Original Article

Knowledge, Attitude, and Practice toward COVID-19 among Sudanese Population, Khartoum 2020

Issra Osman Khojaley, Fadwa Abdalhai Hamad[1], Ali Awadallah Saeed[2], Mai Abdalla Humaida[3], Tarig M. Hassan[4]

Department of Pharmacology and Therapeutic, Faculty of Pharmacy, Al Neelain University, [1]Community Pharmacy, Ahmed Abdulkareem Pharmacy, [2]Department of Pharmacology and Therapeutics, Pharmacy Program, Napata College, Departments of [3]Pharmacy Practice and [4]Clinical Pharmacy, Faculty of Clinical and Industrial Pharmacy, National University, Khartoum, Sudan

Abstract

Introduction: Coronavirus disease 2019 (COVID-19) is defined as an illness caused by a novel coronavirus which is an emerging respiratory infection that was first discovered in December 2019, in Wuhan city, Hubei Province, China, finally named severe acute respiratory syndrome coronavirus 2. This study aimed to evaluate the current level of knowledge regarding transmission, symptoms, and preventive measures of COVID-19 among the general population in Sudan. **Objective:** The objective of the study was to assess knowledge, attitude, and practice toward COVID-19 among Sudanese resident. **Methodology:** This was a cross-sectional, descriptive, community-based study for 1000 respondents selected by convenience sampling technique in seven localities of Khartoum state, Sudan between the periods April 9 and June 9, 2020. Data were collected using a pre designed pretested questionnaire and analyzed using the Statistical Package for the Social Sciences software, version 23.0 (IBM SPSS Inc., Chicago, IL, USA). **Results:** Sixty-four percent of the population had good knowledge regarding COVID-19 clinical presentations transmission routes, prevention method, and self-isolation. Forty-four percent of the population had poor attitude regarding COVID-19 situation. Forty-two percent of the population had poor practice regarding COVID-19 preventive measures. There is a positive association between knowledge and attitude ($P = 0.000001$), positive association between knowledge and practice ($P = 0.000001$), and an insignificant negative association between attitude and practice ($P = 0.453$). **Conclusions:** Sudanese had a good level of knowledge and good practices compared to other nearby countries despite their economic state and lack of possibilities. The stressor experienced by the Sudanese citizens had huge effect on their negative attitude. **Recommendations:** Because good practices depend on good knowledge, it recommends to increase the level of knowledge about the disease, ways of transmission and prevention especially for women, elderly retired, unemployed, and those with low education level, rural resident using all the means of communication available (television and radio, awareness seminars, posters for guidance and alert in mosques, and the houses of worship) by clear, easy, simple language suitable for the elderly and uneducated.

Keywords: Coronavirus disease 2019, Khartoum, population

Introduction

Coronavirus disease 2019 (COVID-19) is defined as an illness caused by a novel coronavirus which is an emerging respiratory infection that was first discovered in December 2019, in Wuhan city, Hubei Province, China, finally named severe acute respiratory syndrome coronavirus 2.[1] The main symptoms of COVID-19 have been identified as fever, dry cough, fatigue, myalgia, shortness of breath, and dyspnea. Some people become infected but do not develop any symptoms. About 80% recover from the disease without needing special treatment. Around 1 out of every 6 people who gets COVID-19 becomes seriously ill and develops difficulty breathing. Older people and those with underlying medical problems such as high blood pressure, heart problems, or diabetes are more likely to develop serious illness.[2]

COVID-19 has spread widely and rapidly, from Wuhan city, to other parts of the world, threatening the lives of many people.[3]

COVID-19 is characterized by high morbidity and mortality rates alongside other ailments. Regarding it, as the most

Access this article online

Quick Response Code:

Website: www.matrixscimed.org

DOI: 10.4103/mtsm.mtsm_59_20

Address for correspondence: Dr. Ali Awadallah Saeed, Department of Pharmacology and Therapeutics, Pharmacy Program, Napata College, Khartoum, Sudan.
E-mail: Ali-awad2009@hotmail.com, alimhsd@gmail.com

How to cite this article: Khojaley IO, Hamad FA, Saeed AA, Humaida MA, Hassan TM. Knowledge, attitude, and practice toward COVID-19 among Sudanese population, Khartoum 2020. Matrix Sci Med 2022;6:6-13.

