Original Research

KNOWLEDGE, PERCEPTIONS, AND PREVENTIVE PRACTICES TOWARDS COVID–19 DURING THE EARLY STAGES OF THE OUTBREAK AMONG SAUDI PEOPLE: A CROSS–SECTIONAL STUDY

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ABSTRACT

Introduction: Knowledge of and adherence to preventive measures concerning the transmission of coronavirus disease (2019) (COVID-19) remain the frontline strategies to control its spread. This cross-sectional study aims to determine the knowledge, perceptions, and preventive practices towards COVID-19 among the general Saudi population. **Methods:** A 40-item self-administered online questionnaire concerning knowledge and preventive practices towards COVID-19 was developed and validated. The questionnaire was highly reliable (standardized Cronbach's alpha = 0.89). **Results:** A total of 2024 participants were included (60% men; age range: 18 to 73 years). Estimated median knowledge and preventive practices score were 63 (IQR = 59–67) and 63 (IQR = 54–68) respectively. The results reflected high levels of knowledge and preventive practices among the participants. The knowledge score and preventive practices score were significantly differed by educational level, work status, region, and purpose of leaving one's house. Correlation analyses demonstrated a significant weak correlation between knowledge and preventive practices (r=0.056, p=0.012). **Conclusion**: This study indicates that majority of Saudi people having above average level of knowledge and preventive practices towards the COVID-19. Health education programs must be designed to target less-

educated residents and expatriates. The findings provide a baseline for the knowledge, perceptions, and preventive practices towards the COVID-19 pandemic among Saudi Arabian residents at the early stages of the outbreak.

Keywords: COVID-19, knowledge, preventive practices, Saudi Arabia

Introduction

Coronavirus disease (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-COV2), was first reported in Wuhan, China (Jin et al., 2020; Zhu et al., 2020) and rapidly became a public health crisis (Ahn et al., 2020). COVID-19 was first declared a public health emergency of international concern on 30th January and subsequently a pandemic on 11th March by the World Health Organization (WHO) (WHO_Director-General's, March 2020). Since then, cases have increased at an alarming rate, and there is no sign of an end to the pandemic (Lee et al., 2020).

The virus can be transmitted through droplet inhalation, with increased disease severity and mortality reported in older adults and patients with pre-existing illnesses (Chan et al., 2020; Leung, 2020; Liu et al., 2020). The most common symptom reported among COVID-19 patients are fever and cough. Other symptoms like shortness of breath, muscle ache, confusion, headache, diarrhea, vomiting have been reported as well.(Chen et al., 2020; Eastin & Eastin, 2020; Pan et al., 2020) conjunctivitis and transmission of the virus by aerosol contact with the conjunctiva have also been reported (Fu et al., 2020; Grant et al., 2020).The WHO's recommended general preventive practices include regular handwashing or the use of alcohol-based hand sanitizers; social distancing; and respiratory hygiene, such as covering one's mouth and nose while coughing or sneezing (WHO, 2020). Presently, the vaccines are available which have shown efficacy in phase three clinical trials were done on a large scale, although novel lineages of SARS-CoV-2 have been identified globally and these variants can evade human immune responses and vaccination alone might not be sufficient for containing outbreaks.(Eastin & Eastin, 2020; Emary et al., 2021; Moore et al., 2021)

Many countries have experienced a dramatic increase in cases, which has overwhelmed their healthcare systems. Currently, in the absence of a cure, supportive therapeutic management is the sole approach for COVID-19 (Tobaiqy et al., 2020). The COVID-19 pandemic is not the first infectious disease outbreak, in recent years—in 2012, Middle East respiratory syndrome coronavirus (MERS) was discovered in Saudi Arabia and was responsible for Middle eastern respiratory syndrome with the majority of cases reported in the kingdom of Saudi Arabia. The previous experience with MERS has helped in the present times of COVID-19 and the Saudi health authorities were quick in action in implementing measures to contain COVID-19 spread. In the same vein, educating the public on various aspects of COVID-19, such as its mode of transmission, infection control measures, and preventive strategies, must be implemented as a routine exercise. (Algaissi et al., 2020).

The first confirmed case of COVID-19 in Saudi Arabia was reported on 2nd March, 2020 (MOH_Saudi_Arabia, March 2, 2020). Displaying vigilance, the country implemented various measures in compliance with the WHO's guidelines (Algaissi et al., 2020). These included the suspension of all domestic and international flights; closure of all commercial establishments except pharmacies and grocery shops; and closure of schools, colleges, and universities. Analogously, the suspension measures included pray in mosques and pilgrimage tourism. A national curfew was also imposed to contain people's movement within the Kingdom. Along with these measures, the general public's adherence to preventive practices will help combat this pandemic. (West et al., 2020).

Adherence to infection control practices is greatly influenced by people's knowledge and perception of disease. Behavioural decisions such as effective hygienic practices and social distancing can drive prevention strategies and lessen the societal impact of COVID-19 (Bavel et al., 2020). Public perception and subsequent behavioral changes are greatly influenced by the government's healthcare approach and governments can intervene through various measures to change health related behaviours among the population (Diepeveen et al., 2013; Jose et al., 2020). Hence understanding the people's perception is very essential in this regard in order to frame guidelines and their implementation. Globally, several studies have examined general public behaviour and individuals' preventive practices regarding COVID-19 (Al-Hanawi et al., 2020; Hezima et al., 2020; Meier et al., 2020; Narayana et al., 2020; Reuben et al., 2020; Zhong et al., 2020). This study was designed to determine the knowledge, perceptions, and preventive practices towards COVID-19 among the general population of Saudi Arabia utilising a large sample in the early stages of the pandemic.

