



BMJ Open Knowledge and practices related to COVID-19 among mothers of under-2 children and adult males: a cross-sectional study in Bangladesh

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ABSTRACT

Objectives To assess the knowledge and practices related to COVID-19 among Bangladeshi mothers with children aged 2 years or less and adult males.

Design We conducted a cross-sectional study to assess the knowledge and practices using a multistage cluster sampling technique.

Settings Six districts with high COVID-19 infection rates in Bangladesh.

Participants 2185 mothers of under-2 children and 657 adult males were surveyed in December 2020.

Main outcome measures We constructed weighted composite knowledge and practice scores and examined associations between composite scores and background characteristics using linear regression models.

Results Knowledge on possible routes of transmission of the novel coronavirus and the critical handwashing and mask-wearing etiquettes was poor. On a scale of 100, the mean composite knowledge scores of mothers and adult males were respectively 33.5 (SD=15; 95% CI 32.9 to 34.1) and 38.2 (SD=14.8; 95% CI 37.1 to 39.4). In contrast to knowledge, adult males obtained lower practice scores than mothers, primarily due to poor physical distancing practices. The mean practice scores of mothers and adult males were 63.0 (SD=18.1; 95% CI 62.3 to 63.8) and 53.4 (SD=17.5; 95% CI 52.0 to 54.7). Moreover, education, household income and access to television and the internet are significantly associated with knowledge. People residing proximal to a city revealed higher knowledge than the relatively distant ones. This was also the case for practice scores; however, the other factors associated with knowledge did not have a significant association with practices.

Conclusions In general, both mothers and adult males presented with poor knowledge and practices related to COVID-19. While local, national and international institutions should design and implement educational interventions to help improve knowledge, our research shows that mere knowledge may not be enough to ensure practice. Hence, authorities could reinforce positive social norms by setting benchmarks and introducing rewards or sanctions to improve practices.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ To the best of our knowledge, this is the first study that assessed knowledge and practices related to COVID-19 among mothers of under-2 children in Bangladesh.
- ⇒ The study was conducted in districts with high infection rates; hence, understanding knowledge and practices related to COVID-19 can guide formulate policies tailored to high-infection settings.
- ⇒ Due to its cross-sectional nature, the study can not infer any causal association.
- ⇒ Practices were assessed through self-reports instead of observations.

INTRODUCTION

The COVID-19 pandemic has been the most disastrous global health crisis since the 1918 influenza pandemic. COVID-19 is a respiratory illness caused by a highly contagious SARS-CoV-2, also known as the novel coronavirus.¹ The SARS-CoV-2 primarily transmits from one person to another through respiratory droplets, usually produced while coughing and sneezing; however, an indirect form of transmission through contact with contaminated surfaces has also been reported.²⁻⁴ As of September 2021, globally, the total number of confirmed COVID-19 cases was reportedly just over 231 million, and the number of deaths has exceeded 4.7 million.⁵ Bangladesh currently stands among the top 29 of the worst hit countries by COVID-19 in terms of the number of test-positive cases, which accounts for around 0.67% of the COVID-19 cases of the world.⁶ Since its first appearance in Bangladesh in March 2020, COVID-19 has so far affected around 1551351 people and has reportedly caused around 27414 deaths in this country as of September 2021.⁶

Although the transmission dynamics of the SARS-CoV-2 makes it challenging to prevent its transmission,⁷ a few measures have been recommended to contain it, such as frequent handwashing with soap, wearing face masks, avoiding mass gatherings, maintaining a safe physical distance and imposing movement restrictions.^{8,9} Enforcement of lockdown in the affected areas is considered an effective strategy to delay or curb the transmission rate; however, prolonged lockdowns disproportionately affect the disadvantaged groups in resource-poor settings, especially where a significant part of the community depends on daily wages for survival.⁹ Like many other countries, Bangladesh has been in and out of nationwide lockdown at different stages of the pandemic.^{8 10–12} However, as the restrictions were relaxed after the infection rate had gone down, people went back to their old habits and showed reluctance in following the protective measures.¹¹ Additionally, the challenge to flatten Bangladesh's rapidly growing infection curve has increased by manifolds due to its high population density, lack of preparedness and awareness, and diffusion of misinformation regarding COVID-19 among the general population.^{10 12–14}

To combat the pandemic, Bangladesh started mass vaccination against COVID-19 across the country in February 2021^{15 16}; however, the campaign was not rolled out massively enough to vaccinate a good majority of the population anytime soon; for instance, as of September 2021, just above 10% of the Bangladeshis reportedly received at least one dose of the vaccines, whereas the proportion having been fully vaccinated was much lesser.¹⁷ Besides, evidence suggests that a large proportion of the population has vaccine hesitancy.^{14 15} Consequently, controlling the pandemic is largely reliant on people's adherence to the recommended preventive measures, which are primarily decided by their knowledge, attitude and practices towards COVID-19.^{18–22} Prior research suggests that knowledge and practices regarding COVID-19 vary across demographic and socioeconomic factors, such as sex, age, occupation, education, income and place of residence.^{18 23} Interestingly, the source of information related to COVID-19 is also found to be highly associated with knowledge and practices relevant to it.^{24 25} The risk of transmission multiplies with the lack of appropriate knowledge, negative attitudes and dangerous practices.²⁶ Practices of the recommended preventive measures, such as maintaining personal hygiene and safe physical distancing, are associated with a dramatic reduction in morbidity and mortality due to COVID-19.^{20 27 28}

Hence, knowledge and practices about COVID-19 are crucial in determining compliance to the behavioural change measures.¹⁹ Surveys and systematic reviews on knowledge and practices played an important role in controlling the transmission of swine influenza in 2009.^{29 30} It also helps understand the specific needs of a community and guides health authorities to act accordingly. Therefore, the lack of a coordinated response to battle the pandemic in Bangladesh^{10 13} warrants a further need to thoroughly assess the knowledge and practices

regarding COVID-19. In this research, we assessed knowledge and practice statuses and associated factors among the mothers with children under 2 years of age and the adult males in six districts of Bangladesh. We considered mothers of children under 2 as our population of interest because the well-being of a child in the first 2 years is mostly reliant on their mothers' knowledge and practices.³¹ Any shortcoming in postnatal growth in infancy could lead to deleterious health consequences in adult life.³² Moreover, we approached adult males from the same households as mothers to have a gender-specific comparison of knowledge and practices of COVID-19.

