	68/2			69/7	16/4	13/9		
Place of living**				0/001	2/7				0/066	2/4
North province	23/1	77/2	22/8			60/1	32/8	7/1		
South province	13/2	57/3	42/7			51/5	40/3	8/2		
East province	20/4	61/9	38/1			48/8	26/9	24/3		
West province	28/3	73/5	26/5			57/7	29/5	14/8		
Central province	15/0	50/7	49/3			53/5	26/3	21/2		
History of using medicinal plants in the family or first-degree relatives*				0/737	-				0/569	-
Yes	87/7	85/3	14/7			91/2	10/5	1/3		
No	12/3	52/7	47/3			69/4	17/7	12/9		
History of COVID-19 infection in the first-degree family or relatives*				0/189	1/3				0/059	1/8
Yes	46/9	61/9	38/1			87/2	10/1	2/7		
No	53/4	57/2	42/8			57/2	39/1	3/7		
Use of a specific drug*				0/079	1/7				0/507	0/66
Yes	42/5	75/4	24/6			57/3	37/2	5/3		
No	57/5	67/1	32/9			64/2	31/7	4/1		
Background disease*				0/164	1/5				0/213	1/9
Yes	53/8	87/5	12/5			66/9	26/7	6/4		
No	46/2	77/3	22/7			67/5	28/8	3/7		
Total	100	67/4	32/6			67/5	24/9	7/6		

Independent t-test\* and ANOVA\*\*

employees had the highest knowledge score (66.7%). ANOVA test showed that there was a statistically significant relationship between job and level of knowledge, people with MA and above had the highest knowledge score (72.7%), and people with diploma had the lowest (37.2%); education and knowledge had a significant relationship ( $p = 0.000$ ). Also, people living in the north of the country with a mean score of 77.2 were more aware than other provinces that this difference was statistically significant ( $P = 0.001$ ). In this study,

people with a family history of COVID-19, people using medicinal plants or a specific drug, and people with underlying diseases had the most knowledge, but the relationship was not statistically significant ( $p \geq 0.05$ ).

In the field of attitude, the highest mean score of positive attitude in women was 74.1% in the age group of 50–40 (88.4%); in the MA and higher education groups, it was 76.1; in the employees, it was 81.5; and in the residents of North province, it was 60.1%. Also, people

with a family history of COVID-19, a history of using medicinal plants, and specific drug use had a positive attitude that in none of the cases, a statistical significant relationship was observed  $P > 0/05$  [Table 1].

In the assessment of attitude model constructs, there was no significant relationship between the variables of gender, occupation, and family history of COVID-19 ( $p > 0.05$ ). There was only a meaningful relationship between the structure of perceived benefits with age ( $p = 0.003$ ), education ( $p = 0.001$ ) and history of use of medicinal plants, perceived barriers with specific drug use ( $p = 0.012$ ), and underlying disease ( $p = 0.013$ ). Also, the relationship between the level of individuals' awareness and the structures of the attitude model showed that there was a positive and significant correlation between awareness and perceived benefits of individuals ( $p = 0.000$ ).

The results showed that the mean score of knowledge was 69.93 and the mean score of attitude was 67.97. The most important reason was the positive attitude structure of perceived benefits with a mean score of 75.06 [Table 2].

Regarding the status of performance, the results showed that 45.2% of people use herbs to prevent COVID-19 without consulting a doctor, and only 16.2% of people were in good condition. Also, 44.2% of people were at an unfavorable level in terms of replacing medicinal plants with chemical drugs. Regarding the recommendation to use medicinal plants to someone, more than half of 51.9% were classified as unfavorable [Table 3].

The statistical analysis showed that there is a significant relationship between the level of knowledge and consulting a physician when using medicinal plants ( $p = 0.012$ ), but there was no significant relationship

between replacing medicinal plants with chemical drugs and recommending the use of medicinal plants ( $p = 0.77$  and  $P = 0.345$ ). Also, no relationship was observed between the attitude and performance of recommending the use of medicinal plants to anyone ( $p > 0.05$ ) [Table 4].

Logistic regression analysis showed that the perceived benefits were the only significant predictor in the performance of replacing medicinal plants with chemical drugs and recommending the use of medicinal plants to the subjects [Table 5].

According to the regression test of education, the use of medicinal plants in the family or the first-degree relatives, perceived benefits, and awareness of predictors were significant in the subjects [Table 6].