Methods

This online survey study, which employed a cross-sectional design, was conducted over 30 days, from 27th March to 28th April 2020. Residents of Saudi Arabia (aged ≥ 18 years) and were willing to participate were eligible for the study. People who had already been diagnosed with COVID-19 and were in a hospital/quarantine facility or had been discharged after recovery were excluded.

The sample size required to achieve objective of this study (n = 1514) was calculated using Epi Info™ software (version 7.2.4, 2020; CDC, Atlanta, GA, USA). For this step, the total number of people living in Saudi Arabia (N = 34,218,169) was retrieved from the General Authority for Statistics, Saudi. The confidence interval was 99%, with a marginal error of 5%.

Ethical approval for this study was obtained from the Deanship of Scientific Research at Al Baha University, Al Baha, Saudi Arabia (1441-28-41206495-2). Consent for participation was provided by completion and submission of the questionnaire.

A 40-item self-administered online questionnaire to measure knowledge and preventive practices towards COVID-19 (COVID-19-KPQ) was developed and validated by authors based on information available from CDC (CDC, 2020), and its reliability was tested using data collected from 2042

participants. The estimated standardised Cronbach's alpha was 0.89, which demonstrates good internal consistency. To ensure that the COVID-19-KPQ was comprehensible to the majority of Saudi residents, three versions were developed: English, Arabic, and Urdu.

The COVID-19-KPQ comprised three parts: socio-demographic variables, knowledge and perceptions, and preventive practices. The demographic variables included age, gender, geographical region, nationality, educational level, employment status, place of work, presence of any chronic diseases, history of infection with other coronaviruses, and frequency of venturing outside the home.

The second part of the COVID-19-KPQ consisted of 16 items to assess participants' knowledge and perceptions of the symptoms and transmission methods of COVID-19. The third section contained 24 items that investigated preventive practices to avoid being infected with COVID-19. For each participant the COVID-19 knowledge score (COVID-19-KS) and preventive practices score (COVID-19-PS) were calculated by summing the scores from each item as follows; COVID-19-KS, for an item making a true statement, the response options were 'strongly agree' (score=5), 'agree' (score=4), 'don't know' (score=3), 'disagree' (score=2), 'strongly disagree' (score=1), For an item making a false statement, the responses were recorded reversely. For the COVID-19-PS For statements related to a lack of preventive practices, the response options were 'always' (score=3), 'sometimes' (score=2), 'never' (score=1), for statements concerning negative preventive practices the responses were recorded reversely.The ranges for the sum scores of COVID-19-KS and COVID-19-PS were 16–80 and 24–120, respectively.

Owing to complete country lockdown, data were collected through non-probability snowball sampling; the authors sent an invitation to participate in this study within their personal networks (colleagues, relatives, friends, etc.) over e-mail and WhatsApp.

Statistical Analyses

Data were analysed using Statistical Package for the Social Sciences version 20.0 (IBM Corp., Armonk, NY, USA). Frequencies, percentages, medians, and interquartile ranges (IQRs) were calculated using descriptive statistics. Kruskal-Wallis H and associated p-value were estimated and reported for the comparison of median scores among different groups. Spearman correlation coefficient were conducted to determine the association between the COVID-19-KS and COVID-19-PS. Standardised Cronbach's alpha was calculated to determine the psychometric properties of the COVID-19-KPQ. Statistical significance was set at 0.05.

Results

A total of 2042 (40% women) participants completed the COVID-19-KPQ. Most respondents were Saudi citizens (88%), had at least an undergraduate education (60%), and were employed (65%). The participants belonged to all regions of Saudi Arabia (Table 1).

Table 1. Participants' demographics and COVID-19 knowledge and preventive practices scores.

