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Knowledge, attitudes and practices of COVID-19 in rural Bangladesh: a cross-sectional study

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ABSTRACT

Objectives Understanding the knowledge, attitudes and practices (KAP) of COVID-19 within distinct populations may aid further public health messaging. This study's aims were to explore KAP towards COVID-19 in rural Bangladesh and identify any potential links to sociodemographics, existing clinical conditions and sources of information.

Design Cross-sectional community-based study.

Setting Participants were recruited from 18 villages using multistage cluster random sampling.

Methods Data were collected through face-to-face interviews, from June to November 2021, using a structured questionnaire. Data included sociodemographics, clinical conditions, sources of information and KAP of COVID-19 questions. X^2 test, multiple logistic regression and correlation analyses were performed.

Results A total of 1603 participants were included with mean ages of 42.3±14.2 years, ranging from 18 to 60 years. Of these, 51% were male, 42.2% had secondary education and 45% had comorbidities. Television was the main source of COVID-19 information (55.8%). The overall correct response rate of KAP questions was 90%, 78% and 59%, respectively. In stepwise multiple logistic regression, good knowledge was associated with higher education (adjusted OR (AOR): 4.61, 95% CI: 2.40 to 8.85, p<0.001), employment, high body mass index (overweight and obese) and trust in the sources of information. Being female (AOR: 1.48, 95% CI: 1.19 to 1.85, p<0.001), having depression (AOR: 1.80, 95% CI: 1.34 to 2.43, p<0.001), being a past smoker and sources of information (family members/friends/relatives/neighbours) were associated with positive attitudes. Good practices were associated with older age (AOR: 1.52, 95% CI: 1.10 to 2.11, p=0.01), higher education (AOR: 2.78, 95% CI: 1.58 to 4.89, p<0.001) and having anxiety, while current smokers and fully vaccinated people were less likely to be engaged in good practices. Positive significant correlations between domains of KAP were observed as well as between past vaccination KAP and COVID-19 KAP.

Conclusion This study uncovered gaps in understanding and practices, and identified targeted intervention especially for young and less educated people using mass media to promote updated knowledge regarding COVID-19 and the efficacy of preventive practices.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Data were collected using a cross-sectional study design and a 'Kish Grid' sampling method from a rural area in Bangladesh.
⇒ Association of knowledge, attitude and practice (KAP) with sociodemographics, clinical conditions and sources of information was evaluated using a multiple regression approach.
⇒ This study did not explore any cultural/religious/financial factors associated with COVID-19 preventive behaviours that might affect their practices.
⇒ This study did not examine the influence of efficacy beliefs and risk perceptions, which may have an important role in the adoption of preventive measures.
⇒ Instead of each question's effect, we used the mean scores of individual components of KAP in the analysis.

INTRODUCTION

COVID-19, caused by the highly contagious SARS-CoV-2, has become a defining pandemic of this era, spreading to 223 countries and territories with 627 million cases and 6.58 million deaths (as of 22 October 2022).[1] Like many countries across the world, in Bangladesh, since its first reported case on 8 March 2020, the number of cases has been growing continuously and as of 22 October 2022, 2.03 million confirmed cases and 29 412 deaths have been recorded.[2]

According to the WHO, the most effective ways of controlling the infection are self-isolating, social distancing, maintaining personal hygiene and getting vaccinated.[3] Many countries initiated different public health measures to combat COVID-19, including face mask wearing, hand washing, social distancing, and city or country-wide lockdowns. To mitigate the outbreak, Bangladesh also sought to implement preventive measures like hand washing, face mask wearing, social distancing, full lockdown

followed by partial lockdown (limited movement of transport and access to offices), closure of educational institutions and restrictions in religious and social gatherings.[4] However, the effectiveness of these measures depends on public adherence, which is influenced by their knowledge, attitude and practice (KAP) towards the disease. Moreover, implementation of these measures is quite challenging for a densely populated country like Bangladesh, which depends on labour-oriented industries.[5] As combatting the COVID-19 pandemic is assumed to be a long-term process, the best approach is to have a positive attitude and the proper knowledge in the lead up to practising the recommended preventive measures set out by health authorities.[6]

Alongside the preventive measures, mass vaccination against COVID-19 is crucial.[7] Like other low-income countries, Bangladesh is also lagging behind in achieving 70% vaccination of the population in order to meet the targeted herd immunity conditions against COVID-19.[8] As of 10 May 2022, approximately 75.6% of the population had received the first dose of the vaccine, 68.5% were fully vaccinated and only 7.7% had received the booster dose.[9] Vaccine acceptance and availability as well as management-related issues such as vaccine storage, equipment, vaccinators, tracking systems, staff availability and equitable distribution could affect the vaccine rollout in Bangladesh.

Further complicating the circumstances surrounding vaccine rollout is the emergence of new SARS-CoV-2 variants and their impact on vaccine efficacy. Although vaccines substantially reduce the risk of severe disease, hospitalisation and death, containing the spread of the disease itself remains challenging. Data published from different countries revealed that vaccine efficacy dropped significantly even in fully vaccinated people.[10–13] Public Health England reported that 49% of people who died within 28 days of testing positive for the Delta variant were fully vaccinated. Among them, around 98% were aged 50 years or above.[14] Variant aside, studies showed that vaccine effectiveness against infection, hospitalisation and death dropped considerably after 6 months, which could be due to waning antibody levels. From 3 May to 25 July 2021, New York also experienced a decline in vaccine effectiveness, coinciding with the rise of Delta variant cases and the relaxation of mask wearing and social distancing.[15]

With an inadequate vaccine rollout especially in many low-income countries, and with declining vaccine efficacy raising heightened concerns, it becomes increasingly vital for the public to engage in precautionary behaviours that are influenced by their knowledge and attitudes. Therefore, assessing public knowledge and attitudes towards COVID-19 and practising engagement with preventive measures against it are crucial in identifying the gaps in understanding and in strengthening ongoing efforts. Several KAP studies have been conducted in Bangladesh. However, most of them were web-based and focused on urban populations, healthcare workers and students. Evidence from rural areas is scarce, although the rural population constitutes 62.6% of the total population in the country[16] and has limited access to healthcare services and facilities. On account of low literacy rates, misconceptions, stigmas associated with diagnosis, reporting of cases and deaths might have been unknown or underestimated among this population. As of 22 October 2022, the number of COVID-19 cases in the study region (the southwest part of Bangladesh) was 115 736 (7.4 in 1000), and the study site was a random small block of this region.[2] The aim of this study is thus to explore KAP towards COVID-19 among the rural population in Bangladesh and evaluate any potential links to sociodemographics, clinical conditions and sources of information of COVID-19-related issues.

