Knowledge, Attitude, and Practice toward the Novel Coronavirus (COVID-19) Outbreak: A Population-Based Survey in Iran

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Abstract

Background: Knowledge and awareness of disease transmission modes and basic hygiene principles during a public health crisis are crucial for developing effective control measures. The researchers aimed to evaluate Iranians' knowledge, attitude, and practice (KAP) throughout the coronavirus disease 2019 (COVID-19) pandemic to detect related sociodemographic variables.

Methods: This cross-sectional, web-based survey was conducted from the 2nd - 8th March 2020 among the general population of Iran above 15 years of age. A 76-item self-designed questionnaire regarding KAP towards COVID-19 was used, and the participants' demographic characteristics and sources of information were collected. The Snowball sampling method was applied for data collection, and responses were scored based on the Likert scale. Simple and multiple linear regression was performed using SPSS version 26. The statistical significance level was P<0.05.

Results: Among 8591 participants, the overall achieved knowledge, attitude, and practice score regarding COVID-19 characteristics were 90%, 90%, and 89%. Also, an overall score of 85% was achieved regarding the knowledge of the transmission mode and high-risk groups for COVID-19. There was a significant association between female gender, higher age, and higher education with knowledge, attitude, and practice. Male gender, being single, and lower education levels were associated with lower scores in knowledge and practice (P<0.001) and poorer attitudes towards COVID-19 (P<0.001, 0.002, and <0.001, respectively).

Conclusion: During its outbreak, the Iranian population demonstrated decent knowledge, appropriate practice, and a positive attitude towards COVID-19. Furthermore, health education programs, mainly targeting lower-knowledge individuals regarding COVID-19, are essential for encouraging a positive attitude and maintaining safe practices. Hopefully, by increasing knowledge via public health policymakers and the cooperation of the Iranian authorities and the general population, optimistic control and elimination of the disease can be anticipated.

Introduction

In December 2019, the world experienced a new outbreak due to a novel Coronavirus (2019-nCoV, officially known as SARS-CoV-2). Before the turn of the century, the disease that was assumed to be somewhat benign came to be the third outbreak of beta coronaviruses in the 21st century, causing a public health crisis,[1] and was declared a global pandemic by WHO on March 12, 2020.[2] The coronavirus outbreak in Iran was officially confirmed to be in Qom on February 19, 2020, while the country was considered amongst the hardest hit countries, especially in the Middle East.[3-5]

The disease has caused a major impact on the country and its policies while also affecting the population in numerous mental, social, and health-related aspects.[6-13] To introduce and install effective control measures, knowing basic hygiene principles and modes of disease transmission and actions in such an environment is vital. To achieve ultimate success against coronavirus disease 2019 (COVID-19) in Iran, people's commitment to control measures is necessary. According to the KAP theory, this is generally affected by their knowledge, attitude, and practices (KAP) concerning COVID-19.[14-16] Health authorities in Iran have made substantial efforts to control the disease through various measures. Public education is considered one of the most critical steps to help control diseases, as has been the case regarding SARS.[17]

Various demographic and socioeconomic features influence the population's awareness and health behaviors towards COVID-19. Multiple studies have demonstrated that males, lower age, and lower education could be associated with poorer attitudes and practices towards the disease.[18-21] Evaluating associating factors with KAP towards COVID-19 is essential to establish community-based awareness programs and provide targeted interventions. It is also necessary to provide a simple, clear, and understandable message to reinforce knowledge, especially regarding the efficacy of the preventive measures in specific groups, leading to good practice.

Evaluation of the population's general knowledge is vital for developing health policies for disease containment. The present study aimed to measure the level of KAP concerning COVID-19, detect sociodemographic variables associated with a satisfactory level of KAP, and explore awareness and health behaviors related to the prevention of COVID-19.

Methods

Study Design

This study was an online cross-sectional nationwide survey conducted among the general population of Iran from the 2nd to the 8th of March 2020. The Medical Ethics Committee of Shiraz University of Medical Sciences approved the present study. Because of the possible risks associated with the disease's infection, a community-based general sampling survey could not be performed; therefore, the data were collected through a cross-sectional web-based survey. The sample size estimation was done based on a study by Zhong et al.[22] assuming a minimum prevalence of no knowledge of 10%, confidence level = 95%, and d (margin of error) = 0.01. This study's calculated sample size was 1382 participants with design effect=2.5 reaching a sample size of nearly 3,500 participants.

Questionnaire Preparation

For this study, the authors used a self-designed questionnaire, which was developed based on WHO training material for the detection, prevention, response, and control of COVID-19. The content validity of the questionnaires was reviewed by five qualified experts, including an infectious disease medical specialist, a physician–epidemiologist, an infection control nurse, a qualified general physician, and a community medicine specialist. Index of Item Objective Congruence: IOC 0.60 – 1 was used. After the confirmation of content and face validity and the skewed distribution of KAP among the general population by independent experts' opinions, this instrument was pilot tested among a sample group of 30 participants from the general public. The Cronbach's alpha of the questionnaire was calculated, with similar demographic characteristics, which showed good internal consistency (α=0.73).

Furthermore, based on Pearson Product Moment Correlation coefficient, a reliability index (r) was established at 0.77. Before the final survey was completed, changes were made for a better understanding of the questions by the participants; moreover, the arrangement of the questions was looked into to ensure its efficiency. Finally, a 76-item survey instrument was developed using WHO course materials on emerging respiratory viruses, including COVID-19[23] (Supplementary Table 1). This survey took approximately 9 minutes to fill out.

