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Knowledge, Attitudes and Preventive Practices towards COVID-19 among Bangladeshi Students: An Online Based Cross-sectional Study

Md. Hasan Al Banna [a], Satyajit Kundu [b,c*], Abu Sayeed [d], Keith Brazendale [e], Musammet Rasheda Begum [f], Bright Opoku Ahinkorah [g], Joshua Okyere [h], Md Shafiqul Islam Khan [a]

[a] Department of Food Microbiology, Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali 8602, Bangladesh.
[b] School of Public Health, Southeast University, Nanjing 210009, China.
[c] Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali 8602, Bangladesh.
[d] Department of Post-Harvest Technology and Marketing, Patuakhali Science and Technology University, Patuakhali 8602, Bangladesh.
[e] Department of Health Sciences, University of Central Florida, Orlando, United States.
[f] Department of Agricultural Economics and Social Sciences, Chattogram Veterinary and Animal Sciences University, Chattogram 4225, Bangladesh.
[g] School of Public Health, Faculty of Health, University of Technology Sydney, Australia
[h] Department of Population and Health, University of Cape Coast, Cape Coast, Ghana

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Correspondence: Satyajit Kundu, Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali 8602, Bangladesh.
Email: satyajitnfs@gmail.com

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ABSTRACT

This study sought to assess the level of knowledge, attitude, and practice (KAP) toward COVID-19 among Bangladeshi students. An online-based cross-sectional study was conducted in late April 2020 among 904 Bangladeshi students using a Snowball sampling technique. Data collected were analyzed using descriptive statistics, independent sample t-tests, and analysis of variance (ANOVA) test. Multiple linear regression was employed to calculate the associations between KAP scores and other demographic variables. The mean COVID-19 knowledge score was 14.45 (SD: 1.72; range: 7-17), indicating a moderate level of knowledge. The mean scores for attitudes and practices were 2.45 (SD: 1.13; range: 0-6) and 4.58 (SD: 0.71; range: 1-5), indicating negative attitudes and reasonable practices toward COVID-19, respectively. Students enrolled at the undergraduate level or higher and from urban areas were associated with higher knowledge and practice scores. Students who read scientific articles as their main source of COVID-19 information were more knowledgeable than their peers. Students who participated in online training/courses about COVID-19 were significantly associated with higher KAP scores. The negative attitude of students reported in this study indicates the need for government and policymakers to ensure more targeted awareness campaigns are implemented to enhance public confidence and participation in COVID-19 preventive measures.

Keywords: KAP, Students, COVID-19, Bangladesh.

1. INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) causes the coronavirus disease-2019 (COVID-19), which has impacted human life around the world [1]. Close contact and contaminated surfaces are the primary routes of transmission, with minute droplets created by the infected individual through coughing, sneezing, or talking [2,3]. Dry cough, fever, anosmia (loss of smell), weakness, headache, bodily pains, vomiting, sore throat, and shortness of breath are all common symptoms of this infectious disease, with an incubation period of 1–14 days [4,5]. However, evidence has shown that infected persons can be asymptomatic (without symptoms) after contracting the SARS-CoV-2 [6].

All age groups are at risk of contracting COVID-19. However, the elderly and individuals with physical co-morbidity such as obesity, diabetes mellitus, systemic hypertension,

cardiac pathologies, and compromising immune diseases are more vulnerable to the ailments of this disease [1,5]. Hence, mortality and fatality rates are higher among these risk groups [7,8]. COVID-19 currently has no vaccine or effective antiviral treatment, leaving only symptomatic management and supportive therapy options [4]. COVID-19 transmission and death appear to be curtailed solely by taking preventive actions based on scientific data. As a result, It is critical to provide accurate information to the general population regarding COVID-19 prevention techniques (e.g., handwashing with soap, using a face mask, covering one's mouth while coughing or sneezing, maintaining social separation and self-isolation) [9].

According to knowledge, attitudes, and practices (KAP) theory, people's adherence to these preventative measures is determined by their knowledge, attitudes, and practices (KAP) concerning COVID-19. According to the KAP hypothesis, a person's knowledge about a particular condition is related to their attitude towards it. These interactions significantly impact the practices and procedures used to control it [10–12]. According to a recent study among Bangladeshis, the overall KAP for COVID-19 was poor, with only one-third of the participants displaying good knowledge, but nearly half of the participants demonstrating good attitudes (52.4%) and practices (44.8%) [13]. Another Bangladeshi study reported that most students had a higher level of knowledge and a positive attitude towards the COVID-19 guidelines [14]. A previous study in China concluded that college students had an excellent KAP towards the COVID-19 pandemic [15]. A Malaysian study among students reported that COVID-19 related knowledge and attitudes were below the satisfactory level during the earlier phase of the pandemic [16]. Other studies discovered that having enough knowledge is linked to a higher possibility of people following healthy-living behaviors [17,18]. Other key considerations include the information's source and credibility and socio-demographic aspects like gender and educational level. These factors have been strongly linked with people's knowledge, perceptions, and compliance towards the necessary preventive measures against a disease outbreak [5,10,12].