METHODS

Study design and study population

This cross-sectional study was conducted in rural Bangladesh from June to November 2021. A multistage cluster random sampling technique was applied to draw the sample from 18 villages from a randomly selected district (second-tier administrative regions) of the country. The study was conducted and reported in compliance with the Strengthening the Reporting of Observational Studies in Epidemiology checklist[17] (online supplemental appendix 1). We included adults aged ≥18 years who were residing in the recruited households within the targeted villages who gave written consent. Pregnant women, people who had surgery in the past 3 months, people with mental illness and people residing in urban areas were excluded. The sample size calculation is provided in online supplemental appendix 2.

Sampling method

Geographically, Bangladesh is divided into eight *divisions* (the first tier of administrative regions). One division with 10 *districts* (the second tier of administrative regions) was randomly selected. A further random selection of one district from these 10 districts was performed. From this selected district, an *upazila* (the third tier of administrative regions) was selected. Finally, from this upazila, a *union parishad* (local geographical regions) was selected. Randomness was maintained in every stage of selection. The interviewers identified a household closest to the centre point of the union parishad to be the first household to enrol in the study. Then, applying inclusion and exclusion criteria, a consenting household member was interviewed.[18] Data were collected from an eligible member in the selected household following the 'Kish Grid' method.[19] This method allowed only a single member of the selected household to be interviewed. If a selected household member declined to participate or the household was locked, this was taken as a refusal to participate in the study, and the next household would be approached. A total of 18 villages (the lowest geographical region in the country) were covered to reach the sample size. Gender and age group proportions were maintained

throughout the data collection period. Details of data collectors, training and COVID-19 safety protocols are discussed in online supplemental appendix 3.

Pilot study

A pilot study was conducted on 24 participants from the selected sampling area to check the acceptability and feasibility of the questionnaire and the average time required to fill it out. On an average, 40 min was required to fill out each questionnaire. A few minor language changes were made to the questionnaire based on the data collectors' feedback. Data collected from these 24 participants were excluded from the final analysis.

Validation of questionnaire

A structured questionnaire based on the published literature regarding KAP of COVID-19 was used to collect data,[20] which was used multiple times in different settings to assess KAP of COVID-19 among the Bangladeshi population.[21–23] However, the research team of this study measured face and content validity of the questionnaire through subjective approach.[24] As part of face validity, the research team subjectively assessed the presentation and relevance of the questionnaire as to whether the items in the questionnaire are relevant, reasonable, unambiguous and clear. The questionnaire was also assessed for content validity, which involved an extensive literature review and then followed up with evaluation by an expert panel in the current research field.

Furthermore, the existing original English version questionnaire was translated into Bangla (the local language). To ensure linguistic and conceptual equivalency, the Bangla version was again converted to English. Two bilingual translators were involved in this process. Two senior public health researchers checked and compared between the English and Bangla versions of the questionnaire, and confirmed that they stand for the same meaning. To assess the feasibility, interpretability and validity of the questionnaire, a pilot study was carried out on 24 participants, after which minor linguistic modifications were performed. For pilot data, the reliability coefficients (Cronbach's alpha) of KAP were 0.86 (high reliability), 0.53 (moderate reliability) and 0.52 (moderate reliability), respectively, and the overall Cronbach's alpha was 0.80 (high reliability).[24] Thus, the questionnaire was found to be a valid and reliable measure of KAP of COVID-19 in rural Bangladesh.

Data collection instrument

Knowledge regarding COVID-19 was assessed using 11 questions related to the main symptoms, transmission, population at risk, prevention and control and isolation/quarantine period.[20] Attitude was assessed by five questions related to the participants' confidence in the country's COVID-19 handling, trust in the government, border closure and social distancing. Practice was assessed by six questions to determine whether participants avoid going to crowded places, wear face masks while going out, regularly wash their hands and maintain social distancing. They were also asked whether they used public transport and attended big gatherings or religious festivals.

Sociodemographics were collected, including the age, gender, education level and employment status of the participants. We also collected clinical data, such as history of diabetes, cancer, cardiovascular disease, stroke, asthma, anxiety and depression. Sources of COVID-19-related knowledge and information (such as television, radio, newspaper, social media, family members, friends, neighbours and health professionals) and trust in these sources were also collected.

To maintain the quality of this study, data collection procedure was regularly monitored. Quality control of data collection, data storage and data access are described in online supplemental appendices 4 and 5. Measures of anthropometric, clinical variables and operational definitions are also provided in online supplemental appendices 6 and 7.

Outcome measures

Knowledge about COVID-19 preventive measures

To assess knowledge, 11 close-ended questions were given to participants. The options were 'yes' and 'no'. An affirmative response to one question was assigned 1 point, while a negative response was given 0. The score ranged from 0 to 11.

Attitude towards COVID-19 preventive measures

To assess attitude, participants were asked five close-ended questions with a response option of 'agree', 'disagree' and 'not sure'. The attitude score was calculated based on the respondent's answer to each statement, consisting of 0 (disagree), 1 (not sure) and 2 (agree). The total attitude score ranged from 0 to 10.

Practice of COVID-19 preventive measures

To identify practices, six close-ended questions were asked with response options of 'yes', 'no' and 'sometimes'. A score of 0 for 'no' responses, 1 for 'sometimes' and 2 for 'yes' responses was given. The total score ranged from 0 to 12.