METHODS

Sampling

We carried out a cross-sectional study in December 2020 as part of a BRAC programme evaluation initiative in six districts, namely Narayanganj, Kishoreganj, Sherpur, Bogura, Bagerhat and Bhola. Among them, the study sites in Sherpur and Bhola consisted of more hard-to-reach areas; hence, they were less equipped with infrastructural capacities. However, the districts represented five of the eight divisions of Bangladesh. The sites were selected by the programme based on the rate of COVID-19 infection, healthcare service utilisation and its operational feasibility.

The present study was part of a broader research project, which aimed to evaluate the effects of a community-based COVID-19 response programme on the utilisation of maternal, neonatal and child health (MNCH) services. Hence, the primary population of interest of this study was mothers of children aged 2 years or less. Among the MNCH service indicators, the postnatal care service uptake within 2 days following delivery (ie, 52% at baseline³³) was used to estimate the sample size. With an effect size of 10%, 80% power of the test and 5% level of statistical significance, the estimated sample size was 300 households (per district), which later increased to 400 households considering a design effect of 1.2% and 10% non-response rate. The total sample size was 2400 households for six districts.

To recruit the study households, we employed a multi-stage cluster sampling technique considering each village a cluster. The 2400 households represented 96 clusters which were proportionately selected from the six districts according to their sizes (ie, number of households residing in that district). Three subdistricts were randomly selected from each district, followed by four randomly selected unions from each subdistrict. Then, based on the proportional allocation, we randomly selected the required number of villages (ie, clusters) from each union. Finally, 25 households meeting the inclusion criteria (ie, having a mother of children aged 2 years or less) were selected from each village using a systematic random sampling technique. Following the procedures, we interviewed 2185 consenting mothers face to face using a structured questionnaire. Based on

availability, we also interviewed 657 adult males using the identical questionnaire.

Data collection

The questionnaire was constructed based on guidelines for COVID-19 infection prevention, precautions and management proposed by the Centers for Disease Control and Prevention (CDC)³⁴ and the WHO.³⁵ Previous studies used similar questions to assess knowledge and practices related to COVID-19.^{22 36 37} Initially, we developed an exhaustive list of questions and shared it with the relevant subject matter experts. Based on the expert reviews we revised the tool. Then, it was pretested on a different subset of the same study population to check for the clarity of the questions and adjust those with the sociocultural context of Bangladesh. The domain of knowledge comprised questions on the transmission of the novel coronavirus and symptoms, management and prevention of COVID-19, whereas self-reported practices were assessed with regard to three key preventive measures: (a) handwashing, (b) use of a face mask, and (c) physical distancing. Along with questions on knowledge and practices related to COVID-19, we enquired the participants about their demographic and socioeconomic features. Moreover, the respondents were asked about the sources of information they received on the three preventive measures—handwashing, mask use and physical distancing. A team of 44 trained surveyors collected the data using SurveyCTO version 2.70. We also revisited 5% of the surveyed households to cross-check the data.

Patient and public involvement

No patient or public was involved in the design, or conduct, or reporting, or dissemination plans of our research.

Data analysis

Scoring knowledge and practices

We constructed composite knowledge and practice scores by aggregating the number of correct responses. A total of eight questions were asked to assess a participant's knowledge related to transmission, symptoms, management and prevention of COVID-19 infection. The questions were of both single-select and multiple-select types and contained a total of 46 correct options. Besides, to understand a participant's handwashing, mask-wearing and physical distancing practices, we asked 10 questions containing 19 correct options (online supplemental table A1.1 and A1.2).

The number of questions for each knowledge and practice domain as well as the number of correct options for different questions within a domain varied considerably. As a result, simply adding the (unweighted) scores would make the composite scores unbalanced. Therefore, balanced scores are obtained by scaling the options to weigh the domains equally (online supplemental table A1.1 and A1.2). Accordingly, the scales of the weighted

knowledge and practice domains had equal weights and added up to 100.

Statistical analysis

We conducted descriptive analysis of background characteristics, knowledge and practices related to COVID-19. Then, we standardised the knowledge and practice scores and estimated the association between the standardised scores and background characteristics using the ordinary least squares technique. The multivariable regression model takes the following functional form:

$$Y_i = \beta_0 + X_i\beta_x + S_i\lambda_s + \varepsilon_i$$

where Y_i is the standardised knowledge score or practice score of an individual i , and X_i represents the corresponding vector of observable socioeconomic features such as age, education, occupation, household size and monthly income (see table 1). In the model, S_i represents a vector of proxies for respondent's access to information: access to a mobile phone, internet and television (TV), and sources of information on various aspects of COVID-19, and the district where the respondent resides. We assume an independent and identical distribution for the unobservable random component ε_i . Moreover, we estimate the regression coefficients using robust SEs. The coefficients can be interpreted as β_x (or λ_s) SD change in the knowledge or practice score due to a unit change in the independent variable, provided the other independent variables of the model remain fixed. To check the robustness of the coefficients, we also fit the model using the unweighted scores (online supplemental table A2). All the analyses were carried out in Stata V.16.1.