Data Collection

This web-based survey was carried out through various social media platforms, including WhatsApp, Instagram, and Telegram. A snowballing sampling method was used to recruit participants. The questionnaire was distributed through the authors' personal and professional contacts and various large social media groups, while requesting each participant to forward and redistribute the questionnaire. Through the link, the participants could view the questions by clicking on and answering them. The questionnaire's

cover page included a short introduction regarding the objectives, procedures, the voluntary nature of participation, declarations of confidentiality, and anonymity. The inclusion criteria regarded Iranian nationality participants aged 15 years and above who would understand the survey's content and agree to participate in the survey.

The questionnaire was answered by 8591 participants anonymously from the 2nd to the 8th of March 2020. Demographic variables, including gender, age, and occupation, were recorded along with other factors regarding the populations' knowledge, attitude, practice, and risk assessment concerning COVID-19. Also, the participants' province of residence was recorded to evaluate the geographical distribution of KAP in the country. Furthermore, based on independent experts' opinions regarding the confirmation of content and face validity and the skewed distribution of KAP among the general population, and based on the modified Bloom's criteria, the scores were categorized as low, moderate, and high KAP towards the disease. The average score in each category was divided by the total achievable score and reported as the average percentage of correct answers in each subgroup.

Knowledge about COVID-19

The knowledge section of the questionnaire consisted of two parts (Supplementary Table 1): the first had 18 questions: 6 regarding the characteristics of the disease (K1-K6), six about the symptoms of the disease (K7-K12), and six regarding the prevention and control of the disease (K13-K18). These questions were in the form of a multiple-choice answer or in the form of true, false, or no opinion. Based on the Likert Scale Score, correct answers had 3 points, while incorrect answers were allocated 1 point. A "no opinion" answer had 2 points. Eventually, the overall knowledge score ranged from 18 to 54. Individuals scoring 46 and under were categorized as having insufficient knowledge, 47 to 50 as having moderate knowledge, and above 50 as enjoying high knowledge of COVID-19. This section was categorized as "Knowledge A".

Furthermore, the authors asked an additional eight questions (K19-K26), four regarding the disease's transmission route and four about the groups of potentially higher risk,. These questions were answered on a true or false basis, with true having 1 point and incorrect 0 points. This section's overall knowledge score ranged from 0 to 8, with a total score of under five as insufficient knowledge, 5 to 7 as moderate knowledge, and eight as high knowledge regarding the transfer routes and risk groups of COVID-19. This section was categorized as "Knowledge B".

Attitude towards COVID-19

The authors asked 15 questions (A1-A15, Supplementary Table 1) to evaluate the general public's attitude toward the disease. The answering and scoring systems were similar to the first section, about knowledge (true=3, false=1, and no opinion=2). The total attitude score ranged from 15 to 45. A score of under 40, 40 to 43, and above 43 was classified as a poor, moderate, and positive attitude towards COVID-19, respectively.

Practice Regarding COVID-19

The authors asked 12 questions regarding the general population's practice and approach towards the disease (P1-P12, Supplementary Table 1), with a similar scoring system as stated earlier (correct=3, incorrect=1, no opinion=2). Scores under 29, 29 to 34, and above 34 were classified as poor, moderate, and good practice towards COVID-19, respectively.

Source of Information Regarding COVID-19

Finally, the source of the individuals' information about COVID-19 was recorded. It included social media and the internet, news media (T.V./video, magazines, newspapers, and radio), family and friends, scientific journals and articles, and healthcare providers such as physicians and nurses. Participants rated each source of information and their reliability from 1 to 5. Scores ≥3 were categorized as considerable for both reliability and usage.

Statistical Analysis

In this cross-sectional study, firstly, the authors performed a descriptive analysis to describe demographic features and their distribution based on KAP. Data were presented as mean±standard deviation (S.D.). Subsequently, a referential analysis was performed to determine the relationship between factors and KAP. The Chi-square or Fisher's exact test was used to compare categorical data. The authors used simple and multiple linear regression to determine the relationship between variables and KAP, which were nominated by a backward stepwise method. The authors used multiple regression to control the confounders. All assumptions were met in the model: the relationship between the independent variable and the dependent variable was linear, the variance of residual was the same for any value of independent variables, observations were independent of each other, and the dependent variable was normally distributed for any fixed value of the independent variable. Unstandardized regression coefficients (95%) were used for evaluating the association among variables with KAP towards COVID-19. The statistical significance level was set at $P<0.05$. All the statistical analyses were performed using Microsoft Excel 2007 (Microsoft Corp., Redmond, USA) and statistical package for social sciences (SPSS Inc., Chicago, Illinois, USA) version 26.0.

Table 1: Number of questions, range, scores, and levels of knowledge, attitude, and practice regarding COVID-19 in the general Iranian population (N=8591)

Variables	Number of Questions; n=53	Range of score	Total score (mean±standard deviation)	Level (%); N=8,591		
				Poor	Moderate	High/Positive
Knowledge A	18	18 - 54	48.83±3.28	22.60	46.50	30.90
Knowledge B	8	0 - 8	6.68±1.60	9.00	56.20	34.70
Attitude	15	15 - 45	40.60±2.40	31.40	60.80	7.80
Practice	12	12 - 36	32.10±2.98	11.90	71.30	16.70

Table 2: Univariate analysis regarding the association of demographic characteristics and the knowledge test A, knowledge test B, attitude, and practice scores of COVID-19 (N=8591)