The mean scores were calculated for KAP and were used as cut-off points to categorise the outcome variables as binary (unsatisfactory/inadequate/negative/poor or satisfactory/adequate/positive/good).[25] Participants receiving scores greater than mean scores for KAP were deemed to be adequate/positive/good and vice versa. The continuous scores were converted to percentages and reported in the results. The Cronbach's alpha of KAP was 0.60, 0.49 and 0.77, respectively, and the overall Cronbach's alpha of the KAP questions of this study was 0.67, indicating acceptable internal consistency and reliability.[26]

Statistical analysis

Data were analysed using Stata V.16 statistical package. Means and SDs were reported for numerical data, while frequencies and percentages were reported for

categorical data. The X^2 test was employed to determine the relationship between each component of KAP and the independent variables. Multiple logistic regression along with stepwise variable selection analysis was performed to find the adjusted effect of the demographic, lifestyle and clinical variables on each of the KAP components. The correlations between domains of KAP were identified using Pearson correlation analysis. Furthermore, the correlations of KAP of previous vaccinations with KAP of COVID-19 were calculated. A p value of 0.05 or less was considered statistically significant.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Demographics, clinical conditions and sources of information

A total of 1603 participants were included in this study. The mean age of the participants was 42.3±14.2 years ranging from 18 to 60 years. Of these, approximately 51% were male, majority were married (87.8%) and 42.2% had secondary level education. Nearly 45% of women were housewives. Chronic diseases or comorbidities were present in 45% of the participants, nearly two-thirds (28.3%) were hypertensive and 8% were diabetics. The prevalence of anxiety and depression was 16.2% and 18.6%, respectively. Regarding sources of COVID-19 knowledge, television was the main source of information (55.8%) followed by family members/friends/relatives/neighbours (33.3%) and social media (10.4%). Altogether, 78.2% of the participants had complete/full trust in these sources of information. Table 1 shows details of the characteristics.

Table 2 presents details of KAP regarding COVID-19. The overall correct response rate of knowledge questions was 90% with a range between 18% and 100%, and 64% of the participants had good knowledge (online supplemental table 1). The majority of the participants identified the main clinical symptoms of COVID-19 correctly (94%); knew respiratory droplets (93.4%) and direct contact with contaminated surfaces (93%) are the modes of transmission; correctly identified the population at risk of COVID-19 (98.7%); and most of the participants correctly identified the preventive measures of COVID-19, such as wearing face masks (99.4%), washing hands (99.2%), avoiding crowded places (99.1%) and isolating and treating infected persons (98.4%). However, only 66.3% and 60.1% of the participants had knowledge about asymptomatic carriers and incubation periods, respectively. In regard to overall attitude, 78% had positive attitudes towards COVID-19 (range: 10%–100%), and 64% had a good attitude (ie, scored above the mean). Nearly 93% of the participants agreed on maintaining social distance to prevent the spread of the virus. However, 26% of participants disagreed and 28.5% were

Table 1 Sociodemographics, clinical conditions of the participants and sources of information

Variables	n (%)
Demographics	
Gender	
Male	818 (51.0)
Female	785 (49.0)
Age groups	
<30 years	377 (23.5)
30–50 years	799 (49.8)
>50 years	427 (26.6)
Marital status	
Unmarried	93 (5.8)
Married	1408 (87.8)
Separated/divorced/widowed	102 (6.4)
Education level	
No formal education	439 (27.4)
Primary	409 (25.5)
Secondary	676 (42.2)
Bachelor and above	79 (4.9)
Employment status	
Employed	714 (44.5)
Unemployed	107 (6.7)
Housewife	713 (44.5)
Retired/students	69 (4.3)
Lifestyle factor	
Smoking history	
Never smoked	1187 (74.4)
Former smoker	92 (5.8)
Current smoker	316 (19.8)
Anthropometric	
BMI (kg/m^2)*	
Underweight	134 (8.3)
Normal	556 (34.7)
Overweight	591 (36.9)
Obese	322 (20.1)
Clinical conditions	
Chronic diseases	
Hypertension	453 (28.3)
Diabetes	129 (8.1)
Cardiovascular disease	69 (4.3)
Stroke	24 (1.5)
Arthritis	13 (0.8)
Cancer	2 (0.1)
Asthma	78 (4.9)
Kidney disease	7 (0.4)
Anxiety	
Present	259 (16.2)
Absent	1344 (83.8)

Continued

Table 1 Continued

Variables	n (%)
Depression	
Present	298 (18.6)
Absent	1305 (81.4)
Sources of information	
Television	895 (55.8)
Social media	166 (10.4)
Newspaper	3 (0.2)
Radio	1 (0.1)
Family members/friends/relatives/neighbours	534 (33.3)
Health professional	2 (0.1)
Other	2 (0.1)
Trust in sources of information	
Completely	1253 (78.2)
Partially	343 (21.4)
Not at all	6 (0.4)
COVID-19 vaccine acceptance	
Yes	1521 (94.9)
No	82 (5.1)
COVID-19 vaccination status	
Not vaccinated	802 (50.0)
Partially vaccinated (first dose)	543 (33.9)
Fully vaccinated (two doses)	258 (16.1)

*BMI: underweight: <18.5 kg/m^2, normal: 18.5–22.9 kg/m^2, overweight: 23.0–27.4 kg/m^2, obese: ≥27.5 kg/m^2.
BMI, body mass index.

not sure that the country will be free of the virus soon. The overall correct response rate of practice questions was 59% (range: 9%–100%). Nearly 56% of the participants had good practices. Among the respondents, 48.5% were using face masks when leaving the house and 32% were washing hands properly. Although 70.1% of the respondents did not go to any gatherings, only 39.2% were avoiding crowded places and 22.9% were always maintaining social distance. Similarly, only 20.5% of the participants were not using public transport.

Factors related to knowledge of COVID-19

Participants' knowledge scores differed significantly across gender, education levels, employment status, body mass index (BMI), anxiety, sources of COVID-19 information, trust in these sources and COVID-19 vaccination status (p<0.05; table 3). Online supplemental figure 1 showed the mean scores by age group and gender. In stepwise multiple logistic regression analysis (table 3), higher education (adjusted OR: 4.61, 95% CI: 2.40 to 8.85, p<0.001) and being employed or self-employed (adjusted OR: 1.33, 95% CI: 1.07 to 1.65, p=0.009) were associated with correct knowledge. Participants who were overweight and obese (adjusted OR: 1.30, 95% CI: 1.03 to 1.65, p=0.027 and adjusted OR: 1.44, 95% CI: 1.07 to 1.92, p=0.013, respectively) and who had complete trust in the sources of their COVID-19 knowledge (adjusted OR: 1.58, 95% CI: 1.22 to 2.05, p=0.001) also had higher odds of having correct knowledge than their counterparts.

