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Medical students' perceptions of coronavirus disease

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Abstract

In addition to affecting millions of people worldwide, the coronavirus disease (COVID-19) is putting a strain on healthcare systems. A descriptive cross-sectional study included medical students from 5 medical schools in Sudan (January to April 2021), to determine their perceptions towards the COVID-19 pandemic in Sudan and to ascertain the sources from which they obtain information. They were approached through random sampling. Bloom's cut-off of 80% was used to determine good knowledge (>32 out of 40), positive attitude (>40 out of 50), and good practice (>29 out of 36). The study included 396 medical students (from 1st to 5th year), the majority were females (65.7%). Their mean age was 21.3± 4 years. Overall, 86 (21.7%) had good knowledge, 129 (32.5%) had a positive attitude, and 190 (47.9%) had good practices. Most of students used social media and mass media as sources of information about COVID-19. In conclusion, a considerable number of undergraduate medical students had positive attitudes and practices against COVID-19, yet only a few had adequate knowledge and depended on social media as a source of information. This warrants further interventions to keep them updated with COVID-19 evidence to maximize their potential in raising public awareness of COVID-19.

Keywords: COVID-19; Knowledge; Attitude; Practice; Medical students; Sudan

1. Introduction

The first instances of pneumonia of unknown etiology were documented in Wuhan, China, in December 2019 [1]. Since then, COVID-19 has swiftly extended to incorporate several nations worldwide and is responsible for millions of confirmed illnesses and fatalities [2]. Likewise, there were 255,253 fatalities and 12,192,138 confirmed cases in Africa during the pandemic [3]. While the first COVID-19 incident in Sudan had been disclosed on March 13, 2020 [4]. Several self-behavioral strategies are being implemented worldwide to prevent COVID-19 transmissions, such as hand disinfectants, and social and physical distancing. Behavioral change depends on an individual's knowledge, sense of the risk, and willingness to modify their own attitude [5]. Consequently, on March 14, 2020, all communities in Sudan implemented curfews. Moreover, the Sudanese government banned airports, land borders, and sea crossings. Also, the decision was taken to avoid and forbid all large gatherings, as well as classes have been halted in schools, universities, colleges, and institutions. Even so, COVID-19 instances were more prevalent in all 18 states of Sudan [6, 7]. At the beginning, in Sudan, there was denial about whether the disease is really existed, or not, also, a vast amount of misconception and false information shared on social media was clouded people's understanding of COVID-19.

As no specific antiviral drug has been developed yet, applying preventive measures is the most critical intervention to reduce the dissemination of the disease [8]. Rising public awareness about the disease mode of transmission, symptoms, risky practices, groups at risk, and other preventive measures (e.g.: hand washing, wearing a mask, and avoiding crowded places) is essential to stop nation spread and assist in controlling this emerging disease. Knowledge, attitude, and practice toward COVID-19 play an integral role in determining a society's willingness to accept behavioral change measures from health authorities [7]. KAP assessment is important to health care providers and medical science

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students. Such assessment has been useful as an important means of education and raising awareness of best practices in previous viral outbreaks, including SARS, MERS, and Ebola [9-11]. Therefore, health workers and medical students must be equipped with the right scientific information and possess a positive attitude toward COVID-19.

The pandemic has postponed the training of medical students in different universities due to the closure of campuses during the lockdown. During pandemics, such as COVID-19, the healthcare system is put under great pressure, so much so that it forces authorities to recruit medical undergraduates to provide medical care to patients, exposing the students to the risk of infection [4]. Moreover, medical students represent common references for healthcare advice for family members and friends [6, 8], particularly senior students (clinical stages) [7]. Thus, it is crucial to assess medical students' knowledge, attitudes, and practices toward the novel coronavirus. To our knowledge, this is the first study to assess the knowledge, attitude, and practice of medical students in private and public schools of medicine in Sudan.

2. Material and methods

2.1. Study setting

An institutional-based multicentric descriptive cross-sectional study was carried out, including participants from Khartoum, Dongola, Shandi, Omdurman Ahlia, and the International University of Sudan. It included all undergraduate students (from the first to fifth year) in schools of medicine at three government universities: Khartoum, Shandi, and Dongola, as well as at two private universities: the International University of Sudan, and Omdurman Ahlia.

2.2. Inclusion criteria

All undergraduate students in medical schools who accepted participation in the current study were included in a prospective manner.

2.3. Exclusion criteria

Students who refused to participate in the study were excluded.

2.4. Sample

2.4.1. Sample size

The sample size was calculated using the formula: $n = Z^2pq/d^2$, where n = minimum sample size required, z = the normal standard deviation (1.96 for 95% confidence level) p = the frequency of occurrence of an event (0.5) q =1-p (the frequency of occurrence of an event) = 1-0.5=0.5 d = level of precision (0.05). n= 1.96^ (2) ×0.5×0.5÷0.05^ (2) =385.

Herein, 15% was added to compensate for the nonresponse rate and other contingencies. The total sample size was calculated as 385+58=443.