In Bangladesh, COVID-19 cases have increased day by day following its first positive case on 8 March 2020 [19,20]. Till the date (25 February 2022), 1,939,651 positive cases have been identified and 29,005 deaths. Since the onset of COVID-19 in Bangladesh, the Government of Bangladesh has taken preventive and mitigating steps to stop the spread of the disease, such as closing educational institutions, mandatory public lockdown measures, and limiting social gatherings. Though the students are not directly involved in managing COVID-19 patients, they can play an essential role as an information provider for COVID-19-related messages. Moreover, Student's more profound insight into the existing knowledge, responsive attitude, and healthy precautionary practice towards COVID-19 may curb the infection rate of coronavirus, breaking the vital chain of transmission in the community [21]. They can educate the public about maintaining personal hygiene, the symptoms of COVID-19, and the necessary steps to take to prevent its spread. Thus, students must possess a basic knowledge of COVID-19. Knowing such information is helpful for understanding and discovering the weaknesses of pandemic prevention among college students. It provides an evidence-based theoretical basis for implementing health education to control and prevent COVID-19. Moreover, it offers a beneficial experience for curbing similar major public health emergencies in the future. Given the potential impact students can have as COVID-19 information providers in Bangladesh, this study aimed to assess knowledge, attitudes, and practices towards COVID-19 among a sample of students in Bangladesh.

2. MATERIALS AND METHODS

2.1. Setting and participants

This study adopted an online cross-sectional survey from April 12 to April 18, 2020, right after Bangladesh's lockdown. Data was obtained through the internet as authorities restricted the peoples' movement. Using a snowball sampling technique, the authors distributed the survey link in all divisions through a personal network and social media and requested their friends to share with the others. Both higher secondary and university students aged 18 years or above were invited to participate. In the study, 904 students finally responded to the survey. Data of all respondents were included in the analyses, as all were required to reply in all fields before submission of survey responses. The study sample was obtained from 8 Bangladesh divisions (i.e., regions/states), each contributing around 10.6 - 15.1% of the total sample (n = 904), except for one division (Sylhet division; 8.9%). Being a Bangladeshi resident and a student aged 18 years or above were the inclusion criteria. A question (Are you a student aged 18 years or above? – yes vs. no) was imposed on the first page of the online survey link. Participants were allowed to enter the main page of the survey questionnaire only if the answer was "yes." Students aged below 18 years were not eligible to participate in the study.

2.2. Procedures

An anonymous online questionnaire was developed for this study, based on WHO course materials on emerging respiratory viruses, including COVID-19 [22]. The questionnaire was initially written in English and then translated into Bangla by an expert in both languages. The questionnaire was checked by an independent researcher and then back-translated by another bilingual translator to examine the consistency and biases. The questionnaire was administered online in both Bangla and English. The questionnaire was tested with a random sample of students to see if there were any concerns in the questionnaire (e.g., clarity, comprehension). The online questionnaire provided a summary of the background, purpose, procedures, comments on voluntary and confidential participant responses, and supplemental notes to help complete the questionnaire. When the students clicked the link given to their inbox, they were taken straight to the study summary and informed consent page. Interested individuals were asked to fill out the demographic information before answering the questionnaire. This study followed the recommendations of the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guidelines [23] and the 2013 amendment of the Helsinki Declaration [24].

2.3. Contents of KAP questionnaire

The questionnaire included 367 questions, and participants required nearly 7-10 minutes to answer. The questionnaire contained information on participants' socio-demographics (811 items), knowledge (17 items), attitudes (6 items), and practices related to COVID-19 (5 items). Each question required a response of "I don't know," "Yes," or "No." Each accurate answer/positive attitude/good practice gained 1 point, while the incorrect/unknown response/negative attitude/bad practice received 0 points. The overall score for knowledge, attitude, and practices could range from 0 to 17, 0 to 6, and 0 to 5, respectively. Cronbach's alpha values were 0.82 (knowledge), 0.72 (attitude), and 0.78 (practices) for each component of the KAP questionnaire, showing good internal consistency [25].

2.4. Statistical analysis

All demographic variables and knowledge, attitude, and practices (KAP) about COVID-19 were subjected to descriptive analyses (frequency, percent, mean, and standard deviation). A one-way analysis of variance (ANOVA) and independent-sample t-tests were used to spread the KAP scores among demographic variables. Multiple linear regression assessed the associations between the dependent variables (KAP scores of COVID-19) and socio-economic and demographic variables. The regression model selected as the final model was based on the highest, adjusted R-squared value. Multicollinearity among the variables was also checked using the Variance Inflation Factor (VIF). Unstandardized beta coefficients (B) and standard errors (SE) were used to quantify associations. For all analyses, the statistical significance level was set at $p < 0.05$. The statistical packages SPSS (version 23.0) and STATA were used to complete all analyses (version 16.0).

3. RESULTS

3.1. Assessment of KAP responses

Based on the responses of the participants to the KAP questions, we found that more than 99% of the participants knew about the transmission (K1) and preventive methods (K6, K12 & K16) towards COVID-19 and participated in home quarantine (K17). Most of the participants reported that they wore a mask when leaving home (95.9%) and washed their hands with soap and water upon returning from public excursions (98.6%) (Table 1).