Factors related to attitudes towards COVID-19

A significant association of attitude with gender, education level, employment status, sources of information, anxiety and depression was found (p<0.05, table 4). Women were more likely to have positive attitudes than men (adjusted OR: 1.48, 95% CI: 1.19 to 1.85, p<0.001). History of smoking (adjusted OR: 1.67, 95% CI: 1.03 to 2.71, p=0.036) and the presence of depression (adjusted OR: 1.80, 95% CI: 1.34 to 2.43, p<0.001) were associated with positive attitudes. Participants who received COVID-19 information from family members, friends, relatives, neighbours and health professionals were more likely to have positive attitudes than their counterparts (adjusted OR: 1.30, 95% CI: 1.03 to 1.64, p=0.022) (table 4).

Factors related to practices of COVID-19 preventive measures

Participants' practice scores differed across gender, education levels, employment status, smoking history, diabetes, anxiety, depression, sources of information and COVID-19 vaccination status (p<0.05, table 5). Increased age (adjusted OR: 1.52, 95% CI: 1.10 to 2.11, p=0.011), higher education (bachelor and above, adjusted OR: 2.78, 95% CI: 1.58 to 4.89, p<0.001) and the presence of anxiety (adjusted OR: 1.82, 95% CI: 1.35 to 2.45, p<0.001) were associated with good practices. On the other hand, being current smokers and fully vaccinated reduced the likelihood of having good practice by 56% and 44%, respectively (table 5).

Correlation among components of KAP and with past vaccinations KAP

Knowledge and attitude (r=0.115), knowledge and practice (r=0.108), attitude and practice (r=0.106) of COVID-19 showed positive correlations (p<0.001). Further correlation analysis between KAP of COVID-19 and KAP of past vaccinations also showed positive correlations (p<0.001) between knowledge of past vaccinations and knowledge of COVID-19 (r=0.190), knowledge of past vaccinations and practice of COVID-19 preventive behaviours (r=0.195), and practice of past vaccinations and practice of COVID-19 preventive behaviours (r=0.134) (online supplemental table 2).

DISCUSSION

The current study assessed the levels and associations of KAP regarding COVID-19 in the rural Bangladeshi population. Our study results show that participants had adequate knowledge and positive attitudes towards COVID-19. However, we found gaps in their understanding and practices in key preventive measures, such

Table 2 Knowledge, attitudes and practices of COVID-19 among people living in rural Bangladesh

Outcome variables	Yes/agree n (%)	No/disagree n (%)	Not sure/ sometimes n (%)
Knowledge			
K1. Do you know the main clinical symptoms of COVID-19?	1507 (94.0)	96 (6.0)	–
K2. Do you think that COVID-19 can spread via respiratory droplets?	1496 (93.4)	106 (6.6)	–
K3. Do you think that the transmission can be through direct contact with contaminated surfaces through eyes, nose and mouth?	1491 (93.0)	112 (7.0)	–
K4. Do you know whether persons with COVID-19, but no symptoms, can spread the virus to others?	1062 (66.3)	541 (33.8)	–
K5. Do you think that people who have chronic illnesses such as heart, lung disease or kidney diseases, diabetes and elderly are more likely to be severe cases, if infected with COVID-19?	1582 (98.7)	21 (1.3)	–
K6. Do you think that children and young adults can get COVID-19?	1408 (87.9)	194 (12.1)	–
K7. Do you think that to prevent the infection by COVID-19, individuals should avoid going to crowded places (such as bazaar, hut, mosque, visiting relatives, etc) and avoid taking public transportation?	1588 (99.1)	15 (0.9)	–
K8. Do you think that everyone should wear face masks to prevent the infection from COVID-19?	1591 (99.4)	10 (0.6)	–
K9. Do you think that isolation and treatment of people who are infected with COVID-19 are effective ways to reduce the spread of the virus?	1574 (98.4)	26 (1.6)	–
K10. Do you think that washing hands with soap frequently or using hand sanitiser can prevent the infection?	1589 (99.2)	13 (0.8)	–
K11. Do you think that people may have COVID-19 without developing the symptoms for 1–14 days?	962 (60.1)	640 (39.9)	–
Attitude			
A1. Do you have confidence that Bangladesh will be free of COVID-19 soon?	730 (45.6)	415 (25.9)	456 (28.5)
A2. Do you agree that the government is handling the COVID-19 health crisis very well?	1432 (89.4)	91 (5.7)	79 (4.9)
A3. Do you agree that Bangladesh should close its borders (land as well as air) with other countries that have an outbreak of COVID-19?	1161 (72.5)	300 (18.7)	141 (8.8)
A4. Do you agree with the country lockdown to combat COVID-19?	989 (61.7)	504 (31.4)	110 (6.9)
A5. Do you agree that it is important to keep your distance 5 feet (at least 3.5 HATH) from others, to avoid spreading infection?	1484 (92.8)	32 (2.0)	83 (5.2)
Practices			
P1. Do you avoid going to crowded places such as weddings/social events/hat/bazaar/ etc?	629 (39.2)	512 (31.9)	462 (28.8)
P2. Do you wear a face mask whenever you leave home?	777 (48.5)	232 (14.5)	594 (37.1)
P3. Do you practise proper hand hygiene by frequently washing your hands or using hand sanitiser?	513 (32.0)	240 (15.0)	849 (53.0)
P4. Have you been practising social distancing/maintaining 5 feet (at least 3.5 HATH) distance from other people (including neighbours) while outside?	367 (22.9)	630 (39.4)	604 (37.7)
P5. Do you take public transport during the COVID-19 pandemic (eg, bus, auto rickshaw, van, etc)?	728 (45.4)	328 (20.5)	546 (34.1)
P6. Have you attended any big gathering recently (including a hat, bazaar, shopping mall)?	479 (29.9)	1124 (70.1)	–

as in avoiding crowded places and washing hands. Despite having good knowledge and attitudes, the rural people were less likely to report engaging in good practices in order to reduce their risk of infection or in spreading COVID-19.

