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Factors Affecting Knowledge, Attitude, and Practice of COVID-19: A Study Among Undergraduate University Students in Bangladesh

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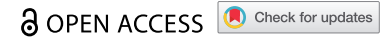
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Factors affecting knowledge, attitude, and practice of COVID-19: A study among undergraduate university students in Bangladesh

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ABSTRACT

The global expansion of the COVID-19 outbreak is one of the worst disasters the world has faced in recent decades. This study explored various factors of knowledge, attitude, and practice regarding COVID-19 among Bangladeshi undergraduate university students. In addition, we also look at how COVID-19 based knowledge, attitude, and practice influence each other. Using a random sampling technique and a self-administered structured questionnaire survey, this study collected data from 167 private university students in Bangladesh from 1st October to 30th October 2020. Data were analyzed using descriptive statistics (including frequencies, percentages, and means), binary logistic regression, bivariate regression analysis, and factor analysis. The findings suggest that most of the students learned about COVID-19 from various sources, including news media (TV, radio, newspapers, etc.), international organizations (WHO, UN, etc.), various government programs, or from their friends, family members, or neighbors. Most of the students were concerned about becoming sick, keeping social distance, and family members' job insecurity, followed by the university shutdown and the subsequent quarantine. Many students believe Bangladesh's media, government, medical sector, and religious organizations played a significant role during COVID-19. Binary logistic regression demonstrates that students' gender, department, and residency significantly explained their COVID-19 knowledge. In addition, students' attitudes significantly vary with their religion and place of residence. Students' departments and semesters found significant in explaining their practice regarding COVID-19. Moreover, factor analysis results also identified several crucial factors in explaining students' overall knowledge, attitude, and practice of COVID-19. Finally, we found a statistically significant relationship between knowledge, attitude, and practice.

Background and introduction

The World Health Organization (WHO) declared the COVID-19 as a pandemic on March 11, 2020; the cause was determined to be a novel coronavirus (SARS-CoV-2).[1] There has been a notable increase in the number of deaths caused by COVID-19, which is highly contagious and has had an effect on a considerable portion of the world's population.[2] It was stated that the virus had spread to several countries throughout the world by the end of April, and there had already been numerous deaths as a result.[3] Bangladesh has been one of the world's worst-affected countries since the first case was reported on March 8, 2020.[4]

Research on COVID-19 is still ongoing, and as a result, various facts and falsehoods about the infection's prevention and treatment are being disseminated to the general public. During outbreaks of worldwide epidemics, commitment to disease prevention is also heavily influenced by individuals' perceptions of the risks involved.[2,5–8] Emotions, anxiety, personality, panic, and stress are all worsened by a lack of knowledge and a negative attitude.[9] As a result of the associated stigma and mistrust, people are less likely to seek medical attention or take precautionary measures to avoid contracting an infectious disease.[10,11] There is evidence from previous outbreaks that people's attitudes and understanding of contagious diseases are coupled with their degree of feeling, which could complicate efforts to stop the sickness from spreading.[10,12] Moreover, people's sentiments toward the government's efforts to manage the outbreak were strongly linked to their level of understanding of COVID-19, according to one of the first studies conducted in Hubei, China.[13]

A knowledge, attitude, and practice (KAP) survey is a method that is generally recognized as an accurate and reliable way to evaluate the individuals' knowledge of a specific subject, as well as their level of critical thinking and the associated abilities.[14] KAP survey is a valuable tool that shows what a certain group of people already know, how they think about it, and what they do about it. COVID-19 is the subject of various KAP surveys undertaken by community pharmacists across the globe.[15–17] Researchers found that people's views on COVID-19 prevention techniques were better when they had greater knowledge and education.[2,13] Furthermore, KAP is a critical mental tool in public health when it comes to promoting health and preventing disease.[18] It includes a wide range of beliefs about what causes the disease and what makes it worse, as well as the symptoms, treatments, and effects of the disease.[19] Acknowledging the role of knowledge, WHO has developed

many guidelines and begun online seminars and training programs to enhance awareness of COVID-19 prevention and control during the current pandemic. Although educational programs have raised awareness about COVID-19, it's unknown how much this knowledge may be applied and how much it limits the virus spread.[20] Therefore, WHO (2008)[21] recognized the knowledge, attitude, and practice survey as a good way to evaluate existing programs and find ways to change people's behaviors that work.

Students' Knowledge, Attitudes, and Practices (KAP) about COVID-19 are the subject of numerous global studies. For instance, Le An et al. (2021)[22] and Le QD et al. (2021)[23] conducted studies in Vietnam, Zhang et al. (2020)[24] conducted a study in China, Adli et al. (2022),[25] Giovanni et al. (2021)[26] and Sondakh et al. (2022)[27] conducted their studies in Indonesia. Moreover, several studies have been conducted in Pakistan, Bhutan, Malaysia, and Iran.[28–31] In Bangladesh, several studies concentrated on students and other groups.[4,18,32–35] The spread of the pandemic will be greatly influenced by the perception and actions of university students, therefore examining the elements that influence knowledge, views, and practices about COVID-19 among university students is critical.[36] In the same way, students who have a better grasp of what is already known are more open to new ideas and take better precautions may be able to reduce the spread of coronaviruses in the community.[37] Students who are enrolling in university are typically between the ages of 19 and 25. They are young, energetic, updated and conscious among students of any level or the general population. Moreover, university students seem to play an important role at home and in the wider society because of their education and familiarity with current affairs gained from exposure to the classroom, the media, and other forms of social networking. Apart from that, undergraduate students also participate in various volunteer work through different groups and organizations in the university to raise awareness among underprivileged groups about their plight and to act in response to various social problems. That is why undergraduate students play a significant role in society and have been chosen for this study. Until recently, little research has been done on the factors influencing undergraduate students' knowledge, attitudes, and practices about COVID-19 in Bangladesh.

Since undergraduate university students in Bangladesh play an important functional role both in their families and in the greater society, therefore; it is important to uncover what factors influence their knowledge, attitude and practice regarding COVID-19, and it will also help ensure their protection while they are learning offline.[38] Moreover, it will also help policymakers and other stakeholders to formulate better policies, especially for students in any future pandemic. The article is structured as follows. It begins with the background and introduction of this study. After this, in the methodology section, we explain our data collection and sample selection procedures and how we analyze data. The following section presents detailed results of the survey. Then we added a discussion section where we compared our findings with other studies. We wrapped up this article with a conclusion section where we also incorporated suggestions for future research.

Methodology

Data collection period and procedures

Data collection for this study was conducted for four weeks, starting from October 1st to October 30th, 2020. At that period, the Government of Bangladesh had imposed a nationwide lockdown to curtail the spread of COVID-19. Therefore, all the educational institutions were closed followed by the direction of the Bangladesh government. However, later following the direction of the government of Bangladesh and the University Grants Commission (UGC), all universities started continuing their classes through online platforms like; Zoom, Google meets etc. Therefore, collectiing information face-to-face was not an option. A self-administered structured questionnaire was circulated on various online platforms like; WhatsApp, Facebook, zoom etc. and students were requested to participate in the research. We collected our data using these online platforms as it was impossible for us to visit the university and collect data. Using the self-administered questionnaire survey method for data collection is also supported by many other studies.[39–45]

We divided our questionnaire into various parts. In the first part of the questionnaire, we wanted to know our respondent's socio-demographic backgrounds like; their gender, religion, their departments and semesters, where do they live (rural or urban areas) etc. In the next section, we asked our participants whether they knew anything about COVID-19 and their sources of understanding of this issue. We asked them to mention the most significant impact of COVID-19. This part of the questionnaire also seeks to understand students' perceptions regarding role of various actors during COVID-19. In the next part, we assessed students' knowledge, attitudes and practices regarding COVID-19. Seven statements in each section were provided to the participants and they were requested to mention their level of agreement or disagreement. For each statement, students indicated their level of agreement or disagreement on a scale of 1 to 5 (1 = 'Strongly Disagree,' 2 = 'Disagree,' 3 = 'Neutral,' 4 = 'Agree,' 5 = 'Strongly Agree.' A details description of each question that is asked to measure students' knowledge, attitudes and practices of COVID-is presented in Table 1.

Population and sample selection

During the COVID-19 pandemic that swept over Bangladesh, many people did not adequately follow the directions provided by the authorities, and as a result, they paid the ultimate price. A great number of people disregarded the guidance provided by the government because of widespread mistrust, superstition, and ignorance regarding the disease. We were interested in gaining a better understanding of the knowledge, attitudes, and practices of undergraduate students at universities regarding COVID-19 because of the significant impact that these individuals have on their families and communities. North East University Bangladesh is one of the leading private universities in Sylhet, Bangladesh, established in 2012. During the period of data collection, there were five departments running at the undergraduate level. These are, the Department of Business Administration,

Table 1. Statements relating to knowledge, attitudes and practices regarding COVID 19.