2.4.2. Sampling technique

It was multistage sampling, in the 1st stage, where the number of universities in Sudan with medical schools is 44 (27 governmental and 17 private), with a roughly public-private medical school ratio of 3:2. A list of all governmental universities was created, as well as a list of private universities. Each university was identified by a unique numerical identifier, which appeared only once in the list. Using a random sequence generator, the list was rearranged. Then, using a random number generator, three governmental medical schools from the first list and two private ones were selected. In the 2nd stage, the total number of students in each medical school was determined. Then added up to determine the total number of students enrolled in the selected schools. The approximate percentage of students in that school of medicine from the total targeted population is obtained by dividing the number of students in that school of medicine by the total population number. The percentage was then multiplied by the total population number to obtain the percentage of students in each medical school out of the total targeted population in the five medical schools (Table 1).

Table 1 Sampling in the 2nd stage of study assessing medical students KAP towards COVID-19, (N=396)

University	Total population	% of the population from the sample	Total number of the calculated sample size for each school of medicine
Khartoum	2,009	33.8	154
Shendi	906	15.05	70
Dongola	826	13.7	64
Omdurman Ahlia	683	11.34	53
Sudan International	1,546	26.48	123

In stage 3, the sample size was distributed proportionally within each school of medicine based on the number of students in each school of medicine (Table 2).

Table 2 Sampling in the 3rd stage of the study assessing medical students' KAP towards COVID-19 (n=396)

University	1st year		2nd year		3rd year		4th year		5th year	
	P	S	P	S	P	S	P	S	P	S
Khartoum	337	26	133	26	350	27	347	27	314	24
	328	25								
Shendi	159	12	176	14	148	11	141	11	137	11
	145	11								
Dongola	158	12	165	13	178	14	147	11	178	14
Omdurman Ahlia	173	14	150	12	167	13	97	7	96	7
Sudan International	344	27	369	29	278	22	273	21	300	24

In stage 4, a list of all students from the first to the fifth year was obtained. Systemic random sampling was used to select the students. The first student was randomly selected from the first interval, followed by others at regular intervals. This was done for four medical schools, apart from Sudan International, because we were unable to obtain a student list, so the sample was convenient sampling.

2.5. Variables

Independent variables were sociodemographic characteristics; sex, age, residence, educational institution, academic year of study, and sources of information on COVID-19. Whereas the dependent variables were knowledge, attitude, and practice toward COVID-19.

2.6. Data collection

Data was collected between January and April of 2021. Since universities were completely closed as part of the Sudanese government's effort to control the outbreak, using Google forms, an online, self-administered, semi-structured questionnaire adapted from previous studies was posted across different social media platforms to the chosen students [10, 12-14]. Bloom's cut-off of 80% was used to determine whether a medical student possessed good knowledge, a positive attitude, and good practice. Knowledge was assessed using 19 items with the responses "yes," "no," and "I don't know." The questions were about the transmission, clinical presentations, complications, prevention, and control of COVID-19. Each correct response was worth one point, while incorrect responses were worth zero. The total score was 40, and >40 (i.e., 80%) correct responses were considered good knowledge, 80%–60% moderate, and < 60% poor knowledge.

Attitudes were assessed using 5-likert-item questions. The responses were: strongly disagree, disagree, neutral, agree, and strongly agree, each weighing 1–5 for each positive statement. Some questions were reversed to eliminate the bias

of giving a single similar response to all items. The total score was 50 and > 40% (i.e., 80%) of correct responses were considered positive attitudes. Practices were assessed using 5-Likert-item questions that have been developed from them. The responses for good practice were always, occasionally, and never, each weighing 3, 2, and 1 point, respectively. The total score was 36, and >29 (i.e., 80%) correct responses were considered good practices.

2.7. Data processing and analysis

Fully complete questionnaires were extracted from Google Forms, and imported into Microsoft Excel for coding and management. The data was then analyzed using SPSS version 26. Numerical data were presented as means and standard deviation, and categorical data were presented as frequencies and proportions. The association between dependent and independent variables was assessed using Chi-square test, correlation test, and t-test where appropriate. A P-value less than 0.05 was considered significant.

3. Results

From January 2021 to April 2021, a total of 396 respondents were reached out of 443 using a multistage cluster sampling technique. The additional responses were due to a 15% increase in the actual sample size of 385 to account for the non-response rate.

Of the 396 respondents, 34.3% (n=136) were males and 65.7% (n=260) were females. Their mean age was 21.3 years (SD = 2.3). The minimum age was 15 years, and the maximum was 38 years. The majority (31%) were from the University of Khartoum (Figure 1).