The average knowledge score across the rural population in Bangladesh was good, with an overall correct response rate of 90%. Given the limited community-based studies published in Bangladesh using offline data collection methods, we compared our findings with online surveys. The knowledge level of the current study participants was higher than that of other studies conducted in Bangladesh.[21 22] The current study was conducted nearly 18 months after the first appearance of COVID-19, during which time people would have been able to discern and gather information. However, the range of correct response rates for COVID-19 knowledge was very wide (from 18% to 100%), indicating that while some participants had considerable knowledge on the disease, others did not. Although participants had good

Table 3 Factors (unadjusted and adjusted) associated with knowledge of COVID-19

Variables	Good, n (%)	Poor, n (%)	P value**	Unadjusted OR (95% CI)	P value**	Adjusted OR (95% CI)*	P value**
Demographics							
Gender							
Male (ref)	545 (66.6)	273 (33.4)	0.088				
Female	491 (62.6)	294 (37.4)		0.84 (0.68 to 1.03)	0.088	–	–
Age group							
<30 years (ref)	250 (66.3)	127 (33.7)	0.403				
30–50 years	521 (65.2)	278 (34.8)		0.95 (0.74 to 1.23)	0.709	–	–
>50 years	265 (62.1)	162 (37.9)		0.83 (0.62 to 1.11)	0.210	–	–
Marital status							
Unmarried (ref)	63 (67.7)	30 (32.3)	0.781				
Married	906 (64.3)	502 (35.7)		0.86 (0.55 to 1.35)	0.508	–	–
Separated/divorced/widowed	67 (65.7)	35 (34.3)		0.91 (0.50 to 1.66)	0.761	–	–
Education level							
No formal education (ref)	263 (59.9)	176 (40.1)	**<0.001**				
Primary	255 (62.3)	154 (37.7)		1.11 (0.84 to 1.46)	0.467	–	–
Secondary	451 (66.7)	225 (33.3)		**1.34 (1.05 to 1.72)**	**0.021**	**1.33 (1.07 to 1.66)**	**0.009**
Bachelor and above	67 (84.8)	12 (15.2)		**3.74 (1.96 to 7.11)**	**<0.001**	**4.61 (2.40 to 8.85)**	**<0.001**
Employment status							
Unemployed (ref)	60 (56.1)	47 (43.9)	0.066				
Employed/self-employed	478 (67.0)	236 (33.0)		**1.59 (1.05 to 2.40)**	**0.028**	**1.33 (1.07 to 1.65)**	**0.009**
Housewives	449 (63.0)	264 (37.0)		1.33 (0.88 to 2.01)	0.171	–	–
Retired/students	49 (71.0)	20 (29.0)		**1.92 (1.01 to 3.66)**	**0.048**	–	–
Lifestyle factor							
Smoking history							
Never smoked (ref)	759 (63.9)	428 (36.1)	0.578				
Past smoker	60 (65.2)	32 (34.8)		1.06 (0.68 to 1.65)	0.806	–	–
Current smoker	212 (67.1)	104 (32.9)		1.15 (0.88 to 1.50)	0.229	–	–
Anthropometric							
BMI (kg/m^2)†							
Normal (ref)	343 (61.7)	213 (38.3)	**0.038**				
Underweight	77 (57.5)	57 (42.5))		0.84 (0.57 to 1.23)	0.368	–	–
Overweight	397 (67.2)	194 (32.8)		**1.27 (1.00 to 1.62)**	**0.053**	**1.30 (1.03 to 1.65)**	**0.027**

Continued

Table 3 Continued

Variables	Good, n (%)	Poor, n (%)	P value**	Unadjusted OR (95% CI)	P value**	Adjusted OR (95% CI)*	P value**
Obese	219 (68.0)	103 (32.0)		1.32 (0.99 to 1.76)	0.060	**1.44 (1.07 to 1.92)**	**0.013**
Clinical condition							
Hypertension							
Absent (ref)	727 (64.2)	406 (35.8)	0.305				
Present	303 (66.9)	150 (33.1)		1.13 (0.90 to 1.42)	0.305	–	–
Diabetes							
Absent (ref)	951 (64.5)	523 (35.5)	0.754				
Present	85 (65.9)	44 (34.1)		1.06 (0.73 to 1.55)	0.754	–	–
Anxiety							
Absent (ref)	881 (65.6)	463 (34.4)	0.079				
Present	155 (59.9)	104 (40.1)		0.78 (0.60 to 1.03)	0.079	–	–
Depression							
Absent (ref)	852 (65.3)	453 (34.7)	0.249				
Present	184 (61.7)	114 (38.3)		0.86 (0.66 to 1.11)	0.249	–	–
Other chronic diseases‡							
Absent (ref)	885 (64.1)	495 (35.9)	0.299				
Present	151 (67.7)	72 (32.3)		1.17 (0.87 to 1.59)	0.300	–	–
Sources of information							
Television/radio/newspaper (ref)	591 (66.0)	304 (34.0)	**0.020**				
Social media	117 (70.5)	49 (29.5)		1.23 (0.86 to 1.76)	0.264	–	–
Family members/friends/relatives/neighbours/health professional	324 (60.2)	214 (39.8)		**0.78 (0.62 to 0.97)**	**0.027**	–	–
Trust in sources of information							
Partially/not at all (ref)	210 (60.0)	140 (40.0)	**0.041**				
Completely	826 (65.9)	427 (34.1)		**1.29 (1.01 to 1.65)**	**0.041**	**1.58 (1.22 to 2.05)**	**0.001**
COVID-19 vaccination status							
Not vaccinated (ref)	499 (62.3)	302 (37.7)	0.087				
Partially vaccinated (first dose)	180 (69.5)	79 (30.5)		**1.38 (1.02 to 1.86)**	**0.036**	–	–
Fully vaccinated (two doses)	357 (65.8)	186 (34.2)		1.16 (0.93 to 1.46)	0.197	–	–

**p value of 0.05 considered as significant and bolded.
*Stepwise multiple logistic regression.
†BMI: underweight: <18.5 kg/m^2, normal: 18.5–22.9 kg/m^2, overweight: 23.0–27.4 kg/m^2, obese: ≥27.5 kg/m^2.
‡Other chronic diseases: cardiovascular disease, stroke, arthritis, asthma, cancer, kidney disease.
BMI, body mass index.