	Frequency n	%	COVID-19-KS Median (IQR)	p	COVID-19-PS Median (IQR)	p
All	2042	100	63 (59–67)		63 (54–68)	
Age (years)						
18–30	674	33	63 (59–67)		62 (52–67)	
31–49	1006	49	64 (59–68)	0.190	63 (54–68)	0.004
≥ 50	362	18	62 (59–66)		64 (55–68)	
Gender						
Women	818	40	63 (60–68)	0.210	63 (53–68)	0.974
Men	1224	60	63 (59–67)		63 (53–68)	
Nationality						
Saudi	1788	88	63 (59–68)	0.044	63 (53–68)	0.347
Non-Saudi	254	12	62 (58–67)		64 (54–67)	
Educational level						
General education ‡	368	18	60 (56–65)		64 (54–68)	
Undergraduate education	1226	60	63 (59–67)	<0.001	63 (54–68)	0.010
Graduate education	448	22	66 (62–70)		62 (53–66)	
Work status						
Employed	1332	65	64 (59–68)		64 (55–68)	
Unemployed	342	17	62 (59–67)	0.017	62 (49–67)	0.002
Student	368	18	62 (58–67)		63 (51–67)	
Working site						
Home-based‡	782	62	64 (59–68)	.127	63 (54–68)	.333
Outside the home	482	38	64 (59–68)		64 (56–68)	
Region						
Al Baha	435	21	64 (60–67)		63 (54–67)	
Eastern province	191	9	62 (58–66)		64 (53–68)	
Makkah	458	22	64 (60–68)		62 (54–67)	
Aseer	82	4	60 (58–65)		64 (52–70)	
Najran	106	5	60 (57–65)		63 (53–68)	
Jazan	67	3	64 (60–68)	<0.001	60 (49–63)	0.009
Riyadh	218	11	64 (59–70)		61 (51–67)	
Qassim	94	5	65 (60–67)		63 (56–67)	
Medina	104	5	63 (60–69)		64 (54–68)	
Hail	92	5	61 (58–67)		64 (51–68)	
Tabuk	60	3	64 (61–66)		65 (60–68)	
Northern border province	135	7	63 (57–67)		63 (56–69)	
Chronic disease						
Presence	442	22	63 (59–67)	0.530	64 (55–68)	0.142
Absence	1600	78	63 (59–68)		63 (32–44)	
Previous infection with any coronavirus (Non-COVID-19)						
Yes	30	1.5	60 (52–69)	0.360	55 (36–68)	0.084
No	2012	98.5	63 (59–67)		63 (54–68)	
Frequency of leaving one's house						
Never	184	9	63 (60–65)		64 (50–68)	
Once a week	574	28	63 (59–68)		63 (53–63)	
Twice a week	408	20	63 (59–68)	0.467	63 (55–67)	0.225
Four times a week	732	36	64 (60–67)		63 (54–68)	
More than once per day	144	7	64 (59–68)		60 (53–66)	
Purpose of leaving one's house						
Necessary#	1844	98	63 (59–68)	0.004	63 (54–68)	0.003
Unnecessary	38	2	60 (57–63)		53 (48–63)	

*p-value calculated using the Kruskal-Wallis H test; IQR: interquartile range; COVID-19-KS: COVID-19 knowledge score; COVID-19-PS: COVID-19 preventive practices score, ‡ General education includes participants of which their highest education is primary, secondary or high school; home-based employment indicates participants had to work at home due to role applied by government during the lockdown,# Necessary leaving of one's house (e.g. going out for groceries or medication, work, receiving healthcare services, etc.).

The median COVID-19-KS score was 63 (IQR = 59–67), while 100% of the participants obtained a score > 50%. Most participants (96%) knew that touching the nose, mouth, or eyes after contacting a contaminated surface was one way of spreading SARS-CoV2 along with exposure to aerosols from an infected person's sneezing or coughing. There was uncertainty among respondents regarding the risk of infection from asymptomatic individuals with COVID-19 (53%). In addition, 43% of the participants were unaware that fever and sore throat are common symptoms of COVID-19. Only 46% of the respondents answered correctly regarding either the use of sanitiser (ethyl alcohol) or washing hands as beneficial for hand hygiene. Only one-third answered correctly when asked if contact with animals increased the risk of infection with COVID-19 (Table 2).

Table 2. A comparison of the frequencies of favourable and other responses.

	Question	Favourable response n (%)
Knowledge and perceptions of the symptoms and transmission methods of COVID-19		
1	The symptoms of COVID-19 are similar to those of the common flu; they include nasal congestion, cold, or sore throat.	1490 (73%)
2	Some people may be infected by COVID-19 without showing any symptoms.	1716 (84%)
3	One of the signs of infection of COVID-19 is that the body temperature is above average (i.e. > 37 degrees Celsius).	1668 (82%)
4	One of the signs of infection of COVID-19 is the discolouration of the skin and the appearance of skin ulcers.	776 (38%)
5	The severity of symptoms of COVID-19 increases in the event of a chronic disease such as diabetes, high blood pressure, heart disease, etc.	1756 (86%)
6	Shortness of breath and dry cough are the main symptoms of COVID-19.	1886 (92%)
7	A simple sore throat accompanied by a slight rise in body temperature is not classified as one of the symptoms of COVID-19.	1172 (57%)
8	Smoking plays a role in increasing the aggressiveness of the symptoms of COVID-19.	1494 (73%)
9	Touching your eyes, nose, or mouth after contacting contaminated surfaces is one of the ways of spreading COVID-19.	1986 (97%)
10	Getting within one metre of people with COVID-19 may lead to infection via air-borne transmission of the virus.	1778 (87%)
11	Contact with animals increases the chance of getting infected by COVID-19.	668 (33%)
12	One way to spread COVID-19 is through exposure to flying mist from an infected person's sneezing or coughing.	1968 (96%)
13	There is no risk of being infected with COVID-19 through contact with asymptomatic people.	1090 (53%)
14	There is a possibility of disease transmission from one person to another during the incubation period of COVID-19 (time gap between entry of the virus and appearance of signs and symptoms).	1758 (86%)
15	Using ethyl alcohol-sanitising products to sanitise hands is the only way to get rid of hand-held viruses.	934 (46%)
16	Sharing personal belongings and other equipment (toothbrush, hookah, etc.) with infected people may lead to being infected with COVID-19.	1858 (91%)