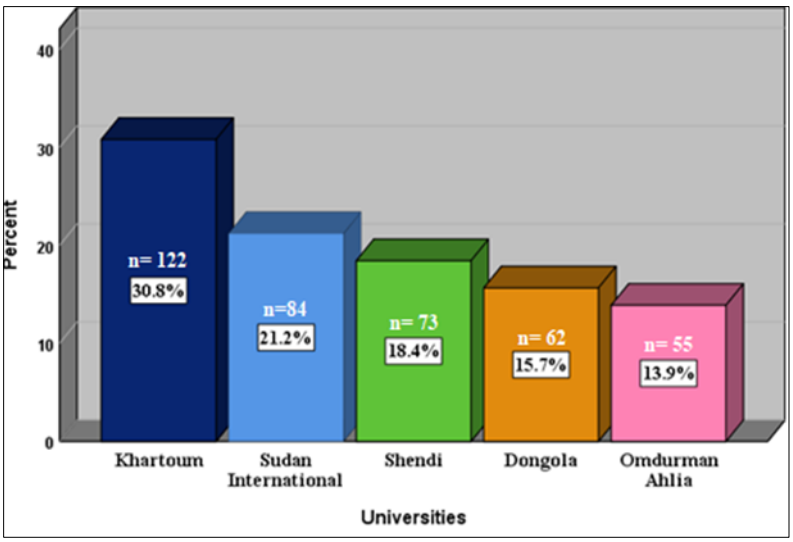

Figure 1 Study population (N= 396)

Table 3 Academic years of the participants (N= 396)

Academic year	Frequency	Percentage
1st	85	21.5
2nd	73	18.4
3rd	95	24
4th	76	19.2
5th	67	16.9

Figure 2 shows their different sources of information about the covid-19, their major source of information gained by mass media (e.g. television and magazines), and social media in 23.5 and 21.4%, respectively. While the minority received their information from family members or friends, medical school, and healthcare workers, as conveyed by

10.5%, 8.5%, and 8.1%, respectively. The acquisition of information from scientific online seminars, conferences, mass media, journals, family, and friends was significantly affected by the university of study (P < 0.05).

Moreover, males used scientific websites and online courses 1.8 times more than females. A proportional relationship between the academic level and obtaining information from medical search engines had been observed but was not significant (P=0.07).

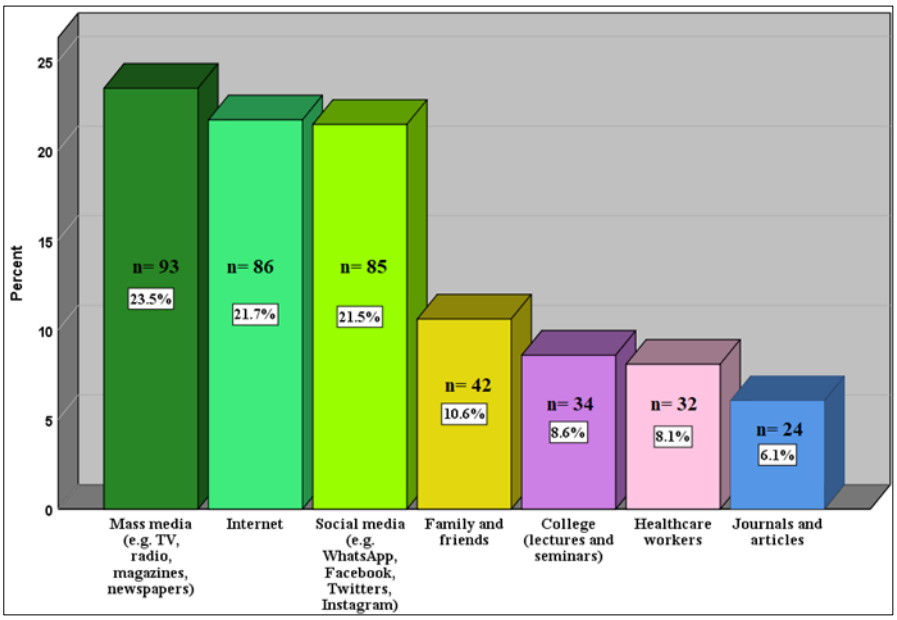

Figure 2 Participants' sources of information about the covid-19 (N=396)

The mean knowledge score of the participant was 28.99 (SD=5.00) (72.5%), indicating that medical students have moderate overall knowledge. The students had moderate, good, and poor knowledge, accounting for 63.4%, 21.7%, and 14.9%, respectively.

Only 33.8% (134) knew that during intubation, suction, bronchoscopy, and cardiopulmonary resuscitation, medical staff must wear an N95 mask. While 31.6% realized that no necessity for children and young adults to take measures to prevent infection by COVID-19 (Table 4).

Table 4 Responses of Sudanese medical students (N=396) to questions on knowledge about COVID-19 (N= 396)

Indicator	**True**		**False**		**I don't know**	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
SARS-COV-2, the virus that causes COVID-19 is a DNA virus	121	30.6	151	38.1	124	31.3
Multiple COVID-19 variants are circulating globally as the virus changes constantly through mutations and it	332	83.8	10	2.5	54	13.6
Seems that new emerging variants spread more easily and quickly than others.						
Persons with COVID-19 cannot transmit the virus to others when a fever is not present.	29	7.3	315	79.5	52	13.1
Its incubation period (the time range between infection with COVID-19 and the onset of symptoms) is up to 14 days with a mean of 5 days	351	88.6	17	4.3	28	7.1