RESULTS

Sociodemographic profile

Table 1 presents the summary statistics of the respondents' background characteristics. The mean age of mothers and adult males was around 25 (SD=5.5, range: 16–45) years and 38 (SD=14.5, range: 18–75) years, respectively. More than two-thirds of mothers were educated above the primary level, but 6.5% did not have any formal education. On the other hand, a quarter of the adult males did not have any formal schooling, whereas nearly 10% attained Higher Secondary Certificate (HSC) or qualifications beyond that level.

About 72.6% of the adult males self-reported themselves as the heads of their households. Wage work (28.8%) and agriculture (26.9%) were reportedly their main forms of occupation, followed by self-employment (21%). On the contrary, the majority of the mothers (94.6%) were reportedly home makers. On average, a study household comprised five members. The average monthly household income was approximately 14000 Bangladeshi taka (BDT). As far as possession of durable assets was concerned, about half of the households owned a TV, and almost all possessed a mobile phone; however, just about 40% had internet access. Nearly a quarter of

Table 1 Sociodemographic characteristics of the respondents

	Mother n=2185	Adult male n=657
Age (years; mean (SD))	25.1 (5.5)	37.9 (14.5)
Education		
No formal education	6.5	25.0
Primary or less	26.2	33.6
Above primary up to SSC	56.8	31.8
HSC and above	10.5	9.6
Household head's education		
No formal education	25.9	
Primary or less	36.3	
Above primary up to SSC	29.9	
HSC and above	7.9	
Household head/ adult male's occupation		
Wage worker	35.3	28.8
Agriculture	23.4	26.9
Service holder	10.8	10.4
Self-employed	20.3	21.0
Home maker	3.9	–
Others	6.3	12.9
Household size (members, mean (SD))	5.2 (1.7)	5.5 (1.8)
Household's monthly income (BDT, mean (SD))	13921 (12 525)	15743 (15 152)
=1 if with access to television	45.7	46.1
=1 if with access to mobile phone	97.7	98.3
=1 if with access to internet	38.2	41.2
Source of information		
No source	6.6	4.0
Single source	17.5	24.4
Multiple sources	75.9	71.6
District		
Bhola	12.6	14.1
Narayanganj	15.4	14.7
Bagerhat	12.8	12.2
Bogura	28.2	27.9
Kishoreganj	21.6	15.1
Sherpur	9.3	16.0

Unless specified otherwise, all the values are reported in percentages.
The majority of adult males (72%) self-reported themselves as household heads, hence occupation of household heads is not reported in the 'Adult male' column.
BDT, Bangladeshi taka; HSC, Higher Secondary Certificate; SSC, Secondary School Certificate.

the adult males and 17.5% of the mothers reportedly acquired their knowledge on preventive measures from a single source, while close to three-fourths mentioned multiple sources.

Knowledge related to COVID-19

Concerning the mode of transmission of the novel coronavirus, three-fourths of the mothers and 80.8% of adult males were aware of the direct transmission mode through respiratory droplets, whereas 59.2% of mothers and 63.7% of adult males identified exposure to contaminated surfaces (ie, indirect transmission). However, about 15% of mothers and 10% of adult males could not identify any transmission modes. When we asked about the common symptoms of COVID-19, more than 80% of mothers mentioned fever and cough, followed by sore throat (45.5%) and shortness of breath (36%), while about 10% could not mention any. Adult males also came up with similar responses (online supplemental table A1.1). Moreover, about 90% of both mothers and adult males could not recognise that even asymptomatic individuals can transmit the virus.

Among the mothers, sanitising hands (50%), physical distancing (48.7%), using face masks (51.7%) and staying home (32.1%) were the most identified preventive measures. Adult males also presented with similar responses (online supplemental table A1.1). We also asked them to describe the proper etiquettes of maintaining the preventive measures. The commonly recognised handwashing etiquettes were: 'applying soap covering all hand surfaces' (approximately 60%), 'wetting hands with water' and 'rubbing hands palm-to-palm' (about 50%) and 'scrubbing both hands for at least 20 seconds' and 'rinsing them with water' (about 40%). However, the majority of respondents could not recall the rest of the essential etiquettes.

A surgical face mask must be worn, covering one's nose, mouth and chin, leaving no gap between the face and the mask.⁴ Besides, the metal strip at the top needs to be pinched so that it moulds to the shape of the nose.⁴ Although more than half of the respondents mentioned the former step, less than one-fifth identified the latter. Only about 25% of mothers and adult males recognised the fact that one's mask should not be shared with others. Regarding the definition of safe physical distancing, a greater proportion of adult males (82.5%) compared with mothers (66.5%) identified the minimum distance that is 3 feet or 1 m.

Practices related to COVID-19

Although almost all the households reportedly possessed soap or detergent, about one-fifth of the households did not have at least one face mask available for each of their members, whereas around 15% reportedly did not possess a single mask. Only about half of the respondents reportedly used to wear a face mask every time they went out. Besides, around 1.5% of the respondents used to share their masks with the other members of the households.