	Preventive practices to avoid getting infected by COVID-19	
1	I immediately contact 937 when experiencing any COVID-19 symptoms.	1884 (92%)
2	I wear a mask, gloves, and/or other protective products when dealing directly with individuals who may have COVID-19 living.	1862 (91%)
3	When leaving the house to buy food and other supplies, I prefer to visit large commercial places and store chains.	1582 (77%)
4	When leaving the house to buy food and other supplies, I avoid buying vegetables and fruits from street vendors or those standing by the side of the road.	1770 (87%)
5	When leaving the house to buy food and other supplies, I wear gloves.	1816 (89%)
6	When leaving the house to buy food and other supplies, I make sure to wash and sanitise my hands.	1990 (97%)
7	After purchasing food and supplies, I sterilise all the purchases and dispose of all carry bags before bringing everything inside the house.	1814 (89%)
8	I make sure to avoid using banknotes or coins; I use electronic payment methods instead.	1928 (94%)
9	When leaving the house to buy food and other supplies, I only purchase necessities.	1894 (93%)
10	I make sure to reduce the number of times I leave the house by buying the weekly/monthly needs in one trip.	1932 (95%)
11	I avoid buying ready-made foods from restaurants and always rely on preparing food at home.	1912 (94%)
12	I rely on delivery services when purchasing my supplies.	1490 (73%)
13	I make sure to wash my hands with soap and water regularly for at least 30 seconds each time.	1912 (94%)
14	I cover my mouth while coughing and sneezing.	1990 (97%)
15	I appropriately and immediately dispose of any waste that may carry the virus (such as wipes used for sneezing or wiping surfaces).	1984 (97%)
16	While I am in my workplace, I avoid indoor gatherings with several people.	1808 (88%)
17	While I am in my workplace, I avoid eating meals with my colleagues.	1666 (82%)
18	While I am in my workplace, I wear a mask and/or gloves.	1676 (82%)
19	While I am in my workplace, I make sure to wash and sterilise my hands regularly.	1786 (87%)
20	While wearing gloves, I use my mobile and some other personal belonging.	1228 (60%)
21	While I am in the workplace, I keep a minimum distance of one metre from other people	1774 (87%)
22	I make sure to dispose of used gloves properly.	1974 (97%)
23	I wear gloves or sterilise my hands after using an ATM to withdraw cash.	1932 (95%)
24	When leaving the house to buy food and other supplies, I wear a mask.	1856 (91%)

The analysis indicated that the knowledge score was significantly different based on nationality ($p=0.044$), educational level ($p<0.001$), work status ($p=0.044$), region ($p<0.001$) and Purpose of leaving one's house ($p=0.004$) (Table 1). There was a significant difference in knowledge between Saudi nationals and non-Saudi respondents, with the former obtaining higher scores. More (vs. less) educated participants scored higher. Those who resided in Qassim had higher knowledge scores in contrast to people from other regions, whereas the lowest score was reported from the Aseer and Najran regions. Those who left their homes for groceries or medication, work, receiving healthcare services knew significantly more about the disease in contrast to people leaving house for unnecessary purpose. The students and unemployed who participated in this study were less knowledgeable in comparison to the participants who were employed.

Preventive Practices Towards COVID-19

A total of 97% of the participants were aware of basic preventive practices such as covering their mouth and nose while coughing and sneezing, handwashing, using sanitiser often, and properly disposing of used wipes and gloves. More than 90% of the participants preferred electronic modes of payment instead of using banknotes or coins, preferred to eat at home instead of buying food from a restaurant, followed preventive practices when dealing with individuals suspected of having COVID-19, and preferred staying at home and not going out unnecessarily or frequently.

A significant incorrect practice reported by 60% of respondents was the usage of individual belongings, such as a mobile phone, after wearing gloves. Other practices are described in Table 2. The median COVID-19-PS score was 63 (IQR = 54–68), while analyses indicated that 88% of participants scored > 50% on the COVID-19-KP. Participants aged > 50 years were more likely to engage in preventive practices than their younger counterparts (p=0.004). There was a significant regional variation among followers of preventive practices (p=0.046): the highest scores were seen in participants from Tabuk regions, whereas those from Jizan did not follow all practices promptly, and their scores were low compared to other regions. Employed (p=0.002) or participants with general education level (p=0.01) were showed higher scores for following preventive practices.

Association Between Knowledge and Preventive Practices Towards COVID-19

Scores on the COVID-19-KS and COVID-19-PS were significantly correlated; however, this association was weak (Spearman correlation coefficient; r=0.056, p=0.012). Although participants from Qassim, Jizan had a high knowledge score, their implementation of preventive practices was low; however, the opposite was true for participants from the Aseer and Hail region. Knowledge scores were positively correlated with practice scores for a few characteristics. However, evidence suggests that there are various factors other than knowledge that influence the implementation of preventive measures towards COVID-19 (Figure 1).