It can be diagnosed by PCR test on samples collected from nasopharyngeal and oropharyngeal discharge or from sputum and bronchial washing	323	81.6	16	4.0	57	14.4
It is not necessary for children and young adults to take measures to prevent the infection by the COVID-19	125	31.6	241	60.9	30	7.6
Wearing a medical mask is an effective prevention strategy for COVID-19.	357	90.2	23	5.8	16	4.0
Washing hands with soap and water can help in the prevention of COVID-19 transmission.	371	93.7	10	2.5	15	3.8
The disease can be prevented through no close contact such as handshakes or kissing and by avoiding going to crowded places such as parties.	366	92.4	14	3.5	16	4.0
There is currently no specific antiviral drug or vaccine for COVID-19 clinical trials are going on, but early symptomatic and supportive treatment can help most patients recover from the infection	276	69.7	78	19.7	42	10.6
Only during intubation, suction, bronchoscopy, and cardiopulmonary resuscitation, medical staff must wear an N95 mask	134	33.8	150	37.9	112	28.3
People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place. In general, the observation period is 14 days.	368	92.9	10	2.5	18	4.5
Not all persons with COVID-19 will develop severe disease. Only those who are elderly, have chronic illnesses, and are obese are more likely to be severely affected	342	86.4	30	7.6	24	6.1

The medical students had good knowledge about fever, headache, cough, difficulty breathing, and the recent loss of taste or smell are clinical symptoms of COVID-19 in 93.7%, 89.1%, 89.1%, 87.6%, and 83.6%, respectively. Whereas they had intermediate knowledge about a sore throat, and myalgia as additional findings in 76.0%, and 69.7% respectively.

Furthermore, they showed poor knowledge about other symptoms that can be reported by a few people, including runny nose/congestion, or diarrhea, as described by 52.8% and 47.2%, respectively. Surprisingly, 61.4% of the participants thought that sneezing is a symptom of COVID-19 infection, which it is not.

When asked about the route of transmission, 64.9% of the students believed that the virus can be transmitted by saliva and nasal drop from those infected by COVID-19, while they conveyed touching the mouth or nose, shaking hands, and using infected persons' objects were the methods of the spread of this viral infection in 59.3%, 56.1%, and 55.6%, respectively.

Whereas, inversely, 36.1% of the participants thought that the virus couldn't be transmitted through touching contaminated surfaces or objects.

Regarding the complications of COVID-19 infection, many of the respondents had recognized pneumonia and respiratory failure as complications that can arise from COVID-19 infection, as shown in 84.3%, and 84.1%, respectively. Whereas only 37.4% of them were aware that sepsis could complicate the infection in some cases. Surprisingly, only 43.4% of the participants knew that severe COVID-19 infection could lead to multi-organ failure (Table 5 and figure 3).

Table 5 Responses of Sudanese medical students to questions on knowledge about covid-19 symptoms, mode of transmission, and complications (N=396)

Indicator	True		False	
	Frequency	%	Frequency	%
Symptoms of COVID-19 may include.				
Fever	371	93.7	25	6.3
Headache	353	89.1	43	10.9
Myalgia	276	69.7	120	30.3
Sore throat	301	76.0	95	24.0
Running nose/congestion	209	52.8	187	47.2
Sneezing	153	38.6	243	61.4
Diarrhea	187	47.2	209	52.8
Cough	353	89.1	43	10.9
Confusion/convulsions	311	78.5	85	21.5
Difficulty in breathing/shortness of breath	347	87.6	49	12.4
New loss of taste or smell	331	83.6	65	16.4
Sources of transmission of COVID-19				
Saliva and nasal drip from COVID-19 infected person	257	64.9	139	35.1
Coughing and sneezing	322	81.3	74	18.7
Touching the nose or mouth	235	59.3	161	40.7
Kissing and shaking hands	222	56.1	174	43.9
The use of objects owned by COVID-19 infected person	220	55.6	176	44.4
Touching contaminated surfaces	253	63.9	143	36.1
Consuming food	356	89.9	40	10.1
Air	263	66.4	133	33.6
Blood transfusion	339	85.6	57	14.4
Complications of COVID-19 infection include				
Pneumonia	334	84.3	62	15.7
Sepsis	148	37.4	248	62.6
Bronchitis	262	66.2	134	33.8
Neuropathy	299	75.5	97	24.5
Multi-organ failure	172	43.4	224	56.5
Hyperglycemia	310	78.3	86	21.7
Severe illness with respiratory failure can lead to death	333	84.1	63	15.9

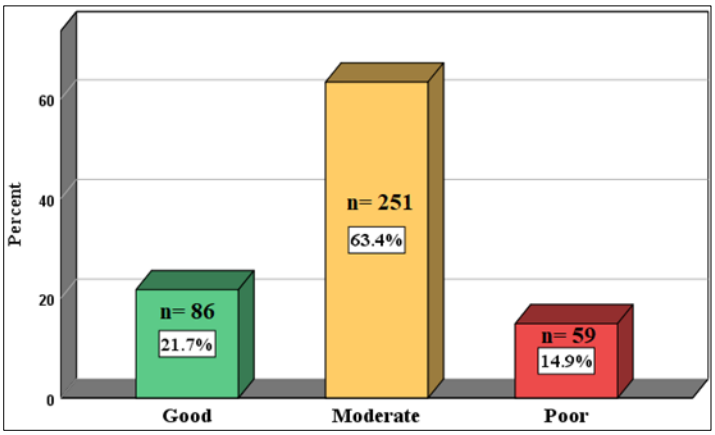

Figure 3 Knowledge about covid-19 symptoms, mode of transmission, and complications (n=396)

