

Knowledge, attitude, and practice toward COVID-19 among the public in three Gulf countries – a cross-sectional survey

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Abstract. – OBJECTIVE: This study investigated the knowledge, attitude, and practice toward COVID-19 among residents/citizens of Saudi Arabia (KSA), the United Arab Emirates (UAE), and Kuwait.

PATIENTS AND METHODS: A cross-sectional online survey on 3,920 citizens/residents from three Gulf-countries (KSA, UAE, and Kuwait) was conducted between June 15 and August 25, 2020. The survey instrument consisted of demographic characteristics, 13 items on knowledge, 4 items on attitudes, and 7 items on practice towards prevention and control of COVID-19. The Survey link was constructed to be available in Arabic and English. Descriptive statistics of frequency distribution and percentages were calculated, and non-parametric tests were applied to compare the mean knowledge, attitude, and practice scores among different countries.

RESULTS: This study included participants from KSA (2,938, 74.9%), UAE (403, 10.3%), and Kuwait (579, 14.8%). The study subjects from KSA, UAE, and Kuwait showed significant differences in the mean knowledge (10.13, 10.52, and 9.19, $p<0.001$), attitude (2.84, 3.12, and 5.98, $p<0.001$), and practice (6.11, 5.98 and 5.38, $p<0.001$) scores towards COVID-19. In addition, Kuwaiti citizens and residents showed significantly lower knowledge, attitude, and practice scores toward COVID-19 than UAE and KSA participants. Participants from Kuwait showed significantly lower knowledge, attitude, and practice scores than the UAE and KSA. However, in general (38.2%), the study participants were optimistic about controlling Coronavirus. Nearly 48.6% started to take an immune-boosting diet to protect themselves from the Coronavirus.

CONCLUSIONS: Study participants from KSA, UAE, and Kuwait demonstrated adequate

knowledge, positive attitude, and acceptable practices towards COVID-19 control. Electronic and social media should be effectively utilized to spread awareness of COVID-19 among the public.

Key Words:

COVID-19, Knowledge, Attitude, Practice, Prevention, Gulf Countries.

Introduction

Coronavirus disease 2019 (abbreviated “COVID-19”) is an emerging respiratory disease caused by a novel coronavirus and was first detected in December 2019 in Wuhan, China¹. Patients present with prodromal symptoms of fever, myalgia, cough, and sore throat, which can become severe, and they can also flinch with shortness of breath and respiratory failure². COVID-19 differs with different patient groups, with the highest severity being reported among older people and those with comorbidity³. Although COVID-19 symptoms are mild, infectivity is higher than SARS-CoV and MERS-CoV⁴. The most convincing mode of transmission of COVID-19 is the inhalation of infectious aerosols. The incubation period is approximately 3-14 days. Humans have acquired the disease by either coming into direct contact with droplets, infected hands, or surfaces⁵. COVID-19 cases continue to be reported globally from over 170 countries, including KSA, Bahrain, Qatar, and Kuwait⁶. The evolving epidemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease (COVID-19) in China has been

brought to global attention and announced pandemic by the World Health Organization on March 11, 2020⁷.

Saudi Arabia and other gulf countries enforced movement regulations to mitigate the virus' spread to avoid overburdening the health-care system. Citizens and residents were only permitted to leave the house for essential activities such as buying foodstuff and seeking medical treatment. Moreover, all non-emergency dental treatments were also deferred due to the potential risk of virus transfer. Non-essential business activities were either closed or enabled to operate from home. Due to this novel virus' anonymity, there has been a great deal of doubt and misinformation regarding the virus itself, its dissemination, and the appropriate measures to deter and contain the infection. This is constantly challenging given the overwhelming volume of misinformation and disinformation spread on social media obscuring people's accurate understanding of COVID-19. Hence there was a need to investigate the public perception of COVID-19.

The theoretical framework for this study is based on the KAP (Knowledge, Attitude, and Practice) model⁸ established in 1960 to analyze changes in health behavior. According to this model, human behavior comprises three successive processes: acquiring knowledge, generating attitudes, and forming behaviors. Given KAP theory, the spread of COVID-19 would undoubtedly be influenced by people's behavioral practices and available knowledge and information essential to the action. KAP surveys are currently the most often utilized public health research studies to elucidate societal context in community health research^{1,9,10}. These surveys are simple to develop, their output is quantitative, their interpretation is robust, and their value for context-specific issues is generalizable¹¹. Hence, knowledge, attitudes, and practices regarding COVID-19 are crucial in assessing a community's willingness to adopt behavioral change interventions from health authorities in preventing and controlling the spread of COVID-19 in the Gulf region.