When asked about their self-reported practices of safe physical distancing, about three-fourths of the respondents reported that they rarely had maintained at least 3-feet distance when they had gone out in the past 2 weeks. They were also asked how many times in the past 2

Table 2 Distribution of weighted knowledge and practice scores

	Questions (n)	Weighted scale	Mothern=2185	Adult malen=657
Knowledge related to COVID-19				
Transmission, symptoms and management	4	0–50	15.4 (7.2)	17.1 (7.4)
Prevention	4	0–50	18.1 (9.7)	21.1 (9.0)
Overall knowledge score	8	0–100	33.5 (15.0)	38.2 (14.8)
Standardised distribution (in percentages)				
–2 SD or less			1.8	3.5
>–2 to –1 SD			16.9	12.8
>–1 to 1 SD			66.0	68.0
1 to <2 SD			13.7	15.1
2 SD or above			1.6	0.6
Practices related to COVID-19				
Handwashing	4	0–33.3	17.1 (4.6)	17.5 (4.9)
Mask wearing	4	0–33.3	26.3 (7.6)	25.7 (7.1)
Physical distancing	2	0–33.3	19.7 (11.2)	10.2 (10.5)
Overall practice score	10	0–100	63.0 (18.1)	53.4 (17.5)
Standardised distribution (in percentages)				
–2 SD or less			1.7	0.5
>–2 to –1 SD			15.4	15.4
>–1 to <1 SD			59.1	66.3
1 to <2 SD			23.8	15.2
2 SD or above			–	2.6

Unless specified otherwise, mean knowledge scores and practice scores are reported. SDs of the scores are reported in parentheses.

weeks they joined any social or mass gathering. Although about one-third of the mothers reportedly did so, the majority of adult males (84.5%) joined social gatherings at least once (online supplemental table A1.2).

Knowledge and practice scores

The distribution of weighted knowledge and practice scores is presented in table 2. The overall mean knowledge scores of mothers and adult males were respectively 33.5 (SD=15) and 38.2 (SD=14.8) on a scale of 100. The standardised knowledge scores were found to be closer to a bell-shaped distribution, where around 66% of the mothers scored between –1 and +1 SD (ie, scored between 18.5 and 48.5) and about 96.6% of the mothers scored between –2 and +2SD. The distribution of the scores for adult males also shows similar characteristics. Concerning the theme-specific knowledge, the score on prevention was greater than that of transmission, symptoms and management for both mothers and adult males.

The domain of practice was also divided into three thematic areas: (1) handwashing, (2) mask wearing, and (3) physical distancing. In contrast to knowledge, mothers scored higher than adult males (63.0 with an SD of 18.1 vs 53.4 with an SD of 17.5) in the overall domain of practice. Standardised scores show that about 59.1% of

the mothers and 66.3% of the adult males scored within –1 and +1 SD. Whereas 23.8% of the mothers and 17.8% of the adult males scored more than 1 SD, 17.1% of the mothers and 15.9% of the adult males scored lower than 1 SD. As to the theme-specific practice, a higher score was secured in the use of face masks compared with handwashing and physical distancing. Adult males secured similar scores as mothers except in the theme of physical distancing where mothers attained a higher score (table 2). The unweighted knowledge and practice scores also depict similar pictures for both mothers and adult males (online supplemental table A3).

Factors associated with knowledge and practices

Table 3 shows the regression results, where we identify the sociodemographic factors associated with the weighted knowledge and practice scores for both mothers and adult males. Education is strongly associated with the weighted knowledge scores for both mothers and adult males. The knowledge scores of the mothers who had some level of primary education are on average 0.24 SD (or 3.6 points) higher compared with those who had no formal schooling. The differences in scores increase to 0.52 SD (or 7.8 points) and 0.79 SD (or 11.9 points) for respondents with Secondary School Certificate (SSC) or

Table 3 Regression results—association between sociodemographic characteristics and weighted knowledge and practice scores

	Knowledge score (standardised)		Practice score (standardised)	
	Mother	Adult male	Mother	Adult male
Age (years)	0.0002 (0.93) (-0.01, 0.01)	-0.007 (<0.01) (-0.01, -0.002)	0.001 (0.89) (-0.01, 0.01)	0.003 (0.36) (-0.003, 0.01)
Education				
No formal education	Base	Base	Base	Base
Primary or less	0.24 (<0.01) (0.11, 0.38)	0.13 (0.14) (-0.04, 0.31)	0.07 (0.46) (-0.11, 0.24)	0.24 (0.03) (0.03, 0.46)
Above primary up to SSC	0.52 (<0.01) (0.38, 0.65)	0.38 (<0.01) (0.19, 0.56)	0.10 (0.27) (-0.08, 0.28)	0.30 (0.01) (0.09, 0.52)
HSC and above	0.79 (<0.01) (0.61, 0.96)	0.72 (<0.01) (0.49, 0.95)	0.17 (0.14) (-0.06, 0.40)	0.58 (<0.01) (0.29, 0.88)
Househol head's education				
No formal education	Base		Base	
Primary or less	0.12 (0.01) (0.03, 0.20)		-0.01 (0.83) (-0.11, 0.09)	
Above primary up to SSC	0.17 (<0.01) (0.08, 0.27)		0.05 (0.38) (-0.06, 0.17)	
HSC and above	0.22 (<0.01) (0.07, 0.37)		0.19 (0.04) (0.01, 0.37)	
Household head/adult male's occupation				
Wage worker	Base	Base	Base	Base
Agriculture	-0.02 (0.64) (-0.11, 0.07)	-0.08 (0.32) (-0.25, 0.08)	0.04 (0.46) (-0.07, 0.15)	0.12 (0.24) (-0.08, 0.31)
Service holder	0.06 (0.37) (-0.07, 0.18)	0.08 (0.48) (-0.15, 0.32)	0.18 (0.01) (0.04, 0.33)	0.23 (0.09) (-0.04, 0.51)
Self-employed	-0.03 (0.47) (-0.13, 0.06)	-0.02 (0.85) (-0.20, 0.16)	0.13 (0.02) (0.02, 0.25)	0.15 (0.15) (-0.06, -0.36)
Home maker	-0.01 (0.90) (-0.20, 0.18)		0.08 (0.41) (-0.11, 0.28)	
Others	0.02 (0.81) (-0.13, 0.17)	-0.04 (0.73) (-0.25, 0.17)	0.09 (0.31) (-0.08, 0.27)	0.33 (0.02) (0.05, 0.60)