Participants' attitudes were either positive, fair, or negative in 32.85%, 60.58%, and 7.07%, respectively. Their mean attitude score was 87.83±4.97. Noteworthy, 25.5% of the participants didn't consider self-quarantine if they got infected. Only a third of the participants agreed that Sudan could contain the pandemic (30.3%). Moreover, regarding the two stigma questions, 26.3 stated that they would like to keep it secret if one of their family members got infected, and only 28.5% of the students agreed that they wouldn't be stressed by the way they would be treated if they got infected and needed admission (Table 6 and figure 4).

Table 6 Participants' responses to questions on attitude toward covid-19, (N=396)

Indicator	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Frequently washing my hands using soap, or alcohol-based sanitizers can prevent me from getting COVID-19	4 (1.0)	11 (2.8)	57 (14.4)	90 (22.7)	234 (59.1)
Wearing a face mask can protect me from getting a COVID-19 infection	5 (1.3)	14 (3.5)	55 (13.9)	105 (26.5)	217 (54.8)
I will self-quadrant stay home and monitor my health if I have been in close contact with someone who has COVID-19.	14 (3.5)	28 (7.1)	59 (14.9)	62 (15.7)	233 (58.8)
When called upon, I will willingly participate front line of the COVID-19 pandemic response	48 (12.1)	38 (9.6)	124 (31.3)	86 (21.7)	100 (25.3)
Sudan is in a good position to contain the COVID-19 pandemic	136 (34.3)	64 (16.2)	76 (19.2)	46 (11.6)	74 (18.7)
If somebody in my family were to get COVID-19, I would want it to remain private or a secret	163 (41.2)	64 (16.2)	65 (16.4)	45 (11.4)	59 (14.9)
If I got infected and need admission, I will be extremely stressed about the way the health workers, people in the hospital, and hospitalization process will deal with me	61 (15.4)	52 (13.1)	113 (28.5)	79 (19.9)	91 (23.0)
Health education has nothing to do with disease prevention	259 (65.4)	53 (13.4)	38 (9.6)	23 (5.8)	23 (5.8)

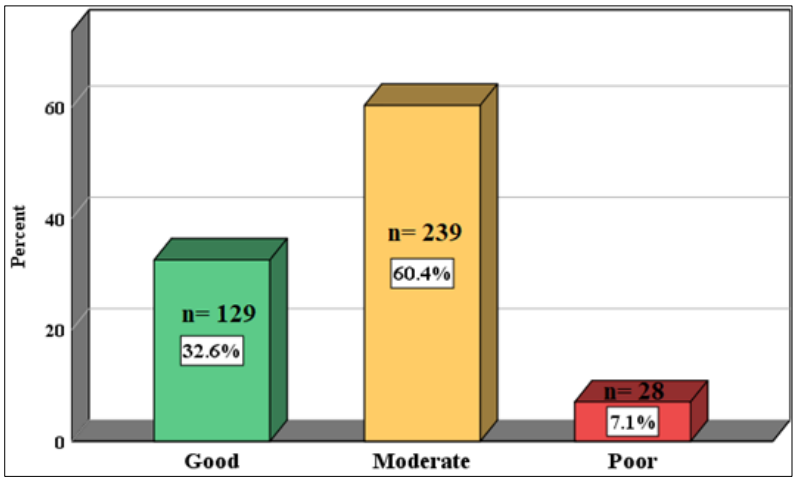

Figure 4 Participants' attitude towards covid-19 (n=396)

Their mean practice score was 29±5.0, thus indicating moderately good practices. The majority of students took the precautionary measure: wearing a face mask to cover their nose and mouth during sneezing, avoiding crowded places, staying at home as much as possible, and maintaining social distancing. Nicely, about 91.2% of the participants discussed the condition with their family and friends, trying to persuade them to follow the precautionary measures. On the other hand, 18.7% of the respondents never avoided shaking hands, and unexpectedly, 38.4% never engage in health information campaigns.

Generally, 47.98% of the students had good practice, and 46.97% had fairly good practice, whereas a few of them (5.05%) had poor practice (Table 7 and figure 5).