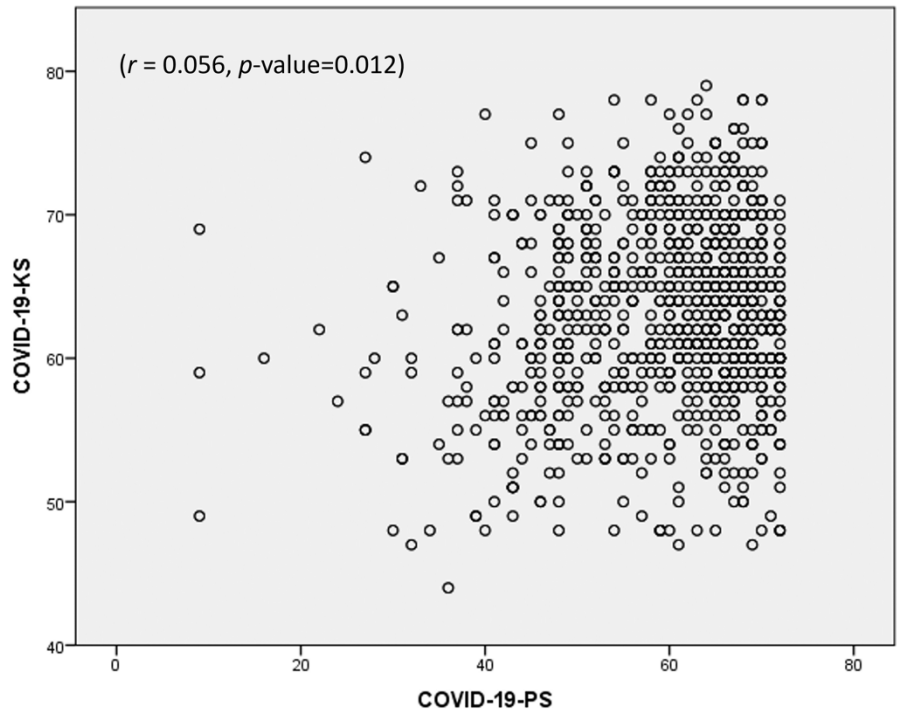

Figure 1. Correlation between the COVID-19 knowledge score (COVID-19-KS) and the preventive practices score (COVID-19-PS).

Discussion

This study was conducted at the end of March 2020, when the pandemic was in the early stages and the level of people's general understanding of COVID-19 was not clear . Our study included a large cross-section of the adult population representing various regions of Saudi Arabia. To the best of our knowledge, this is the second study examining knowledge of and adherence to preventive measures towards COVID-19 utilising a large sample size from various regions of Saudi Arabia. Al-Hanawi et al. (2020) conducted a similar study during the same period. Our study indicated that most respondents were fairly knowledgeable about COVID-19, which was consistent with Al-Hanawi et al.'s results (Al-Hanawi et al., 2020). Various other reports worldwide have also shown a similar level of knowledge regarding COVID-19 among the general population (Azlan et al., 2020; Gao et al., 2020; Hezima et al., 2020; Honarvar et al., 2020; Hussain et al., 2020; Kebede et al., 2020; Mehrotra et al., 2020; Papagiannis et al., 2020; Reuben et al., 2020; Saqlain et al., 2020; Zhong et al., 2020).

Saudi Arabia has successfully dealt with past infectious outbreaks such as SARS and Middle East respiratory syndrome (Al-Tawfiq et al., 2014). In Saudi Arabia, an early curfew helped curb the spread of COVID-19, and most people were at home and had access to COVID-19-related information from sources such as television, social media, and Ministry of Health (MOH) notifications (Alshammari et al., 2020). However, there is also a possibility of the spread of false information about COVID-19 through social media, as reported in other similar studies (Barua et al., 2020; Yusof et al., 2020). Most respondents knew about how the disease spreads; however, nearly half were unaware that fever and sore throat are common symptoms, and 53% were unaware that asymptomatic patients can transmit

the infection. These issues need to be addressed by the authorities by assuring that authentic information is disseminated to all along with keeping a check on spread of false information related to signs and symptoms of COVID-19.

A high knowledge score was noted in Saudi respondents, whereas a low score was reported in the expatriate group. This might be owing to differences in educational levels among expatriate participants. Non-Saudis may not be well versed in Arabic, and they might have difficulties in understanding and following the health advisories delivered through social media, MOH alerts via SMS services, and guidelines displayed on hoardings. However, this issue was subsequently addressed, with the MOH releasing guidelines in 10 languages (MOH_Saudi_Arabia, 2020).

In our study, most participants were well-versed with preventive practices and were following them, especially older adults. Similar findings were reported in studies conducted in the Netherlands, Germany, Italy, Iran, Australia, and Pakistan (Afzal et al., 2020; Meier et al., 2020; Seale et al., 2020). Our study also showed that there was less of a likelihood of wrong practices and negative attitudes in participants with high knowledge scores. Most respondents were aware of basic hygienic practices and the need for disposal of contaminated waste. However, 53% were not aware that asymptomatic patients can also transmit the infection. A similar finding was previously reported—that 69% of participants did not know that COVID-19 can be transmitted by asymptomatic patients (Kebede et al., 2020). 60% Participants were also unaware that the handling of mobile phones or any other personal belongings with gloves is not an advisable practice. The reason could be due to non-clarity of messages given to public regarding conduct while wearing hand gloves as well as due to a casual attitude towards the disease, or an incorrect perception about disease transmission.

During the COVID-19 pandemic, the rules and regulations enacted by the Saudi government could have promoted preventive practices before the related knowledge was obtained. This was clear from the low (although significant) correlation between knowledge and preventive practices scores. Further investigation is required to reveal the influencing association between practising preventive measures and confounding factors such as laws and policies.