Received: 16-12-2020, **Revised:** 05-10-2021,
Accepted: 07-10-2021, **Published:** 25-01-2022

widespread disease that threatened societies and caused spiritual, material, and medical losses this disease led to the collapse of the global economy and the health system in the most countries. The shutting down of social activities through out the world to mitigate the spread of the pandemic has led to a global lockdown, causing a downturn and global economic fall due to a break in the global supply chain.[4]

As of September 20, 2020, the outbreak of coronavirus disease (COVID-19) had been confirmed in over 210 countries or territories.[5] Experts have worried about COVID-19 spreading to Africa because many of the healthcare systems on the continent are inadequate, having problems such as lack of equipment, lack of funding, insufficient training of healthcare workers, and inefficient data transmission. It was feared that the pandemic could be difficult to keep under control in Africa and could cause huge economic problems if it widely spread.[6]

WHO rated Sudan as "at-risk" for COVID-19 spread based on the risk profile and capacity of the country to respond to a potential outbreak. Sudan's health system is marked by decades of limited investment, underfunding, and lack of qualified staff, infrastructure, equipment, medicines, and supplies. The surveillance system does not cover the entire country and is structurally weak with long delays between alert and confirmation of an outbreak.[7] On 13 March, Sudan reported its first novel coronavirus case in Khartoum. COVID-19 is spread in 16 Sudanese states out of 18, and Khartoum is the most affected by the disease, as the majority of cases are concentrated in it. the number of cases gradually increased to 13,535, and the number of deaths had totaled 836.[8]

Strong infection control measures are the primary intervention to minimize the spread of the virus in both health care settings and the community.[9] The most practical available solution to prevent the spread of the virus is to limit the community activities between people to prevent infection through the government's action rules. Social distance and self-isolation and lockdown are important nationwide social measures.[10] After all, the WHO offers the most effective preventive measures: maintain physical distance (minimum 3 feet or 1 m) from other persons; the hands must be cleaned immediately after contact with the respiratory tract; avoid touching eyes, nose, and mouth frequently; regular cleaning and disinfection of environmental and other frequently touched surfaces; improve living space airflow by opening as many windows and doors as possible; fever, cough, and difficulty in breathing, seek immediate treatment.[2]

Justification

In this pandemic, many medicines were used worldwide but unfortunately no definite treatment till now, so knowledge, attitude, and practice to combat the pandemic is essential to be assessed to prevent the population from COVID-19.

Objectives

The aim f the study wad to assess Sudanese residents' knowledge, attitude, and practice toward COVID-19; to describe association between knowledge, attitude, practice, and demographic data; and to assess the impact of knowledge on population's practices.

Methodology

Study design

This was a cross-sectional, descriptive, community-based study, conducted in seven localities of Khartoum state, Sudan (Khartoum, Khartoum Bahrii, Omdurman, Jabal'awlia, Shrq Alnail, Umbadda, and Karrari) between the periods April 9 and June 9, 2020.

Study populations and size

Thousand from population was selected by convenience sampling technique from different areas (residential areas, main roads, transportation station, and public markets) to include individuals from different sectors and backgrounds. Preventive measures such as wearing medical masks and disposable gloves, maintaining a physical distance, and wiping hands with a sterilizer were taken.

Inclusion criteria

Sudanese nationals of both sexes and aged 18 years and above and who had agreed to participate were included and considered appropriate for the study.

Exclusion criteria

Health- care workers (physician, specialist, pharmacist, nurses, medical laboratories technician, X-ray technician, etc.,) and medical students were excluded from this study.

Data collection process

Data were collected using a predesigned pretested questionnaire through a 40-item structured, Arabic language, close-ended and self-administered questionnaire. Some questionnaire filled by researcher from respondents who not formally educated. The questionnaire consisted of two parts: demographics and knowledge, attitude, and practice, in addition to the consent question. The questionnaire had 32 questions. In order to have a better assessment of overall knowledge, each correct answer in the knowledge domain carried 1 mark, while wrong answer carried 0 mark; this gave a total score range of 0–12 then converted to percentages. In an attitude section, a liker scale was used; strongly agree, somewhat agree, undecided, somewhat disagree, and strongly disagree were scored 4, 3, 2, 1, and 0 marks, respectively, also for negatively quoted question reverse scoring was used, this gave a score range of 0–32 then converted to percentages. For practice, A likert scale was used; always, sometimes, and never were scored 1, 0.5, and 0 marks, respectively, also for negatively quoted question reverse scoring was used, this gave a score range of 0–12 then converted to percentages. The scores in knowledge, attitude, and practice domains were not normally distributed were expressed as median then were categorized as poor (less

than median) and good (median and above).

Data analysis

Statistical Package for Social Sciences software, version 23.0 (IBM SPSS Inc., Chicago, IL, USA) was used.

Ethical considerations

Ethics approval for this study was conducted under permission from the National University Human Research Ethics Committee faculty of clinical and industrial pharmacy on April 2020, and informed consent was taken verbally from all study participants.