Characteristics		Number (%); N=8591	Mean±Standard deviation							
			Knowledge A	P*	Knowledge B	P*	Attitude	P*	Practice	P*
Sex	Male	2,888 (33.6)	48.54±3.48	<0.001	6.57±1.60	<0.001	40.46±2.48	<0.001	31.40±3.30	<0.001
	Female	5,703 (66.4)	48.98±3.17		6.74±1.59		40.67±2.35		32.46±2.74	
Age group (years)	≤ 20	894 (10.4)	47.39±3.53	<0.001	6.44±1.73	<0.001	39.61±2.57	<0.001	30.99±3.54	<0.001
	21 - 30	2533 (29.5)	48.53±3.25		6.71±1.52		40.46±2.44		31.74±3.10	
	31 – 40	2978 (34.7)	49.01±3.10		6.74±1.60		40.79±2.33		32.36±2.81	
	41 - 50	1351 (15.8)	49.55±3.13		6.74±1.64		40.87±2.28		32.71±2.58	
	> 50	820 (9.6)	49.60±3.29		6.60±1.63		40.99±2.26		32.57±2.58	
Occupation	Healthcare-related	6,817 (79.4)	49.65±3.03	<0.001	7.06±1.22	<0.001	40.70±2.38	<0.001	31.81±2.64	0.046
	Non-healthcare-related	1,774 (20.6)	48.62±3.31		6.59±1.67		40.58±2.40		32.18±3.06	
Marital status	Single	3,544 (41.3)	48.32±3.37	<0.001	6.62±1.57	0.003	40.30±2.49	<0.001	31.53±3.27	<0.001
	Married	5,047 (58.7)	48.19±3.17		6.06±1.62		40.81±2.31		32.51±3.70	
Number of household members	≤4	7,109 (82.7)	48.88±3.24	0.003	6.69±1.58	<0.001	40.67±2.37	<0.001	32.15±2.91	0.003
	≥5	1,482 (17.3)	48.59±3.47		6.63±1.68		40.38±2.53		31.88±3.31	
Level of education	Illiterate	12 (0.1)	45.50±4.38	<0.001	5.25±2.73	<0.001	38.58±2.77	<0.001	29.25±5.77	<0.001
	Under diploma	536 (6.2)	47.21±4.02		6.05±2.05		39.77±2.89		31.44±3.50	
	Diploma	1,590 (18.5)	48.38±3.45		6.45±1.83		40.39±2.47		32.06±3.21	
	Academic	6,453 (75.1)	49.09±3.12		6.80±1.47		40.73±2.32		32.18±2.86	
Living place	Apartment	5,164 (60.1)	48.90±3.20	0.082	6.71±1.56	0.013	40.69±2.33	<0.001	32.25±2.82	<0.001
	House, Villa	3,238 (37.7)	48.74±3.39		6.63±1.68		40.48±2.48		31.95±3.16	
	Dorm	189 (2.2)	48.70±3.45		6.88±1.38		40.22±2.83		30.68±3.61	

*ANOVA or independent sample t-test analysis; P: P value; N: Total number of cases

Results

Demographic Information

In our study, 25026 individuals viewed the link and questionnaire; however, only 8591 (47%) completed questionnaires were received from the participants. The mean age of participants was 34.37 years old (SD=11.25; range: 15-87). Among the participants, 5703 (66.4%) were female, 1774 (79.4%) had non-healthcare-related occupations, 5047 (58.7%) were married, and 6453 (75.1%) had an academic degree. Also, 5164 (60.1%) participants lived in apartments, and 7109 (82.7%) had 4 or fewer household members. Also, 1950 (22.7%) participants had a history of traveling in the last month, and 430 (5%) reported having a family member infected with SARS-CoV-2.

Knowledge of COVID-19

The questions regarding participants' knowledge

of COVID-19 were divided into two sections; one considers their understanding of the characteristics of the disease (Knowledge Test A), and the other one considers what they knew about the transmission routes and groups at higher risk of the illness (Knowledge Test B). Based on our results, nearly half of the general population had moderate knowledge about the disease (46.5% for Knowledge Test A and 56.2% for Knowledge Test B). The knowledge mean score was 48.8 and 6.8, suggesting an overall 90% and 85% correct rate for knowledge A and B tests, respectively (Table 1). Our study's knowledge scores (both A and B) were considerably variable among age groups, genders, marital status, occupation, education levels, and the number of individuals living together. However, regarding the individuals' living place, only the knowledge B test had a significant association (Table 2). Based on multiple regression analysis, being male, having non-healthcare related professions, being single, and having a lower level of education

were significantly associated with lower scores in knowledge A and B test. The participants' age was only significantly associated with lower scores in knowledge test A (P<0.001) (Table 3).

Attitude towards COVID-19

The mean score for the correct answer to the 15 questions regarding the attitude towards COVID-19 rate was 40.6 (SD=2.4, range 15-45), suggesting an overall 90% correct rate in this test. Most participants (60.8%) had a moderate attitude toward COVID-19. Attitude scores significantly differed across age groups, genders, occupations, marital status, education levels, living places, and the number of individuals residing together (Table 2). Multiple regression analysis showed that age, being male, having a lower level of education, being single, and having a higher number of household members were significantly associated with having a poorer attitude toward COVID-19 (P<0.01) (Table 3).

Practice towards COVID-19

Based on our results, the mean score for the correct answer to the 12 questions regarding the rate of the COVID-19 practice was 32.1 (SD=2.9, range: 12-36), suggesting an overall 89% correct rate in the practices test. Most participants (71.3%) had moderate practice toward COVID-19. Practice scores significantly varied across genders, age groups, occupations, marital status, education levels, living places, and the number of individuals residing together (Table 2). Multiple regression analysis showed that age (as increasing years, β=0.040, P<0.001), male gender, being single, having health-care-related occupations, and lower levels of education were significantly associated with poorer practice (Table 3).

Based on our data and the participants' KAP scores toward COVID-19, there was a significant association between the participants' knowledge, attitude, and practice (P<0.001) (Table 4).