Table 1: Responses of participants to different questions regarding knowledge, attitudes, and practices towards COVID-19 (N = 904).

Questions	Response; n (%)		
Knowledge	**Yes**	**No**	**Don't know**
K1. COVID-19 is transmitted through the sneezing, coughing and contact of affected people.	889 (99.4)	3 (0.3)	2 (0.2)
K2. Headache, fever, cough, sore throat, and flu are symptoms of COVID-19.	830 (91.8)	59 (6.5)	15 (1.7)
K3. COVID-19 symptoms appear in 2-14 days.	836 (92.5)	42 (4.6)	26 (2.9)
K4. COVID-19 leads to pneumonia, respiratory failure, and death.	847 (93.7)	13 (1.4)	44 (4.9)
K5. Supportive care is the current treatment for COVID-19.	697 (77.1)	68 (7.5)	139 (15.4)
K6. Hand hygiene, covering nose and mouth while coughing, and avoiding sick contacts can help in the prevention of COVID-19 transmission.	897 (99.2)	0 (0.0)	7 (0.8)
K7. Flu vaccinated is sufficient for preventing COVID-19.	38 (4.2)	645 (71.3)	221 (24.4)
K8. Eating well-cooked and safely handled meat would result in the infection by the COVID-19 virus.	52 (5.8)	655 (72.5)	197 (21.8)
K9. Sick patients should share their recent travel history with healthcare providers.	839 (92.8)	11 (1.2)	54 (6.0)

K10. Disinfect equipment and working areas in markets at least once a day.	851 (94.1)	10 (1.1)	43 (4.8)
K11. It is not necessary for children and young adults to take measures to prevent the infection by the COVID-19 virus.	70 (7.7)	792 (87.6)	42 (4.6)
K12. To prevent the infection by COVID-19, individuals should avoid going to crowded places.	898 (99.3)	5 (0.6)	1 (0.1)
K13. COVID-19 is caused by a virus called SARS-CoV-2.	287 (31.7)	249 (27.5)	368 (40.7)
K14. Antibiotics are effective in preventing or treating the COVID-19.	110 (12.2)	502 (55.5)	292 (32.3)
K15. COVID-19 is a contagious disease.	834 (92.3)	49 (5.4)	21 (2.3)
K16. Hand should be washed with soap for at least 20 sec.	895 (99.0)	5 (0.6)	4 (0.4)
K17. Home quarantine is crucial to safe other from COVID-19.	900 (99.6)	0 (0.0)	4 (0.4)
Attitudes	**Yes**	**No**	
A1. Do you agree that COVID-19 will finally be successfully controlled within short period of time?	143 (15.8)	761 (84.2)	
A2. Do you agree that the medicine for COVID-19 will be available within short period of time?	98 (10.8)	806 (89.2)	
A3. Do you have confidence that Bangladesh can win the battle against the COVID-19?	490 (54.2)	414 (45.8)	
A4. Do you think that you and your family may get sick with COVID-19?	487 (53.9)	417 (46.1)	
A5. Do you think social distancing is essential to stop the spreading of the virus?	850 (94.0)	54 (6.0)	
A6. Would you allow those individuals in your community after recovery from COVD-19 illness?	477 (52.8)	427 (47.2)	
Practices	**Yes**	**No**	
P1. In recent days, have you gone to any crowded place?	63 (7.0)	841 (93.0)	
P2. In recent days, have you worn a mask when leaving home?	867 (95.9)	37 (4.1)	
P3. Do you disinfect your hand with soap upon returning from the outside?	891 (98.6)	13 (1.4)	
P4. Do you change your clothes when you go back from outside?	743 (82.2)	161 (17.8)	
P5. Do you disinfect your hand after sneezing or coughing, whether you cover your mouth with hand?	797 (88.2)	107 (11.8)	

3.2. Socio-demographic characteristics

This cross-sectional study included 904 Bangladeshi students with a mean age of 21.82 years (±SD = 2.1) and 59.3% of the sample was male. Most of the participants studied at the undergraduate level (74.7%). Almost one-third (32.6%) of the participants were from rural localities. Only 14.9% of the students received online training/courses related to COVID-19 (Table 2).

Table 2: Distribution of knowledge, attitude and practice scores of COVID-19 across socio-demographic characteristics of students in Bangladesh (N = 904).