Results

Females 69.3% were higher than that of males 30.7%., 60.5% were aged between (26 and 45) years, and 18.9% were aged between (46 above) years. The proportion of single 45.5% and married 43.1% were higher than divorced and widowed 11.4%. 48.3% were university educated and 36.6% were preuniversity educated while 3.6 was illiterate. Nearly 41.4% were private employees, only 17.3% were government employees, while 33.3% were unemployed. Population was well distributed between seven localities(Omdurman locality 20%, Khartoum locality 16.6%, Ombadda locality 15.1%, Karrary locality 14.9%, Khartoum Bahrri locality 13.4%, Sharg-Alneel locality 10.1%, and 9.9% from Jabal 'awlia). Social and news media 51.2% were the main sources of information, while official government websites 17.9% were the least and 18.4% get it from family and friends. Table 4 reprsent the knowledge, attitude and practice varible responses of participants.

Knowledge scores of population

- Table 1 shows that the lowest percent was 0 and the highest was 100. The average mark was between 50 and 92 (mean ± standard deviation [SD])
- Sixty-four percent of the population had good knowledge regarding COVID-19 clinical presentations transmission routes, prevention method, and self-isolation, and 36% of the population had poor knowledge regarding COVID-19 clinical presentations, transmission routes, prevention method, and self-isolation.

Attitude scores of population

- Table 2 shows that the lowest percent was 19 and the highest was 100. The average mark was between 55 and 83 (mean ± SD)
- Forty-four percent of the population had poor attitude regarding COVID-19 situation and 56% of the population had good attitude regarding COVID-19 situation.

Practice scores of populations

- Table 3 shows that the lowest percent was 0 and the highest was 95. The average mark was between 36 and 74 (mean ± SD)
- Forty-two percent of the population had poor practice regarding COVID-19 preventive measures and 58% of the population had good Practice regarding COVID-19 preventive measures.

As shown in Figure 1.

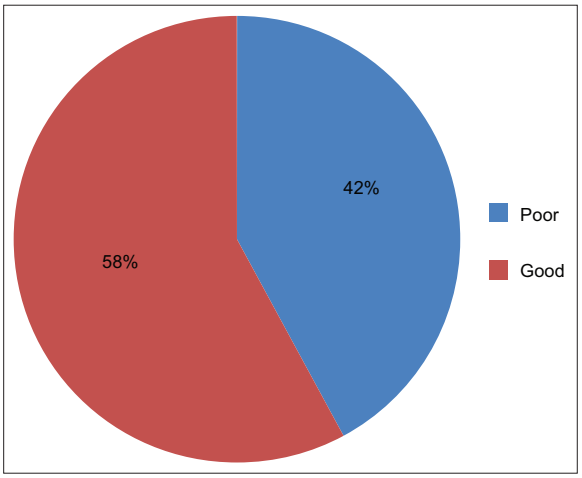

Figure 1: Distribution of population according to practice score

Table 1: Knowledge scores of population towards coronavirus disease 2019

Descriptive statistics	*n*	Minimum	Maximum	Median	Mean±SD
Knowledge score (%)	1000	0	100	75	71±21

SD: Standard deviation

Table 2: Attitude scores of population towards coronavirus disease 2019

Descriptive statistics	Number	Minimum	Maximum	Median	Mean±SD
Attitude score (%)	1000	19	100	69	69±14

SD: Standard deviation

Table 3: Practice scores of population towards coronavirus disease 2019

Descriptive statistics	Number	Minimum	Maximum	Median	Mean±SD
Practice score (%)	1000	0	95	55	55±19

SD: Standard deviation

Association between knowledge and demographic data

There is a significant association between

Knowledge and age ($P = 0.045$) (younger <45 year had good knowledge compared to elderly), knowledge and Education level ($P = 0.00001$) (people with high education level had good knowledge compared to preuniversity educated), knowledge and occupation ($P = 0.021$) (employed had good knowledge compared to retired and unemployed), knowledge and place of current residence ($P = 0.00001$). (Jabal 'awlia, Khartoum, and Khartoum-bahrii had good knowledge compared to other residence area) and knowledge and source(s) of information about COVID-1, ($P = 0.00001$). (People who gathered information from official government websites and social and news media had good knowledge compared to those gathered information from family, friends.

Association between attitude and demographic data

There is a significant association between

Attitude and gender ($P = 0.00001$) (female had good attitude compared to Male), attitude, and education level ($P = 0.00001$) (people with high education level had good attitude compared to preuniversity educated), attitude and place of current residence ($P = 0.00001$) (Jabal 'awlia, Khartoum, and ombadda had good attitude compared to other residence area), attitude and Source(s) of information about COVID-19, ($P = 0.00001$) (People who gathered information from social and news media had good attitude compared to those gathered information from official government websites and family and friends), and knowledge score and attitude ($P = 0.0000001$).