Geographical Information Regarding KAP towards COVID-19

Participants from the Northern Khorasan province, northeast of Iran, had the highest level of knowledge about COVID-19 (43.8% and 50% for

Table 3: Multiple regression of association between demographic characteristics with knowledge A, knowledge B, attitude, and practice scores of COVID-19 in the Iranian population (N=8591)

Variables	Knowledge A			Knowledge B			Attitude			Practice		
	Coefficient (95%)	P	VIF	Coefficient (95%)	P	VIF	Coefficient (95%)	P	VIF	Coefficient (95%)	P	VIF
Age (Year)	0.040 (0.033 to 0.047)	<0.001	1.412	0.002 (-0.006 to 0.001)	0.223	1.412	0.021 (0.016 to 0.027)	<0.001	1.412	0.030 (0.023 to 0.036)	<0.001	1.412
Sex (Male/ Female)	-0.428 (-0.571 to -0.286)	<0.001	1.007	-0.155 (-0.226 to -0.084)	<0.001	1.007	-0.229 (-0.335 to -0.122)	<0.001	1.007	-1.098 (-1.227 to -0.969)	<0.001	1.007
Job (Non-health-related/ Health-related)	-0.900 (-1.070 to -0.729)	<0.001	1.058	- 0.380 (-0.465 to -0.295)	<0.001	1.058	-0.038 (-0.165 to 0.089)	0.559	1.058	0.437 (0.282 to 0.592)	<0.001	1.058
Marital status (Single/ Married)	-0.371 (-0.533 to -0.208)	<0.001	1.422	- 0.109 (-0.190 to -0.028)	0.014	1.422	-0.188 (-0.309 to -0.066)	0.002	1.422	-0.526 (-0.673 to -0.378)	<0.001	1.422
Level of education	0.599 (0.480 to 0.717)	<0.001	1.078	0.307 (0.248 to 0.366)	<0.001	1.078	0.354 (0.266 to 0.443)	<0.001	1.078	0.238 (0.131 to 0.345)	<0.001	1.078
Living place (Apartment/ House)	0.050 (-0.092 to 0.192)	0.502	1.057	-0.024 (-0.095 to 0.046)	0.470	1.057	-0.060 (-0.167 to 0.046)	0.258	1.057	-0.120 (-0.249 to 0.009)	0.069	1.057
Number of household members (≥5/≤4)	-0.014 (-0.198 to 0.170)	0.880	1.069	-0.008 (-0.100 to 0.083)	0.860	1.069	-0.230 (-0.367 to -0.093)	0.001	1.069	-0.015 (-0.182 to 0.152)	0.858	1.069

VIF: Variance inflation factor; P: P value

Table 4: Correlation scatter among knowledge, attitude, and practice in the Iranian general population (N=8591)

Variables; Pearson Correlation; Sig. (2-tailed)	Knowledge A	Knowledge B	Attitude	Practice
Knowledge A	1; <0.001	0.216; <0.001	0.191; <0.001	0.179; <0.001
Knowledge B	0.216; <0.001	1; <0.001	0.049; <0.001	0.046; <0.001
Attitude	0.191; <0.001	0.049; <0.001	1; <0.001	0.203; <0.001
Practice	0.179; <0.001	0.046; <0.001	0.203; <0.001	1; <0.001

knowledge tests A and B, respectively), while those from Kurdistan province, northwest of Iran (achieving 12% knowledge test A) and Ilam province, western Iran (achieving 16.7% for knowledge test B) had the lowest levels of knowledge toward COVID-19. The most positive attitude (10.9%) toward COVID-19 was among participants from Alborz province, western Iran; the lowest score was among Kurdistan Province, northwest Iran, Northern Khorasan, Northeast Iran, and Ardabil, Northwest Iran. The most positive practice towards COVID-19 was among Semnan Province participants, northern Iran (38.1%); the lowest was seen in Hamedan Province, west-central Iran (5.6%). Figure 1 demonstrates data regarding KAP toward COVID-19 among participants from different Provinces of Iran.

Source of Information

Participants were asked where they obtained their disease-related information. The findings showed that social media and the internet accounted for 82.9% of their information, family and friends 52.7%, scientific articles and journals 47.7%, healthcare providers 67.4%, and news media 46.4%. Based on our results, the highest trust among platforms' users was toward scientific articles and journals (79.3%), followed by healthcare providers (77.9%). Among the news media users, the majority (40%) distrusted of the information received. Among the social media and internet users,

the majority (38.7%) had moderate trust, and among the individuals who received their information from family and friends, the majority (45%) had average trust toward the received data (Table 5).

Based on our data regarding the source of information among the participants, there was a significant association between platforms' use and the participants' reliability towards them. Also, participants, whose information sources weresocial media, scientific articles and journals, and healthcare workers, had a significantly higher knowledge of the disease (P≤0.001). Furthermore, news media users had significantly lower knowledge of transfer routes and groups at higher risk regarding COVID-19 (P=0.006).

Our results show that those who obtained their information mostly from any source had significantly higher scores regarding attitude and practice toward the disease.