Variables	N (%)	Knowledge score[a] in 17	p	Attitude score[a] in 6	p	Practice score[a] in 5	p
Gender							
Male	536 (59.3)	14.50±1.74	0.307	2.47±1.19	0.521	4.41±0.80	**0.000**
Female	368 (40.7)	14.38±1.68		2.42±1.04		4.82±0.48	
Age in years; M±SD	21.82±2.1						
18-21 years	418 (46.2)	14.12±1.88	**0.000**	2.45±1.15	0.850	4.56±0.76	0.362
≥ 22 years	486 (53.8)	14.74±1.51		2.44±1.12		4.60±0.67	
Family monthly income							
≤ 30000 BDT	497 (55.0)	14.37±1.68	0.091	2.49±1.11	0.216	4.55±0.73	0.118
> 30000 BDT	407 (45.0)	14.56±1.76		2.40±1.15		4.62±0.68	
Marital status							
Married	38 (4.2)	14.03±1.55	0.117	2.21±1.17	0.188	4.55±0.80	0.819
Unmarried	866 (95.8)	1.72±1.72		2.46±1.13		4.58±0.71	
Study level							
Higher secondary	139 (15.4)	13.78±2.19	**0.000**	2.60±1.20	**0.003**	4.59±0.72	0.083
Under graduation	675 (74.7)	14.53±1.60		2.37±1.09		4.56±0.73	
Post-graduation or higher	90 (10.0)	14.94±1.44		2.74±1.27		4.73±0.58	
Residence							
Rural	292 (32.3)	14.33±1.78	0.051	2.43±1.12	0.264	4.41±0.83	**0.000**
Semi-urban	326 (36.1)	14.39±1.66		2.38±1.05		4.70±0.58	
Urban	286 (31.6)	14.65±1.71		2.53±1.22		4.62±0.68	
Source of information							

Facebook	456 (50.4)	14.46±1.61	0.229	2.38±1.06	0.217	4.58±0.73	**0.000**
TV	344 (38.1)	14.36±1.82		2.47±1.15		4.62±0.65	
Newspaper	38 (4.2)	14.79±1.89		2.55±1.20		4.03±0.92	
Scientific features	31 (3.4)	15.00±1.07		2.58±1.41		4.48±0.77	
Others	35 (3.9)	14.43±2.16		2.80±1.43		4.77±0.43	
Received online training							
Yes	135 (14.9)	15.13±1.32	**0.000**	2.71±1.03	**0.003**	4.73±0.63	**0.004**
No	769 (85.1)	14.33±1.75		2.40±1.14		4.55±0.72	

[a] Knowledge, attitude and practice scores are presented as Mean ± Standard Deviation (M ± SD)

3.3. COVID-19 KAP scores of Bangladeshi students

Knowledge

The mean score of the knowledge regarding COVID-19 was 14.45 (SD = 1.72, range: 7 – 17) on a scale of 17.0, and we estimated an 85% correct rate for the knowledge test was 85% (14.45/17×*100), indicating moderate to good knowledge. Conversely, age, study level, and receiving online course/training had a statistically significant ($p<0.001$) association with knowledge scores (Table 2). Specifically, students ≥22 years old were more likely to have higher knowledge on COVID-19 compared to students aged 18-21 years old (B = 0.617, $p < 0.001$). Students who were studying at the undergraduate (B = 0.742, $p < 0.001$) and graduate or higher level (B = 1.160, $p < 0.001$) were significantly associated with a higher score of knowledge on COVID-19, compared to secondary education students. Participants from urban areas were associated with a higher score of COVID-19 knowledge than participants from rural localities (B = 0.329, $p < 0.05$). Students who received online courses/training on COVID-19 (B = 0.799, $p < 0.001$) reported higher scores on COVID-19 knowledge compared to those who didn't receive any online courses/training on COVID-19 (Table 3).

Table 3: Associations between socio-demographic variables, and knowledge, attitude and practice scores of Bangladeshi students (N = 904).

Variables	Knowledge		Attitude		Practice	
	B	**SE**	**B**	**SE**	**B**	**SE**
Gender (ref.: Female)						
Male	0.119	0.116	0.048	0.076	**-0.408*****	0.046
Age in years (ref.: 18-21 years**)**						
≥ 22 years	**0.617*****	0.113	-0.014	0.075	0.044	0.048
Family monthly income (ref.: > 30000)						
≤ 30000 BDT	-0.194	0.115	0.093	0.075	-0.074	0.048
Marital status (ref.: Married)						
Unmarried	0.446	0.284	0.247	0.188	0.027	0.118
Study level (ref.: Higher secondary)						
Under graduation	**0.742*****	0.157	**-0.230***	0.105	-0.034	0.066
Post-graduation or higher	**1.160*****	0.229	0.140	0.152	0.143	0.096
Residence (Ref.: Rural)						
Semi-urban	0.067	0.138	-0.051	0.091	**0.285*****	0.057
Urban	**0.329***	0.142	0.097	0.094	**0.204*****	0.058
Source of information (Ref.: TV)						
Facebook	0.100	0.122	-0.087	0.081	-0.039	0.050
Newspaper	0.429	0.293	0.082	0.193	**-0.596*****	0.120
Scientific features	**0.640***	0.322	0.110	0.212	-0.138	0.132
Others	0.068	0.304	0.329	0.200	0.149	0.125
Received online training (Ref.: No)						
Yes	**0.799*****	0.158	**0.311****	0.105	**0.173****	0.066

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B = Unstandardized beta coefficient; SE = Standard error

Attitudes

The mean attitude score was 2.45 (SD = 1.13, range: 0 – 6) on a scale of 6.0, indicating a more negative attitude toward COVID-19. The score varied significantly among education levels of the study participants ($p<0.01$) and between students who participated in online

courses/training about COVID-19 versus those who did not participate. (p<0.01) (Table 2). Undergraduate students were negatively associated with attitude scores toward COVID-19, compared to secondary education students (B = –0.230, p<0.05). Students who received online courses/training on COVID-19 were significantly associated with higher scores (more positive attitude) toward COVID-19 compared to their peers (B = 0.311, p < 0.01) (Table 3).