Category	Statement number	Statement
Knowledge of COVID −19	Statement-1	COVID-19 is an infectious disease that is transmitted by close contact with the infected person.
	Statement-2	The common symptoms of COVID-19 are fever, fatigue, dry cough, and body aches.
	Statement −3	People who are infected with the COVID-19 virus need to be isolated for at least 14 days to reduce the spread of the virus.
	Statement −4	Washing hands usually helps to prevent disease transmission.
	Statement −5	We need to take the vaccine for COVID-19.
	Statement −6	Wearing a mask is an effective way to stop the spreading of the Corona Virus (COVID-19).
	Statement −7	Children and adults are also affected by COVID-19.
Attitudes toward COVID-19	Statement −8	Isolating a person with corona symptoms stops the spread of the novel coronavirus (COVID-19).
	Statement −9	Social distance can stop the spread of the Novel Corona Virus (COVID −19).
	Statement −10	Strict lockdown can be an effective measure to control the increasing transmission of COVID-19.
	Statement −11	Not everyone affected by the COVID-19 virus will die.
	Statement −12	COVID-19 will not spread in a crowd that happens for religious purposes.
	Statement −13	The government of Bangladesh is handling the COVID-19 health crisis very successfully.
	Statement −14	Self-Protection is necessary for everyone.
Practices of COVID −19	Statement −15	In the last 14 days, I hardly visited any crowded place.
	Statement −16	In the last 14 days, I have worn a mask while leaving home for any reason.
	Statement −17	In the last 14 days, I washed my hand regularly with hand sanitizer.
	Statement −18	In the last 14 days, I followed social distancing.
	Statement −19	In the last 14 days, I stayed home and followed the lockdown.
	Statement −20	In the last 14 days, I refrained from shaking hands with anyone.
	Statement −21	In the last 14 days, I avoided these people with symptoms suggestive of COVID-19.

Sources: Kumar et al. (2021);[36] Giao et al. (2020);[46] Ferdous et al. (2020);[18] Kundu et al. (2021);[47] Ladiwala et al. (2021);[48] Wong et al. (2023);[49] Dubik et al. (2021);[50] Al Sha'bani (2020);[51] and author's own constructions and modifications.

Department of Computer Science and Engineering, Department of Applied Sociology and Social Work, Department of English and Department of Law and Justice. At that time, these programs served roughly 1000 undergraduate students. Due to the lockdown and university closure, it was not possible to include all the students from all departments at NEUB. This study is conducted among undergraduate students only and there were 12 semesters at the undergraduate level during the data collection period. We tried to incorporate undergraduate students from all departments and all semesters using a random sampling technique. After the one-month-long data collection, we gathered total data from 167 undergraduate students. Among them, we received 40 responses from the department of Business Administration (24%), 28 responses from the department of English (16.8%), 67 responses from the department of Computer Science and Engineering (40.1%), 05 responses from the Department of Applied Sociology and Social Work (3%) and 27 responses from the department of law and justice (16.2%). The majority of the participants are from the second semester (28.7%), followed by the third semester (19.2%) and fifth semester (16.8%). Although we obtained the sample from one particular private university in Bangladesh, we collected samples from a variety of departments and semesters in order to understand factors that influence the knowledge, attitudes, and practices of students.

Data analysis tools and techniques

This study used descriptive statistics like; frequencies, percentages, and means to present the data. We used mean variations to assess how students' socio-demographic backgrounds influence their knowledge, attitudes, and practices regarding COVID-19. In addition, we used factor analysis to identify some of the most influential factors underlying students' knowledge, attitudes, and practices regarding COVID-19. According to Choon et al. (2019)[52], factor analysis helps to reveal hidden patterns and reduce data overlaps. Moreover, we performed a binary logistic regression to examine significant factors influencing the student's knowledge, attitudes, and practices regarding COVID-19. We calculated the arithmetic mean of each of the seven statements measuring students' knowledge, attitudes, and practices, respectively. Then we formed a dichotomous variable with two responses. Respondents who scored 3.00–3.49 in the knowledge, attitudes, or practices regarding COVID-19 we grouped them as "Low" (dummy '0'), and those who scored 3.50 to 5.00, we categorized them as 'High" (dummy '1'). For the binary logistic regression models, respondents with low levels of knowledge, attitudes, and practices were considered as a reference group. SPSS IBM version 25.0 was used for data analysis.

Results

Participant's socio-demographic background and understanding of COVID-19

The Table 2 shows the demographic descriptions, almost three-fifth (64.1%) were men, and two-fifth (35.9%) were women. Most of the respondents in this study (85%) were Muslims, and the rest (15%) were from the Hindu religion. The table above table also specifies that 24% of respondents belong to the department of "Business Administration," 16.8% from the department of "English," 40.1% participants were from the department of "Computer Science" and the rest 3% and 16.2% students are from the department of "Sociology" and "Law and Justice" respectively. Regarding participants' semester, we

Table 2. Participant's socio-demographic background and understanding of COVID-19.

Participant's variables	Frequency n	Percentage %
Gender		
Male	107	64.1
Female	60	35.9
Religion		
Muslim	142	85.0
Hindu	25	15.0
Department		
Business Administration	40	24.0
English	28	16.8
Computer Science	67	40.1
Sociology	05	3.0
Law	27	16.2
Semester		
First	15	9.0
Second	48	28.7
Third	32	19.2
Fourth	03	1.8
Fifth	28	16.8
Sixth	02	1.2
Seventh	08	4.8
Eight	16	9.6
Nine	06	3.6
Ten	03	1.8
Eleven	03	1.8
Twelve	03	1.8
Residence		
Rural	51	30.5
Urban	116	69.5
Heard about CORONA VIRUS (COVID 19)		
Yes	164	98.2
No	03	1.8
Source of receiving information on COVID-19 for the first time		
Government	06	3.3
International organizations (e.g., WHO, UN, etc.)	14	8.5
Social media (e.g., WhatsApp, Facebook, Twitter)	82	50.0
News media (e.g., TV, radio, newspaper)	45	27.4
Friends, Family members, Neighbors etc.	14	8.5
Others	03	1.8
Major Impacts of COVID −19		
Fear of getting sick	38	22.8
Social distancing	37	22.1
Job insecurity of family members	29	17.4
University closure	25	15.0
Quarantine	25	15.0
Travel restrictions	05	3.0
Affected with COVID-19	04	2.4
Shops being closed	01	0.6
Others	03	1.8

observed that majority are from the second semester (28.7%), followed by the third (19.2%) and fifth semester (16.8%), respectively. Moreover, eight semesters consist of 9.6%, and the first semester consists of 9% students. Table 2 also shows that 69.5% of the respondents residing in urban areas, whereas 30.5% of respondents had rural background. We found that most of the students who participated in this study had already heard about Corona Virus (COVID-19). A tiny percentage of respondents (1.8%) mentioned that they were not familiar with this. Most of the students said that they heard about this from social media like; WhatsApp, Facebook, Twitter, etc. 27.4% mentioned news media like; TV, radio, newspaper, etc. as their sources of understanding about this. 8.5% knew about this from any international organizations like; WHO, UN, etc., and their friends, family members, or neighbors. A small percentage of the students (3.3%) mentioned that they knew about Corona Virus (COVID-19) from various government initiatives Moreover, the

participants were also asked to state the significant impact of COVID-19. Table 1 shows that the largest numbers of respondents referred to the fear of getting sick (22.8%), social distancing (22.2%), and Job insecurity of family members (17.4%) followed by university closure (15%), and quarantine (15%). Relatively a small percentage of respondents mentioned several other issues, including travel restrictions (3%), affected by corona (2.4%), shops being closed (0.6%), and others (1.8%).

Perception about role of different actors during COVID −19

The survey participants were asked to express their perceptions regarding the role of different actors during COVID-19 in Bangladesh. Figure 1 shows that most of the participants were either strongly agreed (39.5%) or agreed (42.5%) with statement 1; the majority of the participants think that 'media
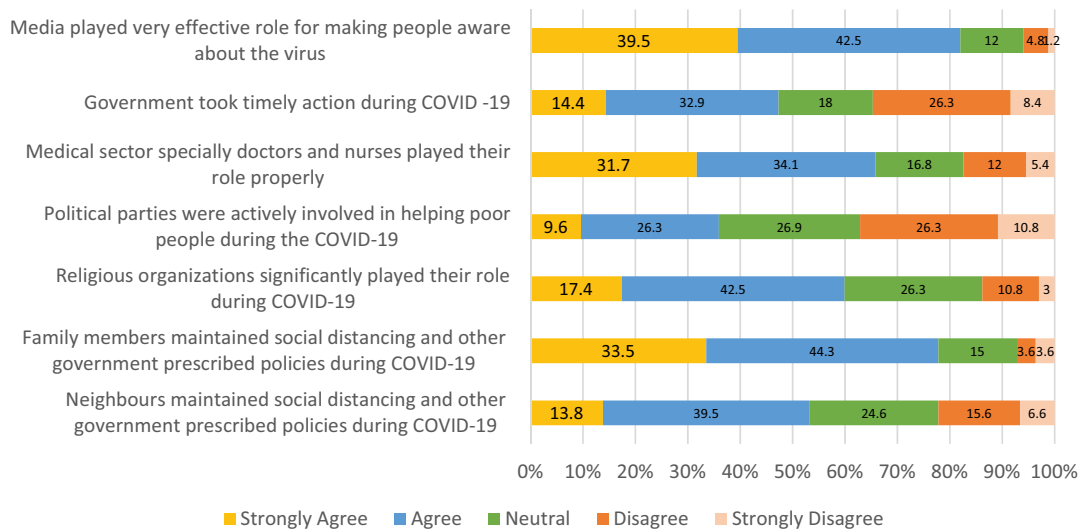
Figure 1. Respondent's perception regarding the role of different actors during COVID-19.

played a very effective role in making people aware about the virus. The majority of the participants also opined that the 'government took timely action during COVID −19' (Strongly Agree: 14.4%, Agree: 32.9%). While 26.3% of participants disagreed with that. Statement 3 which is whether the 'medical sector especially doctors and nurses played their role properly' was supported positively most the respondents (Agree: 31.7%, Strongly Agree: 34.1%). In contrast, a larger number of participants disagreed (26.3) or strongly disagreed (10.8%) with statement 4, they do not think political parties were actively involved in helping poor people during the COVID-19. The majority of those surveyed were supported positively that they think, religious organizations significantly played their role during COVID −9 (Agree:17.4%, Strongly Agree: 42.5%), their family members maintained social distancing and other government-prescribed policies during COVID-19 (Agree:33.5%, Strongly Agree: 44.3%) and their neighbors maintained social distancing and other government prescribed policies during COVID-19 (Agree:13.8%, Strongly Agree: 39.5%).