Discussion

To the best of our knowledge, our data contains the most preliminary data among all studies regarding KAP towards COVID-19 amongst the general Iranian population during the early period of the outbreak of the disease in the country. Based on our findings, the KAP toward COVID-19 score was significantly higher among females, married people, and those with higher education.
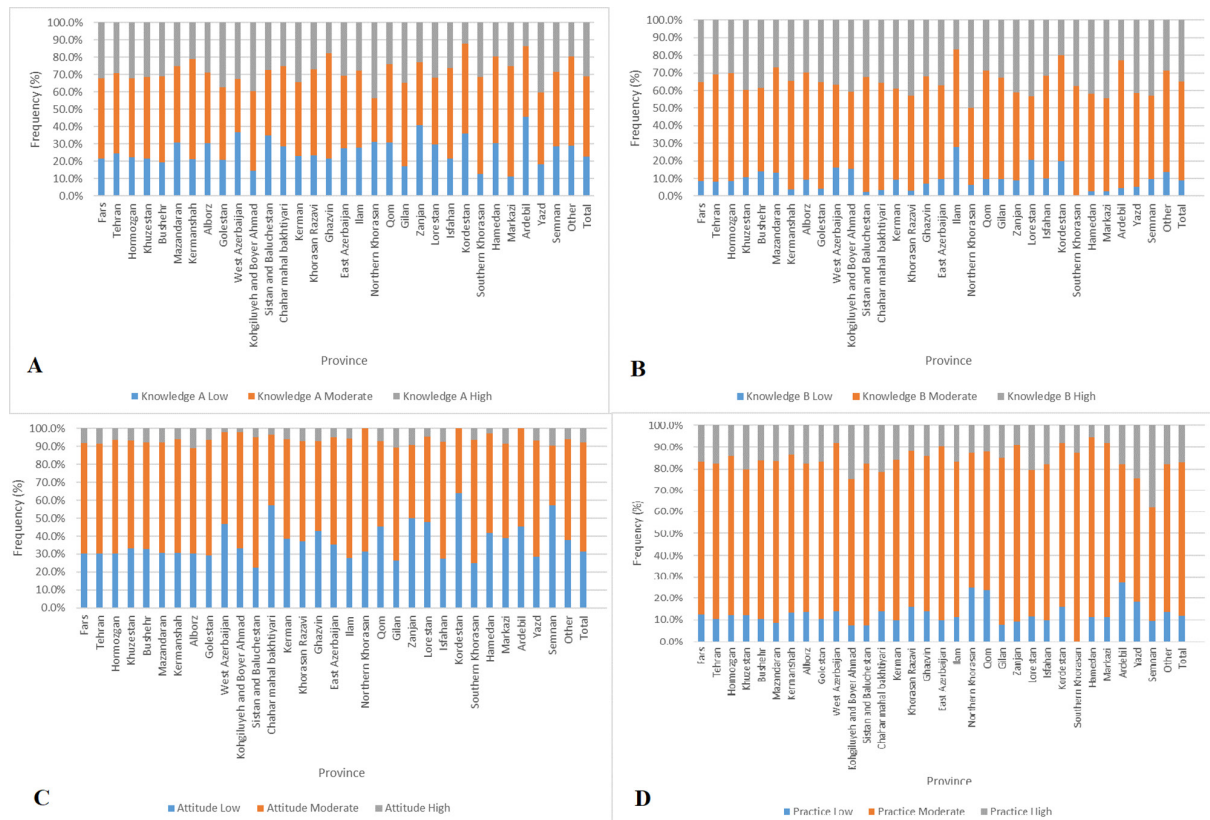

Figure 1: Distribution of A: Knowledge A, B: Knowledge B, C: Attitude, and D: Practice among the general population of different provinces of Iran.

Table 5: Source of information among the general public and its association with reliability, knowledge, attitude, and practice. (N=8591)

Media	User; N=8591	Trust towards Source			P*	Knowledge A	P*	Knowledge B	P*	Attitude	P*	Practice	P*
		Low (%)	Moderate (%)	High (%)									
News media	No (4604)	4188 (91)	275 (6)	141 (3.1)	<0.001	48.77±3.3	0.059	6.73±1.5	0.006	40.46±2.4	<0.001	31.39±3.1	<0.001
	Yes (3987)	1593 (40)	1153 (28.9)	1241 (31.1)		48.91±3.3		6.63±1.7		40.77±2.4		32.32±2.9	
Social media and the internet	No (1472)	1254 (85.2)	144 (9.8)	74 (5)	<0.001	48.47±3.6	<0.001	6.52±1.8	<0.001	40.19±2.6	<0.001	31.39±3.1	<0.001
	Yes (7119)	1912 (26.9)	2756 (38.7)	2451 (34.4)		48.91±3.2		6.72±1.6		40.69±2.4		31.39±3.1	
Family/ friends	No (4028)	3435 (85.3)	403 (10)	190 (4.7)	<0.001	48.82±3.4	0.707	6.71±1.6	0.166	40.53±2.4	0.004	31.92±3.1	<0.001
	Yes (4501)	1234 (27.4)	2027 (45)	1240 (27.5)		48.85±3.2		6.66±1.6		40.68±2.4		32.27±3.1	
Scientific Articles/ Journals	No (4457)	2333 (52.3)	625 (14)	1499 (33.6)	<0.001	48.63±3.3	<0.001	6.63±1.5	0.001	40.48±2.5	<0.001	31.84±3.2	<0.001
	Yes (4095)	120 (2.9)	728 (17.8)	3247 (79.3)		49.06±3.2		6.74±1.5		40.74±2.3		32.39±2.6	
Health care providers	No (2797)	1139 (40.7)	497 (17.8)	1161 (41.5)	<0.001	48.48±3.3	<0.001	6.58±1.7	<0.001	40.29±2.5	<0.001	31.67±3.1	<0.001
	Yes (5794)	172 (3)	1106 (19.1)	4516 (77.9)		49.00±3.2		6.74±1.6		40.75±2.3		32.31±3.1	

*Chi-square or ANOVA/independent sample t-test analysis; P: P value

Since our data collection and publication of our report, various studies have been done regarding the evaluation of Iranian citizens' knowledge, attitude, and practice toward COVID-19, which almost all reported high scores.[19-21, 24-27] It is worth mentioning that our study was the earliest among all reported studies to date. Parallel to our results, many studies highlighted that females had higher knowledge[20-27] and more positive attitudes and practice[14, 15] toward COVID-19 compared to males.[21] Moreover, in other studies done in Iran, those with higher education had higher knowledge,[19, 21, 26, 27] and more positive practice.[21] Our results were also confirmed by a study by Ghaderi et al., who reported higher age to be associated with higher knowledge and more positive practice.[28] In contrast, another study by Honarvar et al. reported that older participants had lower knowledge.[21] This finding may be because the face-to-face interview, which facilitated access to individuals without internet access and also lower educational and illiterate populations. which Including only participants with internet access was among the limitations of our study. In line with our results, Shahbaznejad et al. demonstrated that having higher knowledge is followed by safer practice, which emphasizes the importance of raising awareness during pandemic to break the chain of the viral transmission.[25]

Based on a recent meta-analysis regarding the Global epidemiology of KAP toward COVID-19 KAP, the estimated overall correct answers for knowledge, good attitude, and good practice were 75%, 74%, and 70%, respectively.[18] Our study demonstrated higher scores in all three aspects; however, both studies have reported men, lower age, and lower education associated with lowest practice scores.