Table 7 Participants' practice during COVID-19 (n=396)

Indicator	Always	Sometimes	Never
I increased the frequency of cleaning and disinfecting items that can be easily touched with hands (i.e. mobile phones, door handles, and surfaces).	159 (40.2)	194 (49.0)	43 (10.9)
I have maintained a social distance of 1 meter from anyone coughing or sneezing	171 (43.2)	183 (46.2)	42 (10.6)
I have worn a mask when getting outside home	205 (51.8)	165 (41.7)	26 (6.6)
I cover my nose and mouth with a tissue during sneezing or coughing	299 (75.5)	80 (20.2)	17 (4.3)
If no tissue is available, I cough or sneeze into my upper sleeve	269 (67.9)	102 (25.8)	25 (6.3)
I throw the used tissue in the trash bin	264 (66.7)	101 (25.5)	31 (7.8)
I avoid touching my face (eyes, nose or, mouth) with contaminated hands	152 (38.4)	216 (54.5)	28 (7.1)
I avoid public gatherings and crowded places	138 (34.8)	217 (54.8)	41 (10.4)
I avoid shaking hands when greeting others	72 (18.2)	250 (63.1)	74 (18.7)
I Stay at home as much as possible	184 (46.5)	175 (44.2)	37 (9.3)
I discussed COVID-19 prevention with my family and friend, persuading them to follow the precautionary guidance	176 (44.4)	185 (46.7)	35 (8.8)
I have engaged in health information campaigns on COVID-19	90 (22.7)	154 (38.9)	152 (38.4)

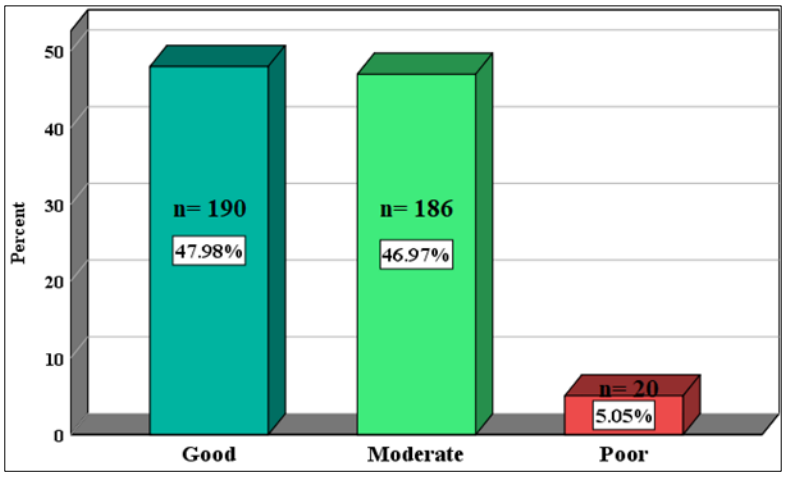

Figure 5 The practice of the participants during COVID-19 (N=396)

There were significant associations between knowledge, attitude, and practice, as those with good knowledge were more likely to have good attitudes and practices than those with moderate or poor knowledge (P =0.000).

Female medical students showed better attitudes when compared to males (odds ratio [OR]: 1.72; 95% confidence interval [CI]: 1.08– 2.74; P = 0.02. The academic level of the participants was significantly associated with their knowledge and attitude but not with their practice (P = 0.000 and P = 0.021, respectively). Those in the 4th and 5th years are more likely to have good knowledge and attitudes during COVID-19 when compared to others.

4. Discussion

The median age of the respondents was 21.5 years, and the majority were female. This is explained by the educational system in Sudan, where students' average age during college entry is about 18 years, and girls account for the largest proportion of medical students in Sudanese medical colleges. This is in line with many studies in which the major participants were female [12, 13, 15,16].

Regarding knowledge, majority of students had an acceptable level of knowledge (72.5%) regarding the disease, including its mode of transmission, the incubation period, clinical manifestations, preventive measures, availability of a vaccine or effective drugs, and its serious complications in high-risk groups. This almost coincides with the Egyptian study (74.3%) [17].

In contrast, it is higher than the studies in Indonesia and China, as it was 29.2%, and 28.3%, respectively [16, 18]. Whereas it is far below that demonstrated in other studies [13-15].

Despite the overall acceptable knowledge level, they had deficient knowledge about gastrointestinal symptoms, which is in accordance with that reported by Badi et al. [19]. In a similar way, the respondents had a low level of knowledge about the possibility of COVID-19 being complicated by sepsis and multi-organ failure, which corresponds to findings in other studies [10, 19].

The assessment of the sources of information used by medical students to learn about COVID-19 revealed an expected massive reliance on mass media, followed by social media, whereas few of them use the medical search engine or articles as a source of information. This is in accordance with other studies when the major source of information for medical students was TV & radio [13], and social media [10, 15, 20]. We also found reliable sources of information, like journals and articles, medical search engines, and webinars, are less used, even within a subpopulation that should be more familiar than the public with credible medical websites. These findings are more or less similar to those of other studies [10,13, 21]. Nonetheless, the usage of those information sources among Sudanese medical students is much lower than that reported in other studies [10, 13, 15, 20]. The current study showed a significant correlation between the source of information and the level of knowledge, which agrees with other studies [15, 21].

The disparity in knowledge can be explained by the rapid evolution, continuous updating of information about COVID-19 infection, and ongoing studies that require students to be updated. Also, other studies had more senior students than

those in the current study, which had mostly junior medical students. This may be explained by the lack of a standard tool for assessing students' knowledge, attitudes, and practices towards COVID-19, as well as the different cut-off points between studies in which knowledge is considered good. The significant relationship between knowledge, attitude, and practice highlights the importance of raising awareness. Those who obtain information from scientific sources that provide up-to-date evidence-based information, such as journals, webinars, medical search engines, tutorials, or faculty lectures, are more knowledgeable than others. But we couldn't figure out why those who used social media knew more than those who didn't. As the mass media is subject to regulatory guidelines from government agencies, it provides more censored information, and students who rely on it have better knowledge and attitudes [22].