Respondents' knowledge regarding COVID 19

The respondents were shown a set of seven statements regarding issues relating to COVID-19 and asked to replied each statement with their level of agreement or disagreement. The below Figure 2 shows that majority of the students either strongly agree or agree with each of the given statements. This indicates that most of the students opined that COVID-19 is an infectious disease that is transmitted by close contact with the infected person (strongly agree: 52.10%, agree: 16.20%). They also think the common symptoms of COVID-19 are fever, fatigue, dry cough, body aches etc.(strongly agree: 48.50%, agree: 16.80%). And people who are infected with the
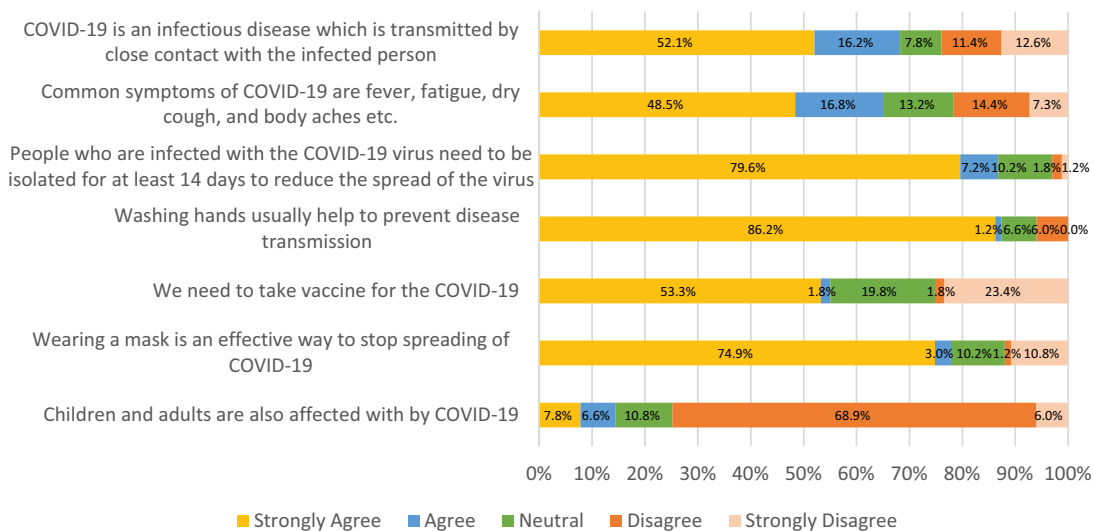

Figure 2. Respondents' knowledge regarding COVID−19.

COVID-19 virus need to be isolated for at least 14 days to reduce the spread of the virus (strongly agree: 79.60%, agree: 7.20%). Moreover, the majority of the students think that washing hands usually helps to prevent disease transmission (strongly agree: 86.20%, agree: 1.20%). They need to take a vaccine for COVID-19 (strongly agree: 53.30%, agree: 1.80%)., wearing a mask is an effective way to stop spreading of COVID-19 (strongly agree: 74.90%, agree: 3.00%). However, more than half of the students who participated in this study do not think that children and adults are also affected by COVID-19 - (disagree: 68.9%, strongly disagree: 6.00%).

Table 3 shows the socio-demographic background and mean score of each statement of knowledge regarding COVID-19. Results show that females are found more knowledgeable than males (females' total mean score: 4.27, males' total mean score: 4.09). Females also showed higher mean scores in each of the statements related to their knowledge of COVID-19 issues. Hindu students showed higher mean scores in statements 1, 3, 4, and 6. This indicates that they know that, COVID-19 is an infectious disease that is transmitted by close contact with the infected person, and people who are infected with the COVID-19 virus need to be isolated for at least 14 days to reduce the spread of the virus. Moreover, they are more knowledgeable about washing hands usually helps to prevent disease transmission, and wearing a mask is an effective way to stop the spreading of Corona Virus (COVID-19). In contrast, mean scores show that Muslim students

are more knowledgeable about the common symptoms of COVID-19, taking vaccines, and the possibilities of children and adults affected with COVID-19. English department students have a higher total mean score (4.42) compared to Business Administration (4.18), Computer Science (4.17), Sociology (4.16), and Law (3.81). Sixth-semester students represented a higher total mean score (4.71) followed by fifth (4.53), eleventh (4.48), and seventh-semester students (4.30). Urban students have shown higher total mean scores compared to rural resident students. Interestingly, a higher mean score of rural resident students indicates that they are more knowledgeable regarding children and adults affecting by COVID-19.

Respondents' attitudes regarding COVID-19

Figure 3 depicts that statement 1 which is whether isolating a person with corona symptoms stops the spread of novel coronavirus (COVID-19) is either strongly agreed (40.7%) or agreed by the majority of the respondents (35.3%). Similarly, most of the students opined that social distance can stop the spread of COVID −19 (strongly agree: 47.3%; Agree: 34.7%), strict lock-down can be an effective measure to control the increasing transmission of COVID-19 (strongly agree: 49.7%; Agree: 28.1%) and not everyone affected with COVID-19 virus will die (strongly agree: 47.9%; Agree: 32.9%). 31.1% of students strongly agreed that they think COVID-19 will not be spreading to crowds

Table 3. Socio-demographic backgrounds and mean score of knowledge regarding COVID-19.

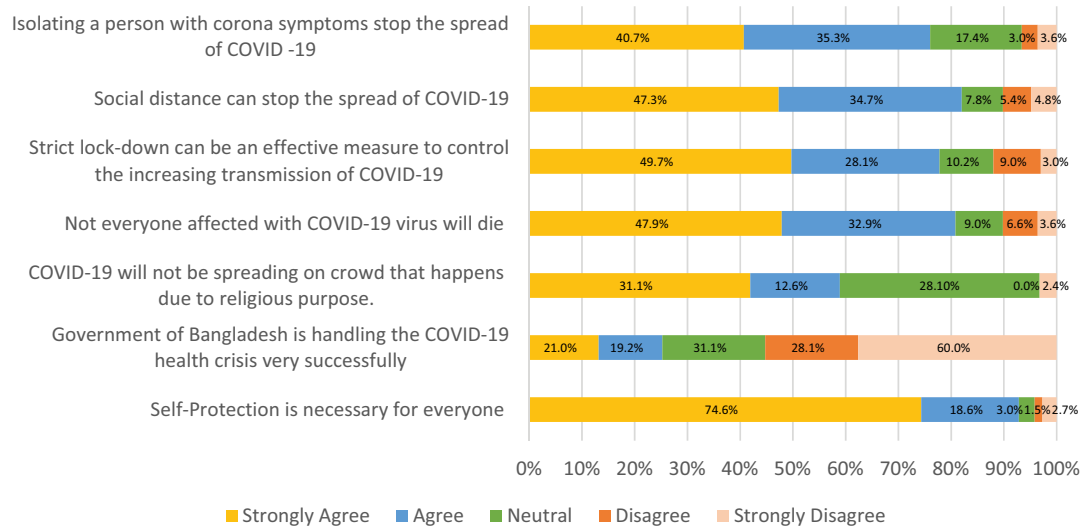| Participant's variables	COVID-19 is an infectious disease which is transmitted by close contact with the infected person.	The common symptoms of COVID-19 are fever, fatigue, dry cough, and body aches.	People who are infected with the COVID-19 virus need to be isolated for at least 14 days to reduce the spread of the virus.	Washing hands usually helps to prevent disease transmission.	We need to take a vaccine for COVID-19.	Wearing a mask is an effective way to stop spreading of Corona Virus (COVID-19).	Children and Adults are also affected by COVID-19.	Total Mean Score
Gender								
Male	3.76	3.84	4.55	4.52	3.53	4.21	4.20	4.09
Female	3.98	3.87	4.75	4.78	3.72	4.47	4.33	4.27
Religion								
Muslim	3.80	3.92	4.61	4.63	3.61	4.32	4.25	4.16
Hindu	4.00	3.50	4.71	4.71	3.58	4.33	4.17	4.14
Department								
Business Administration	3.85	3.88	4.78	4.50	3.90	4.48	3.90	4.18
English	4.04	3.68	4.93	4.55	3.82	4.54	4.96	4.42
Computer Science	3.78	3.87	4.66	4.20	3.52	4.46	4.28	4.16
Sociology	4.20	4.40	4.60	4.63	4.20	3.40	4.20	4.17
Law	3.70	3.85	4.00	4.22	3.00	3.56	3.93	3.81
Semester								
First	3.67	4.47	4.27	4.87	3.07	4.40	4.53	4.18
Second	3.96	3.46	4.79	4.42	3.83	4.23	4.54	4.19
Third	3.75	4.09	4.03	4.56	3.03	3.75	3.91	3.88
Fourth	3.67	2.33	3.01	4.23	1.67	4.12	3.56	3.95
Fifth	4.21	4.04	4.93	4.86	4.14	4.79	4.75	4.53
Sixth	3.87	2.33	4.21	2.99	4.00	4.00	3.33	4.71
Seventh	3.13	3.63	3.16	4.75	4.50	4.33	4.13	4.30
Eight	3.69	4.00	4.94	4.63	3.63	4.31	2.69	3.98
Nine	3.83	3.67	3.83	4.33	2.33	3.67	3.50	3.59
Ten	4.33	3.33	2.98	3.67	3.67	3.67	3.66	4.29
Eleven	3.67	3.33	3.77	4.10	4.22	4.22	4.33	4.48
Twelve	2.00	4.67	4.56	3.67	3.98	4.67	4.67	4.09
Residence								
Rural	3.75	3.82	4.51	4.61	3.55	4.18	4.34	4.06
Urban	3.88	3.86	4.67	4.62	3.62	4.35	4.14	4.19