Association between practice and demographic data

There is a significant association between

Practice and gender ($P = 0.00001$) (male had good practice compared to female), practice, and age (older than 45 years had good practice compared to those <45 years), practice and occupation ($P = 0.00001$) (governmental and private employees had good practice compared to Unemployed resident), practice and Place of current residence ($P = 0.00001$) (Khartoum, Jabal awlia, and Khartoum-bahrii had good practice compared to other residence area), and knowledge and practice ($P = 0.0000001$).

Knowledge, attitude, and practice correlations

There is a positive association between

Knowledge and attitude ($P = 0.000001$), knowledge and practice ($P = 0.000001$) and attitude and practice ($P = 0.453$).

Level of knowledge among population according to demographic data

- Binary logistic regression for prediction knowledge has been used, and it was found that Retired and Unemployed participants contributed more to being poor in knowledge 1.355 (1.016–1.807) times statistically significant with *a* P value $0.039 < 0.05$
- Participants had a lower attitude score contributed more to being poor in knowledge 0.959 (0.949–0.969) times statistically significant with P value $0.000001 < 0.05$
- Participants had a lower practice score contributed more to being poor in knowledge 0.975 (0.968–0.983) times statistically significant with a P value $0.000001 < 0.05$.

Level of Attitude among population according to demographic data

- Binary logistic regression for prediction Attitude has been used, and it was found that Male participants contributed more to being poor in attitude 2.002 (1.492–2.686) times statistically significant with a P value $0.000001 < 0.05$
- Married participants contributed more to being poor in attitude 1.631 (1.212–2.196) times statistically significant with a P value $0.001 < 0.05$
- Noneducated participants contributed more to being poor in attitude 2.532 (1.198–5.351) times statistically significant with a P value $0.015 < 0.05$
- Participants had a lower knowledge score contributed more to being poor in attitude 0.974 (0.967-0.981) times statistically significant with a P value $0.000001 < 0.05$
- Participants had a higher practice score contributed more to being poor in attitude 1.016 (1.008-1.023) times statistically significant with a P value $0.000001 < 0.05$.

Level of practice among population according to demographic data

- Binary logistic regression for prediction practice has been used, and it was found that female participants contributed more to being poor in practice 2.072 (1.532–2.802) times statistically significant with *a* P value $0.000002 < 0.05$
- Younger age participants (<36 years) contributed more to being poor in practice 1.355 (1.006–1.824) times statistically significant with a P value $0.046 < 0.05$
- Retired and Unemployed participants contributed more to being poor in practice 1.437 (1.090–1.896) times statistically significant with a P value $0.01 < 0.05$.
- Participants had a lower knowledge score contributed more to being poor in practice 0.978 (0.971–0.984) times statistically significant with a P value $0.0000001 < 0.05$.

Discussion

The study showed that more than half of participants had good knowledge toward COVID-19. One-third of the population had poor knowledge regarding COVID-19 it's not a simple ratio, when the severity of the disease and the speed of its spread were taken into account. The seriousness of this was the possibility of infecting others and transmitting the disease to them. This might be to the presence of elderly, uneducated participants; also the study was conducted at the beginning of the outbreak in Sudan when people had a little knowledge about it. The study showed consistency with the study conducted in Turkey (2020)[16] showed that most of the participants had inadequate knowledge about COVID-19, also showed consistency with the study conducted in Al-Jouf (Saudi 2012)[27]

Table 4: Variables of Knowledge, attitude and practice of participants toward coronavirus disease 2019