Table 4 Factors (unadjusted and adjusted) associated with attitudes towards COVID-19

Variables	Positive, n (%)	Negative, n (%)	P value**	Unadjusted OR (95% CI)	P value**	Adjusted OR (95% CI)*	P value**
Demographics							
Gender							
Male (ref)	483 (59.1)	335 (40.9)	**<0.001**				
Female	545 (69.4)	240 (30.6)		**1.58 (1.28 to 1.94)**	**<0.001**	**1.48 (1.19 to 1.85)**	**<0.001**
Age group							
<30 years (ref)	233 (61.8)	144 (38.2)	0.377				
30–50 years	511 (64.0)	288 (36.0)		1.10 (0.85 to 1.41)	0.475	–	–
>50 years	284 (66.5)	143 (33.5)		1.23 (0.92 to 1.64)	0.165	–	–
Marital status							
Unmarried (ref)	54 (58.1)	39 (41.9)	0.303				
Married	904 (64.2)	504 (35.8)		1.30 (0.85 to 1.98)	0.234	–	–
Separated/divorced/widowed	70 (68.6)	32 (31.4)		1.58 (0.88 to 2.84)	0.127	–	–
Education level							
No formal education (ref)	304 (69.2)	135 (30.8)	b0.072				
Primary	252 (61.6)	157 (38.4)		**0.71 (0.54 to 0.95)**	**0.020**	–	–
Secondary	423 (62.6)	253 (37.4)		0.74 (0.57 to 0.96)	**0.022**	–	–
Bachelor and above	49 (62.0)	30 (38.0)		0.73 (0.44 to 1.19)	0.206	–	–
Employment status							
Unemployed (ref)	68 (63.6)	39 (36.4)	**0.003**				
Employed/self-employed	433 (60.6)	281 (39.4)		0.88 (0.58 to 1.35)	0.565		
Housewives	490 (68.7)	223 (31.3)		1.26 (0.82 to 1.93)	0.285	–	–
Retired/students	37 (53.6)	32 (46.4)		0.66 (0.36 to 1.23)	0.191	–	–
Lifestyle factor							
Smoking history							
Never smoked (ref)	769 (64.8)	418 (35.2)	0.127				
Past smoker	65 (70.7)	27 (29.3)		1.31 (0.82 to 2.08)	0.256	**1.67 (1.03 to 2.71)**	**0.036**
Current smoker	190 (60.1)	126 (39.9)		0.82 (0.64 to 1.06)	0.126	–	–
Anthropometric							
BMI (kg/m^2)†							
Normal (ref)	352 (63.3)	204 (36.7)	0.830				
Underweight	83 (61.9)	51 (38.1)		0.94 (0.64 to 1.39)	0.768	–	–
Overweight	381 (64.5)	210 (35.5)		1.05 (0.83 to 1.34)	0.683	–	–

Continued

Table 4 Continued

Variables	Positive, n (%)	Negative, n (%)	P value**	Unadjusted OR (95% CI)	P value**	Adjusted OR (95% CI)*	P value**
Obese	212 (65.8)	110 (34.2)		1.12 (0.84 to 1.49)	0.451	–	–
Clinical condition							
Hypertension							
Absent (ref)	725 (64.0)	408 (36.0)	0.732				
Present	294 (64.9)	159 (35.1)		1.04 (0.83 to 1.31)	0.732	–	–
Diabetes							
Absent (ref)	943 (64.0)	531 (36.0)	0.664				
Present	85 (65.9)	44 (34.1)		1.09 (0.74 to 1.59)	0.664	–	–
Anxiety							
Absent (ref)	842 (62.7)	502 (37.3)	**0.005**				
Present	186 (71.8)	73 (28.2)		**1.52 (1.13 to 2.03)**	**0.005**	–	–
Depression							
Absent (ref)	801 (61.4)	504 (38.6)	**<0.001**				
Present	227 (76.2)	71 (23.8)		**2.01 (1.51 to 2.69)**	**<0.001**	**1.80 (1.34 to 2.43)**	**<0.001**
Other chronic diseases‡							
Absent (ref)	892 (64.6)	488 (35.4)	0.292				
Present	136 (61.0)	87 (39.0)		0.86 (0.64 to 1.14)	0.292	–	–
Sources of information							
Television/radio/newspaper (ref)	551 (61.6)	344 (38.4)	**0.011**				
Social media	102 (61.4)	64 (38.6)		1.00 (0.71 to 1.40)	0.977	–	–
Family members/friends/relatives/neighbours/health professional	372 (69.1)	166 (30.9)		**1.40 (1.11 to 1.76)**	**0.004**	**1.30 (1.03 to 1.64)**	**0.022**
Trust in sources of information							
Partially/not at all (ref)	217 (62.0)	133 (38.0)	0.347				
Completely	811 (64.7)	442 (35.3)		1.12 (0.88 to 1.44)	0.348	–	–
COVID-19 vaccination status							
Not vaccinated (ref)	501 (62.6)	300 (37.4)	0.336				
Partially vaccinated (first dose)	166 (64.1)	93 (35.9)		1.07 (0.80 to 1.43)	0.654	–	–
Fully vaccinated (two doses)	361 (66.5)	182 (33.5)		1.19 (0.95 to 1.49)	0.140	–	–

** p value of 0.05 considered as significant and bolded.
*Stepwise multiple logistic regression.
†BMI: underweight: <18.5 kg/m^2, normal: 18.5–22.9 kg/m^2, overweight: 23.0–27.4 kg/m^2, obese: ≥27.5 kg/m^2.
‡Other chronic diseases: cardiovascular disease, stroke, arthritis, asthma, cancer, kidney disease.
BMI, body mass index.