Continued

Table 3 Continued

	Knowledge score (standardised)		Practice score (standardised)	
	Mother	Adult male	Mother	Adult male
Household size (number of members)	-0.001 (0.91) (-0.02, 0.02)	-0.03 (0.09) (-0.07, 0.005)	0.03 (0.03) (0.002, 0.05)	0.03 (0.12) (-0.01, 0.08)
Household's monthly income (standardised)	0.10 (<0.01) (0.06, 0.14)	0.13 (<0.01) (0.05, 0.21)	0.03 (0.22) (-0.02, 0.09)	0.01 (0.84) (-0.09, 0.12)
=1 if with access to television	0.23 (<0.01) (0.16, 0.30)	0.17 (<0.01) (0.05, 0.30)	0.11 (0.01) (0.02, 0.19)	0.03 (0.67) (-0.12, 0.18)
=1 if has access to mobile phone	0.04 (0.72) (-0.18, 0.26)	-0.22 (0.32) (-0.66, 0.21)	0.29 (0.04) (0.02, 0.56)	0.42 (0.19) (-0.21, 1.05)
=1 if with access to internet	0.09 (0.02) (0.01, 0.16)	0.10 (0.13) (-0.03, 0.23)	0.02 (0.73) (-0.07, 0.11)	-0.05 (0.54) (-0.20, 0.11)
Source of information				
No source	Base	Base	Base	Base
Single source	1.78 (<0.01) (1.66, 1.89)	1.77 (<0.01) (1.53, 2.01)	-0.10 (0.35) (-0.31, 0.11)	0.19 (0.37) (-0.23, 0.60)
Multiple sources	1.34 (<0.01) (1.24, 1.43)	1.52 (<0.01) (1.30, 1.74)	-0.01 (0.92) (-0.18, 0.17)	0.11 (0.56) (-0.26, 0.48)
District				
Bhola	Base	Base	Base	Base
Narayanganj	0.82 (<0.01) (0.70, 0.94)	0.97 (<0.01) (0.74, 1.21)	0.50 (<0.01) (0.34, 0.66)	0.28 (0.06) (-0.01, 0.57)
Bagerhat	0.53 (<0.01) (0.41, 0.65)	0.52 (<0.01) (0.29, 0.75)	0.04 (0.61) (-0.12, 0.20)	0.12 (0.45) (-0.19, 0.42)
Bogura	0.26 (<0.01) (0.15, 0.36)	0.30 (<0.01) (0.08, 0.53)	0.24 (<0.01) (0.10, 0.38)	0.39 (<0.01) (0.14, 0.63)
Kishoreganj	0.47 (<0.01) (0.37, 0.58)	0.43 (<0.01) (0.21, 0.65)	0.26 (<0.01) (0.12, 0.40)	0.01 (0.97) (-0.25, 0.26)
Sherpur	0.10 (0.11) (-0.02, 0.22)	0.03 (0.79) (-0.18, 0.23)	0.14 (0.13) (-0.04, 0.33)	0.16 (0.23) (-0.10, 0.41)
Knowledge score (standardised)			0.26 (<0.01) (0.20, 0.31)	0.24 (<0.01) (0.15, 0.34)

Continued

Table 3 Continued

	Knowledge score (standardised)		Practice score (standardised)	
	Mother	Adult male	Mother	Adult male
Constant	-2.43 (<0.01) (-2.74, -2.12)	-1.59 (<0.01) (-2.15, -1.03)	-0.88 (<0.01) (-1.30, -0.45)	-1.42 (<0.01) (-2.22, -0.62)
Observations	2185	657	2185	657
R ²	0.445	0.461	0.170	0.208
F-statistics (p value)	128.6 (<0.001)	42.6 (<0.001)	20.6 (<0.001)	8.2 (<0.001)

P values and 95% CIs are reported in parentheses.
HSC, Higher Secondary Certificate; SSC, Secondary School Certificate.

less and HSC or above educational qualifications, respectively. For adult males, knowledge scores are about 0.38 SD (or 5.6 points) and 0.72 SD (or 10.7 points) higher for similar education levels. Moreover, we found positive and similarly expanding associations with the household heads' educational qualifications, however, of much lesser magnitude in comparison to the mothers.

No association was found between knowledge scores and occupation. However, the household's monthly income is strongly associated with the knowledge score. A single SD increase in the monthly household income (ie, BDT12525) is associated with a 0.10 SD (1.5 points) increase in the mother's overall knowledge score, whereas for the adult males, it is about 0.13 SD (or 1.9 points).

Access to TV is significantly associated with knowledge. Knowledge scores increase by about 0.23 and 0.17 SDs for mothers and adult males, respectively, if they have access to TV. We also found a similar association with access to the internet; however, not statistically significant for adult males. Moreover, we could not find any significant association with access to mobile phones. We asked the respondents to state the sources (eg, electronic media, print media, friends, etc) from which they received information related to COVID-19. Compared with those who did not mention any source, the mothers who received information from a single source attained 1.78 SD (or 26.7 points) higher knowledge scores. In contrast, the knowledge scores were 1.34 SD (or 20 points) higher for those who mentioned multiple sources. We found similar results for adult males.