KAP studies offer specific details about the type of intervention expected to change misconceptions regarding COVID-19. Evaluating KAP relevant to COVID-19 among the general population would help to provide deeper insight into poor disease knowledge and the creation of prevention measures and health improvement

programs. The survey also gives a general picture concerning the prevention practices of COVID-19 in KSA, UAE, and Kuwait. Moreover, it enables effective tackling of the current and future health catastrophes involving infectious diseases by governmental agencies. The results of this study are important because they can help planning community-based activities that will help with pandemic control steps.

Hence, this study aimed at comparing the knowledge, attitude, and practices toward COVID-19 among citizens and residents of the Kingdom of Saudi Arabia, the United Arab Emirates, and Kuwait. It was hypothesized that there would be no difference in the mean knowledge, attitude, and practice scores of COVID-19 among citizens and residents of the KSA, UAE, and Kuwait.

Patients and Methods

Ethical Consideration

Ethical approval for the study was obtained from Riyadh Elm University, Riyadh, Saudi Arabia. The study proposal was registered (SRS/2020/30/207). The institutional review board reviewed the requirements and approved the study (SRS/2020/30/207/203) on June 7, 2020. Informed consent was obtained from all participants online, who were assured of privacy and confidentiality. Data were collected from the study participants anonymously.

Study Design

A cross-sectional survey was conducted among citizens and residents of KSA, UAE, and Kuwait from June 15 to August 25, 2020.

Sample Size Calculation

The sample size was calculated based on the acceptable margin of error of less than 5%, the confidence level of 95%, and the response distribution of 50% from the three countries (KSA, UAE, and Kuwait). Sample size calculation was performed by using the RaoSoft online sample size calculator.

Study Instrument

A structured, close-ended, self-administered questionnaire was sent to citizens and residents through social media platforms (WhatsApp and Twitter). A questionnaire consisting of 4 parts (demographic information, knowledge, attitude,

and practices) was prepared using the “Survey Monkey” application (California, USA). The questionnaire items were derived after reviewing published articles on the KAP on COVID-19 and the Center for Disease Control’s latest recommendations^{1,10,12,13}. The face validity of the questionnaire was established by taking the opinion of a dental public health expert. The forward and backward translation method was used to translate the questionnaire into Arabic. The questionnaire was pilot tested on 30 individuals to determine the Cronbach’s alpha coefficient, which was reported to be 0.73, suggesting that the questions had good internal consistency.

The questionnaire’s knowledge domain consisted of 13 questions eliciting clinical presentations, modes of transmission, prevention, and control of COVID-19. These items were answered on a “true/false/I do not know” option. A most appropriate answer was assigned a score of 1, and an incorrect/unknown answer was assigned a score of 0. The total knowledge domain score ranged from 0 to 13, with a higher score suggesting better knowledge of COVID-19. Similarly, attitude and practice scores ranged from 0-4 and 0-7, with a higher score indicating better attitude and practices towards preventing and controlling the COVID-19. The questionnaire was distributed among residents/citizens in KSA, UAE & Kuwait, and at the same time, 4 questions measured attitudes towards COVID-19. The assessment of respondents’ practices was composed of 7 items.

Questionnaire Administration

The questionnaire was converted to an electronic format utilizing the online survey monkey platform. Before proceeding to the next item on the questionnaire, each participant had to complete the previous one. We tested the electronic questionnaire’s functionality and response recording by distributing the link to 30 Saudi residents over WhatsApp, and a final version was developed and shared on different social media groups of residents/citizens of KSA, UAE, and Kuwait. There was no attempt to collect clinical information or individual identities. The excel spreadsheet with the participants’ replies was acquired from the survey monkey application. After eliminating insufficient and duplicate replies, data were coded and imported into statistical software. This survey adhered to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

Statistical Analysis

The data were analyzed using the statistical analysis software (version 25.0, IBM Corp., Armonk, NY, USA). Descriptive statistics of frequency distribution and percentages were calculated for the categorical variables. The Kolmogorov-Smirnov test was used to evaluate the normality distribution of data, and it was discovered that data were not normally distributed. Finally, the knowledge, attitude, and practice scores were calculated and compared using the Kruskal-Wallis and Mann-Whitney U tests. A value of $p < 0.05$ was kept significant for all statistical purposes.