Analysis of the obtained correlation coefficient data showed that the use of medicinal plants in prevention of COVID-19 had a positive and significant correlation with perceived sensitivity ( $p = 0.000$ ,  $r = 0.3$ ), perceived benefits ( $p = 0.012$ ,  $r = 0.126$ ), perceived barriers ( $p = 0.000$ ,  $r = 0.179$ ), and perceived self-efficacy ( $p = 0.000$ ,  $r = 0.305$ ). The strongest correlation was observed between the structure of perceived self-efficacy and the use of herbs in prevention of COVID-19. Multi-linear regression analysis was used to investigate the predictor factors of medicinal plant usage in prevention of COVID-19 by HBM constructs and other variables. The studied variables predicted variance of about 26% in the use of medicinal plants to prevent COVID-19. In addition, the predictive power of perceived self-efficacy ( $\beta = 0.230$ ) for the use of medicinal plants was higher [Table 7].

This study showed that age, gender, occupation, level of education, place of residence, previous COVID-19 infection, history of using medicinal plants, and having background disease are related to the use of medicinal plants in prevention of COVID-19.

## Discussion

The aim of this study was to identify the knowledge, attitude, and performance of individuals toward the use of medicinal plants and identify the predictors of the use of medicinal plants in the prevention of COVID-19. In general, the results showed that the subjects have a positive attitude and good knowledge about the use of medicinal plants but do not have a good performance.

**Table 2: Mean and standard deviation of the variables of attitude and knowledge toward the use of medicinal plants to prevent COVID-19**

Variables	Mean percentage	SD	Min	Max
Knowledge	69/93	16/56	5/78	88/24
Attitude	67/97	9/72	1	97/33
Perceived sensitivity	63/10	17/19	1	100
Perceived Severely	69/05	18/24	1	92/17
Perceived benefits	75/06	12/33	1	100
Perceived barriers	65/09	18/33	1	91/10
Perceived self-efficacy	67/58	25/67	1	100

**Table 3: Status of participants' attitude toward the use of medicinal plants to prevent COVID-19**

Performance	Favorable	Relatively Favorable	Unfavorable
Consult a physician on the use of herbs to prevent COVID-19	16/2	28/6	45/2
Replacement of medicinal plants with chemical drugs	35/6	19/2	44/2
Advise the use of herbs to prevent COVID-19	31/7	16/4	51/9
Total	27/8	21/4	47/1

**Table 4: Performance status with the level of knowledge and attitude of participants toward the use of medicinal plants in the prevention of COVID-19**

Performance	SD	P
Consult a physician on the use of herbs to prevent COVID-19		
Awareness	0/439	0/012
Attitude	0/657	0/018
Replacement of medicinal plants with chemical drugs		
Awareness	1/316	0/077
Attitude	0/247	0/001
Advise the use of herbs to prevent COVID-19		
Awareness	2/74	0/345
Attitude	1/42	0/508

**Table 5: Logistic regression analysis of effective factors in replacing medicinal plants with chemical drugs and recommending the use of medicinal plants to others**

Effective factor	Replacement of medicinal plants with chemical drugs			Advise the use of herbs to prevent COVID-19		
	OR	CI (95%)	P	OR	CI (95%)	P
Perceived benefits	1/96	1/012-1/187	0/02	1/93	1/022-1/17	0/01

**Table 6: Logistic regression analysis of factors affecting consultation with a physician for the use of medicinal plants in the prevention of COVID-19**

	OR	CI (95%)	P
Perceived benefits	1/032	1/008-1/057	0/01
History of using medicinal plants in the family or first-degree relatives			
Yes	1	1/08-3/09	-
No	1/83	-	-
Education			
Diploma	1	-	0/003
Under diploma	0/070	0/013-0/379	0/002
Associate Degree	0/087	0/015-0/495	0/006
Bachelor	0/181	0/033-0/998	0/05
Masters degree and higher	0/109	0/009-1/37	0/08
Awareness	1/027	1/01-1/04	0/002

The results of Alyami *et al.*<sup>[19]</sup> (2020) also showed that the Saudi Arabia people have a positive attitude toward the use of medicinal plants in the effective treatment of COVID-19. El Alami *et al.*<sup>[14]</sup> (2020) also emphasized that Moroccans have a good level of awareness and attitude toward medicinal plants.