Participants' attitudes are less positive when compared to those reported by others [13-15, 18]. However, the overall mean attitude score was 87.83%, indicating the general positive attitude of the Sudanese medical students; this is consistent with other studies' findings [23,24]. Less than half of the participants agreed that they would volunteer for the COVID-19 response, this was fewer than that reported in previous studies [13, 15]. Only a third of the students agreed that Sudan could contain the pandemic, surprisingly it is much lower than the percentage of the Sudanese general population who thought that Sudan will cope with COVID-19 [25]. Females had a good attitude by 1.7 times more than males. Females' higher care and curiosity behaviors may be attributed to this. Similar findings were found in the study by Badi et al. [19].

Moreover, stigmatization is much lower among Sudanese students, with only one-third of them preferring to keep it secret if one of their family members became infected with COVID-19, which is much less than that reported in other studies [10, 20]. Only 28.5% of the students wouldn't express fear of the diagnostic and therapeutic approaches in the local hospitals in case they were infected with COVID-19; this is comparable to the 41.9% reported in a Jordanian study [10].

With regard to the practice of Sudanese medical students, the current study indicated nearly half of the participants had good practice, and most of them adopted precautionary measures such as using disinfectants, avoiding crowded places, wearing a facemask, and maintaining social distancing. This is consistent with other studies [10, 13, 16-18, 24]. Whereas only 18.2% of the participants always avoid shaking hands, which is much lower than that reported by others 13, 16-18, 24].

Despite the fact that the study was conducted in Sudan during the second and third waves of COVID-19, the level of practice among Sudanese medical students is lower than expected. It could be explained by the fact that in 2021, most of the government's strict rules and regulations were relaxed, and the country was not completely shut down, in contrast to other studies conducted at the start of the pandemic in 2020, when strict rules were imposed, and many countries were completely shut down.

Lower levels of practice can be linked to lower levels of knowledge because they are statistically related. Also, there is being a global shortage of resources, such as face masks and disinfectants, which is particularly acute in our country. Sudan is a poor country, so financial costs may be a significant barrier. It can also be justified by Sudanese not becoming accustomed to new conditions, such as staying at home and wearing a mask, and exhaustion from a previous first COVID-19 wave condition.

Study limitations

This study has limitations, firstly, as it is a cross-sectional observational nature study, it does not conclude any cause-effect relationship, and secondly, the questionnaire was online and self-administered which may have a chance of recall bias and misrepresentation. The generalizability of this study to all medical students in Sudan may be affected by the fact that some of the students were collected conveniently. Lastly, the study was conducted at the end of the 2nd wave of COVID-19 and the beginning of the 3rd wave in Sudan.

5. Conclusion

Medical students have demonstrated moderate levels of knowledge and positive attitude regarding COVID-19 and are undertaking a moderate level of precautionary measures. Similar to most reports, obtaining medical information tends to rely more on social media rather than scientific sources. Programs should be implemented to keep health workers and medical students up to date on emerging public health problems and medical emergencies. Importantly, medical students must be kept up to date on any health problem or epidemic medical information not only through research articles, but also through academic media, webinars, and their faculty's curriculum. We need to increase the visibility of

credible news sources, even within a subpopulation that should be more familiar with credible medical websites than the public.

In the case of a medical emergency developing tools to assess knowledge, attitude, and practice about specific health problems, or at least establishing guidelines to be followed in such assessment and interpretation of the results, may greatly assist investigators and benefit authorities.

As the number of students willing to participate in the response to the COVID-19 pandemic is limited, we recommend that the ministry of health collaborate with the ministry of higher education in encouraging medical students to provide care to patients if the condition requires it, especially in countries like Sudan where the health system faces numerous challenges. Policymakers should be aware of the importance of social media and mass media in disseminating information to the public, particularly during pandemics, and use that to implement more effective tools to disseminate the right information, raise awareness about the condition and precautionary measures, and correct misconceptions.

Compliance with ethical standards

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Disclosure of conflict of interest

The author declares that there are no conflicts of interest in this study.

Statement of ethical approval

Approval from the Department of Community Medicine, faculty of medicine, University of Khartoum has obtained prior to conducting this study. As well as permission for data collection was obtained from the other schools of medicine separately.

Statement of informed consent

All questionnaires were completed anonymously; no information could be used to identify the participant. Informed consent was obtained from all individual participants included in the study.

References

[1] Lu H, Stratton CW, Tang YW. Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle. J Med Virol. 2020, 92(4):401-2.

[2] Organization WH. WHO Coronavirus (COVID-19) Dashboard 2022 [Available from: https://covid19.who.int/.

[3] Worldmeter. [Available from: https://www.worldometers.info/coronavirus/.

[4] Health SsFMo. Corona's first case in 2020 [Available from: http://fmoh.gov.sd/index.php/posts/post/1673.

[5] Bavel JJV, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, et al. Using social and behavioural science to support COVID-19 pandemic response. Nature human behaviour. 2020, 4(5):460-71.