Results

A total of 3,920 subjects with a mean age of 29.96 ± 9.87 years participated in this study. Out of the study participants, 2,938 (74.9%) were from KSA, 403 (10.3%) were from UAE, and 579 (14.8%) were from Kuwait. Nearly 3,461 (88.3%) of the study participants were citizens and stayed in urban areas 3,179 (81.1%). Most of the study participants were females, 2,336 (59.6%), and a large number had a university level of education 3,212 (81.95%). Nearly half, 1,928 (49.2%) of the study subjects, did not work or were unemployed. Most of the participants were not attached to the health sector (3,145, 80.2%), and a large percentage of study participants were not suffering from any health problems (3,281, 83.7%). The mean perceived seriousness of COVID-19 was 7.51 ± 2.01 (0-10 scale). The demographic variables of the study participants are shown in Table I.

Multiple response analysis indicated that Twitter (28.9%) was the primary source of information on COVID-19, followed by television (20.2%), government websites (16.7%), and other sources, as shown in Figure 1.

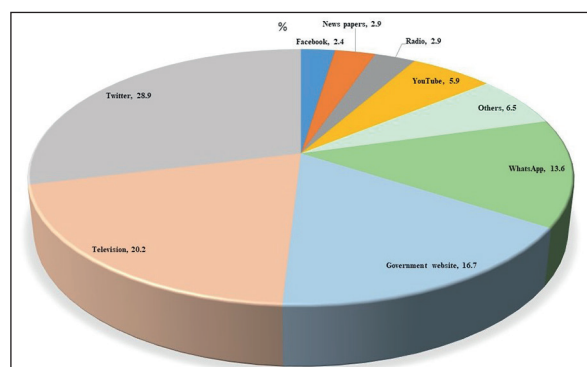
The correct answer rates of the 13 questions on the COVID-19 knowledge domain were 8.8-97.7%. The mean COVID-19 knowledge score was 10.3 (SD: 1.8, range: 0-13), indicating an overall 79.23% ($10.3/13 \times 100$) correct rate on this knowledge test. The lowest percentage (8.8%) of correct knowledge responses was observed with item number 5 (“eating or contacting wild animals would result in infection by the COVID-19 virus”), while the highest percentages of correct responses (97.7%) were observed with item K12 (“isolation and treatment of people infected with the COVID-19 virus effectively reduce the virus’ spread”). The correct

Table I. Demographic variables (n = 3,920).

Variables		N	%
Country	KSA	2,938	74.9%
	UAE	403	10.3%
	Kuwait	579	14.8%
Resident type	Citizen	3,461	88.3%
	Resident	459	11.7%
Resident Area	Urban	3,179	81.1%
	Rural	741	18.9%
Gender	Male	1,584	40.4%
	Female	2,336	59.6%
Education	Primary	7	0.18%
	Intermediate	33	0.83%
	Secondary	668	17.04%
Occupation	University	3,212	81.95%
	Government Employee	1,250	31.9%
	Private/self-employed business	742	18.9%
Marital status	Don't work/unemployed	1,928	49.2%
	Married	1,755	44.8%
	Single	2,165	55.2%
Do you study/work in health care	No	3,145	80.2%
	Studying health science	400	10.2%
	Work in healthcare	375	9.6%
Do you suffer from any health problem	Yes	639	16.3%
	No	3,281	83.7%
Age (Mean $\pm$ SD)	29.96 $\pm$ 9.87 Years		
Perceived seriousness of COVID-19	7.51 $\pm$ 2.01 (1-10 scale)		

knowledge response rate of KSA (78%), UAE (80.9%), and Kuwaiti (70.7%) study participants were observed (Table II).

Four questions assessed the attitude of the research participants towards the control of COVID-19 in their respective countries. An average right attitude answer rate of 71.3% was observed among the research participants. The correct answers to attitude ranged between 38.2% and 90.2%. The highest percentage (77.9%) of correct attitude response was observed in the UAE, followed by KSA (70.9%) and Kuwait (63.3%), as shown in Table III.


Figure 1. Source of information on COVID-19 among study participants (Multiple response analysis n=11258).