Based on the participants' knowledge scores, a correct overall rate of 90% and 85% demonstrated that most participants are knowledgeable about COVID-19. Our results were similar to a previous study regarding the KAP towards COVID-19 in China,[29] which also showed a correct overall rate of 90% knowledge among the Chinese; however, a lower knowledge regarding the transmission routes and groups at higher risk was achieved among the general population of Iran (85% for knowledge test B).

The high correct answer rate regarding knowledge of COVID-19 among the Iranian population is partly rooted in their high exposure to the information provided by the government and media about the virus since the start of the outbreak. Another reason could be that 75.1% of the participants held an academic degree and responded actively to the pandemic's severe condition and the overwhelming news reports by collecting information from reliable sources. This finding is supported by the considerably positive correlation between the level of education and knowledge regarding COVID-19 and is similar to the results of other studies in this regard.[29]

Compared to a study about KAP toward COVID-19 among northern Thailand's bordered population in the early period of the outbreak, Iranians under investigation demonstrated higher KAP toward COVID-19.[30] In Thailand, 73.4% had poor knowledge of disease prevention and control, while in our study, 22.6% showed poor knowledge in test A, and

9% demonstrated insufficient knowledge in test B. Furthermore, in the Thailand study, 28.5% had a poor attitude toward disease prevention and control, whereas in our study, 31.4% had a poor attitude toward COVID-19. In Thailand, only 13.6% had proper skills to prevent and control the disease, while in Iran, 16.7% showed excellent practice scores in our study. The underlying reason for these score differences could be the period and the place the two studies were conducted. In Iran, the research was done at the time of the main phase of the outbreak when the population was exposed to much information about the disease, its route transmission, and prevention ways, whereas in Thailand, the study was done on the people who were not seriously affected by the outbreak.

Furthermore, our study showed that a higher knowledge score regarding COVID-19 was significantly associated with a higher chance of having a positive attitude and good practices during the COVID-19 pandemic. These results show the significance of improving the general population's knowledge regarding COVID-19 through health education programs, enhancing their attitude and practice regarding COVID-19. Our findings of the demographic variables related to KAP concerning COVID-19 are similar to previous KAP studies regarding SARS and COVID-19 in China.[29, 31] Based on these findings, to improve health education support programs regarding the knowledge of COVID-19, more targeted approaches for specific demographic groups such as single men, young people, and those with lower education are required.

Our study showed that, compared to non-healthcare workers, healthcare professionals have higher knowledge about COVID-19. This finding could be because of their access and exposure to more reliable information sources such as healthcare authorities and medical journals. However, our findings contradicted a study by Bhagavathula et al., which reported a significant gap between the high amount of knowledge healthcare workers are exposed to and the actual knowledge they have obtained regarding COVID-19.[32] This finding was particularly true regarding the disease's mode of transmission and incubation period. In our study, however, the average score of healthcare-related workers regarding the transmission route was 88% (vs. 82% in non-healthcare-related workers).

However, our study showed that non-healthcare-related professionals had higher practice scores toward COVID-19 than healthcare-related ones. Due to the increasing number of cases and mortalities of COVID-19 worldwide, healthcare professionals need to assimilate COVID-19-related knowledge and practice because they are more likely to have contact with infected subjects.[32-34]

Relying on authentic sources is a crucial factor in understanding COVID-19, especially for healthcare professionals, as they need to be prepared and respond actively during the outbreak. However, it was found that 60% of healthcare workers use social media as a source of information. Currently, the vast diversity of information available through the internet, including unverified malicious information, can spread quickly and misguide healthcare workers. In this regard, health authorities and scientists have warned against general wrong information about COVID-19 since it is a severe concern causing xenophobia.[35-38]

Our study showed that most participants (82.9%) obtained information from social media and the Internet. Also, there was a significant correlation between having higher knowledge of the disease and healthcare workers whose source of information was social media and scientific articles and journals. In this regard, healthcare-related professionals should carefully evaluate COVID-19-related information and use scientific and authentic materials as their source of information.

Zhou et al., via sensitivity analysis, suggested that, during the early phase of the COVID-19 outbreak, enhancing the response rate of the media reporting the severity of COVID-19, as well as increasing the response rate of the public awareness of the media reports, both can significantly bring forward the peak time and reduce the peak size of the infection. These findings suggested that besides improving medical help, media coverage can be considered an effective way to mitigate the disease spreading during the initial stages of an outbreak.[39]

The overall attitude score toward COVID-19 was 90% among the Iranian population under study. This score was significantly lower among young, single, and male individuals with lower education and more crowded households. Based on the questionnaire results, most participants agreed with quarantining, locking down cities, restricting travel, and closing educational centers and religious sites (96%, 96.8%, 99.3%, and 98.5%, respectively). Previous experience with the SARS virus showed that extensive implementation of traditional public health measures in the absence of vaccines and antiviral treatment completely interrupted human-to-human transmission and eradicated the virus. In this closely related virus, taking such actions is necessary to prevent the person-to-person spread of the disease by separating people to interrupt transmission and curb the epidemic of this respiratory disease. The tools we have at hand are isolation and quarantine, social distancing, and community containment. All these tools are currently being employed at an unprecedentedly massive scale in China.[40] However, despite the association between good attitudes and good practice, only 85% of the residents avoided leaving their houses. Further practice implementation and encouragement from the government are required to transform these well-adjusted attitudes into proper practice.