Practice

The participants' mean practice score was 4.58 (SD = 0.71, range: 1 – 5) on a scale of 5.0, indicating a high level of practice. There was a significant difference between males (mean: 4.41, SD:±0.80) and females (mean: 4.82, SD:±0.48) with respect to the practice scores (p<0.001). Residence (p < 0.001), sources of information (p<0.001) and receiving COVID-19 online course/training (p<0.01) had statistically significant association with practice scores (Table 2). COVID-19 practices were lower among males than females (B = – 0.408, <0.001), but higher among students from semi-urban (B = 0.285, p<0.001) and urban (B =0.204, p<0.001) areas compared to students from rural areas. We also found that students who received online courses/training on COVID-19 had better practices than those who didn't receive (B = 0.173, p < 0.01) (Table 3).

3.1. Correlations among knowledge, attitudes and practices toward COVID-19

Spearman correlation analysis shows that attitude and practice scores were moderately correlated (r = 0.139, p < 0.01), significant. In contrast, no significant correlations between knowledge and attitude and knowledge and practice were found in the study (Table 4).

Table 4: Correlation among knowledge, attitude, and practice towards COVID-19

Variable	1	2	3
1. Knowledge score	1		
2. Attitude score	0.026	1	
3. Practice score	0.059	0.139**	1

** Correlation is significant at 0.01 level
Spearman correlation coefficient is calculated as the variables are not normally distributed.

4. DISCUSSION

COVID-19 is an emerging infectious disease that poses a global threat to public health. Given the significant adverse impact of COVID-19 and the lack of a widespread COVID-19 vaccine, preventive practices play a vital role in containing the disease outbreak. The present study provides initial evidence of socio-demographic factors that affect knowledge, attitudes, and preventive practices regarding COVID-19 in a large sample of Bangladeshi students.

"Knowledge" about symptoms, transmission, prevention, and epidemiology of COVID-19

Our findings demonstrated overall moderate knowledge about COVID-19 among students, which reflects the findings of previous studies conducted among student populations in India [26], Nepal [27], Baghdad City [28], China [29], and Iraq [18]. Almost all of the students (70%) had a high level of knowledge about the transmission nature and prevention procedures of COVID-19, which is similar to prior research in a sample of Indian students where over 70% of students had adequate knowledge of symptoms, mode of transmission and preventive measures of COVID-19, and 66% knew treatment approaches [30].

Students' knowledge about COVID-19 was significantly associated with their socio-demographic characteristics (age, study level, residence type). For example, students who were either ≥22 years old or were enrolled at the undergraduate level or above reported greater knowledge about COVID-19 than their counterparts. These findings align with a previous study conducted among medical students in Baghdad city [28] and are also supported by other Saudi Arabian studies that have reported older and more educated participants are more knowledgeable about emerging infectious diseases [31,32]. Moreover, the individual's education and age have been considered a determinant of health knowledge [33]. The spectrum of knowledge tends to increase progressively with the level of education, and the findings herein related to age/education and knowledge could explain students' proficiency to understand and critically analyze information about COVID-19 presented from differing sources (e.g., social media, local news, health organizations, etc.). Our study also found that respondents from urban areas were more knowledgeable about COVID-19 as compared to rural areas, which was in opposition to a recent Bangladeshi KAP study [34]. Ferdous et al. [34] found respondents from rural areas were more knowledgeable about the

COVID-19 outbreak and reported that the majority of their participants were also students who had returned home to rural areas during the lockdown. The plausible explanation of our finding is that students from urban areas have more access to more sources of information (e.g., daily newspapers, public internet facilities, and local radio channels) where they may get more informative and timely information regarding COVID-19. Interestingly, this study found students who participated in online courses/training about the COVID-19 pandemic and students who reported relying on scientific features as their primary source of information for COVID-19 were associated with higher knowledge scores. This finding is in agreement with a study of medical students in Nepal [27] that concluded better knowledge is associated with COVID-19 online or onsite training. Collectively, it appears that online courses/training offered by the Ministry of Health, awareness program and messages about the pandemic distributed on social media (Facebook), and Televisions and Newspapers, can have a positive effect on students' knowledge of COVID-19. These findings necessitate that action should be taken by policymakers and public health practitioners to place a greater emphasis on distributing information in a timely manner through multiple sources in order to reach individuals who may not be receiving the necessary information (i.e., young adolescents, secondary education students, and students from rural areas) in order to improve knowledge on the COVID pandemic.