7 questions assessed the practice of the research participants toward the prevention and control measures of COVID-19. The average correct practice answer of 85.56% was observed among the research participants. The correct answers to practice ranged between 48.6% and 97.4% (Table IV). The highest percentage of correct practice responses of (87.3%) was observed in KSA, followed by UAE (85.4%) and Kuwait (76.9%), as shown in Table IV.

When mean knowledge scores were compared across study participants from KSA (10.13 $\pm$ 1.65), UAE (10.52 $\pm$ 1.80), and Kuwait (6.11 $\pm$ 0.96), a statistically significant difference was observed ($p<0.001$). The study subjects from UAE demonstrated significantly higher mean knowledge scores toward COVID-19 when compared to the KSA and UAE. Similarly, a comparison of the mean attitude score of study subjects of KSA (2.84 $\pm$ 1.06), UAE (3.12 $\pm$ 0.91), and Kuwait (2.53 $\pm$ 1.1) showed a significant difference ($p<0.001$). The UAE study subjects exhibited a significantly higher mean attitude score than the KSA and Kuwait. In contrast, study participants from Kuwait showed significantly lower mean attitude scores towards COVID-19 prevention

Table II. Knowledge items with correct responses of the study participants (n=3,920).

Items	Correct reponses	Responses type		
K1. The main clinical symptoms of COVID-19 are fever, fatigue, dry cough, dry cough, and chills repeated shaking with chills, muscle pain, headaches, and a sore throat.	83.3%	T	F	IDK
K2. Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus.	63.4%	T	F	IDK
K3. Currently, there is no effective cure for COVID-19, but early symptomatic and supportive treatment can help most patients recover from the infection.	88.5%	T	F	IDK
K4. Not all persons with COVID-19 will develop to severe cases. Only those who are elderly, have chronic illnesses, and are obese are more likely to be severe cases.	58.0%	T	F	IDK
K5. Eating or contacting wild animals would result in the infection by the COVID-19 virus.	8.8%	T	F	IDK
K6. Persons with COVID-19 cannot transmit the virus to others when a fever is not present.	71.5%	T	F	IDK
K7. The COVID-19 virus spreads via respiratory droplets of infected individuals.	82.2%	T	F	IDK
K8. Ordinary People can wear general medical masks to prevent the infection by the COVID-19 virus.	85.3%	T	F	IDK
K9. It is not necessary for children and young adults to take measures to prevent the infection by the COVID-19 virus.	95.5%	T	F	IDK
K10. To prevent the infection of COVID-19, individuals should avoid going to crowded places such as train stations and avoid taking public transportations.	95.7%	T	F	IDK
K11. To prevent of infection by COVID-19, individuals should gargle or inhale disinfectant frequently	77.4%	T	F	IDK
K12. Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	97.7%	T	F	IDK
K13. People who have contact with someone infected with the COVID-19 observation period is 14 days.	96.1%	T	F	IDK

Total average correct responses (77.18%), KSA (78%), UAE (80.9%), and Kuwait (70.7%). T=True, F= False, IDK=I Don't Know. Bold letters indicates correct response.

measures. Similarly, the mean practice scores differed significantly across KSA (6.11 ± 0.96), UAE (5.98 ± 1.11), and Kuwait (5.38 ± 1.48) ($p < 0.001$). Kuwaiti study subjects demonstrated significantly lower mean practice scores than KSA and UAE participants (Figure 2).

The mean knowledge, attitude, and practice scores were compared across various demograph-

ic variables and health problems. It was observed that the residents (10.46 ± 1.79) demonstrated a significantly higher mean knowledge score than the citizen (10.14 ± 1.64), $p < 0.001$. Similarly, females (10.29 ± 1.51) showed a significantly higher mean knowledge score compared to males (9.99 ± 1.84), $p < 0.001$. The mean knowledge score varied across the different educational levels [primary

Table III. Attitude items with correct responses of the study participants (n=3,920).

Items	Correct reponses	Response type
A1. How do you feel about control of Coronavirus spread in your country?	38.20%	F, NF, OP*
A2: The Governmental Organizations of your Country (KSA/UAE/ Kuwait) are handling COVID-19 crises very well	90.20%	A*, D, IDK
A3. Your Governmental Organizations & Populations of your Country can win the battle against the COVID-19 virus?	79.60%	A*, D, IDK
A4. COVID-19 will finally be successfully controlled.	77.20%	A*, D, IDK

Total average correct responses (71.3%), KSA (70.9%), UAE (77.9%), and Kuwait (63.3%). F=Fearful, NF=No Feelings, OP=Optimistic, A=Agree, D=Disagree, IDK=I Don't Know. *Indicates correct responses.