Based on the overall practice score (89%), most participants took precautions to avoid contamination by COVID-19. It could be primarily attributed to the government's vast broadcasting and good knowledge considering the high infectivity and easy transmission of the COVID-19 virus through droplets. However, these scores were lower than practice scores toward COVID-19 among Chinese residents.[29] The present study showed that 25% did not wear masks in public places, and 9.6% didn't limit their commuting during the outbreak. These potentially unsafe practices were associated with male gender, older age, lower education, being single, and poor COVID-19 knowledge. Previous studies also supported this suggestion that men and late adolescents should be engaged in risk-taking behaviors.[41-43]

Strengths and Limitations

Among our study's strengths, one can name the significant number of participants during the early days of this public health emergency, with an over-representation of females and higher-educated individuals. Since educational attainment and occupation are frequently proxy measures of socioeconomic status,[44] our results can only be comprehensive to relatively high socioeconomic status, particularly female Iranians. In addition to the limited sample representativeness, another limitation of our study can be the web-based approach adopted for this study. The authors understood that in this method, the mentioned population would hold a selection bias and could not represent the general population; however, it was the optimum approach during this critical period to limit the disease spread. Since COVID-19 can be transmitted via droplets or close contacts, this approach was chosen to decrease transmission chances; however, some biases, such as lack of internet access and illiteracy, affected the results, so further studies should focus more on underprivileged and remote rural people.

Conclusion

Our findings suggest that the general Iranian population demonstrated good knowledge, positive attitudes, and reasonable practice regarding COVID-19 during the outbreak. Furthermore, based on the significant positive association among knowledge, attitude, and practice in our study, health education programs, mainly targeting lower-knowledge individuals regarding COVID-19, are essential for encouraging a positive attitude and maintaining safe practices. Hopefully, by increasing knowledge via public health policymakers and the cooperation of the Iranian authorities and the general population, optimistic control and elimination of the disease can be anticipated. However, more studies are necessary to investigate the KAP toward COVID-19 among Iranians with low socioeconomic status

Ethical Approval and Consent to Participate

Available Data and Materials

Data are attached as supplementary materials, and information related to the study is in the manuscript. Please get in touch with the corresponding author for any further data. The questionnaire of this study has also been added as supplementary data for further use in other studies.

Acknowledgment

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Supplementary Table 1: Questionnaire regarding the Knowledge, attitude and practice questionnaire towards the novel corona virus 2019 (COVID-19).

Questions		Answers (No: %)
Knowledge		
K1	I have heard about COVID-19	True* (7335: 85.4%) False (1184:13.8%) No opinion (71:0.8%)
K2	COVID-19 is a contagious disease	True* (7971: 92.8%) False (265: 3.1%) No opinion (355:4.1%)
K3	Which of the following is the cause of COVID-19?	Bacteria (38:0.4%) Virus* (8058:93.8%) Fungi (5:0.1%) Parasite (4: 0%) Immunodeficiency (391: 4.6%) No opinion (95:1.1%)
K4	How long is the incubation period of the disease?	Less than 2 days (44: 0.5%) 2 to 5 days (384: 4.5%) 3 to 14 days* (7891: 91.9%) No opinion (272:3.2%)
K5	Which of the following is the treatment for COVID-19?	Symptomatic therapy* (3566:41.5%) Antibiotics (197:2.3%) No treatment (3863:45%) No opinion (965: 11.2%)
K6	In which age group is the disease more dangerous?	Under 15 years (28: 0.3%) 15 to 30 years (54: 0.6%) 30 to 50 years (454: 5.3%) Above 50 years* (8055:93.8%) No opinion (0: 0%)
K7	Fever is a symptom of COVID-19	True* (8591: 97.5%) False (143: 1.7%) No opinion (73: 0.8%)
K8	Cough is a symptom of COVID-19	True* (8400: 97.8%) False (132: 1.5%) No opinion (59: 0.7%)
K9	Sore throat is a symptom of COVID-19	True* (5804: 67.6%) False (2029:23.6%) No opinion (758:8.8%)
K10	Body pain is a symptom of COVID-19	True* (6853: 79.8) False (1055:12.3%) No opinion (683: 8%)
K11	Diarrhea or constipation is a symptom of COVID-19	True* (4015: 46.7%) False (3070: 35.7%) No opinion (1506: 17.5%)
K12	Headache is a symptom of COVID-19	True* (6239: 72.6%) False (1359: 15.8%) No opinion (993: 11.6%)
K13	In suspecting infection with COVID-19, primarily I will measure fever	True* (7858: 91.5%) False (457: 5.3%) No opinion (276: 3.2%)
K14	In suspecting infection with COVID-19, primarily I will visit a physician	True (7231: 84.2%) False* (1360: 15.8%) No opinion (0: 0%)
K15	In suspecting infection with COVID-19, I will avoid unnecessary daily activities	True* (6620: 77.1%) False (1409: 16.4%) No opinion (562: 6.5%)
K16	To avoid contracting COVID-19, I avoid contact with individuals suspected to be infected with COVID-19	True* (8392: 97.7%) False (199: 2.3%) No opinion (0: 0%)