"Attitudes" towards COVID-19 preventive measures

The majority of participants in the present study reported a negative attitude towards COVID-19 preventative measures of COVID-19, which is supported by a recent study among Bangladeshi internet users [17]. However, this finding contradicts previous studies among students in Jordan [35], Baghdad City [28], Nepal [27], China [29], and Iraq [18], where most respondents have reported positive attitudes toward COVID-19 prevention practices. A possible explanation of this negative attitude toward COVID-19 prevention practices could be due to the highly infectious and rapidly-spreading nature of this novel disease, even in developed countries such as Italy and the United States of America. This is evidenced in our findings, where only half of the respondents (45.8%) reported having confidence that Bangladesh could win the battle against COVID-19. This finding was lower than Nepal (66.6%) [27], China (97.1%) [10], and Saudi Arabia [36]. Bangladeshi peoples' negative mindset may be attributed to inadequate health care services for a highly- and densely-populated country, low COVID-19 testing rates, and overall lower economic circumstances. Further, there is evidence that people tend to express negative emotions and mental disorders (e.g., depression, anxiety, stress, and panic) during pandemics that could affect the attitudes and outlook of the current respondents [37,38].

This study also revealed an association between higher scores of attitudes and socio-demographic factors, such as study level (undergraduate level) and receiving online training/courses related to COVID-19. This agrees with the findings from a study among general residents in China [10], where the higher educational qualification was associated with a positive attitude towards the COVID-19 outbreak. Individuals' educational qualification has been linked to knowledge of a disease condition, which, given this higher understanding of the disease as a whole, may positively influence their attitude towards the disease. This notion is supported by our finding that students who obtained online training/courses in COVID-19 were positively associated with a higher score of attitudes towards COVID-19. Students who completed online courses/training offered by the different organizations or the Health Ministry of Bangladesh were more knowledgeable about the epidemiology of COVID-19 and were presented with a clearer picture of the implications of COVID-19, hence why they might be more optimistic toward the pandemic and future progress towards tackling and preventing the spread of the disease.

"Practices" related to COVID-19

Generally speaking, students' attitudes towards the control of COVID-19 were not optimistic in this study, yet, this study found students reported engaging in practices to protect themselves from being infected by COVID-19. To prevent the spread of the disease, students reported conducting correct preventative practices recommended by health organizations such as wearing face masks, frequently washing their hands, particularly after coughing, sneezing, returning home from outside, and maintaining a social distance (6 feet) from other persons. These findings align with other studies among student populations [29,30,39]. Individuals may be more inclined to adhere to these preventative practices due to larger measures taken by the local government, such as prohibiting public gatherings, closing educational institutions, and essentially 'locking down' the whole country, which can demonstrate the seriousness of the situation to the public. In addition, respondents likely adopted correct and safe practices due to the Government of Bangladesh'sBangladesh's education and outreach materials provided to increase the public's understanding of the disease and influence changes in behaviors.

Similar to knowledge and attitude, our study showed preventive practices against COVID-19 were associated with socio-demographic factors such as sex, age, residence type, source of information, and online training. Males were more likely to have a lower score of practices towards COVID-19 than females, which agrees with recent previous studies among general populations and undergraduate students in China [10,29]. Broadly, evidence from previous studies exploring risky behaviors and sex differences found males are more likely to participate in risk-taking behaviors compared to females [40,41]. This might be a plausible explanation for the observed differences in practices towards COVID-19 among males and females in this study. Another finding in this study shows a low score for COVID-19 practices was more common among students who used daily newspapers as their main source of COVID-19 information than television. In Bangladesh, television is common to most households regardless of economic status. It is an effective and reliable method to distribute information in a timely and widespread manner, resulting in improved knowledge and appropriate practices related to COVID-19. Intuitively, students from semi-urban or urban areas who received online training /courses were associated with better practices towards the disease. This finding affirms that online training/courses about the signs, symptoms, transmission, and preventive measures of COVID-19 were effective at instilling a good level of knowledge positive attitudes, which ideally result in better practices concerning COVID-19 prevention. An awareness of these associations is important to formulate contingency plans and to training for students and the broader population in response to future public health emergencies and pandemics.

Finally, in this study region, better COVID-19 knowledge scores were found to be substantially associated with a higher chance of positive attitudes and practices regarding the COVID-19 pandemic. Bangladeshi internet users and Chinese citizens have a similar relationship [10,17]. These links can be traced back to the fact that the disease has received widespread media attention, which has covered issues of disease knowledge, attitude, and prevention.

Strengths and limitations

To the researchers ' knowledge, this is one of the first studies to look into the factors that influence KAP towards COVID-19 in a broad group of Bangladeshi students. However, there are several limitations to this study that should be acknowledged. Data was self-reported, which can contribute to biases in reporting. For example, we were unable to verify the student status of the participants rather. We relied on their self-reported information. Since we collected data online, this can lead to less reliable data due to the lack of a trained interviewer to clarify the questions. To remedy this issue, future studies may use administrative data. The cross-sectional study design also limits the capacity to determine causality between factors. Finally, because this was an internet-based online survey, responses from areas without internet access were not collected, potentially resulting in demographic selection bias and limiting the findings' generalizability.