The distribution of knowledge scores varies across the six selected districts. We chose Bhola as the reference district since it is one of the hard-to-reach sites among the study districts. Compared with Bhola, respondents from all the other districts, except for Sherpur, have relatively higher knowledge related to COVID-19. The mothers and adult males of Narayanganj attained the highest knowledge scores (0.82 and 0.97 SD higher than Bhola).

Education is not significantly associated with mothers' practice related to COVID-19. However, the adult males' practice scores are positively associated with their level of education. The practice scores of the adult males who

had some level of primary education are on average 0.24 SD (or 4.2 points) higher compared with those who had no formal schooling. The differences in scores increase to 0.30 SD (or 5.3 points) and 0.58 SD (or 10.2 points) for respondents with SSC or less and HSC or above educational qualifications, respectively. All the coefficients are statistically significant.

Among other covariates, household income is not found to be significantly associated with the practice. Access to TV and mobile phone is positively associated with the practice scores of mothers; however, it was not statistically significant for adult males. Unlike the relationship with the knowledge score, sources from which the respondent received COVID-19-related information are not associated with practice.

Similar to knowledge scores, practice scores also vary significantly across the six districts. In comparison to Bhola, respondents from the Narayanganj, Bogura and Kishoreganj districts attained significantly higher practice scores. Additionally, practice is positively associated with the knowledge related to COVID-19. For mothers, if the knowledge score increases by 1 SD, the practice score increases, on average, by about 0.26 SD (or 3.9 points); in contrast, it is approximately 0.24 SD (or 4.2 points) for adult males. Both the coefficients are statistically significant.

DISCUSSION

This study assessed knowledge and practices related to different domains of COVID-19 among mothers of children aged 2 years or less and adult males aged 18 years or above in randomly selected households across six districts of Bangladesh.

Evidence suggests that about one in every five people who have contracted the novel coronavirus may not reveal any symptom.³⁸ Although asymptomatic individuals can transmit the virus to considerably fewer people than those with symptoms, they can be a silent propagator of the pandemic; therefore, researchers advise to comply with the preventive protocols, regardless of the presence of symptoms.³⁸ Nevertheless, the findings of

this study reveal that people are largely unaware of this aspect of the pandemic. Should it remain unchecked, asymptomatic groups may be reluctant to adhere to the protocols, contributing to a rise in the number of cases. On another note, although this may be implicit of symptoms being a tangible indicator for identifying potential carriers of the virus, most of the common symptoms of COVID-19 (except fever, chills and cough) were unrecognised by many. Therefore, even those intending to prevent the disease by being wary of the symptomatic cases may fail to do so unless they learn the common symptoms at least.^{39 40} Knowledge regarding transmission was not satisfactory either. Nearly half of the people were unaware of the common modes of transmission. This could have far-reaching implications, as awareness of preventive measures itself may not be sufficient for adherence to their practices unless people know the underlying motives.

A considerable discrepancy is found regarding awareness of protective measures versus having an in-depth understanding of the key etiquettes embedded in the measures. Roughly half of the respondents identified handwashing, physical distancing and the use of face masks as key measures to prevent transmission and were able to recall the basic etiquettes of handwashing and using a face mask. However, very few could recall the protocols exhaustively and the correct practices in depth. An online survey on COVID-19 conducted in Bangladesh highlights the gross discrepancy between recognising preventive measures and having a comprehensive knowledge of the proper practices.⁴¹ Acquiring partial or incorrect information regarding the protocols of preventive behaviours might even worsen the situation instead of curbing the transmission rate. By contrast, a good majority of the respondents correctly recalled the minimum recommended physical distance at public places. The physical distancing protocol incorporates a single message (ie, keeping a distance of at least 3 feet) that may be easy to keep in mind. In contrast, the protocols of handwashing and mask use comprise multiple etiquettes that may be difficult to recollect. Although it may seem troublesome to conform to every single detail of the handwashing and mask use etiquettes, failure to do so could result in inadequate protection, thereby increasing vulnerability to infection.

Practising frequent hand hygiene etiquettes, wearing face masks and maintaining adequate physical distance have been recommended to prevent or minimise the risk of transmission.⁴ With reference to that, most of the households reportedly possessed soap or detergent and face masks (as well as at least one mask per household member). These findings are potentially suggestive of their preparedness and ability to comply with the preventive protocols. However, when it comes to the use of face masks and physical distancing, the practice was reportedly poor. Just about half of the respondents reportedly wear a face mask every time they go out despite an overwhelming majority's recognition of the importance

of wearing a mask. Moreover, a considerable difference between knowledge and practice was found in respect of physical distancing. Only around 10% perceived that they had maintained a distance of at least 3 feet from others most of the times they went out. Unlike handwashing and the use of masks, proper implementation of the physical distancing protocol is not always reliant on individuals, instead it takes a collective approach to make this successful. Perhaps, the magnitude of the current problem with the COVID-19 pandemic is underestimated in the study areas, resulting in the poor practice of mask use and physical distancing. Notably, unlike the other knowledge and practice characteristics, males had considerably higher participation in mass gatherings in the past 2 weeks, supposedly because of their greater degree of mobility compared with females in the study context.⁴² A systematic review and meta-analysis similarly reported a lower practice score among males.⁴³

In comparison to our study, a systemic review of research articles published up until 1 January 2021 reported a greater level of knowledge in Asian countries representing similar contexts.⁴⁴ Moreover, a study in Nigeria and Egypt also reported a higher level of knowledge and practices compared with our study.⁴⁵ However, these studies carried out web-based surveys, where the respondents were conveniently sampled internet users, whereas ours was a probability sample of rural dwellers.