Figure 3. Respondents' attitudes regarding COVID-19.

that happen due to religious purpose. However, 25.7% of students disagreed with that. A large number of respondents either disagreed (28.1%), or neutral (31.1%) on whether the government of Bangladesh is handling the COVID-19 health crisis very successfully. Self-Protection is necessary for everyone strongly agreed my almost three quarter of the respondents (74.6%). Additionally, Table 4 shows that males show higher attitudes compared to females in statements 2, 5, and 7. This indicates that

males are more likely to have higher compliance that social distance can stop the spread of the Novel Corona Virus (COVID-19). Additionally, they also think COVID-19 will not be spreading to crowds that happen due to religious purposes and self-protection is necessary for everyone. In contrast, females have higher mean scores in statements 3, 4, and 6 which denotes their higher attitudes regarding strict lock-down which can be an effective measure to control the increasing transmission of COVID-19. Higher

Table 4. Socio-demographic backgrounds and mean score of attitudes regarding COVID–19.

Participant's variables	Isolating a person with corona symptoms stops the spread of novel corona virus (COVID-19).	Social distance can stop the spread of the Novel corona Virus (COVID-19).	Strict lockdown can be an effective measure to control the increasing transmission of COVID-19.	Not everyone affected by COVID-19 virus will die.	COVID-19 will not spread in a crowd that happens due to religious purpose.	The government of Bangladesh is handling the COVID-19 health crisis very successfully.	Self-Protection is necessary for everyone.	Total Mean Score
Gender								
Male	4.07	4.23	3.98	4.12	3.60	3.29	4.61	3.97
Female	4.07	4.09	4.38	4.20	3.28	3.37	4.55	4.01
Religion								
Muslim	4.04	4.14	4.07	4.22	3.43	3.39	4.60	3.98
Hindu	4.29	4.25	4.50	3.75	3.75	2,96	4.54	4.01
Department								
BusinessAdministion	4.05	4.23	4.25	4.25	3.38	3.35	4.78	4.04
English	4.00	4.29	4.46	4.46	3.50	3.57	4.86	4.16
Computer Science	4.04	4.07	4.03	4.01	3.67	3.12	4.43	3.91
Sociology	3.20	4.40	4.20	4.40	3.00	3.40	4.40	3.86
Law	4.37	4.00	3.81	3.96	3.26	3.48	4.44	3.90
Semester								
First	3.93	4.33	4.13	3.87	3.80	3.00	4.20	3.89
Second	4.04	4.13	4.13	4.23	3.38	3.35	4.71	3.99
Third	4.22	4.13	4.03	4.16	3.28	3.59	4.28	3.96
Fourth	4.33	4.55	3.33	4.33	2.33	3.18	4.67	3.86
Fifth	3.96	4.25	4.32	4.18	3.93	3.22	4.86	4.10
Sixth	3.63	2.50	4.50	4.21	2.50	3.56	4.50	3.29
Seventh	4.31	3.44	4.00	3.88	3.63	2.88	4.75	3.89
Eight	4.17	4.50	4.31	4.19	3.50	3.63	4.69	4.12
Nine	3.88	3.33	3.67	3.67	3.50	4.17	4.50	3.86
Ten	4.33	4.00	4.67	4.67	3.67	2.33	4.67	4.05
Eleven	4.67	4.67	4.33	4.67	3.67	2.67	4.11	4.24
Twelve	3.67	3.00	3.33	4.33	2.67	3.33	4.00	3.48
Residence								
Rural	4.04	3.94	4.20	3.94	3.29	3.43	4.43	3.90
Urban	4.08	4.23	4.09	4.24	3.57	3.27	4.66	4.02

mean scores also show that females compared to males more likely to believe that not everyone affected by the COVID-19 virus will die and the government of Bangladesh is handling the COVID-19 health crisis very successfully. Hindu students have a higher total mean score than Muslims which denotes their higher level of attitudes toward COVID-19 issues. English department students compared to all other departments and eleventh-semester students compared to all other semesters show higher total attitudes scores. In comparison with urban students, rural students are more likely to think that strict lock-down can be an effective measure to control the increasing transmission of COVID-19 (Rural: 4.20, Urban: 4.09) and the government of Bangladesh is handling the COVID-19 health crisis very successfully. (Rural: 3.43, Urban: 3.27). However, urban students with higher total mean scores express a higher level of attitudes than rural students.

Respondents' practices regarding COVID-19

We found that 28.6% and 28.1% of students disagreed and strongly disagreed respectively that in the last 14 days they hardly visited any crowded place (Figure 4). More than half of the respondents strongly agreed that in the last 14 days they had worn a mask while leaving home for any reason (55.1%) and in the last 14 days they washed their hands with hand sanitizer (53.9%). The majority of the students also opined that in the last 14 days they followed social distancing (strongly agree: 37.7%, agree: 26.3%), stayed home, and followed the lock-down (strongly agree:34.7%, agree: 22.8%), they refrained from shaking hands with anyone (strongly agree: 36.5%, agree: 12.6%) and they avoided these people who had symptoms suggestive of COVID-19 (strongly agree: 40.7%, agree: 21.6%). Furthermore, Table 5 shows that females have a higher total mean score than males which denotes that they practiced and maintained health issues more consciously than their counterparts. However, males show a higher mean score in statement 1 as compared to females they are more likely to visit any crowded place in the last 14 days. Muslims show

higher mean scores in statements 1, 4, and 7 which indicates that in the last 14 days they are more likely to visit any crowded place, followed social distancing, and avoided these people who had symptoms suggestive of COVID-19. However, Hindu students have a higher total mean score in practices regarding COVID-19 issues. Sociology students showed higher mean scores in practices regarding COVID-19 (3.97) followed by English (3.65) and Business Administration department students (3.59). In terms of semesters, sixth-semester students have a higher mean score in practices (4.37) followed by the eleventh-semester (4.19), fifth-semester (3.85), third-semester (3.57), and tenth-semester students (3.57). Urban students show higher mean scores in practices regarding COVID-19 issues than rural resident students.

Factors affecting respondents' knowledge, attitudes, and practices regarding COVID- 19

We performed binary logistic regression models to explore the factors that significantly influence students' knowledge, attitudes, and practices regarding COVID-19. In this study, we used five independent or explanatory variables such as gender, religion, department, semester, residence, etc. This first regression model (for knowledge) as a whole explained 21.2% (Nagelkerke R-square) of the variance and correctly classified 70.6% of cases. Results also show that the second which is for attitudes as a whole, explained 26.7% (Nagelkerke R-square) of the variance and correctly classified 71.4% of cases. Finally, the regression model for practices explained 24.5% of the variance (Nagelkerke R-square) with 68.3% classification.

The result indicates (Table 6) that, three predictors; gender, department, and residence significantly explain our first model 'knowledge.' The model shows that males were less likely to have high levels of knowledge regarding COVID-19. In other words, females are found to be more knowledgeable compared to males. In addition, students from business and engineering departments are 5.5 times less likely to have a level of knowledge compared to those students who are from social science departments. Finally, we found that students who are from the
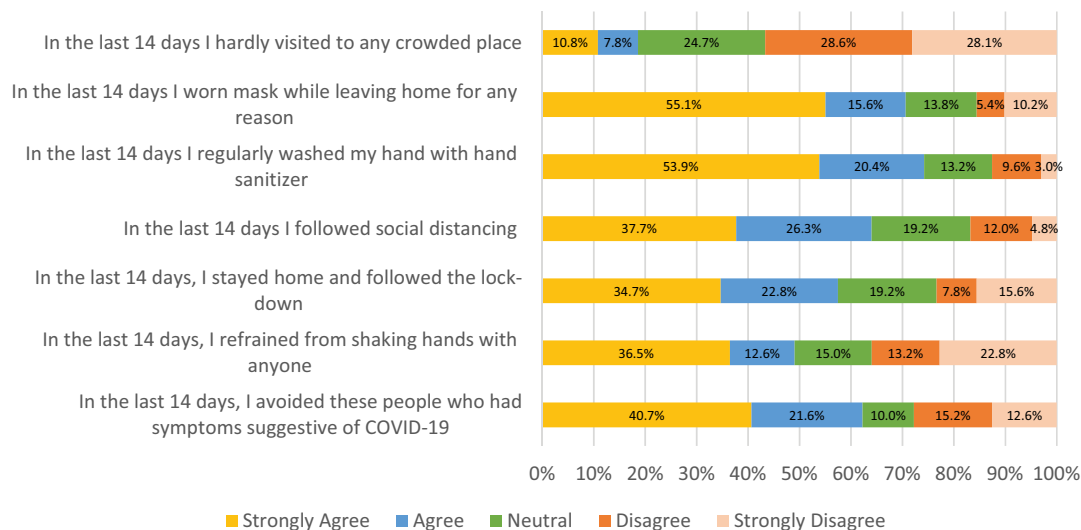

Figure 4. Respondents' practices regarding COVID-19.