Table IV. Practice items with correct responses of the study participants (n=3,920).

Items	% Correct reponses	Response type
P1. In recent days are you washing your hands for 20 seconds with soap and water to protect yourself and/or your family from the Coronavirus?	94.5%	Yes*, No
P2. In recent days have you started Using Sanitizers to protect yourself and/or your family from the Coronavirus?	94.1%	Yes*, No
P3. In recent days are you wearing a mask to cover your nose and chin when you are out of the house to protect yourself and/or your family from the Coronavirus?	97.4%	Yes*, No
P4. In recent days are you Standing 6 feet apart from people to protect yourself and/or your family from the Coronavirus?	89.2%	Yes*, No
P5. In recent days do you Stay at home (unless it is absolutely necessary to go out) to protect yourself and/or your family from the Coronavirus?	89.8%	Yes*, No
P6. In recent days have you changed to an immune-boosting diet to protect yourself and/or your family from the Coronavirus?	48.6%	Yes*, No
P7. In recent days, have you gone to any crowded place?	85.3%	Yes, No*

Total average correct responses (85.56%), KSA (87.3%), UAE (85.4%) and Kuwait (76.9%). *Indicates correct response.

(9.50±2.51), intermediate (9.52±2.28), secondary (9.80±1.94), and university (10.26±1.56)], with a statistically significant difference $p<0.001$. The study participants with a university level of education showed a significantly higher mean knowledge than all the other educational categories. The mean knowledge score of government-employed (10.27±1.67), private/self-employed (10.04±1.65), and unemployed (10.16±1.64) differed significantly ($p<0.001$). Government employees showed a significantly higher mean knowledge score than other categories (Table V).

The gender demonstrated a significant difference in the mean attitude score. Females (2.94±0.86) showed a significantly higher mean

attitude than males (2.85±0.91, $p=0.015$). In contrast, no other demographic variables showed significant differences in mean attitude scores. Practice scores differed significantly between male vs. female (6.71±1.25 vs. 6.98±1.22, $p<0.001$), married vs. single (7.05±1.20 vs. 6.71±1.25, $p<0.001$), and with health problem-yes vs. no (7.15±1.22 vs. 6.82±1.23, $p<0.001$). While practice scores showed statistically significant differences across various occupational categories ($p=0.014$). Study participants who did not work/were unemployed (6.82±1.25) showed significantly lower practice scores compared to the government employees (6.95±1.23) and private/self-employees (6.85±1.21), as shown in Table V.