Knowledge variables	Correct (%)	Incorrect (%)	Not sure (%)
COVID-19 is an infectious disease caused by bacteria	37.3	41.2	21.5
Touching and shaking hands with an infected person does not transmit the disease	17.2	73.4	9.4
The COVID-19 can infect some animals such as camels and bats	50.7	12.9	36.4
Signs and symptoms of the disease are the same as seasonal flu (fever, cough, sore throat, muscle ache) with some differences	84.4	4.2	11.4
Signs and symptoms of the disease appear immediately after the exposure to the disease	24.5	56	19.5
Elderly, diabetic and cardiovascular disease patients are at higher risk of death from the disease	82.5	4.5	13
Persons with COVID-19 cannot transmit the infection to others when a fever is not present	14	61.9	24.1
There currently is no effective cure for COVID-19, but early symptomatic and supportive treatment can help most patients recover from the disease	84.4	4.3	11.3
Children do not need to take measures to prevent the infection by the COVID-19 virus	14.2	73.6	12.2
To prevent the infection y COVID-19, individuals should avoid going to crowded places such as train stations, events, and avoid taking public transportations	92	2.3	5.7
Isolation of people who are infected with the COVID-19 virus is effective ways to reduce the spread of the virus	91.7	1.7	6.6
People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place at least for 14 days	90.7	1.1	8.2
Attitude variable (*n*=1000)	**Agree (%)**	**Undecided (%)**	**Disagree (%)**
COVID-19 is widespread in Sudan	62.8	20.9	16.3
Sudan public health Authorities is doing enough to control COVID-19 outbreak	60.8	6.2	33
Sudan can win the battle against the COVID-19 virus	41.7	11.3	47
Sudanese people strictly following the preventive measures	35.7	5.2	59.1
Complete curfew is not necessary	44.1	6.9	49
Financial obligations will be the first obstacle to curfew	90.9	3.5	5.6
Everyone who came from the outside country should be quarantined	94	3	3
Everyone who came in contact with infected person should be quarantined	93.9	3.4	2.7
Practice variables (*n*=1000)	**Always (%)**	**Sometimes (%)**	**Never (%)**
In the last days have you: Gone to any crowded place	30.7	40.4	28.9
In the last days have you: Shacked hands with other people	47	36.2	16.8
In the last days have you: Eaten at restaurants and cafes or ordered delivery	24.3	30.9	44.8
In the last days have you: Traveled in or out of Sudan during the past 30 days	8	10.7	81.3
Nowadays, are you: Wearing a mask to cover the nose and mouth when leaving home	20.3	25.3	54.4
Nowadays, are you: Washing your hands correctly after touched any contaminated surfaces	54.1	31.6	14.3
Nowadays, are you: Covering your nose and mouth with a tissue when coughing or sneezing and threw the tissue in the trash after use	55.1	25.4	19.5
Nowadays, are you: Taking Vitamin C containing food or tablets	28.1	45.9	26
Nowadays, are you: Practicing exercise	24.3	31.3	44.4
Nowadays, are you: Sticking with curfew regulations	62.1	19.2	18.7
Nowadays, are you: Reporting if someone suspected to have COVID-19	64.1	12.5	23.4

COVID-19: Coronavirus disease 2019

Found that knowledge of participants about incubation period and clinical picture of MERS-CoV was not enough. Most of the participants were aware of the clinical symptoms, its methods of spread, people at higher risk, and knew that there is no clinically approved treatment for COVID-19. And this was not surprising as 60% of participants were higher educated (university and postgraduate), aged between 26 and 45 years who they were followers of the social media that was interested in raising awareness about COVID-19 during the last period. However, they were Ignorant the cause of disease if its bacteria or virus, the possibility of infecting animals, and the onset of symptoms after exposure to the disease. The mean knowledge score was significantly lower among older participants, those living in rural areas, with lower educational levels, and among unemployed and retired. These findings were consistent with a study conducted in China that showed Most Chinese residents of a relatively high socioeconomic status are knowledgeable about COVID-19. The study showed consistency with the study conducted in Egypt[9] found that COVID-19 Knowledge was significantly lower among older, less educated participants, and rural residents. In addition, another study conducted in Tanzania[15] found that most of participants had good knowledge which was significantly associated with education level the same study also showed that, age-group of 16–29 years (in different to our study), and education of secondary or lower were significantly associated with lower knowledge score. Furthermore, the study showed consistency with the study conducted in Sudan[13] found that

elderly and participants with no formal education were the least knowledgeable. The study showed consistency with the study conducted in Ethiopia[12] that found age above 35 years, lack of formal education and unemployed significantly associated with poor knowledge. The study found there was no difference in knowledge among male and female in different to studies that were conducted in Chine[28] and kingdom of Saudi Arabia[1] found that women were high knowledgeable about COVID-19, hold optimistic attitudes. This might be because the most female participants were elderly and secondary educated.