In this study, a significant relationship between education, gender, occupation, and the province of residence and the level of knowledge was observed. The research hypotheses also emphasize the relationship and positive effect between education and gender with awareness of using herbs to prevent COVID-19.<sup>[20]</sup> Therefore, the individuals' education level can be considered

an important and influential factor on the level of awareness. In the gender variable, this significant relationship may be because of the greater sensitivity of women in obtaining information about the therapeutic effect of medicinal plants from available and different sources than men. Vasisht *et al.*<sup>[32]</sup> showed that areas with rich coverage of medicinal plants have higher attention and scientific support in terms of the use of medicinal plants in the treatment of diseases and this can affect the experience and knowledge of residents in the use of medicinal plants in the prevention or treatment of diseases, which confirmed the results of this study, because the northern and western provinces of Iran have more diversity of vegetation and most of the participants living in these provinces had a higher level of awareness than other provinces.

In this study, only 7.6% of the subjects had a negative attitude about the use of herbs to prevent COVID-19. The results of the study by Vikraman *et al.* (2020) and Malik *et al.* (2020) showed that more than half of the people have a positive attitude toward the use of medicinal plants in the treatment of COVID-19.<sup>[18,20]</sup> Therefore, the results of this study were in line with the performed studies. In the attitude model structures, there was a significant relationship between the structure of perceived benefits with age, education, and history of use of medicinal plants. It may be inferred that older people in the study were more likely to believe in the perceived benefits of using herbs to prevent COVID-19. These results demonstrate the strong belief and credibility of older people in the perceived benefits of the effectiveness of medicinal plants in the prevention of COVID-19. Also, the positive attitude of the educated and even people with a history of using medicinal plants in the family or first-degree relatives toward the perceived benefits of medicinal plants in the prevention of COVID-19 can be derived from their knowledge and experience of chemical drug complications and the use of medicinal plants in the treatment of other diseases with the less complications. The results of some studies also showed that the most important benefits perceived in the use of medicinal plants are coronavirus resistance to some chemical drugs, good experiences of using medicinal plants in the treatment of infectious diseases such as MERS and SARS, and better quality and fewer side effects of medicinal plants. Prescribed chemical drugs were considered to be easy to access and cost-effective.<sup>[15,17,24,26,27]</sup>

Another part of the results showed that there is a significant relationship between the structure of perceived barriers and the use of specific drugs and having an underlying disease. Because people taking certain drugs or having an underlying disease are in a group that prohibits the use of herbs without consulting a doctor, being aware of the possible side effects and

**Table 7: Regression coefficient of predictors of the use of medicinal plants in the prevention of COVID-19**

Independent Variables	B	SD	β	t	P	R <sup>2</sup>
Constant Value	3/494	0/432	-	8/431	0/000	2=0/258, F <sup>2</sup>
Age	0/045	0/038	0/078	0/419	0/526	Adjusted=0/034
Gender	0/036	0/065	0/028	0/487	0/627	
Job	0/044	0/031	0/085	1/59	0/112	
Address	0/142	0/094	0/089	1/56	0/127	
Level of Education	0/019	0/027	0/037	0/715	0/469	
History of COVID-19	0/035	0/087	0/021	0/385	0/070	
History of Using Medicinal Plants in the Family and	-0/063	0/068	-0/055	-1/094	0/028	
Use of a specific drug	0/075	0/056	0/061	0/692	0/195	
Background disease	0/061	0/071	0/059	0/752	0/127	
Awareness	0/109	0/085	0/068	1/287	0/197	
Perceived Sensitivity	-0/046	0/052	-0/047	-0/843	0/382	
Perceived Severely	0/095	0/054	0/095	1/791	0/075	
Perceived benefits	0/004	0/046	0/003	0/067	0/951	
Perceived barriers	-0/008	0/044	-0/011	-0/192	0/864	
Perceived self-efficacy	0/182	0/042	0/230	4/195	0/000	
Performance	0/005	0/012	0/023	0/410	0/684	

problems caused by chemical drug interactions with herbs has been able to understand the barriers, and they should be more cautious in using medicinal plants. Sen *et al.*<sup>[23]</sup> (2020), in their research, showed that there are serious discussions in clinical use of herbs for the prevention of COVID-19 in cardiovascular patients, cancer, diabetes, respiratory patients, people on dialysis, or uncontrolled hypertension because of dangerous drug interactions. Other studies have shown that although biomedical evidence suggests that some herbs have beneficial effects on controlling or reducing the function of some diseases, including high blood pressure and diabetes, clinical evidence does not support it and use of medicinal plants without medical consultation is dangerous.<sup>[33,34]</sup> The results also showed that there was a positive and significant relationship between the level of awareness about the use of medicinal plants and the perceived benefits. These results were not unexpected because the benefits perceived by people with more experience and knowledge in the use of herbs in the treatment of disease are higher.