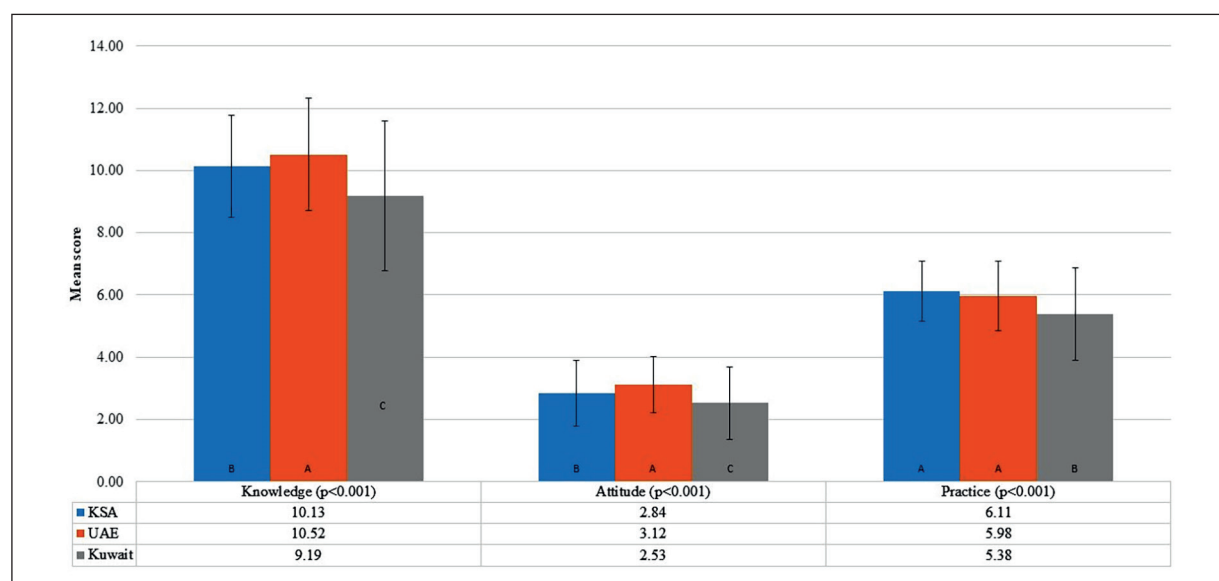


Figure 2. Comparison of knowledge, attitude and practice scores among participants of KSA, UAE and Kuwait.

Table V. Comparison of knowledge, attitude and practice scores across demographic variables.

Variables		Knowledge			Attitude			Practice		
		Mean	SD	p	Mean	SD	p	Mean	SD	p
Resident type [§]	Citizen	10.14	1.64	< 0.001	2.90	0.88	0.720	6.87	1.25	0.509
	Resident	10.46	1.79		2.91	0.89		6.85	1.16	
Residence area [§]	Urban	10.20	1.64	0.058	2.90	0.88	0.297	6.89	1.21	0.276
	Rural	10.03	1.73		2.94	0.87		6.79	1.34	
Gender [§]	Male	9.99	1.84	< 0.001	2.85	0.91	0.015	6.71	1.25	< 0.001
	Female	10.29	1.51		2.94	0.86		6.98	1.22	
Education [¶]	Primary	9.50	2.51 ^b	< 0.001	2.67	0.82	0.323	7.33	1.03	0.775
	Intermediate	9.52	2.28 ^b		2.84	0.75		6.76	1.67	
	Secondary	9.80	1.94 ^b		2.97	0.81		6.84	1.26	
	University	10.26	1.56 ^a		2.89	0.90		6.87	1.23	
Occupation [¶]	Government	10.27	1.67 ^a	0.004	2.85	0.92	0.084	6.95	1.23 ^a	0.014
	Employee									
	Private/self-employed business	10.04	1.65 ^b		2.89	0.90		6.85	1.21 ^a	
	Unemployed	10.16	1.64 ^b		2.95	0.85		6.82	1.25 ^b	
Marital status [§]	Married	10.20	1.68	0.073	2.91	0.91	0.422	7.05	1.20	< 0.001
	Single	10.14	1.63		2.90	0.86		6.71	1.25	
Health problems [§]	Yes	10.27	1.54	0.199	2.93	0.90	0.527	7.15	1.22	< 0.001
	No	10.15	1.68		2.90	0.88		6.82	1.23	

[§]Mann-Whitney U test, [¶]Kruskal-Wallis test, SD = Standard Deviation.

Discussion

This is the first study to examine the knowledge, attitude, and practices toward COVID-19 among residents and citizens from KSA, UAE, and Kuwait. Our study found an overall correct response rate of 77.18% on the knowledge of COVID-19, indicating that most respondents had adequate knowledge of COVID-19. Previous studies^{1,14} have reported a correct knowledge response rate of 48.3-90% from different countries. However, poor knowledge was identified concerning the development of severity of COVID-19 and viral spread.

Almost 38.2% of the participants were optimistic about preventing and controlling the COVID-19 epidemic. Nearly 90.2% of the participants agreed that their countries' governmental organizations (KSA/UAE/Kuwait) were handling COVID-19 crisis very well, and 79.6% had confidence that their countries could win the battle against the virus. More than three-fourths (77.2%) agreed that the COVID-19 would finally be successfully controlled. The extraordinary actions can clarify positive attitudes and strong trust in managing COVID-19 and the governments' timely response in taking strict control and precautionary steps against COVID-19 to protect residents and ensure their well-being.

These involve the closing and suspending of all domestic and foreign airlines, mosque worship, colleges and universities, and the nationwide curfew put on residents¹⁵. This finding is in line with recent research in China and Saudi Arabia^{1,15}, where most participants were assured that the epidemic was curable, and the governments would effectively be able to control it. However, the participants' lower optimism towards preventing and controlling COVID-19 was due to anxiety and panic during the pandemic¹⁶.