Knowledge related to COVID-19 is highly associated with the educational qualification and household income of the respondent. Moreover, access to TV and the internet is also strongly associated with higher knowledge scores. These findings indicate that lower endowment, either in the form of formal schooling or economic ability or other means of access to information, ultimately makes the respondent more vulnerable to acquiring accurate information related to COVID-19. Studies from China,²² Egypt,^{18 45} Nigeria⁴⁵ and India⁴⁶ similarly reported a positive association between knowledge and socioeconomic features considered in our study.

Additionally, except for Sherpur, in comparison with Bhola, all four other districts scored higher in knowledge. Bhola is a hard-to-reach district surrounded by water bodies from almost everywhere. The literacy rate and the per-capita income of Bhola are lower than the national average and also the lowest after Sherpur (ie, another hard-to-reach area) among the six study districts.⁴⁷ The findings indicate that proximity to the capital or a nearby city is strongly associated with the knowledge related to COVID-19. Similar to our study, a scoping review in sub-Saharan Africa reported a geographical variation in the level of knowledge. The western part of sub-Saharan Africa revealed better knowledge and practices related to COVID-19 compared with the east. This discrepancy has reportedly resulted due to the differences in access to information,⁴⁸ which is also reflected in our study and a study in Sierra Leone.³⁶ Hard-to-reach areas are less likely to receive the required information and support to prevent COVID-19. The resource-poor settings of these



areas make them more vulnerable to the pandemic. The findings are particularly relevant for the local, national and international institutions since it warrants additional efforts while designing and communicating educational interventions for these disadvantaged and marginalised parts of the population.

In our study, we found that the number of sources used by the respondent to obtain information related to COVID-19 is crucial for securing correct knowledge. Those who obtained information from a single source secured higher knowledge scores in comparison to ones who gathered information from multiple sources. The underlying reason for these score differences could be attributed to the amount of false information available on social media and the extent of misinformed individuals spreading them further among the general population. Previous studies also suggest that the source of information plays an important role in obtaining accurate knowledge.^{44 49 50} As the central authority, the government should deliver clear and correct information through local and national campaigns, TV and other verified social media platforms. Information obtained from the scientific studies, opinions of the recognised experts and guidelines shared by internationally recognised institutions, such as the WHO and CDC, could be used to prepare the information materials.

Interestingly, practice is not associated with the features that influence knowledge related to COVID-19. Although positively associated with the COVID-19-related practices of adult males, education is not associated with the practices among the mothers. Moreover, household income, access to TV and the internet and sources of information are also strongly associated with the practice. However, practice scores varied significantly across the six districts. In our study, respondents from Narayanganj, Bogura and Kishoreganj secured higher practice scores than Bhola. The findings suggest that similar to knowledge, practices related to COVID-19 are also better in districts with well-established administrative facilities and/or higher connectivity with a nearby city with the required amenities.

We should also point out that knowledge is a statistically significant correlate of practice; however, it is not the most important one. The results of our study show that 1 SD increase in knowledge is associated with 0.26 SD of increase in practice scores, suggesting a partial contribution of the knowledge in ensuring the preventive practices related to COVID-19. However, relevant literature suggests that there are other important factors, such as the presence of positive social norms,^{51 52} benchmarks set by neighbours or other role models^{51 53–55} and the presence of positive or negative reinforcements in the community,^{51 55–58} which can guide practice.

Limitations

Much as this study provides useful insights on knowledge and practices related to COVID-19 in Bangladesh, it also highlights the need to interpret its findings in light of

potential limitations. First, the cross-sectional nature of this study prevents us from establishing any causal relationship of knowledge and practices with the reported background characteristics. Second, the practices are self-reported, which may have led to a reporting bias.

Strengths

Notwithstanding the aforementioned limitations, to the best of our knowledge, this study is the first one to assess knowledge and practices related to COVID-19 among mothers with children aged 2 years or less in multiple districts of Bangladesh. The findings may be generalisable to comparable settings as we employed a probability sampling technique to select the participants.

CONCLUSIONS

Overall, both mothers and adult males in this study presented with a poor level of knowledge and practice related to COVID-19. They severely lack in having a complete understanding of the preventive behaviours. Moreover, we found that people with lower education, limited access to information and who reside in resource-poor settings have a low level of knowledge and practice related to COVID-19. Hence, they are more vulnerable to the pandemic. Educational interventions such as social awareness campaigns and tailored TV-based and/or social media-based edutainment initiatives could help improve the knowledge regarding the preventive behaviours among these disadvantaged and marginalised parts of the population. However, improving knowledge may not be sufficient enough to ensure corresponding practices. Local, national and international institutions should also employ evidence-based alternative strategies such as reinforcing positive social norms, setting benchmarks and introducing rewards and/or sanctions to improve the practices.

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Ethics approval The ethical review committee of the BRAC James P Grant School of Public Health (JPGSPH) at BRAC University, Bangladesh, approved the study protocol (reference number: IRB-20-November'20-049). Before starting any data collection activity, authorisations were collected from the respective local administrative bodies of the selected subdistricts. Informed written consents were also obtained from the participants of this study. All procedures performed in this study involving human participants were in accordance with the ethical standards of JPGSPH, BRAC University, and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Moreover, since the survey was conducted during the COVID-19 pandemic, all the recommended protective measures (eg, wearing face masks, maintaining a physical distance of at least 2 m) were taken while interviewing the participants.