[6] Health SsFMo. The First Infection With The Corona Virus By Contact 2020 [Available from: http://fmoh.gov.sd/index.php/posts/post/1710.

[7] 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(5):e0233668.

[8] Bhagavathula AS, Aldhaleei WA, Rahmani J, Mahabadi MA, Bandari DK. Knowledge and perceptions of COVID-19 among health care workers: cross-sectional study. JMIR public health and surveillance. 2020, 6(2):e19160.

[9] Kobayashi M, Beer KD, Bjork A, Chatham-Stephens K, Cherry CC, Arzoaquoi S, et al. Community knowledge, attitudes, and practices regarding Ebola virus disease—five counties, Liberia, September–October, 2014. MMWR Morbidity and mortality weekly report. 2015, 64(26):714.

[10] Khasawneh AI, Humeidan AA, Alsulaiman JW, Bloukh S, Ramadan M, Al-Shatanawi TN, et al. Medical students and COVID-19: knowledge, attitudes, and precautionary measures. A descriptive study from Jordan. Frontiers in public health. 2020, 8:253.

[11] Almutairi KM, Helih EMA, Moussa M, Boshaiqah AE, Alajilan AS, Vinluan JM, et al. Awareness, attitudes, and practices related to coronavirus pandemic among public in Saudi Arabia. Family and Community Health. 2015, 38(4):332-40.

[12] Olaimat AN, Aolymat I, Shahbaz HM, Holley RA. Knowledge and information sources about COVID-19 among university students in Jordan: a cross-sectional study. Frontiers in public health. 2020, 8:254.

[13] Olum R, Kajjimu J, Kanyike AM, Chekwech G, Wekha G, Nassozi DR, et al. Perspective of medical students on the COVID-19 pandemic: survey of nine medical schools in Uganda. JMIR public health and surveillance. 2020, 6(2):e19847.

[14] Taghrir MH, Borazjani R, Shiraly R. COVID-19 and Iranian Medical Students, A Survey on Their Related-Knowledge, Preventive Behaviors and Risk Perception. Arch Iran Med. 2020, 23(4):249-54.

[15] Le An P, Huynh G, Nguyen HTN, Pham BDU, Nguyen TV, Tran TTT, et al. Knowledge, attitude, and practice towards COVID-19 among healthcare students in Vietnam. Infection and drug resistance. 2021, 14:3405.

[16] Zhang J, Yin Y, Dean J, Zhang X, Zhang Y, Wang J, et al. Knowledge, Attitude, and Practice Survey of COVID-19 Among Healthcare Students During the COVID-19 Outbreak in China: An Online Cross-Sectional Survey. Frontiers in Public Health. 2021, 9.

[17] Emara HE, Alhindi AA, Orebi HA, Kabbash IA, Elghazally NM. COVID-19 Pandemic: Knowledge, Attitude, and Perception of Medical Students Toward the Novel Coronavirus Disease. Disaster medicine and public health preparedness. 2021:1-8.

[18] Adli I, Widyahening IS, Lazarus G, Phowira J, Baihaqi LA, Ariffandi B, et al. Knowledge, attitude, and practice related to the COVID-19 pandemic among undergraduate medical students in Indonesia: a nationwide cross-sectional study. PloS one. 2022, 17(1):e0262827.

[19] Badi S, Abdulraheem MA, Mustafa AA, Matar MS, Yousef BA. Knowledge, attitude, and practice of university students toward COVID-19 in Sudan: an online-based cross-sectional study. Current Medical Issues. 2021, 19(2):70.

[20] Khalil NS, Al-Yuzbaki DB, Tawfeeq RS. COVID-19 knowledge, attitude and practice among medical undergraduate students in Baghdad City. EurAsian Journal of BioSciences. 2020, 14(2):4179-86.

[21] Olaimat AN, Aolymat I, Shahbaz HM, Holley RA. Knowledge and Information Sources About COVID-19 Among University Students in Jordan: A Cross-Sectional Study. Frontiers in Public Health. 2020, 8.

[22] Boodman C, Lee S, Bullard J. Idle medical students review emerging COVID-19 research. Medical Education Online. 2020, 25(1):1770562.

[23] Adam M, Gameraddin M, Alelyani M, Zaman GS, Musa A, Ahmad I, et al. Assessment of Knowledge, Attitude, and Practice Concerning COVID-19 Among Undergraduate Students of Faculty of Applied Medical Sciences at King Khalid University, Abha, Kingdom of Saudi Arabia: A Cross-Sectional Surveyed Study. Advances in Medical Education and Practice. 2021, 12:789.

[24] Maheshwari S, Gupta P, Sinha R, Rawat P. Knowledge, attitude, and practice towards coronavirus disease 2019 (COVID-19) among medical students: A cross-sectional study. Journal of Acute Disease. 2020, 9(3):100-4.

[25] Mousa KNAA, Saad MMY, Abdelghafor MTB. Knowledge, attitudes, and practices surrounding COVID-19 among Sudan citizens during the pandemic: an online cross-sectional study. Sudan Journal of Medical Sciences. 2020, 15(2):32-45.