The study also reflected another finding there was a significant association between source(s) of information about COVID-19 and participant's knowledge People who gathered information from Official government websites and Social and news media had good knowledge compared to those gathered information from family, friends. This is not surprising as 63.7 of participants pointed social and news media (Instagram, Facebook, WhatsApp, Television, mobile message, etc.) as the main source of information. Social and news media characterized by ease of use and rapid access to information in addition Rights from the WHO declaration of COVID-19 as pandemic, several guidelines, and COVID-19 information have been uploaded online by WHO. Recently, FMOH started using this media including television and mobile messages as well as Facebook pages to educate public about COVID-19. Accordingly, this led to an improve participant's knowledge. This is consistent with many studies that was conducted in Nigeria,[4] Egypt,[9] and China[28] that found access to such reliable information in social media, and the internet pages could improve citizen knowledge about COVID-19. Regarding attitude, the study showed that nearly all of participants had agreed the isolation of infected and suspected patients and those coming from outside the country. People differed in their belief of the disease spread, necessarily of complete curfew, adherence of Sudanese people to the preventive measures. Sixty percent agreed that Sudan public health authorities is doing enough to control COVID-19 outbreak, while remain disagreed. Most of the participants think the state does not has the potential and abilities to control the epidemic. The majority Complain about the ability of Sudan to win the battle against the COVID-19. Nearly half of participants had poor attitude toward COVID-19 situation. This might be due to the discontent of the citizens and the volatile political situation in Sudan. The rapid spread of the disease, high mortality rate, the fear of losing dear people, state lockdown, the collapse of the local and global economy in addition to the collapse of the health system even in the great countries such as Italy, the United States of America all this led to a state of fear and terror of the disease that reflected on negative attitude. This finding is inconsistent with many studies that were conducted in Malaysia,[14] Tanzania,[15] Palestine[18] and other countries that found most study participants' expressed positive attitude and confidence that COVID-19 would be successfully controlled. Gender, age, marital status, education level, and knowledge score were significantly associated with a positive attitude (Female, aged less than 45, single and divorced, People with high education level and the higher the knowledge level of COVID-19,) were more optimistic. Thats optimism, it might be because of the participation of these segments in the voluntary initiatives that took place, younger began to support the ministry and government institutions concerned to deal with the pandemic where thousands of young men and women from different disciplines volunteered, and many initiatives emerged such as the field awareness initiative, sanitizer manufacturing, and distribution initiative, rehabilitation of isolation and quarantine centers initiative, Call Center initiative and many many more. This is consistent with most of the studies in the literature that was conducted[11,16,17,19,21,23,25] and also to studies conducted in China,[28] Saudi Arabia,[1] Ghana,[29] and Sudan[13] that found female, younger, those with high education level and higher knowledge score held positive attitude toward COVID-19 situation. The study also reflected there was a significant association between Source(s) of information about COVID-19 and participant's attitude. People who gathered information from Social and news media had good attitude compared to official governmental website; again this due to the availability of huge COVID-19 information, guidelines, and WHO rights. Furthermore, the news of the decline in the number of infections in some countries, including China and easing restrictions. In addition to the follow-up of latest scientist's findings of the virus nature and the attempt to find the vaccine the presence of such news gives reassurance. Concerning practice the study found that despite the economic conditions the Sudanese had good practicing regarding Sticking with curfew, travel regulations and reporting of suspected cases. This consistent with the study that was conducted in Cameroon that found population had well practicing regarding calling the emergency number and reporting of suspected case of COVID-19 at home. Sudanese also practicing well regarding washing hands correctly after touched contaminated surfaces, more than half Covering nose and mouth with a tissue when coughing or sneezing; this reflected Sudanese awareness and adherence to FMOH directions. The study showed consistency with many studies that was conducted in Bangladesh,[10] Nigeria,[4] Turkey, and Philippine[30] that found almost participants had good practicing regarding washing and improved personal hygiene. Avoided crowded place and Shacked hands, wore a mask, taking vitamin C tablets or food enriched with it, were less practiced; this could be primarily attributed to strong Sudanese social relationships and traditions of shaking hands which hard to give up, the economic state of Sudan, unavailability of facemasks and the Exaggerate in their prices which increased by 5–10 folds particularly during the outbreak time and inability of the government to provide enough protective medical tools to their residents. This finding is inconsistent with studies that were conducted in kingdom of Saudi Arabia,[1] Cameroon,[24] Nigeria,[4] Turkey,[16] and Pakistan[20] where most residents adopted good and safe practices. As a result of the availability of tools and strict laws. The study showed that gender, age, education level, and knowledge score were significantly associated

with good practicing. Male had good practice compared to females this attributed to they were afraid to transmit the disease to their families. In contrast to the poor Elderly's knowledge and attitude, they were most adhere to preventive measures this might be because they were more vulnerable to disease and its complication. Furthermore, younger had a misconception that they are at lower risk. Governmental and Private Employees were more adhere to preventive measures compared to Unemployed and retired this may be institution adherence, adherence to the guidelines of the Ministry of Health, by maintain spacing, and wear a mask while in the workplace. This was consistence with many studies that were conducted in China,[28] Saudi Arabia,[1] Syria,[31] Cameroon,[24] and Pakistan[20] that found female, younger, unemployment low education and low knowledge level of COVID-19 were associated with bad practice.