This study has a few limitations. Owing to recruitment through online snowball sampling, there is insufficient evidence to estimate or report a response rate. In addition, as the recruiting strategies directly influenced the number of participants from each region of the country, gender and nationality, the sample's representativeness might have been affected. However, most participants were from three geographical regions—Makkah, Albaha, and Riyadh—which account for approximately 50% of the total population of Saudi Arabia. This may, to some extent, support the generalisability of the findings (General Authority for Statistics, 2019). Furthermore, the resident participants were more in number than their expatriate counterparts. This might have been owing to expatriates' limited access to the online questionnaire. Moreover, circumstances surrounding the lockdown like unavailability of internet connection at home and closure of public transport facilities to reach out, which might have limited

chance to participate in this study. At early phase of the pandemic, associations such as that between smoking or animal contact with chances of getting affected by COVID-19 or severity of the disease might were not clear, however, analysis of data and responses from participants were carried taking into account available evidence on current literature.

Conclusion

This study found significant differences in participants' knowledge of COVID-19 based on age, gender, educational level, and place of residence. Health education programs should target less-educated residents, and expatriate populations. Health education programmes directed at disseminating accurate COVID-19 knowledge may foster optimistic attitudes and appropriate practices. In sum, the current findings highlight the knowledge, perceptions, and preventive practices towards COVID-19 among Saudi residents in the early stages of the pandemic. Furthermore, evidence from this study emphasis the need for further exploring factors influencing association between knowledge and practices toward COVID-19.

Conflicts of Interest

The author declares no conflicts of interest.

References

- Afzal, M. S., Khan, A., Qureshi, U. U. R., Saleem, S., Saqib, M. A. N., Shabbir, R. M. K., . . . Ahmed, H. (2020). Community-Based Assessment of Knowledge, Attitude, Practices and Risk Factors Regarding COVID-19 Among Pakistanis Residents During a Recent Outbreak: A Cross-Sectional Survey. *J Community Health*, *46*(3), 476–486. https://doi.org/10.1007/s10900-020-00875-z
- Ahn, D. G., Shin, H. J., Kim, M. H., Lee, S., Kim, H. S., Myoung, J., . . . Kim, S. J. (2020). Current Status of Epidemiology, Diagnosis, Therapeutics, and Vaccines for Novel Coronavirus Disease 2019 (COVID-19). *J Microbiol Biotechnol*, *30*(3), 313-324. https://doi.org/10.4014/jmb.2003.03011
- Al-Hanawi, M. K., Angawi, K., Alshareef, N., Qattan, A. M. N., Helmy, H. Z., Abudawood, Y., . . . Alsharqi, O. (2020). Knowledge, Attitude and Practice Toward COVID-19 Among the Public in the Kingdom of Saudi Arabia: A Cross-Sectional Study. *Front Public Health*, *8*, 217. https://doi.org/10.3389/fpubh.2020.00217
- Al-Tawfiq, J. A., Zumla, A., & Memish, Z. A. (2014). Coronaviruses: severe acute respiratory syndrome coronavirus and Middle East respiratory syndrome coronavirus in travelers. *Curr Opin Infect Dis*, *27*(5), 411-417. https://doi.org/10.1097/qco.0000000000000089
- Algaissi, A. A., Alharbi, N. K., Hassanain, M., & Hashem, A. M. (2020). Preparedness and response to COVID-19 in Saudi Arabia: Building on MERS experience. *Journal of infection and public health*, *13*(6), 834-838. https://doi.org/10.1016/j.jiph.2020.04.016
- Alshammari, T. M., Altebainawi, A. F., & Alenzi, K. A. (2020). Importance of early precautionary actions in avoiding the spread of COVID-19: Saudi Arabia as an Example. *Saudi Pharmaceutical Journal*, *28*(7), 898-902. https://doi.org/10.1016/j.jsps.2020.05.005
- Azlan, A. A., Hamzah, M. R., Sern, T. J., Ayub, S. H., & Mohamad, E. (2020). Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLoS One*, *15*(5), e0233668. https://doi.org/10.1371/journal.pone.0233668
- Barua, Z., Barua, S., Aktar, S., Kabir, N., & Li, M. (2020). Effects of misinformation on COVID-19 individual responses and recommendations for resilience of disastrous consequences of

misinformation. *Progress in Disaster Science*, 8, 100119. https://doi.org/10.1016/j.pdisas.2020.100119

- Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, *4*(5), 460-471. https://doi.org/10.1038/s41562-020-0884-z
- CDC. (2020). *COVID-19*. Centers_for_Disease_Control_and_Prevention_(CDC). Retrieved 11_March_2020 from https://www.cdc.gov/coronavirus/2019-ncov/communication/guidance.html
- Chan, J. F., Yuan, S., Kok, K. H., To, K. K., Chu, H., Yang, J., Yuen, K. Y. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*, *221*(11):1757-1761. https://doi.org/10.1016/s0140-6736(20)30154-9
- Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Zhang, L. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*, *395*(10223), 507-513. https://doi.org/10.1016/s0140-6736(20)30211-7
- Diepeveen, S., Ling, T., Suhrcke, M., Roland, M., & Marteau, T. M. (2013). Public acceptability of government intervention to change health-related behaviours: a systematic review and narrative synthesis. *BMC Public Health*, *13*(1), 756. https://doi.org/10.1186/1471-2458-13-756
- Eastin, C., & Eastin, T. (2020). Clinical Characteristics of Coronavirus Disease 2019 in China: Guan W, Ni Z, Hu Y, et al. N Engl J Med. 2020 Feb 28 [Online ahead of print] DOI: 10.1056/NEJMoa2002032. *The Journal of Emergency Medicine*, *58*(4), 711-712. https://doi.org/10.1016/j.jemermed.2020.04.004
- Emary, K. R. W., Golubchik, T., Aley, P. K., Ariani, C. V., Angus, B., Bibi, S., . . . Pollard, A. J. (2021). Efficacy of ChAdOx1 nCoV-19 (AZD1222) vaccine against SARS-CoV-2 variant of concern 202012/01 (B.1.1.7): an exploratory analysis of a randomised controlled trial. *Lancet*, *397*(10282), 1351-1362. https://doi.org/10.1016/s0140-6736(21)00628-0
- Fu, L., Wang, B., Yuan, T., Chen, X., Ao, Y., Fitzpatrick, T., . . . Zou, H. (2020). Clinical characteristics of coronavirus disease 2019 (COVID-19) in China: A systematic review and meta-analysis. *The Journal of infection*, *80*(6), 656-665. https://doi.org/10.1016/j.jinf.2020.03.041
- Gao, Z., Ying, S., Liu, J., Zhang, H., Li, J., & Ma, C. (2020). A cross-sectional study: Comparing the attitude and knowledge of medical and non-medical students toward 2019 novel coronavirus. *J Infect Public Health*, *13*(10), 1419-1423. https://doi.org/10.1016/j.jiph.2020.06.031
- General Authority for Statistics, S. A. (2019). *Population by Age Groups ,and Gender 2019*. https://www.stats.gov.sa/en/43
- Grant, M. C., Geoghegan, L., Arbyn, M., Mohammed, Z., McGuinness, L., Clarke, E. L., & Wade, R. G. (2020). The prevalence of symptoms in 24,410 adults infected by the novel coronavirus (SARS-CoV-2; COVID-19): A systematic review and meta-analysis of 148 studies from 9 countries. *PLoS One*, *15*(6), e0234765. https://doi.org/10.1371/journal.pone.0234765
- Hezima, A., Aljafari, A., Mohammad, A., & Adel, I. (2020). Knowledge, attitudes, and practices of Sudanese residents towards COVID-19. *East Mediterr Health J*, *26*(6), 646-651. https://doi.org/10.26719/emhj.20.076
- Honarvar, B., Lankarani, K. B., Kharmandar, A., Shaygani, F., Zahedroozgar, M., Rahmanian Haghighi, M. R., . . . Zare, M. (2020). Knowledge, attitudes, risk perceptions, and practices of adults toward COVID-19: a population and field-based study from Iran. *Int J Public Health*, *65*(6), 731-739. https://doi.org/10.1007/s00038-020-01406-2
- Hussain, A., Garima, T., Singh, B. M., Ram, R., & Tripti, R. P. (2020). Knowledge, attitudes, and practices towards COVID-19 among Nepalese Residents: A quick online cross-sectional survey. *Asian Journal of Medical Sciences*, *11*(3), 6-11. https://doi.org/0000-0001-6218-0500
- Jin, Y., Yang, H., Ji, W., Wu, W., Chen, S., Zhang, W., & Duan, G. (2020). Virology, Epidemiology, Pathogenesis, and Control of COVID-19. *Viruses*, *12*(4). https://doi.org/10.3390/v12040372
- Jose, R., Narendran, M., Bindu, A., Beevi, N., L, M., & Benny, P. V. (2020). Public perception and preparedness for the pandemic COVID 19: A Health Belief Model approach. *Clinical Epidemiology and Global Health*, *9*:41-46. https://doi.org/https://doi.org/10.1016/j.cegh.2020.06.009
- Kebede, Y., Yitayih, Y., Birhanu, Z., Mekonen, S., & Ambelu, A. (2020). Knowledge, perceptions and preventive practices towards COVID-19 early in the outbreak among Jimma university

medical center visitors, Southwest Ethiopia. *PLoS One*, *15*(5), e0233744. https://doi.org/10.1371/journal.pone.0233744