Table 5 Factors (unadjusted and adjusted) associated with practices of COVID-19 preventive measures

Variables	Good, n (%)	Poor, n (%)	P value**	Unadjusted OR (95% CI)	P value**	Adjusted OR (95% CI)*	P value**
Demographics							
Gender							
Male (ref)	428 (52.3)	390 (47.7)	**0.004**				
Female	467 (59.5)	318 (40.5)		**1.34 (1.10 to 1.63)**	**0.004**	–	–
Age group							
<30 years (ref)	214 (56.8)	163 (43.2)	0.895				
30–50 years	442 (55.3)	357 (44.7)		0.94 (0.74 to 1.21)	0.642	**1.36 (1.03 to 1.80)**	**0.029**
>50 years	239 (56.0)	188 (44.0)		0.97 (0.73 to 1.28)	0.821	**1.52 (1.10 to 2.11)**	**0.011**
Marital status							
Unmarried (ref)	51 (54.8)	42 (45.2)	0.577				
Married	782 (55.5)	626 (44.5)		1.03 (0.67 to 1.57)	0.895	–	–
Separated/divorced/widowed	62 (60.8)	40 (39.2)		1.28 (0.72 to 2.26)	0.401	–	–
Education level							
No formal education (ref)	208 (47.4)	231 (52.6)	**<0.001**				
Primary	225 (55.0)	184 (45.0)		**1.36 (1.04 to 1.78)**	**0.026**	**1.37 (1.03 to 1.82)**	**0.030**
Secondary	406 (60.1)	270 (39.9)		**1.67 (1.31 to 2.13)**	**<0.001**	**1.72 (1.31 to 2.27)**	**<0.001**
Bachelor and above	56 (70.9)	23 (29.1)		**2.70 (1.61 to 4.55)**	**<0.001**	**2.78 (1.58 to 4.89)**	**<0.001**
Employment status							
Unemployed (ref)	60 (56.1)	47 (43.9)	**0.040**				
Employed/self-employed	371 (52.0)	343 (48.0)		0.85 (0.56 to 1.28)	0.427	–	–
Housewives	424 (59.5)	289 (40.5)		1.15 (0.76 to 1.73)	0.506	–	–
Retired/students	40 (58.0)	29 (42.0)		1.08 (0.59 to 1.99)	0.804	–	–
Lifestyle factor							
Smoking history							
Never smoked (ref)	705 (59.4)	482 (40.6)	**<0.001**				
Past smoker	47 (51.1)	45 (48.9)		0.71 (0.47 to 1.09)	0.120	–	–
Current smoker	139 (44.0)	177 (56.0)		**0.54 (0.42 to 0.69)**	**<0.001**	**0.56 (0.43 to 0.73)**	**<0.001**
Anthropometric							
BMI (kg/m^2)†							
Normal (ref)	303 (54.5)	253 (45.5)	0.229				
Underweight	74 (55.2)	60 (44.8)		1.03 (0.70 to 1.50)	0.879	–	–
Overweight	323 (54.7)	268 (45.3)		1.01 (0.80 to 1.27)	0.958	–	–
Obese	195 (60.6)	127 (39.4)		1.28 (0.97 to 1.69)	0.081	–	–

Continued

Table 5 Continued

Variables	Good, n (%)	Poor, n (%)	P value**	Unadjusted OR (95% CI)	P value**	Adjusted OR (95% CI)*	P value**
Clinical condition							
Hypertension							
Absent (ref)	626 (55.2)	507 (44.8)	0.707				
Present	255 (56.3)	198 (43.7)		1.04 (0.84 to 1.30)	0.707	–	–
Diabetes							
Absent (ref)	811 (55.0)	663 (45.0)	**0.027**				
Present	84 (65.1)	45 (34.9)		**1.53 (1.05 to 2.22)**	**0.028**	–	–
Anxiety							
Absent (ref)	718 (53.4)	626 (46.6)	**<0.001**				
Present	177 (68.3)	82 (31.7)		1.88 (1.42 to 2.50)	**<0.001**	**1.82 (1.35 to 2.45)**	**<0.001**
Depression							
Absent (ref)	697 (53.4)	608 (46.6)	**<0.001**				
Present	198 (66.4)	100 (33.6)		**1.73 (1.33 to 2.25)**	**<0.001**	–	–
Other chronic diseases‡							
Absent (ref)	766 (55.5)	614 (44.5)	0.514				
Present	129 (57.9)	94 (42.1)		1.10 (0.83 to 1.46)	0.514	–	–
Sources of information							
Television/radio/newspaper (ref)	524 (58.6)	371 (41.4)	**0.043**				
Social media	90 (54.2)	76 (45.8)		0.84 (0.60 to 1.17)	0.300	–	–
Family members/friends/relatives/neighbours/health professional	279 (51.9)	259 (48.1)		**0.76 (0.62 to 0.95)**	**0.014**	–	–
Trust in sources of information							
Partially/not at all (ref)	199 (56.9)	151 (43.1)	0.662				
Completely	696 (55.6)	557 (44.4)		0.95 (0.75 to 1.20)	0.663	–	–
COVID-19 vaccination status							
Not vaccinated (ref)	495 (61.8)	306 (38.2)	**<0.001**				
Partially vaccinated (first dose)	165 (63.7)	94 (36.3)		1.09 (0.81 to 1.45)	0.582	–	–
Fully vaccinated (two doses)	235 (43.3)	308 (56.7)		**0.47 (0.38 to 0.59)**	**<0.001**	**0.44 (0.36 to 0.55)**	**<0.001**

** p value of 0.05 considered as significant and bolded.
*Stepwise multiple logistic regression.
†BMI: underweight: <18.5 kg/m^2, normal: 18.5–22.9 kg/m^2, overweight: 23.0–27.4 kg/m^2, obese: ≥27.5 kg/m^2.
‡Other chronic diseases: cardiovascular disease, stroke, arthritis, asthma, cancer, kidney disease.
BMI, body mass index.

knowledge of symptoms, transmission and preventive measures, they had inadequate knowledge on asymptomatic patients who can spread the virus and on the incubation period of the disease, which might increase their risk of contracting and spreading the infection. Participants with secondary, bachelor and higher education had greater knowledge scores than those with no formal education, while employed/self-employed participants had more knowledge than other categories of participants. A meta-analysis on KAP among the general population also reported an association of knowledge with educational attainment and employment, where unemployed people and people with low education levels reflected poor levels of knowledge.[27] Indeed, knowledge acquisition is often dependent on a person's socioeconomic status, cognitive abilities and prior knowledge.[28 29] In the current study, overweight and obese participants were found to have more knowledge than others. Like other chronic diseases, obese and overweight people may consider themselves more vulnerable to COVID-19 and thus have acquired more knowledge than others. Evidence shows a relationship between high BMI and the development of severe complications following COVID-19.[30] A meta-analysis also reported the linking mechanism between obesity and the severity of the disease, increased hospitalisation, intensive care unit admission, morbidity and mortality.[31] Finally, the findings of our study showed that television was the main source of COVID-19 information, followed by family members, relatives, friends and neighbours, while participants who had complete trust in their sources had greater knowledge than those with partial or no trust. A study conducted among slum dwellers in Bangladesh also reported television as the main source of COVID-19 knowledge,[32] while another study conducted through online surveys found social media platforms like Facebook to be the main source of information.[21] In rural areas, where there is limited access to the internet and a lack of familiarity with modern technology, the use of social media is more restricted, and most of the older adults still rely on television as their main source of recreation and information.