Table 5. Socio-demographic backgrounds and mean score of practices regarding COVID−19.

Participant's variables	In the last 14 days, I hardly visited any crowded place.	In the last 14 days, I have worn a mask while leaving home for any reason.	In the last 14 days, I washed my hand regularly with hand sanitizer.	In the last 14 days, I followed social distancing.	In the last 14 days, I stayed home and followed the lockdown.	In the last 14 days, I refrained from shaking hands with anyone.	In the last 14 days, I avoided these people with symptoms suggestive of COVID-19.	Total Mean Score
Gender								
Male	2.84	3.82	3.95	3.55	3.15	3.03	3.59	3.42
Female	1.85	4.32	4.43	4.25	4.22	3.70	3.83	3.80
Religion								
Muslim	2.56	3.99	4.11	4.08	3.42	3.25	3.68	3.56
Hindu	2.04	4.17	4.25	3.76	3.55	3.42	3.67	3.58
Department								
Business Administration	2.23	3.95	4.43	3.73	3.48	3.48	3.83	3.59
English	1.79	4.50	4.46	4.25	4.25	3.18	3.11	3.65
Computer Science	2.78	3.96	3.85	3.67	3.30	3.16	3.85	3.51
Sociology	3.20	3.80	4.80	4.11	3.20	4.60	3.20	3.97
Law	2.74	3.70	3.89	3.56	3.52	3.07	3.70	3.46
Semester								
First	2.87	4.20	3.60	2.87	3.00	2.87	3.47	3.27
Second	2.25	3.71	4.19	3.96	3.50	3.15	3.58	3.48
Third	2.78	3.91	3.94	3.75	3.59	3.34	3.45	3.57
Fourth	3.00	3.33	3.00	2.67	2.33	3.33	4.67	3.19
Fifth	2.14	4.61	4.57	4.18	4.07	3.50	4.00	3.85
Sixth	2.00	4.00	3.50	4.20	4.22	3.67	3.50	4.37
Seventh	3.10	3.87	4.38	3.75	4.25	3.75	3.83	3.45
Eight	2.50	4.31	4.19	3.81	3.06	2.88	3.51	3.54
Nine	3.06	2.67	4.33	3.67	2.83	3.33	3.83	3.24
Ten	2.00	4.33	4.00	3.33	4.67	2.67	4.00	3.57
Eleven	2.00	4.21	4.12	3.57	3.33	2.99	4.00	4.19
Twelve	3.11	2.67	3.00	3.00	2.33	2.67	1.33	2.57
Residence								
Rural	2.63	4.02	4.14	3.75	3.45	2.92	3.57	3.50
Urban	2.42	3.99	4.12	3.83	3.57	3.42	3.72	3.58

Table 6. Parameter estimates for levels associated with participant's knowledge, attitudes, and practices of COVID-19.

Higher Level			
Explanatory variables	Knowledge Coefficient (Odds ratio)	Attitudes Coefficient (Odds ratio)	Practices Coefficient (Odds ratio)
Gender			
Male (ref = Female)	−.685 (0.504)*	−.318 (.728)	−1.154 (.315)
Religion			
Muslim (ref = Hindu)	−.463 (1.623)	−.324 (.723)*	−.134 (1.875)
Department			
Business and Engineering (ref = Social Science)	−.598 (5.50)*	.022 (1.02)	−.455 (.310)*
Semester			
First to six semesters (ref = Seven to twelve semesters)	.120 (.887)	−.008 (.992)	−.655 (1.16)*
Residence			
Urban (ref = Rural)	.244 (1.22)**	.367 (1.44)*	.317 (1.37)

Reference category: Lower level.
Knowledge: Observation = 167; Chi-square = 11.523; R^2 (Nagelkerke) = 21.2%; Classification = 70.6%.
Attitudes: Observation = 167; Chi-square = 19.203; R^2 (Nagelkerke) = 26.7%; Classification = 71.4%.
Practices: Observation = 167; Chi-square = 17.331; R^2 (Nagelkerke) = 24.5%; Classification = 68.3%.
**$p < .010$, *$p < .05$.

urban area are 1.2 times more knowledgeable compared to rural resident students regarding COVID-19. Although the variable 'religion' was not significant but the odd ratio suggests that Muslims are 1.6 times less likely to have a higher level of knowledge than Hindus.

Two predictors namely, religion and residence of the students are found statistically significant for explaining our second model 'attitudes' regarding COVID-19. Results show that Muslims are less likely to have a higher level of attitudes than Hindus. Furthermore, urban resident students are 1.4 times more likely to have a higher level of attitudes as compared to rural residence students. The odd

ratio tells us that students from the Business and Engineering departments are 1.02 times more likely to have a higher level of attitudes than those of students from the social science departments, although the result is insignificant.

Finally, two predictors' department' and 'semester,' are found to be significant in explaining our third model, 'practices' regarding COVID-19. Our result shows that students from the Business and Engineering departments are less likely to have a higher level of practice regarding COVID-19 compared to their counterparts. In addition, we found that students from the first to sixth semesters are 1.16 times less likely

to have higher practices as compared to students from the seven to twelve semesters. This indicates that senior students show a higher level of practice regarding COVID-19 compared to junior-level students. Although the results are not significant but the odd ratio signifies that Muslims are 1.87 times less likely to have higher practices than Hindus and urban resident students are 1.37 times more likely to have higher perceptions compared to rural resident students.

Factor analysis: Student's knowledge, attitudes, and practices regarding COVID-19

In this study, a total of twenty-one statements were used to examine students' knowledge, attitudes, and practices of COVID-19 Factor analysis of these scale items (mentioned in Table 7) was used to obtain underlying information about their knowledge, attitudes, and practices regarding COVID-19. The Cronbach's alpha value of .706 indicates that the scale items are reliable for factor analysis. The Kaiser-Meyer-Olkin (KMO) value of .579 indicates that the sampling adequacy of the scale items is good and the data are appropriate for factor analysis. We found that factor analysis extracts eight components or factors by regressing the factor extraction on an eigenvalue greater than one, as shown in the table (see Table 7).

The first factor consists of two highly loaded statements (Statement 16 and Statement 19). This factor primarily shows that in the last 14 days, respondent's worn masks while they leaving their home for any reason. Moreover, they also stayed home and followed lockdown policies directed by the government. Factor two is loaded heavily with three statements

(Statements 2, 6, and 14) indicating that students are aware of the symptoms of COVID-19. Furthermore, they think that wearing masks is effective in stopping the spread of COVID-19, as well as self-protection is necessary for everyone. Three statements (8, 15, and 20) are heavily weighted for factor three, which describes the importance of isolating a person with corona symptoms to stop the spread of the novel coronavirus. This factor also denotes that in the last 14 days, students hardly visited any crowded place and refrained from shaking hands with anyone. Factor 4 contains four heavily loaded statements (3, 9, 10, and 18) that describe the importance of quarantining the COVID-19 affected person. Moreover, this factor also shows the effectiveness of following a strict lockdown and social distancing. Three statements (7, 11, and 17) loaded in explaining factor 5 which represents that not everyone affected with the COVID-19 virus will die and children and adults are also affected by COVID-19. This factor also shows the practice of using hand sanitizer. Factor six loaded heavily with two statements (Statements 4 and 13) that express the importance of washing hands to prevent disease transmission and the role of the government of Bangladesh in handling the COVID-19 health crisis. Factor seven incorporates three statements (1, 5, and 21) that denote transmission of COVID-19 by close contact with the infected person. Moreover, this factor also shows a need of taking the vaccine and avoiding these people who had symptoms suggestive of COVID-19. Finally, a single statement (statement 12) loaded in factor 8 which expresses the notion of some people who believe that COVID-19 will not be spreading to any crowd including that happens due to religious purposes.

Table 7. Factor analysis.