In the performance of recommending the use of herbs to others to prevent COVID-19, people were in a more unfavorable situation. This is probably because people have a positive experience in using herbs to treat disease and mistakenly think that herbs are harmless because they are natural and that even their use by others is not dangerous for their health. The results of some research studies also emphasize that although the use of some medicinal plants such as Ginseng, liquorice, ginger, cinnamon, guduchi, and so on as the anti-viral plants was found to be useful in preventing COVID-19 and increasing the immune system, the consumption of these plants is not recommended at all without consulting physicians.<sup>[35,36]</sup>

In this study, the perceived benefits as a significant predictor in the replacement of medicinal plants with chemical drugs were identified and the use of medicinal plants to others was reviewed. Perhaps, it can be argued that the high volume of media advertisements about the effective and safe therapeutic effects of medicinal plants in the prevention of COVID-19, the high cost of chemical drugs compared to medicinal plants, the perception of low side effects of medicinal plants, and the positive experience of some therapeutic effects have been observed. These issues have led people to believe that herbs can be a good alternative to chemical drugs but that replacing herbs with chemical drugs can make a patient worse.

In addition to the perceived benefits, structure, people’s knowledge, level of education, and history of using herbs were also the determining factors in the performance of medicinal plants in the prevention of COVID-19 with the advice of a physician, and it is necessary to provide scientific reasons.

In addition to the structure of perceived benefits, people’s knowledge, level of education, and history of using medicinal plants were also determining factors in the performance of medicinal plants in preventing COVID-19 with the physician’s advice. In the studies, the relation between knowledge and constructs of the attitude model and the performance of individuals regarding the use of medicinal plants has not been mentioned. Even studies have not identified perceived benefits as predictors of performance in this area. Perhaps, the difference in the findings can be attributed to the trust, interest, and history of using medicinal plants and related products in Iranian culture.

The results of correlation coefficient showed that preventive behaviors had a positive and significant correlation with perceived sensitivity, benefits and barriers, and self-efficacy. Although, in this study, the correlations were weak to moderate, people with higher perceived intensity scores naturally had a higher perceived sensitivity score, and the strongest correlation was observed between these two structures. On the other hand, people who had a higher perception of herbal medicine benefits were more sensitive to using them in prevention of COVID-19.

Based on the results of regression analysis, the structures of HBM were able to predict 26% of the overall variance of medicinal plant usage in prevention of COVID-19. In this study, self-efficacy was the strongest construct in predicting the use of medicinal plants in prevention of COVID-19. It seems that because of the widespread information on social and national media, public awareness has increased, and these factors have led to higher sensitivity and perceived intensity regarding the use of medicinal plants. On the other hand, understanding the benefits of using medicinal plants and the disadvantages of not using has increased the individual effectiveness in the positive belief about the use of medicinal plants in prevention of COVID-19.<sup>[37,38]</sup> Therefore, it can be beneficial to design the appropriate interventions to establish the educational programs and interventional techniques aiming to increase people awareness and proper use of medicinal plants.

One of the limitations of the present study was the possibility of frequent responses of the user. The researchers tried to overcome this limitation by using software potential so that each user has the right to participate in the survey only once.

Considering a wide range of demographic variables including different age groups and both gender groups at the national level of the population of the studied provinces and with high involvement in terms of the prevalence of COVID-19 is one of the strengths of this study, and the use of a tool based on HBM for the first time in the use of medicinal plants in the prevention of COVID-19 is another strength of this study.

## Conclusion

Although the participants in the study had a good level of knowledge and attitude toward the use of herbs to prevent COVID-19, the poor performance of most participants led to the importance of educating and informing by the health system about side effects, dosage, method of administration, use of herbs, and possible interactions of the medicinal plants that should be identified in order to improve the performance of

people in the use of medicinal plants with appropriate changes. It is also necessary to pay attention to the role of predicting the self-efficacy construct for the use of medicinal plants in the prevention of COVID-19 and improve the performance of individuals in the correct use of medicinal plants by training programs and providing appropriate intervention models.

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## Authors' contribution

Latifi, M and Maraki F participated in the collection of the data, performed the statistical analysis, and wrote the manuscript, equally. Parvaresh MJ and Zarei M participated in the design of the study and helped to draft the manuscript. Allabakhshian L substantial contributor to conception and design the study, interpretation of data, revising the manuscript critically, and has given final approval of the version to be published. All authors read and approved the final manuscript.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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