Overall, 78% of the participants had positive attitudes towards COVID-19. Most of the participants (92.8%) agreed that maintaining physical distance can prevent the spread of the infection. A high level of positive attitudes towards COVID-19 was also reported in other studies conducted in Bangladesh.[21 22] Women, past smokers, those with depression and people who received COVID-19 information from family members, friends, relatives, neighbours and health professionals were more likely to report positive attitudes towards COVID-19. This is similar to the findings reported in a previous study.[33]

Beyond knowledge and attitudes, the practice scores of the current study were comparatively poor, indicating a gap in the translation of knowledge into practice. For example, 99.1% of participants knew that avoiding crowded places and public transport helps to prevent the spread of the infection, but only 39.2% and 20.5% of them, respectively, were practising it. In terms of frequent hand washing, although 99.2% participants had the knowledge, only 32% were frequently practising it and 53% were doing it sometimes. Likewise, 92.8% of participants agreed on the importance of maintaining social distancing, but only 22.9% applied it to everyday practice. Previous research also revealed a significant gap between people's intentions and their health behaviour, which resulted in only half of their intentions being translated into practice.[34] Efficacy belief may also have an impact on practising preventive measures. Indeed, knowledge and efficacy belief act together to promote preventive behaviours. This means that after acquiring knowledge regarding preventive measures, people need to believe that these measures would be effective in preventing the spread of the infection.[35] In the current study, participants aged 30 years or more and who were educated (primary/secondary/bachelor and above) were more likely to adopt and practise the preventive behaviours than those without formal education. Similar age and education differences were found in previous studies.[21 36] In this study, current smokers were less likely to engage in preventive measures, which contrasted with the finding of another study conducted in Bangladesh.[36] We also found that fully vaccinated participants were less likely to practise preventive measures—an alarming discovery, considering breakthrough infections can still occur and highly contagious variants have continued to spread across the globe, spurring fresh outbreaks. Vaccinated people might have inadequate information regarding the efficacy and effectiveness of vaccines against the virus and its variants. As a result, they might feel safe from the infection, and thus less likely to engage in preventive behaviours. This study also found that participants with anxiety were more likely to practise preventive measures than those without it, which is similar to the findings of a previous study conducted in Taiwan.[37] This could be due to the fact that severe anxiety levels have detrimental health impacts, while a moderate level of anxiety can perhaps encourage people to adopt preventive practices.[37]

In this study, we found a significantly positive but weak correlation between components of KAP, which reaffirms the relationship between knowledge, attitudes and practices with infection or disease control measures. We also found a very weak positive correlation between participants' prior knowledge and practice of vaccination measures for other diseases with current knowledge and practice towards COVID-19. Evidence supports this relationship of prior knowledge with the current knowledge in similar areas.[38]

Limitations and implications

Several limitations of this study should be acknowledged. First, our study did not explore additional factors associated with COVID-19 preventive behaviours, such as barriers (cultural/religious/financial) that might affect people adopting and practising them. Second, we did not examine the influence that efficacy belief and risk

perceptions may have in adopting preventive measures. Third, we did not examine each question's effect, and instead used the mean scores of individual components of KAP in the analysis. Finally, as this is a cross-sectional study, causal inferences cannot be drawn between significant factors and KAP levels. Despite these limitations, however, this is, to our knowledge, the first KAP study on the rural population in Bangladesh, which could provide insights into the KAP level among this population and assist health authorities to develop context-specific strategies and implement preventive protocols in rural areas in Bangladesh. Moreover, this study will also be useful to other countries with limited resources and similar sociodemographics to Bangladesh. In future studies, however, it is recommended that efficacy belief, risk perceptions, observation of individual involvement in practices and a qualitative assessment of barriers be considered.

CONCLUSION

After 2years following the onset of the COVID-19 pandemic, people in rural Bangladesh demonstrate adequate knowledge and attitudes towards COVID-19 but dissatisfactory levels of practice. To combat the emerging variants, continue with vaccination rollouts and other efforts to end the pandemic, updated knowledge regarding COVID-19 and its preventive practices can help people to manage the disease and protect those most vulnerable. This study identified gaps between the understanding and translation of knowledge of COVID-19 into common practice among people in rural Bangladesh. This suggests an urgent need to promote evidence-based health literacy for the young and less educated population, which could be achieved by introducing mass media outlets (such as televisions) throughout this rural setting.

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Contributors BNS, BB, AA and FS conceived of and designed the study together with AS, LA and SMA. BNS, FS, AS, OB and HAC did the questionnaire formulation, validation and translation. MRKC and MSI did the data curation. BNS, AA, MRKC and MNH did the analysis and interpretation. BB and LA supervised the study. BB was the guarantor. BNS drafted the manuscript. All authors contributed to reviewing the manuscript and approved it for publication.

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Ethics approval This study was conducted following the ethics approval granted by the Monash University Human Research Ethics Committee (project ID 29358), and approval was also received from the respective authorities in Bangladesh. All study procedures were carried out in accordance with the principles of the Declaration of Helsinki, as revised in 2013. Before the interview, the data collectors informed each participant of the purpose and procedure of the study, their voluntary participation and the confidentiality and use of the collected information. An explanatory statement was provided to the eligible and consenting participants, and any further queries from the participants were addressed. For individuals with inadequate or no literacy, the information sheet was read out by the data collectors. Written informed consent was then obtained from each participant.

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