		Rotated Component Matrix							
		Component							
Statements		1	2	3	4	5	6	7	8
1	COVID-19 is an infectious disease that is transmitted by close contact with the infected person.	.375	.043	−.153	.119	.422	.282	**−.627**	−.060
2	The common symptoms of COVID-19 are fever, fatigue, dry cough, and body aches.	.047	**−.785**	.186	.176	.213	−.217	.343	−.269
3	People who are infected with the COVID-19 virus need to be isolated for at least 14 days to reduce the spread of the virus.	.248	.328	−.281	**−.628**	−.008	−.155	.343	.060
4	Washing hands usually helps to prevent disease transmission.	.361	.061	−.071	−.342	.166	**−.782**	−.036	−.401
5	We need to take the vaccine for COVID-19.	.165	.163	−.132	.452	.009	.068	**.514**	−.068
6	Wearing a mask is an effective way to stop the spreading of the Corona Virus (COVID-19).	.381	**.532**	.062	−.192	.095	.086	.045	−.130
7	Children and Adults are also affected by COVID-19.	.011	−.167	−.378	.111	**.604**	.168	−.083	.298
8	Isolating a person with corona symptoms stops the spread of the novel coronavirus (COVID-19).	.151	.258	**.737**	−.016	−.086	.192	−.252	−.124
9	Social distance can stop the spread of the Novel coronavirus (COVID-19).	.341	.303	.256	**.712**	.016	.306	.166	−.098
10	A strict Lockdown can be an effective measure to control the increasing transmission of COVID-19.	.449	.232	.133	**.662**	.048	−.183	.037	−.227
11	Not everyone affected by the COVID-19 virus will die.	.203	.187	.263	.025	**.797**	−.358	.017	.402
12	COVID-19 will not spread in a crowd that happens for religious purposes.	.139	.267	.227	−.164	.061	.162	.335	**.618**
13	The government of Bangladesh is handling the COVID-19 health crisis very successfully.	.058	−.090	.343	.203	−.399	**−.597**	−.249	.410
14	Self-Protection is necessary for everyone.	.335	**.670**	−.329	−.038	−.269	−.113	−.007	.087
15	In the last 14 days, I hardly visited any crowded place.	−.377	−.155	**.529**	−.235	.118	.238	.306	−.002
16	In the last 14 days, I have worn a mask while leaving home for any reason.	**.617**	−.244	.277	−.075	.243	−.241	.030	−.012
17	In the last 14 days, I washed my hand with hand sanitizer.	.034	−.378	−.042	.030	**−.861**	.070	.142	.127
18	In the last 14 days, I followed social distancing.	.096	−.222	−.299	**.784**	−.232	.105	−.069	.092
19	In the last 14 days, I stayed home and followed the lockdown.	**.695**	−.277	−.074	−.006	−.037	−.011	.020	.139
20	In the last 14 days, I refrained from shaking hands with anyone.	.484	−.324	**.740**	−.391	−.122	.306	.157	−.039
21	In the last 14 days, I avoided these people who had symptoms suggestive of COVID-19.	.149	.009	.275	−.255	.006	.223	**−.654**	−.060

Cronbach's alpha =.706; KMO =.579; Chi-square = 190.523; p = .000; 60.2% variance explained by the eight components.

Table 8. Descriptive statistics of the bivariate relationship between knowledge, attitude, and practice.

Independent Variable	Dependent Variable	Adjusted R Square	B (Std. Error)	t	Sig
Knowledge	Attitudes	.106	.152 (.034)	4.54	.000
Attitude	Practice	.043	.331 (.114)	2.90	.004
Knowledge	Practice	.123	.245 (.050)	4.93	.000

Bivariate relationship between knowledge, attitude, and practice

Table 8 highlighted descriptive statistics of the bivariate relationship between knowledge, attitude, and practice among the respondents. There was a positive significant ($p < .001$, B=.152) association between knowledge and attitude, which suggested that higher knowledge of COVID-19 predicted a favorable attitude toward COVID-19. The value of adjusted R^2 suggested that the association between knowledge and attitude was predicted by 11% of the population. Similarly, there was a positive significant association between attitude and practice, which suggested that a favorable attitude predicted higher practice toward COVID-19. The value of adjusted R^2 suggested that the association between attitude and practice was predicted by 4.3% of the population. Finally, there was a significant positive association between knowledge and practice, which suggested that higher knowledge of COVID-19 resulted in higher practice of COVID-19. The value of adjusted R^2 suggested that the association between knowledge and practice was predicted by 12.3% of the population.

Discussions

We found that most of the participating students in this study knew the term 'COVID-19.' Students heard the term through social media, followed by News media and Friends, Family members, Neighbors, etc., or various international organizations. In addition, students highlighted the fear of getting sick, social distancing, job insecurity of family members, university closure, and quarantine as the major impacts of COVID-19. Previous studies in Bangladesh highlighted that the closure of universities during COVID-19 had impacted students by disrupting students learning and decreasing study hours.[53] Similarly, social distancing was a fear for students because it hampered the study flow by creating an element of physical remoteness from their academic sphere[53] as classes started happening online in the virtual sphere. Consequently, these fears of COVID-19 were contributing to anxiety, depression, and sleeplessness. Therefore, the current study also corroborated the findings of previous research on COVID-19-related fear among the Bangladeshi public.[54] Moreover, in the previous study, it was also found that individuals who are quarantined and held in isolation have been shown to suffer from symptoms of anxiety, rage, bewilderment, and severe post-traumatic depression, according to new research.[55]

Students expressed their perception about the role of different actors (such as media, government, health, political parties, etc.) during COVID-19. In addition. students have some knowledge about the nature, symptoms, and preventive measures, but almost two-thirds of the participants (68.9%) did not think that children and adults are also affected by COVID-19. Our findings on gender contradicted the findings of Hossain et al. (2020),[54] which stated that males have higher knowledge of CVOID-19. In addition, knowledge of COVID-19 was higher among females and students of social sciences. Similarly, a study in China highlighted the variance in the knowledge of COVID-19 among students where major medical students show higher knowledge than non-medical majors.[56]

Students have a favorable attitude toward social distancing to stop the spread, lockdown as an effective measure, and self-protection from COVID-19. In addition, Hindus and students living in urban areas have a favorable attitude toward COVID-19. Furthermore, a higher level of the study predicted higher practice among students. Similarly, findings were highlighted by previous research, which found an association between old age and higher practice.[54] Senior students having higher practice, so the age factor was visible among students with higher practice. Wearing face masks, using hand sanitizer, avoiding handshakes, following social distancing, and lockdowns were higher practices among students, but they were not avoiding crowded places during COVID-19. Empirical evidence of the study confirmed the findings of the previous study on the adoption of preventive measures during COVID-19.[57] Many factors might have influenced these preventive measures during COVID-19, such as fear of COVID-19, morbidities during a disease outbreak, and the effective role of government. Hossain et al. (2021)[54] found that vaccine acceptability is closely related to three factors – information, perspective, and attitude – that should be prioritized during vaccination. They found that the vast majority of students are well-informed about the vaccine, supportive of its implementation, and ready to get vaccinated, but that a sizable minority had a negative outlook on it. Socio-demographic factors and COVID-19 vaccine-related knowledge, perception, and attitude are substantially linked to vaccination reluctance.[58]

According to Roy et al. (2020),[2] the amount to which individuals adhere to personal safety precautions and, ultimately, the treatment effect will be greatly determined by the public's knowledge, perceptions, and attitudes. There was a positive association between knowledge, attitude, and practice that predicted cognitive-affective behavior among students in Bangladesh.[59] Similarly, there was a positive association between knowledge and practice among respondents in Saudi Arabia.[60] The current study offers many contributions. First, limited research is based on students, especially undergraduate university students, as the major focus of the existing studies is on medical students, health professional workers, etc. Second, this research will bring practical benefit by identifying the most influential features of university undergraduate students' understanding of COVID-19 and their subsequent behavior. Therefore, it is possible that future efforts to stop the spread of

COVID-19 or other pandemics may concentrate on the factors that have been identified as having an influence on undergraduate students. Third, the major contribution of the study to the field is that it predicted the practice as an outcome of knowledge and attitude. Fourth, the current study is one of the few studies incorporating the application of cognitive-affective -behavior theory[59] during the COVID-19 pandemic in Bangladesh. In addition, attitude is an outcome of knowledge that states how academic institutions, in collaboration with policy intervention (by the relevant department, for example, health department, etc.), can get the desired results in terms of favorable attitude and higher practice. Furthermore, it highlighted the importance of knowledge as a predictor of attitude and practice during pandemics and health crises. Furthermore, it also highlights the importance of imparting relevant knowledge in controlling pandemics. Although this association between cognitive-affective-behavior was overlooked by the previous research in Bangladesh.[54] Finally, the findings of this study might potentially be used by several different parties, including the government, in order to improve their ability to respond to future pandemics. Our main suggestion to the government especially to revive the education sector, as this sector can play a pivotal role in tackling any future pandemic-related challenge or crisis in the country. Students who come from more rural environments are typically less knowledgeable about health standards and more resistant to being immunized than their counterparts who come from urban environments. Reaching out to this subset of the student body with accurate communication exposure on the vaccine's safety and efficacy and including a rural community health clinic in the vaccination campaign could be all needed to improve students' intentions to be vaccinated against the disease. During the COVID-19 pandemic, the Bangladesh government took the initiative to provide vaccines to students at their own university, which is one of the important lessons learned for the future pandemic to incorporate them into vaccination programs as much as possible. In addition, as part of a preventative strategy to deal with any future pandemic-related issue to revitalize the education sector, the government may pursue the universities to preserve separate budgets and fix alternative education systems by improving the online education system.

Conclusion

The overwhelming fear of COVID-19 among students underscores the mental and psychological needs of students. Our findings suggest that effective safety intervention programs are necessary to increase familiarity with COVID-19, which in turn increases knowledge, positive attitudes, and practice of safety measures. Government initiatives to motivate people to maintain safety protocols also help students become better known about COVID-19 and improve their attitudes and practices.