Questions		Answers (No: %)
K17	The prevalence of COVID-19 disease is increasing in Iran	True* (8178: 95.2%) False (112: 1.3%) No opinion (301: 3.5%)
K18	Washing hands with water and soap can eliminate the disease cause	True* (7987: 93%) False (337: 3.9%) No opinion (267: 3.1%)
K19	The disease can be transmitted directly through cough	True* (960: 11.2%) False (7631: 88.8%)
K20	The disease can be transmitted directly through contact with infected surfaces	True* (7794: 90.7%) False (797:9.3%)
K21	The disease can be transmitted directly through the consumption of contaminated dairy and meat	True (3773:43.9%) False* (4818: 56.1%)
K22	The disease can be transmitted directly through contact with infected individuals (handshaking, hugging, kissing)	True* (8186: 95.3%) False (405:4.7%)
K23	The disease is more dangerous in pregnant women	True* (5848: 68.1%) False (2743: 31.9%)
K24	The disease is more dangerous is old individuals	True* (8017: 93.3%) False (574: 6.7%)
K25	The disease is more dangerous in people with weakened immune systems	True* (8109: 94.4%) False (482: 5.6%)
K26	The disease is more dangerous is people with cancer, diabetes, and chronic respiratory diseases	True* (8109: 94.4%) False (482: 5.6%)
Attitude		
A1	It is my opinion that early detection of COVID-19 can improve treatment and outcome	True* (7282: 84.8) False (576: 6.7%) No opinion (733: 8.5%)
A2	It is my opinion that COVID-19 can be treated at home	True* (4830: 56.2%) False (2328: 27.1%) No opinion (1433: 16.7%)
A3	It is my opinion that health education can help prevent COVID-19	True* (8373: 97.5%) False (82: 1%) No opinion (136: 1.6%)
A4	It is my opinion that COVID-19 is a serious disease	True* (6664: 77.6%) False (1132: 13.2%) No opinion (795: 9.3%)
A5	It is my opinion that that COVID-19 can be avoided by proper percussion	True* (8078: 94%) False (159: 1.9%) No opinion (354: 4.1%)
A6	It is my opinion that if there is an available vaccine for the disease, It should be used	True* (7398: 86.1%) False (604: 7%) No opinion (589: 6.9%)
A7	It is my opinion that COVID-19 is a curable disease	True* (5840: 68%) False (1403: 16.3%) No opinion (1348: 15.7%)
A8	It is my opinion that the awareness considering COVID-19 disease in society is necessary.	True* (3388:39.4%) False (4300: 50.1%) No opinion (10.5%)
A9	It is my opinion that COVID-19 disease results in death in all cases	True (189: 2.2%) False* (8041:93.6%) No opinion (361: 4.2%)
A10	It is my opinion that COVID-19 disease can be transmitted through household pets to humans	True (3325: 38.7%) False* (3886: 45.2%) No opinion (1380: 16.1%)
A11	It is my opinion that authorities should restrict travel to and from COVID-19 disease areas to prevent contamination.	True* (8317: 96.8%) False (114: 1.3%) No opinion (160: 1.9%)
A12	It is my opinion that authorities should quarantine COVID-19 patients in special hospitals	True* (8309: 96.7%) False (120: 1.4%) No opinion (162: 1.9%)
A13	It is my opinion that in the event of an increase in the number of cases of COVID-19, authorities should be ready to close educational centers (kindergartens, schools, and universities).	True* (8533: 99.3%) False (23: 0.3%) No opinion (35: 0.4%)
A14	It is my opinion that authorities should be prepared to restrict access to religious sites, shrines, and mosques if the number of COVID-19 cases increases.	True* (8462: 98.5%) False (64: 0.7%) No opinion (65: 0.8%)

Questions		Answers (No: %)
A15	It is my opinion that if the number of COVID-19 cases increases, authorities should be ready to lock down and quarantine the city to reduce infection transmission	True* (8245: 96%) False (148: 1.7%) No opinion (198.2.3%)
Practice		
P1	In order to prevent contracting and spreading COVID-19, I avoid going out of my home	True* (7331: 85.3%) False (829: 9.6%) No opinion (431: 5%)
P2	In order to prevent contracting and spreading COVID-19, I avoid unnecessary vacations	True* (8463: 98.5%) False (62: 0.7%) No opinion (66: 0.8%)
P3	In order to prevent contracting and spreading COVID-19, I avoid consuming outdoor food	True* (8157: 94.9%) False (254: 3%) No opinion (180: 2.1%)
P4	In order to prevent contracting and spreading COVID-19 I avoid handshaking, hugging and kissing	True* (8466: 98.5%) False (75: 0.9%) No opinion (50: 0.6%)
P5	In order to prevent contracting and spreading COVID-19, I avoid public transportations (taxi, bus, subway, plane, train)	True* (7955: 92.6%) False (383: 4.5%) No opinion (253: 2.9%)
P6	In order to prevent contracting and spreading COVID-19, I avoid going to work	True* (5465: 63.6%) False (2234: 26%) No opinion (892: 10.4%)
P7	In order to prevent contracting and spreading COVID-19, I frequently wash my hands	True* (8467: 98.6%) False (77: 0.9%) No opinion (47: 0.5%)
P8	In order to prevent contracting and spreading COVID-19, I pay more attention to my personal hygiene than usual	True* (8296: 96.6%) False (75: 0.9%) No opinion (220: 2.6%)
P9	In order to prevent contracting and spreading COVID-19, I use disinfectant and solutions	True* (7989: 93%) False (467: 5.4%) No opinion (135: 1.6%)
P10	In order to prevent contracting COVID-19, I use herbal products and traditional medicine	True* (3440: 40%) False (4235: 49.4%) No opinion (916: 10.7%)
P11	In order to prevent contracting COVID-19, I take vitamin supplements	True* (5677: 66.1%) False (2408: 28%) No opinion (506: 5.9%)
P12	In order to prevent contracting and spreading COVID-19, when do you use facial masks?	Never (2149: 25%) Only in public and crowded places* (4700: 54.7%) Most of the time even in none-public and crowded places (1220:14.2%) Always (315: 3.7%) No opinion (207:2.4%)

*Indicator of the correct answer