5. CONCLUSION

This study provides a comprehensive assessment of the KAP of Bangladeshi students towards COVID-19 during the strict lockdown period enforced by the government. Overall, the findings suggest that Bangladeshi students have adequate knowledge regarding COVID-19, negative attitudes toward the disease, yet good preventive practices to mitigate the spread of COVID-19. KAP of students is crucial to stop the spread of COVID-19, as students or college-aged individuals are most likely to spread the virus. The present study found that students studying at an undergraduate level or higher, and those who received online training/courses regarding COVID-19, had higher knowledge of COVID-19 and better preventive practices. Thus, the design of COVID-19 programs, training, or courses delivered online may help to improve the knowledge, attitude, and practices toward COVID-19 and may be a worthwhile endeavor to implement in other populations. Lastly, policymakers must communicate more transparent and timely to improve public confidence and attitudes towards COVID-19 by sharing accurate information on preventive measures and their effectiveness.

REFERENCES

[1] Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020 Feb ;395:507–13. DOI: 10.1016/s0140-6736(20)30211-7

[2] Hassan SA, Sheikh FN, Jamal S, Ezeh JK, Akhtar A, et al. Coronavirus (COVID-19): a review of clinical features, diagnosis, and treatment. Cureus. 2020 Mar 21;12(3) :e7355. DOI: 10.7759/cureus.7355

[3] Adhikari SP, Meng S, Wu YJ, Mao YP, Ye RX, Wang QZ, et al. Epidemiology, causes, clinical

manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. Infect Dis Poverty. 2020 Mar 17;9(1):29. DOI: 10.1186/s40249-020-00646-x

[4] Wang Y, Wang Y, Chen Y, Qin Q. Unique epidemiological and clinical features of the emerging 2019 novel coronavirus pneumonia (COVID-19) implicate special control measures. J Med Virol. 2020 Jun;92(6):568-576. DOI: 10.1002/jmv.25748

[5] Ahmed SS. The Coronavirus disease 2019 (COVID-19): a review. J Adv Med Med Res. 2020;32(4):1–9. DOI: 10.9734/jammr/2020/v32i430393

[6] Oran DP, Topol EJ. Prevalence of asymptomatic SARS-CoV-2 infection: a narrative review. Ann Intern Med. 2021 Feb;174(2):286-287. DOI: 10.7326/l20-1285

[7] Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020; 382(18): 1708-20. DOI: 10.1056/nejmoa2002032

[8] Zhang J, Wang X, Jia X, Li J, Hu K, Chen G, et al. Risk factors for disease severity, unimprovement, and mortality in COVID-19 patients in Wuhan, China. Clin Microbiol Infect. 2020 Jun; 26(6):767-772. DOI: 10.1016/j.cmi.2020.04.012

[9] WHO. Coronavirus disease (COVID-19) Advice for the Public. 2020. [Acceessed 2022 Mar 04]. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public

[10] Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. Int J Biol Sci. 2020 Mar 15; 16(10):1745-1752. DOI: 10.7150/ijbs.45221

[11] Yap J, Lee VJ, Yau TY, Ng TP, Tor PC. Knowledge, attitudes and practices towards pandemic influenza among cases, close contacts, and healthcare workers in tropical Singapore: a cross-sectional survey. BMC Public Health. 2010 Jul 28;10:442. DOI: 10.1186/1471-2458-10-442

[12] Ayinde O, Usman AB, Aduroja P, Gbolahan A. A cross-sectional study on Oyo state health care workers knowledge, attitude and practice regarding corona virus disease 2019 (COVID-19). 2020; 10(3). DOI: 10.4236/aid.2020.103002

[13] Paul A, Sikdar D, Hossain MM, Amin MR, Deeba F, Mahanta J, et al. Knowledge, attitudes, and practices toward the novel coronavirus among Bangladeshis: Implications for mitigation measures. PLoS One. 2020 Sep 2; 15(9):e0238492. DOI: 10.1371/journal.pone.0238492

[14] 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%2Fj.ssaho.2021.100194

[15] Jia Y, Ma S, Bai L, Xiao Q, Wu Y, Gao Y, et al. Health Literacy and Disparities in Knowledge, Attitude and Practice Regarding COVID-19 Among College Students During the COVID-19 Outbreak in China: A Cross-Sectional Study. Risk Manag Healthc Policy. 2021 Nov 2;14:4477-4488. DOI: 10.2147/rmhp.s319331

[16] Sazali MF, Rahim SSSA, Mohamed MH, Omar A, Pang NTP, Jeffree MS, 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 Mar 24;10(3):2122. DOI: 10.4081/jphr.2021.2122

[17] Rahman A, Sathi NJ. Knowledge, Attitude, and Preventive Practices toward COVID-19 among Bangladeshi Internet Users. Electron J Gen Med. 2020;17(5): em245. DOI: 10.29333/ejgm/8223

[18] Hussein NR, Naqid IA, Jacksi K, Ali Abdi B. Assessment of knowledge, attitudes, and practices toward COVID-19 virus among university students in Kurdistan region, Iraq: Online cross-sectional study. J Fam Med Prim care. 2020 Sep;9(9):4809-4814. DOI: 10.4103%2Fjfmpc.jfmpc_870_20

[19] BBC. Coronavirus: One month of identifying the first case, what is the current situation of Bangladesh? 2020.