The study has many limitations. One of the major limitations is that we only collected samples from one private university in Bangladesh. Since all the Bangladeshi universities were closed during the pandemic following government directions, therefore; we couldn't collect data from many universities. The small sample size might limit the generalization of the study to the

student community. However, although our samples were drawn from a single private university, we made sure to include students from a wide range of academic programs and different semesters in order to learn more about their KAP regarding COVID-19. Secondly, the current study used an online survey to collect the data, which might have memory bias and social acceptability, as highlighted by the previous research.[58] So, collecting the data through face-to-face interviews or questionnaires will be interesting. Thirdly, the data were collected online survey (an inevitable restriction during COVID-19). Still, due to this restriction, many students with limited internet access could have been excluded by design. Future research can overcome these shortcomings of sample selection. A more extensive study considering more university students from all regions of the country will be interesting to see whether various factors affect differently. Moreover, a comparative study among public and private university students taking extensive factors will also be interesting to explore institutional variations among students regarding their COVID-19-related KAP. COVID-19 has been a focus of academic literature (although it is still prevalent in certain parts of the world), so these rare studies can inform literature to prepare for a future pandemic. Further research can offer meta-analysis of many small-scale studies with a broader scope which can inform policy and serve as a guidebook for preparedness against future pandemics. Additionally, more studies need to address whether governmental and non-governmental initiatives work to improve KAP among different populations, including students. Finally, other research can be done on various professionals, including university teachers, NGO employees, voluntary workers, healthcare professionals, journalists, etc., to explore their KAP regarding COVID-19 or any future pandemic.

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Data availability statement

Data will be available on a reasonable request to the authors.

Ethics approval

Due to the COVID-19 pandemic, it wasn't easy to get ethical approval as all the universities in Bangladesh remain closed following government instructions. However, we verbally talked with some teachers from various departments about the purpose of this study.

Consent to participate

At the beginning of the questionnaire, we asked participants to participate in this study only if they were willing to give us their consent.

Consent for publication

Yes

References

1. Bedford J, Enria D, Giesecke J, Heymann DL, Ihekweazu C, Kobinger G, Lane HC, Memish Z, Oh MD, Sall AA, et al. COVID-19: towards controlling of a pandemic. Lancet. 2020;395 (10229):1015–18. doi:10.1016/S0140-6736(20)30673-5.
2. Roy D, Tripathy S, Kar SK, Sharma N, Verma SK, Kaushal V. Study of knowledge, attitude, anxiety & perceived mental health-care need in Indian population during COVID-19 pandemic. Asian J Psychiatr. 2020;51:102083. doi:10.1016/j.ajp.2020.102083.
3. Johns Hopkins Coronavirus Resource Center. 2020. https://coronavirus.jhu.edu/
4. Kumar B, Kamal RS, Parvin RA, Waresi NM Assessing the impact of COVID-19 pandemic on vulnerable populations in Bangladesh. SocArXiv 7d8gc, Center for Open Science. 2021. doi:10.31219/osf.io/7d8gc.
5. Corrin T, Waddell L, Greig J, Young I, Hierlihy C, Mascarenhas M. Risk perceptions, attitudes, and knowledge of chikungunya among the public and health professionals: a systematic review. Trop Med Health. 2017;45(1):21. doi:10.1186/s41182-017-0061-x.
6. Janjua NZ, Razaq M, Chandir S, Rozi S, Mahmood B. Poor knowledge – predictor of nonadherence to universal precautions for blood borne pathogens at first level care facilities in Pakistan. BMC Infect Dis. 2007;7(1):81. doi:10.1186/1471-2334-7-81.
7. Lau JT, Kim JH, Tsui H, Griffiths S. Perceptions related to human avian influenza and their associations with anticipated psychological and behavioral responses at the onset of outbreak in the Hong Kong Chinese general population. Am J Infect Control. 2007;35(1):38–49. doi:10.1016/j.ajic.2006.07.010.
8. Smith RD. Responding to global infectious disease outbreaks: lessons from SARS on the role of risk perception, communication and management. Soc Sci Med. 2006;63(12):3113–23. doi:10.1016/j.socscimed.2006.08.004.
9. Hinthorn DR. Quarantine! East European Jewish Immigrants and the New York city epidemics of 1892. Ann Intern Med. 1997;127 (10):950. doi:10.7326/0003-4819-127-10-199711150-00022.
10. Person B, Sy F, Holton K, Govert B, Liang A, Garza B, Gould D, Jickson M, McDonald M, Meijer C, et al. Fear and stigma: the epidemic within the SARS outbreak. Emerg Infect Dis. 2004;10 (2):358–63. doi:10.3201/eid1002.030750.
11. Siddique MKB, Islam SMS, Banik PC, Rawal LB. Diabetes knowledge and utilization of healthcare services among patients with type 2 diabetes mellitus in Dhaka, Bangladesh. BMC Health Serv Res. 2017;17(1). doi:10.1186/s12913-017-2542-3.
12. Tao N. An analysis on reasons of SARS-induced psychological panic among students. J Anhui Inst Educ. 2003;21:78–79.
13. Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, Li Y. 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(10):1745–52. doi:10.7150/ijbs.45221.

14. World Health Organization. A guide to developing knowledge, attitude and practice surveys. 2021. https://apps.who.int/iris/bitstream/handle/10665/43790/9789241596176_eng.pdf?sequence=1
15. Hussain I, Majeed A, Saeed H, Hashmi FK, Imran I, Akbar M, Chaudhry MO, Rasool MF. A national study to assess pharmacists' preparedness against COVID-19 during its rapid rise period in Pakistan. PloS One. 2020;15(11):e0241467. doi:10.1371/journal.pone.0241467.
16. Tesfaye ZT, Yismaw MB, Negash Z. Ayele AG.COVID-19-related knowledge, attitudes and practice among hospital and community pharmacists in Addis Ababa, Ethiopia. Integr Pharm Res Pract. 2020;9:105–12. doi:10.2147/IPRP.S261275.
17. Karasneh R, Al-Azzam S, Muflih S, Soudah O, Hawamdeh S, Khader Y. Media's effect on shaping knowledge, awareness risk perceptions and communication practices of pandemic COVID-19 among pharmacists. Res Social Adm Pharm. 2021;17 (1):1897–902. doi:10.1016/j.sapharm.2020.
18. Ferdous MZ, Islam MS, Sikder MT, Mosaddek ASM, Zegarra-Valdivia JA, Gozal D, Gańczak M. Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: an online-based cross-sectional study. PloS One. 2020;15(10):e0239254. doi:10.1371/journal.pone.0239254.
19. Szymona-Pałkowska K, Janowski K, Pedrycz A, Mucha D, Ambrozy T, Siermontowski P, Adamczuk J, Sapalska M, Mucha D, Kraczkowski J. Knowledge of the disease, perceived social support, and cognitive appraisals in women with urinary incontinence. Biomed Res Int. 2016;2016:1–7. doi:10.1155/2016/3694792.
20. Saqlain M, Munir MM, Rehamn S, Gulzar A, Naz S, Ahmed Z, Tahir AH, Mashhood M. Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: a cross-sectional survey from Pakistan. J Hosp Infect. 2020;105 (3):419–23. doi:10.1016/j.jhin.2020.05.007.
21. WHO. A guide to developing knowledge, attitude and practice surveys. 2008.
22. Le an P, Huynh G, Nguyen HTN, Pham BDU, Nguyen TV, Tran TTT, Tran TD. Knowledge, attitude, and practice towards COVID-19 among healthcare students in Vietnam. Infect Drug Resist. 2021;14:3405–13. doi:10.2147/IDR.S328677.
23. Le QD, To NH, Nguyen TTT. Knowledge, attitude and practice towards COVID-19 pandemic of pharmacy students in university of medicine and pharmacy at Ho Chi Minh city, Vietnam. MedPharmres. 2021;5(4):5–11. [accessed 2022 Nov 21]. https://vjol.info.vn/index.php/TCYDHCM/article/view/60903.
24. Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L, You G. Knowledge, attitude and practice regarding COVID-19 among health care workers in Henan, China. J Hosp Infect. 2020;105 (2):183–87. doi:10.1016/j.jhin.2020.04.01218.
25. Adli I, Widyahening IS, Lazarus G, Phowira J, Baihaqi LA, Ariffandi B, Putera AM, Nugraha D, Gamalliel N, Findyartini A, 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. doi:10.1371/journal.pone.0262827.
26. Giovanni LY, Suryadinata H, Sofiatin Y, Rakhmilla LE, Ruslami R. Knowledge, attitude, and practice of undergraduate medical students in Indonesia on the COVID-19 prevention. J Prev Med Hyg. 2021;62 (3):E598–604. doi:10.15167/2421-4248/jpmh2021.62.3.1885.
27. Sondakh JJS, Warastuti W, Susatia B, Wildan M, Sunindya BR, Budiyanto MAK, Fauzi A. Indonesia medical students' knowledge, attitudes, and practices toward COVID-19. Heliyon. 2022;8(1): e08686. doi:10.1016/j.heliyon.2021.e08686.
28. Salman M, Mustafa ZU, Asif N, Zaidi HA, Hussain K, Shehzadi N, Khan TM, Saleem Z. Knowledge, attitude and preventive practices related to COVID-19: a cross-sectional study in two Pakistani university populations. Drugs Ther Perspect. 2020;36(7):319–25. doi:10.1007/s40267-020-00737-7.
29. Dorji T, Wangmo K, Yezer, Wangchuk T, Tshokey, Wangdi K. Knowledge, attitude, and practice toward COVID-19 among Sherubtse college students in Bhutan: a web-based

cross-sectional study. Front Public Health. 2021;9:721493. doi:10.3389/fpubh.2021.721493.