Even after the study, participants were careful towards their practices: they washed their hands for 20 seconds with soap and water (94.5%), started using sanitizers (94.1%), wore a mask to cover their nose and chin (97.4%), maintained social distance by standing 6 feet apart from people (89.2%), stayed at home (89.8%), avoided any crowded place (85.3%), and less than half changed to an immune-boosting diet (48.6%). These findings suggest that study participants from three countries embraced excellent and safe practices due to health authorities offering education and outreach materials, increasing the public awareness of the epidemic, and encouraging behavioral improvement. This finding is similar to the previous study reported in Saudi Arabia¹⁵.

Although an overall knowledge, attitude, and practices towards COVID-19 were adequate

among respondents from the UAE, KSA, and Kuwait, significant differences were observed suggesting different approaches in the country's planning of the healthcare delivery environment, mobilizing all related social sectors through consensus, and guiding people based on the best standard information and facts during the pandemic.

In this study, an analysis of knowledge, attitude, and practices toward COVID-19 was performed to identify differences in scores associated with demographic variables. Residents in these countries refer to expatriates or foreigners with valid residency permits in various sectors. In our study, residents demonstrated a significantly higher mean knowledge score than citizens. It may be because of cultural norms and living situations between residents and citizens. Most of the residents are foreigners and likely to stay alone in these countries with their family members living in their home countries. Hence residents are more likely to be concerned with the COVID-19 pandemic than the citizens. On the contrary, increased concerns about COVID-19 among citizen health workers relative to residents were observed in Saudi Arabia as citizens prefer to remain with their families and have an active social life. Moreover, living with others was an independent predictor of grave concern over COVID-19 infection^{17,18}.

The evaluation of knowledge is a vital component of rural/urban health inequality during the COVID-19 pandemic. As the first phase of the pandemic stormed urban areas, rural communities' interests were likely under-represented. Ignorance and lack of knowledge also placed more severe threats of COVID-19 on rural populations¹⁹. However, in our study, the mean knowledge, attitude, and practice scores of study participants between urban and rural areas across three countries did not differ significantly. It suggests strong public health efforts made by the respective governments to disseminate COVID-19 information targeting rural/urban populations.

When mean knowledge, attitude, and practice scores towards COVID-19 were compared between male and female study participants, statistically significant differences were observed. Females showed significantly higher scores compared to males. It may be due to their higher inclination towards preventive and risk-averse behavior towards COVID-19 than males²⁰. This finding is similar to the previous studies^{1,13,15} reported in China, Malaysia, and Saudi Arabia. Contrarily, a

Bangladeshi study²¹ showed significantly higher knowledge of COVID-19 among male participants than females.

In this study, participants with a university level of education demonstrated significantly higher knowledge of COVID-19 than the other educational levels. This may be because individuals with a greater level of education are more knowledgeable about emerging and communicable diseases than those with a lower level of education. People with a university level of education had greater knowledge than their peers. It has been shown that individuals with higher education have increased awareness and a greater cognitive capacity, making it easier to understand the relevant knowledge of COVID-19¹⁰. Moreover, education is a significant predictor of the participant's knowledge of infectious diseases^{15,22,23}.

In this study, participants from the government sector showed significantly higher knowledge and practice scores than those either self/private employed or unemployed. It could be attributed to the fact that all the government offices issued stricter guidelines than other sectors on compliance of prevention and control of COVID-19 in workplaces. In addition, the health ministries of KSA, UAE, and Kuwait interacted with and educated their population *via* websites and social networking channels, including Facebook, Twitter, Instagram, YouTube, Snapchat, and other internet platforms. In this study, many participants were unemployed, large numbers were women, and likely homemakers had access to these websites, which may have affected the COVID-19 knowledge and practice scores of the study participants. The culture of mobile telephony is widespread among women who are less frequently working than men and who, as homemakers, spend more time on digital technology. In line with this finding, previous studies^{1,10,15,24} from different countries have reported an association between occupation and knowledge and practice towards COVID-19.

Married study participants and those with health problems demonstrated positive behavior by higher practice scores than their counterparts. This finding can be explained by the fact that married people had a greater understanding of knowledge, were more involved in protective behaviors, and had a higher degree of commitment to protective actions than unmarried or single individuals. This may be because, in addition to self-protection, married persons are

liable for caring for their families. Consequently, they prefer to understand more about protection, have a more optimistic outlook, and participate in proactive protective actions. Mastering the basic knowledge on COVID-19 prevention and control should aim at putting it into practice, i.e., to properly take protective measures, control the roots of infection, cut off the transmission route, and protect susceptible groups¹⁰.