- Lee, T. Y., Zhong, Y., Zhou, J., He, X., Kong, R., & Ji, J. (2020). The outbreak of coronavirus disease in China: Risk perceptions, knowledge, and information sources among prenatal and postnatal women. *Women Birth*. *34*(3), 212-218. https://doi.org/10.1016/j.wombi.2020.05.010
- Leung, C. (2020). Risk factors for predicting mortality in elderly patients with COVID-19: A review of clinical data in China. *Mechanisms of ageing and development*, *188*, 111255-111255. https://doi.org/10.1016/j.mad.2020.111255
- Liu, J., Liao, X., Qian, S., Yuan, J., Wang, F., Liu, Y., . . . Zhang, Z. (2020). Community Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, Shenzhen, China, 2020. *Emerg Infect Dis*, *26*(6), 1320-1323. https://doi.org/10.3201/eid2606.200239
- Mehrotra, S., Jambunathan, P., Jindal, M., Gupta, A., & Kapoor, K. (2020). A cross-sectional survey to assess the knowledge regarding coronavirus disease (COVID-19) among health care professionals. *Med J Armed Forces India*, *77*(Suppl 2), S437-S442. https://doi.org/10.1016/j.mjafi.2020.07.001
- Meier, K., Glatz, T., Guijt, M. C., Piccininni, M., van der Meulen, M., Atmar, K., . . . Zamanipoor Najafabadi, A. H. (2020). Public perspectives on protective measures during the COVID-19 pandemic in the Netherlands, Germany and Italy: A survey study. *PLoS One*, *15*(8), e0236917. https://doi.org/10.1371/journal.pone.0236917
- MOH Saudi Arabia. (2020). *Ministry of Health, Saudi Arabia: Issues COVID-19 Awareness Guidelines in Many Languages*. Retrieved 15 Sep from https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/News-2020-03-17-001.aspx
- MOH_Saudi_Arabia. (March 2, 2020). *Ministry of Health, Saudi Arabia: Reports First Case of Coronavirus Infection*. Retrieved 15 Sep
- from https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/News-2020-03-02-002.aspx
- Moore, S., Hill, E. M., Tildesley, M. J., Dyson, L., & Keeling, M. J. (2021). Vaccination and non-pharmaceutical interventions for COVID-19: a mathematical modelling study. *Lancet Infect Dis*. *21*(6), 793-802. https://doi.org/10.1016/s1473-3099(21)00143-2
- Narayana, G., Pradeepkumar, B., Ramaiah, J. D., Jayasree, T., Yadav, D. L., & Kumar, B. K. (2020). Knowledge, perception, and practices towards COVID-19 pandemic among general public of India: A cross-sectional online survey. *Curr Med Res Pract*, *10*(4), 153-159. https://doi.org/10.1016/j.cmrp.2020.07.013
- Pan, L., Mu, M., Yang, P., Sun, Y., Wang, R., Yan, J., Tu, L. (2020). Clinical Characteristics of COVID-19 Patients With Digestive Symptoms in Hubei, China: A Descriptive, Cross-Sectional, Multicenter Study. *Am J Gastroenterol*, *115*(5), 766-773. https://doi.org/10.14309/ajg.0000000000000620
- Papagiannis, D., Malli, F., Raptis, D. G., Papathanasiou, I. V., Fradelos, E. C., Daniil, Z., Gourgoulianis, K. I. (2020). Assessment of Knowledge, Attitudes, and Practices towards New Coronavirus (SARS-CoV-2) of Health Care Professionals in Greece before the Outbreak Period. *Int J Environ Res Public Health*, *17*(14), 4952. https://doi.org/10.3390/ijerph17144925
- Reuben, R. C., Danladi, M. M. A., Saleh, D. A., & Ejembi, P. E. (2020). Knowledge, Attitudes and Practices Towards COVID-19: An Epidemiological Survey in North-Central Nigeria. *J Community Health*, 1-14. https://doi.org/10.1007/s10900-020-00881-1
- Saqlain, M., Munir, M. M., Rehman, S. U., Gulzar, A., Naz, S., Ahmed, Z., . . . Mashhood, M. (2020). Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: a cross-sectional survey from Pakistan. *J Hosp Infect*, *105*(3), 419-423. https://doi.org/10.1016/j.jhin.2020.05.007
- Seale, H., Heywood, A. E., Leask, J., Sheel, M., Thomas, S., Durrheim, D. N., . . . Kaur, R. (2020). COVID-19 is rapidly changing: Examining public perceptions and behaviors in response to this evolving pandemic. *PLoS One*, *15*(6), e0235112. https://doi.org/10.1371/journal.pone.0235112
- Tobaiqy, M., Qashqary, M., Al-Dahery, S., Mujallad, A., Hershan, A. A., Kamal, M. A., & Helmi, N. (2020). Therapeutic management of patients with COVID-19: a systematic review. *Infection Prevention in Practice*, *2*(3), 100061-100061. https://doi.org/10.1016/j.infpip.2020.100061
- West, R., Michie, S., Rubin, G. J., & Amlôt, R. (2020). Applying principles of behaviour change to reduce SARS-CoV-2 transmission. *Nature Human Behaviour*, *4*(5), 451-459. https://doi.org/10.1038/s41562-020-0887-9

- WHO. (2020). *Coronavirus disease (COVID-19) advice for the public*. Retrieved 15 Sep from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public
- WHO Director-General's. (March 2020). Opening remarks at the media briefing on COVID19. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---4-september-2020
- Yusof, A. N. M., Muuti, M. Z., Ariffin, L. A., & Tan, M. K. M. (2020). Sharing Information on COVID-19: the ethical challenges in the Malaysian setting. *Asian Bioethics Review*, 1-13. https://doi.org/10.1007/s41649-020-00132-4
- Zhong, B. L., Luo, W., Li, H. M., Zhang, Q. Q., Liu, X. G., Li, W. T., & Li, Y. (2020). Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci*, *16*(10), 1745-1752. https://doi.org/10.7150/ijbs.45221
- Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., . . . Tan, W. (2020). A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med*, *382*(8), 727-733. https://doi.org/10.1056/NEJMoa2001017