[20] Kundu S, Al Banna MH, Sayeed A, Begum MR, Brazendale K, Hasan MT, et al. Knowledge, attitudes, and preventive practices toward the COVID-19 pandemic: an online survey among Bangladeshi residents. Z Gesundh Wiss. 2021 Aug 14:1-15. DOI: 10.1007/s10389-021-01636-5

[21] 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 Jul 23;15(7):e0236337. DOI: 10.1371/journal.pone.0236337

[22] WHO. Emerging respiratory viruses, including COVID-19: methods for detection, prevention, response, and control. 2020. [Accessed 2022 Mar 04]. Available from: https://extranet.who.int/goarn/emerging-respiratory-viruses-including-covid-19-methods-detection-prevention-response-and-control

[23] Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res. 2004 Sep 29;6(3):e34. DOI: 10.2196/jmir.6.3.e34

[24] Williams JR. The Declaration of Helsinki and public health. Bull World Health Organ. 2008;86(8):650-2. DOI: 10.2471/blt.08.050955

[25] Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. Res Sci Educ. 2018; 48:1273–96. DOI: 10.1007/s11165-016-9602-2

[26] Gohel KH, Patel PB, Shah PM, Patel JR, Pandit N, Raut A. Knowledge and perceptions about COVID-19 among the medical and allied health science students in India: An online cross-sectional survey. Clin Epidemiol Glob Health. 2021 Jan-Mar;9:104-109. DOI: 10.1016/j.cegh.2020.07.008

[27] Singh AK, Karmacharya RM, Vaidya S, Malla BR, Bhatt G. Knowledge, Attitude and Practices towards COVID-19 among Medical Students. J KIST Med Coll. 2020; 2(2):1–10. DOI: 10.3126/jkistmc.v2i2.33564
[28] Khalil NS, Al-Yuzbaki DB, Tawfeeq RS. COVID-19 knowledge, attitude and practice among medical undergraduate students in Baghdad City. Eur Asian J Biosci. 2020; 14:4179–86.
[29] Peng Y, Pei C, Zheng Y, Wang J, Zhang K, Zheng Z, et al. A cross-sectional survey of knowledge, attitude and practice associated with COVID-19 among undergraduate students in China. BMC Public Health. 2020 Aug 26;20(1):1292. DOI: 10.1186/s12889-020-09392-z
[30] Prasad Singh J, Sewda A, Shiv DG. Assessing the knowledge, attitude and practices of students regarding the COVID-19 pandemic. J Health Manag. 2020;22:281–90. DOI: 10.1177%2F0972063420935669
[31] Al-Mohrej OA, Al-Shirian SD, Al-Otaibi SK, Tamim HM, Masuadi EM, Fakhoury HM. Is the Saudi public aware of Middle East respiratory syndrome? J Infect Public Health. 2016 May-Jun;9(3):259-66. DOI: 10.1016/j.jiph.2015.10.003
[32] Bawazir A, Al-Mazroo E, Jradi H, Ahmed A, Badri M.MERS-CoV infection: mind the public knowledge gap. J Infect Public Health. 2018 Jan-Feb;11(1):89-93. DOI: 10.1016/j.jiph.2017.05.003
[33] Beier ME, Ackerman PL. Determinants of health knowledge: an investigation of age, gender, abilities, personality, and interests. J Pers Soc Psychol. 2003; 84(2), 439–448. https://psycnet.apa.org/doi/10.1037/0022-3514.84.2.439
[34] Ferdous MZ, Islam MS, Sikder MT, Mosaddek ASM, Zegarra-Valdivia JA, Gozal D. Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: An online-based cross-sectional study. PLoS One. 2020 Oct 9;15(10):e0239254. DOI: 10.1371/journal.pone.0239254
[35] Alzoubi H, Alnawaiseh N, Al-Mnayyis A, Abu-lubad M, Aqel A, Alshagahin H. COVID-19-knowledge, attitude and practice among medical and non-medical University Students in Jordan. J Pure Appl Microbiol. 2020; 14:17–24. [Accessed 2022 Mar 04]. Available from: https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/pt/covidwho-142234
[36] Al-Hanawi MK, Angawi K, Alshareef N, Qattan AMN, Helmy HZ, Abudawood Y, et al. Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: a cross-sectional study. Front public Heal. 2020 May 27;8:217. DOI: 10.3389/fpubh.2020.00217
[37] Blendon RJ, Benson JM, DesRoches CM, Raleigh E, Taylor-Clark K. The public's response to severe acute respiratory syndrome in Toronto and the United States. Clin Infect Dis. 2004 Apr 1;38(7):925-31. DOI: 10.1086/382355
[38] Banna MHA, Sayeed A, Kundu S, Christopher E, Hasan MT, Begum MR, et al. The impact of the COVID-19 pandemic on the mental health of the adult population in Bangladesh: a nationwide cross-sectional study. Int J Environ Health Res. 2022 Apr;32(4):850-861. DOI: 10.1080/09603123.2020.1802409
[39] 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 Apr 1;23(4):249-254. DOI: 10.34172/aim.2020.06
[40] Pawlowski B, Atwal R, Dunbar RIM. Sex differences in everyday risk-taking behavior in humans. Evol Psychol 2008; 6(1): 29-42. DOI: 10.1177%2F147470490800600104