There was most important finding reflected by this study which was a significant association between lace of current residence and knowledge, attitude, and practice. As this study was conducted in Khartoum state with its seven localities, it is difficult to divide it into rural and urban, but we can consider it according to the distance or proximity of the center. The study found that residence of Jabal Awleia had better knowledge and attitude than residence of three large cities Khartoum, Khartoum Bahri, and Omdurman. This is not shocking because the people of rural areas are highly educated, and their workplaces in central Khartoum, so they can get the news easily. As what was expected practice was better in Khartoum followed by Jabal Awleia, Khartoum Bahri, and Omdurman. Sharg Alnile, Ombadda, and Kararri suffered from poor knowledge and practice. The study showed consistency with the many studies were conducted in Egypt,[9] China,[28] United Arab Emirates,[22] Saudi Arabia,[1] Bangladesh,[10] and Nigeria[4] found that urban residence type significantly associated with higher knowledge score. Finally, this study provides evidence on the positive and significant correlations between knowledge attitudes, Knowledge practice, among the respondents (Pearson correlation coefficient approximately 0.3); this mean that a better knowledge associate with better attitudes and practice. Hence, a good knowledge is important for a better practice toward COVID-19.

Strength and limitations

The strength of this study lies on its large sample recruited during a critical period, the initial stage of the COVID-19 outbreak.

The limitations are the refusal of participants to complete the questionnaire, the selection of participants from each locality was not based on a real statistics of the population in each local, and sampling method by convenience.

Conclusions

Findings of this study suggest that the Sudanese had a good level of knowledge and good practices compared to other nearby countries despite their economic state and lack of possibilities. The stressor experienced by the Sudanese citizens had huge effect on their negative attitude. Finally, the study provides evidence on the positive and significant correlations between knowledge-attitudes, knowledge-practice that mean a better knowledge associate with better attitudes and practice. Hence a good knowledge was important for a better practice toward COVID-19.

Recommendations

Because good practices depend on good knowledge, it recommend to increase the level of knowledge about the disease, ways of transmission, and prevention, especially for women, elderly retired, unemployed and those with low education level, rural resident using all the means of communication available (television and radio, awareness seminars, posters for guidance and alert in mosques and the houses of worship) by clear, easy, and simple language suitable for the elderly and uneducated.

It also recommend for decision-makers in the country to provide medical preventive equipment tools and sanitizers for free or adjust and control their prices to maintain the health and safety of all Sudanese citizen.

It also recommends decision-makers and higher authorities that curfew must be imposed and the guidelines of the WHO are adhered to, and those who are compromised should be held accountable in the event of a second wave of COVID-19 or any other global epidemic.

It also recommend effective intervention with more research efforts.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Al-Hanawi MK, Angawi K, Alshareef N, Qattan AM, Helmy HZ, Abudawood Y, *et al.* Knowledge, attitude and practice toward COVID-19 among the public in the kingdom of Saudi Arabia: A cross-sectional study. Front Public Health 2020;8:1-10.
2. World Health Organization (WHO). Coronavirus Disease (COVID-19) Advice for the Public. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public. Accessed by Issra Osman Khojaley.
3. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, *et al.* Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323:1061-9.
4. Reuben RC, Danladi MM, Saleh DA, Ejembi PE. Knowledge, attitudes and practices towards COVID-19: An epidemiological survey in north-central Nigeria. J Community Health 2020; July 4:1-14.
5. World Health Organization (WHO). Coronavirus Disease (COVID-19) Situation-Reports. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/. [Last accessed on 2020 Sep 20].
6. "African Countries Respond Quickly To Spread Of COVID-19". Archived from the Original on 26 March 2020. Available from: https://NPR.org. [Last accessed on 2020 Mar 23].
7. United Nations Office for the Coordination of Humanitarian Affairs. Available from: https://www.unocha.org. [Last accessed on