Our results showed that the main factors affecting the public's preventive behavior were the resident type, gender, education, occupation, marital status and presence of health problems, knowledge, and attitude towards COVID-19. According to the KAP paradigm, knowledge is the foundation, and attitude is the guiding factor of behavioral transformation²⁵. Hence, improving people's awareness and promoting positive attitudes towards epidemic prevention is critical for fighting against the COVID-19 pandemic¹⁰. Moreover, this finding suggests that it is crucial to effectively take tailored steps to enhance people's protective behavior based on country, gender, occupation, marital status, and health problems. Therefore, health officials should use these findings to create more targeted strategies to fight against the COVID-19 pandemic. Since knowledge, attitude, and practice of citizens/residents toward COVID-19 differed significantly in KSA, UAE, and Kuwait, the proposed null hypothesis of no difference has been rejected.

This study has limitations: first, it was conducted online using non-random, convenience sampling from three countries. Secondly, 74.9% of the respondents came from KSA; thirdly, the sample composition was uneven, mainly including females, citizens, urbanites, and university-educated individuals. Therefore, the generalizability of the study finding has certain limitations. Besides, this research was focused on self-reported COVID-19 knowledge, attitudes, and practices.

Before addressing any of the queries, participants might have searched for the replies, affecting the accuracy rate of COVID-19 information. Participants may likely have addressed attitude and practice questions favorably due to social desirability²⁶. Hence, the questionnaire was made voluntary, and the data's confidentiality was emphasized to obtain the accuracy of the completed questionnaire. Finally, cross-sectional studies are not able to include proof of causality. The instrument used in this research was derived from previously reported similar studies. Our research did

not assess potential factors leading to knowledge, attitude, and practice, such as risk perception and health literacy^{27,28}.

Additional limitations included that the data collection was carried out between June 15 and August 25, 2020, which may not accurately describe the pandemic's exact phase since it has varied across three countries. With time, the level of knowledge of the population has improved, and practices might have changed. At the onset of the local epidemic, the local epidemic's peak and the wave's receding could potentially differ. Attitude questions were derived from the study conducted by Zhong et al¹. It included more opinions regarding the governments' efforts and hope towards prevention and control of COVID-19 in respective countries. The study involved three governments and maybe even their provincial/local bodies, and the implementation of strategies, such as lockdown, isolation, and quarantine, which could have potentially differed. The public's views regarding them are likely to be influenced by their local situation. The practice is hindered by the absence of objective measurements, such as the kind of mask worn, which might influence transmission but will not be recorded in the questions. Physical distance in the neighborhoods has been challenging to achieve in urban slum settings where people may have to use common amenities. The data was collected electronically, and the most disadvantaged who would have faced challenges to practice did not get captured in the study. Moreover, responses were obtained only from people who have had access to the internet and who have been active on social media. Hence, the results apply to these men and women and not to all men and women from the three studied countries.

Conclusions

The current study provided a complete insight into participants' knowledge, attitudes, and practices from KSA, UAE, and Kuwait toward COVID-19. The results indicate that the subjects have adequate knowledge and demonstrated a positive attitude and good practices toward COVID-19 prevention and control. Ministry of health and other government authorities should emphasize targeted health education based on demographic factors towards COVID-19. Educational campaigns should be strengthened, especially in Kuwait, to improve citizens' and resi-

dents' knowledge, attitude, and practices towards preventing and controlling COVID-19. Electronic and social media should be effectively used to spread awareness of COVID-19 among the public. Governments should build an electronic and social media framework for strengthening COVID-19 prevention and control practices by considering the public's risk perception and health literacy.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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Authors' Contribution

Osamah Mohammed AlMugeiren: conception and design of the study, analysis, and interpretation of data, drafting of the article, supervision, final approval. Abdulmohsen AlAnazi: Acquisition of data, Analysis, interpretation of data, drafting of the article. Abeer AlNafea and Anas Basim: Acquisition of data, drafting of the article. Saleh AlGhufaili: Interpretation of data, revising of the article. All authors approved the final version of the article.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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