30. Sazali MF, Rahim SSSA, Mohamed MH, Omar A, Pang NTP, Jeffree MS, Tat YB, Giloi N, Mohd Bahar FH, Afridah W, et al. Knowledge, attitude and practice on COVID-19 among students during the early phase of pandemic in a university in Borneo, Malaysia. J Public Health Res. 2021;10(3): 2122. doi:10.4081/jphr.2021.2122.

31. Dashti S, Abadibavil D, Roozbeh N. Evaluating e-health literacy, knowledge, attitude and practice regarding COVID-19 prevention and self-protection among Iranian students: a cross-sectional online survey. BMC Med Educ. 2022;22(1):148. doi:10.1186/s12909-022-03210-3.

32. Patwary MM, Disha AS, Bardhan M, Haque MZ, Kabir MP, Billah SM, Hossain MR, Alam MA, Browning MHEM, Shuvo FK, et al. Knowledge, attitudes, and practices toward coronavirus and associated anxiety symptoms among university students: a cross-sectional study during the early stages of the COVID-19 pandemic in Bangladesh. Front Psychiatry. 2022;13:856202. doi:10.3389/fpsyt.2022.856202.

33. Haque T, Hossain KM, Bhuiyan MMR, Ananna SA, Hussain MA, Islam MR, Ahmed A, Rahman MM. Knowledge, attitude and practices (KAP) towards COVID-19 and assessment of risks of infection by SARS-CoV-2 among the Bangladeshi population: an online cross sectional survey. Res Square. 2020. doi:10.21203/rs.3.rs-24562/v2.

34. Banik R, Rahman M, Sikder MT, Rahman QM, Pranta MUR. Knowledge, attitudes, and practices related to the COVID-19 pandemic among Bangladeshi youth: a web-based cross-sectional analysis. J Public Health. 2021;1–11. doi:10.1007/S10389-020-01432-7.

35. Rana MM, Karim MR, Wadood MA, Kabir MM, Alam MM, Yeasmin F, Islam MR. Knowledge of prevention of COVID-19 among the general people in Bangladesh: a cross-sectional study in Rajshahi district. PloS One. 2020;15(12):e0243410. doi:10.1371/journal.pone.0243410.

36. Kumar B, Pinky SD, Nurudden AM. Knowledge, attitudes and practices towards COVID-19 guidelines among students in Bangladesh. Soc Sci Humanit Open. 2021;4(1):100194. doi:10.1016/j.ssaho.2021.100194.

37. Elmer T, Mepham K, Stadtfeld C. Students under lockdown: comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. PloS One. 2020;15(7):e0236337. doi:10.31234/0sf.io/uattq.

38. Doan DA, Ho HH, Tran LD, Nguyen PL, Le AT, Dinh DX. Knowledge, attitudes, and practices of university students regarding COVID-19: a cross-sectional study in Vietnam. BMC Public Health. 2022;22(1). doi:10.1186/s12889-022-14442-9.

39. Ahmed Z, Hussain AHMB, Ambinakudige S, Ahmed MNQ, Alam R, Rezoan HA, Das Dola D, Rahman MM, Hassan R, Mahmud S. Perceived human-induced causes of landslide in Chattogram metropolitan area in Bangladesh. Earth Syis St Environ. 2022;6(2):499–515. doi:10.1007/s41748-022-00304-2.

40. Ahmed MNQ, Haq SMA. Indigenous people's perceptions about climate change, forest resource management, and coping strategies: a comparative study in Bangladesh. Environ Dev Sustain. 2019;21(2):679–708. doi:10.1007/s10668-017-0055-1.

41. Mugambiwa SS, Dzomonda O. Climate change and vulnerability discourse by students at a South African university. Jàmbá J Disaster Risk Stud. 2018;10(1):476. doi:10.4102/jamba.v10i1.476.

42. Ahmed MNQ, Ahmed KJ, Chowdhury MTA, Haq SMA. Teachers' perceptions about climate change: a comparative study of public and private schools and colleges in Bangladesh. Front Clim. 2022;4:784875. doi:10.3389/fclim.2022.784875.

43. Chowdhury MTA, Ahmed KJ, Ahmed MNQ, Haq SMA. How do teachers' perceptions of climate change vary in terms of importance, causes, impacts and mitigation? A comparative study in Bangladesh. SN Soc Sci. 2021;1(7):174. doi:10.1007/s43545-021-00194-7.

44. Ahmed Z, Alam R, Ahmed MNQ, Ambinakudige S, Almazroui M, Islam MN, Chowdhury P, Kabir MN, Mahmud S. Does anthropogenic upstream water withdrawal impact on downstream land use and livelihood changes of Teesta transboundary river basin in Bangladesh? Environ Monit Assess. 2022;194(2):59. doi:10.1007/s10661-021-09726-3.

45. Ahmed Z, Hussain AHMB, Ahmed MNQ, Lalin SAA, Endut N, Sultana S. Do perceived working conditions increase life satisfaction? Case of SME workers in Bangladesh. SN Soc Sci. 2023;3(1):5. doi:10.1007/s43545-022-00597-0.

46. Giao H, Han NTN, Khanh TV, Ngan VK, Tam VV, An PL. Knowledge and attitude toward COVID-19 among healthcare workers at district hospital, Ho Chi Minh city. Asian Pac J Trop Med. 2020;13(6):260–65. doi:10.4103/1995-7645.280396.

47. Kundu S, Banna MHA, Sayeed A, Begum MR, Brazendale K, Hasan MT, Habiba SJ, Abid MT, Khan MA, Chowdhury S, et al. Knowledge, attitudes, and preventive practices toward the COVID-19 pandemic: an online survey among Bangladeshi residents. J Public Health (Bangkok). From Theory to Practice. 2021. doi:10.1007/s10389-021-01636-5.

48. Ladiwala ZFR, Dhillon RA, Zahid I, Irfan O, Khan MS, Awan S, Khan JA. Knowledge, attitude and perception of Pakistanis towards COVID-19; a large cross-sectional survey. BMC Public Health. 2021;21(1):21. doi:10.1186/s12889-020-10083-y.

49. Wong CY, Tham JS, Foo CN, Ng FL, Shahar S, Zahary MN, Ismail MN, Tan CS, Hoh BP, Kumar SV, et al. Factors influencing COVID-19 vaccination intention among university students: a cross-sectional study in Malaysia. Biosaf Health Xxx. 2023. doi:10.1016/j.bsheal.2022.12.005.

50. Dubik SD, Amegah KE, Adam AS. Resumption of school amid the COVID-19 pandemic: a rapid assessment of knowledge, attitudes, and preventive practices among final-year senior high students at a technical institute in Ghana. Hindawi Educ Res Int. 2021;2021:1–8. doi:10.1155/2021/8893057.

51. Al Sha'bani MWAO. Knowledge, attitude, and practice toward covid-19 among the faculty of health sciences students at Mogadishu university, Somalia. Mogadishu Univ J. 2020; 6:145–160.

52. Choon SW, Ong HB, Tan SH. Does risk perception limit the climate change mitigation behaviors? Environ Dev Sustain. 2018;21(4):1891–917. doi:10.1007/s10668-018-0108-0.

53. Dutta S, Smita MK. The impact of COVID-19 pandemic on tertiary education in Bangladesh: students' perspectives. Open J Social Sci. 2020;8(9):53–68. doi:10.4236/jss.2020.89004.

54. Hossain MA, Jahid MIK, Hossain KMA, Walton LM, Uddin Z, Haque MO, Kabir MF, Arafat SMY, Sakel M, Faruqui R, et al. Knowledge, attitudes, and fear of COVID-19 during the rapid rise period in Bangladesh. PloS One. 2020;15(9):e0239646. doi:10.1371/journal.pone.0239646.

55. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, Rubin GJ. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020;395(10227):912–20. doi:10.1016/S0140-6736(20)30460-8.

56. Peng Y, Pei C, Zheng Y, Wang J, Zhang K, Zheng Z, Zhu, PA. A cross-sectional survey of knowledge, attitude and practice associated with COVID-19 among undergraduate students in China. BMC Public Health. 2020;20(1):1292. doi:10.1186/s12889-020-09392-z.

57. Wilder-Smith A, Freedman DO. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCov) outbreak. J Travel Med. 2020;27(2):1–4. doi:10.1093/jtm/taaa020.

58. Hossain E, Rana J, Islam S, Khan A, Chakrobortty S, Ema NS, Bekun FV. COVID-19 vaccine-taking hesitancy among Bangladeshi people: knowledge, perceptions and attitude perspective. Hum Vaccines Immunother. 2021;17(11):4028–37. doi:10.1080/21645515.2021.1968215.

59. Schwartz NE. Nutrition knowledge, attitudes and practices of Canadian public health nurses. J Nutr Educ. 1976;8(1):28–31. doi:10.1016/S0022-3182(76)80113-6.

60. Siddiqui AA, Alshammary F, Amin J, Rathore HA, Hassan I, Ilyas M, Alam MK. Knowledge and practice regarding prevention of COVID-19 among the Saudi Arabian population. Work. 2020;66(4):767–75. doi:10.3233/WOR-203223.