2020 Mar 20].
8. Sudan Federal Ministry of Health (FMOH). Available from: http://www.fmoh.gov.sd. [Last accessed on 2020 Sep 20].
9. Abdelhafiz AS, Mohammed Z, Ibrahim ME, Ziady HH, Alorabi M, Ayyad M, *et al.* Knowledge, perceptions, and attitude of Egyptians towards the novel coronavirus disease (COVID-19). J Community Health 2020;45:881-90.
10. Rahman A, Sathi NJ. Knowledge attitude and preventive practices toward Covid-19 among Bangladeshi internet users. Electron J Gen Med 2020;17:em245.
11. Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, *et al.* 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 2020;16:1745-52.
12. Bekele D, Tolossa T, Tsegaye R, Teshome W. The knowledge and practice towards COVID-19 pandemic prevention among residents of Ethiopia: An online cross-sectional study. bioRxiv 2020; 06.01. [doi: 10.1101/2020.06.01.127381].
13. Hezima A, Aljafari A, Aljafari A, Mohammad A, Adel I. Knowledge, attitudes, and practices of Sudanese residents towards COVID-19. East Mediterr Health J 2020;26:646-51.
14. Azlan AA, Hamzah MR, Sern TJ, Ayub SH, Mohamad E. Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. PLoS One 2020;15:e0233668.
15. Rugarabamu S, Ibrahim M, Byanaku A. Knowledge, attitudes, and practices (KAP) towards COVID-19: A quick online cross-sectional survey among Tanzanian residents. medRxiv 2020.04.26. [doi: 10.1101/2020.04.26.20080820].
16. Yıldırım M, Güler A. COVID-19 severity, self-efficacy, knowledge, preventive behaviors, and mental health in Turkey. Death Stud. 2020 Jul 16:1-8. doi: 10.1080/07481187.2020.1793434. Epub ahead of print. PMID: 32673183.
17. Honarvar B, Lankarani KB, Kharmandar A, Shaygani F, Zahedroozgar M, Rahmanian Haghighi MR, *et al.* Knowledge, attitudes, risk perceptions, and practices of adults toward COVID-19: A population and field-based study from Iran. Int J Public Health 2020;65:731-9.
18. Qutob N, Awartani F, Asia M, Abu Khader I. Knowledge, attitudes and practices (KAP) towards COVID-19 among Palestinians during the COVID-19 outbreak: A cross sectional survey. MedRxiv 2020.10.13.20211888; doi: https://doi.org/10.1101/2020.10.13.20211888.
19. Amalakanti S, Raman Arepalli KV, Koppolu RK. Gender and occupation predict coronavirus disease 2019 knowledge, attitude and practices of a cohort of a South Indian state population. Indian J Med Microbiol 2020;38:144-51.
20. Saqlain M, Ahmed A, Nabi I, Gulzar A, Naz S, Munir MM, Ahmed Z and Kamran S (2021) Public Knowledge and Practices Regarding Coronavirus Disease 2019: A Cross-Sectional Survey From Pakistan. Front. Public Health 9:629015. doi: 10.3389/fpubh.2021.629015.
21. Rios-González CM. Knowledge, attitudes and practices towards COVID-19 in Paraguayans during outbreaks: A quick online survey. https://doi.org/10.1590/SciELOPreprints.149.
22. Qubais B, Elbarazi I, Barakat M. Novel coronavirus (COVID-19) health awareness among the United Arab Emirates population. medRxiv 2020, doi: https://doi.org/10.1101/2020.09.10.20191890.
23. Van Nhu H, Tuyet-Hanh TT, Van NT, Linh TN, Tien TQ. Knowledge, attitudes, and practices of the Vietnamese as key factors in controlling COVID-19. J Community Health 2020;45:1-7.
24. Ngwewondo A, Nkengazong L, Ambe LA, Ebogo JT, Mba FM, Goni HO, *et al.* Knowledge, attitudes, practices of/towards COVID 19 preventive measures and symptoms: A cross-sectional study during the exponential rise of the outbreak in Cameroon. PLoS Negl Trop Dis 2020;14:e0008700.
25. ALdowyan N, Abdallah AS, El-Gharabawy R. Knowledge, attitude and practice (KAP) study about middle East respiratory syndrome coronavirus (MERS-CoV) among population in Saudi Arabia. Int Arch Med 2017;10: volume 10.
26. Bener A, Al-Khal A. Knowledge, attitude and practice towards SARS. J R Soc Promot Health 2004;124:167-70.
27. Nooh HZ, Alshammary RH, Alenezy JM, Alrowaili NH, Alsharari AJ, Alenzi NM, Sabaa HE. Public awareness of coronavirus in Al-Jouf region, Saudi Arabia. Z Gesundh Wiss. 2020 Feb 13:1-8. doi: 10.1007/s10389-020-01209-y. Epub ahead of print. PMID: 32206545; PMCID: PMC7088303.
28. Yue S, Zhang J, Cao M, Chen B. Knowledge, attitudes and practices of COVID-19 among urban and rural residents in China: A cross-sectional study. J Community Health 2020, August 5:1-6.
29. Essel HB, Tachie-Menson A, Osei M, Yeboah E. Towards the easing of restrictions during an infectious outbreak: A cross-sectional online survey to assess the knowledge, misperceptions, attitudes and behaviour of Ghanaians on the COVID-19 pandemic. CC BY 4.0 2020, August. [doi: 10.21203/rs. 3.rs-60334/v1].
30. Lau LL, Hung N, Go DJ, Ferma J, Choi M, Dodd W, *et al.* Knowledge, attitudes and practices of COVID-19 among income-poor households in the Philippines: A cross-sectional study. J Glob Health 2020;10:011007.
31. Al Ahdab S. Knowledge, attitudes and practices (KAP) towards pandemic COVID-19 among Syrians. BMC Public Health. 2021 Feb 5;21(1):296. [doi: 10.21203/rs. 3.rs-27859/v1].