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REFERENCES

- Lai C-C, Shih T-P, Ko W-C, *et al*. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): the epidemic and the challenges. *Int J Antimicrob Agents* 2020;55:105924.
- Lotfi M, Hamblin MR, Rezaei N. COVID-19: transmission, prevention, and potential therapeutic opportunities. *Clin Chim Acta* 2020;508:254–66.
- van Doremalen N, Bushmaker T, Morris DH, *et al*. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N Engl J Med* 2020;382:1564–7.
- World Health Organization. *Transmission of SARS-CoV-2: implications for infection prevention precautions*, 2020.
- World Health Organization. *COVID-19 Weekly epidemiological update*, 2021.
- World Health Organization. *Coronavirus disease (COVID-2019) Bangladesh situation reports*, 2021.
- Li Q, Guan X, Wu P, *et al*. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020;382:1199–207.
- Kostoff RN, Briggs MB, Porter AL. COVID-19: post-lockdown guidelines. *Int J Molec Med* 2020;46:463–6.
- World Health Organization. *Coronavirus disease (COVID-19): herd immunity, lockdowns and COVID-19*, 2020.
- Anwar S, Nasrullah M, Hosen MJ. COVID-19 and Bangladesh: challenges and how to address them. *Front Public Health* 2020;8.
- Biswas RK, Huq S, Afiaz A. Relaxed lockdown in Bangladesh during COVID-19: should economy outweigh health? *Int J Health Policy Manag* 2020;9:488.
- Shammi M, Bodrud-Doza M, Islam ARMT, *et al*. Strategic assessment of COVID-19 pandemic in Bangladesh: comparative lockdown scenario analysis, public perception, and management for sustainability. *Environ Dev Sustain* 2021;23:6148–91.
- Haque A. The COVID-19 pandemic and the public health challenges in Bangladesh: a commentary. *J Health Res* 2020;34:563–7.
- SaMM M, Khan IA, Mian AU. Acceptance of COVID-19 vaccine and its determinants in Bangladesh. *arXiv* 2021:2103.15206.
- Ali M, Hossain A. What is the extent of COVID-19 vaccine hesitancy in Bangladesh? A cross-sectional rapid national survey. *BMJ Open* 2021;11:e050303.
- Dhaka Tribune. Covid-19 vaccination across Bangladesh to start from Feb 7 2021.
- Our World in Data. Bangladesh: coronavirus pandemic country profile [online], 2021. Available: <https://ourworldindata.org/coronavirus/country/bangladesh> [Accessed Sep 2021].
- Abdelhafiz AS, Mohammed Z, Ibrahim ME, *et al*. Knowledge, perceptions, and attitude of Egyptians towards the novel coronavirus disease (COVID-19). *J Community Health* 2020;45:881–90.
- Azlan AA, Hamzah MR, Sern TJ, *et al*. Public knowledge, attitudes and practices towards COVID-19: a cross-sectional study in Malaysia. *PLoS One* 2020;15:e0233668.
- Lee M, Kang B-A, You M. Knowledge, attitudes, and practices (KAP) toward COVID-19: a cross-sectional study in South Korea. *BMC Public Health* 2021;21:1–10.
- Ssebuufu R, Sikakulya FK, Mambo SB, *et al*. Knowledge, attitude, and self-reported practice toward measures for prevention of the spread of covid-19 among Ugandans: a nationwide online cross-sectional survey. *Front Public Health* 2020;8:890.
- Zhong B-L, Luo W, Li H-M, *et al*. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci* 2020;16:1745–52.
- Paul A, Sikdar D, Hossain MM, *et al*. Knowledge, attitudes, and practices toward the novel coronavirus among Bangladeshis: implications for mitigation measures. *PLoS One* 2020;15:e0238492.
- Geana MV. Kansans in the middle of the pandemic: risk perception, knowledge, compliance with preventive measures, and primary sources of information about COVID-19. *Kans J Med* 2020;13:160–4.
- Geldsetzer P. Knowledge and perceptions of COVID-19 among the general public in the United States and the United Kingdom: a cross-sectional online survey. *Ann Intern Med* 2020;173:157–60.
- Ali SH, Foreman J, Tozan Y, *et al*. Trends and predictors of COVID-19 information sources and their relationship with knowledge and beliefs related to the pandemic: nationwide cross-sectional study. *JMIR Public Health Surveill* 2020;6:e21071.
- Anderson RM, Heesterbeek H, Klinkenberg D, *et al*. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *Lancet* 2020;395:931–4.
- Ferguson N, Laydon D, Nedjati Gilani G. *Impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand*. London, 2020.
- Bults M, Beaujean DJMA, Richardus JH, *et al*. Perceptions and behavioral responses of the general public during the 2009 influenza A (H1N1) pandemic: a systematic review. *Disaster Med Public Health Prep* 2015;9:207–19.
- Lietz J, Westermann C, Nienhaus A, *et al*. The occupational risk of influenza A (H1N1) infection among healthcare personnel during the 2009 pandemic: a systematic review and meta-analysis of observational studies. *PLoS One* 2016;11:e0162061.
- Barker DJP, Bergmann RL, Ogra PL. *The window of opportunity: pre-pregnancy to 24 months of age*. Karger Medical and Scientific Publishers, 2008.
- Al-Ayed IH. Mothers' knowledge of child health matters: are we doing enough? *J Family Community Med* 2010;17:22–8.
- NIPORT, ICF. *Bangladesh demographic and health survey 2017-18*. Dhaka and Maryland, 2020.
- Centers for Disease Control and Prevention. COVID-19 [online], 2021. Available: <https://www.cdc.gov/coronavirus/2019-ncov/index.html> [Accessed Sep 2021].
- World Health Organization. Coronavirus disease (COVID-19) [online], 2021. Available: https://www.who.int/health-topics/coronavirus#tab=tab_1 [Accessed Nov 2021].
- Sengeh P, Jalloh MB, Webber N, *et al*. Community knowledge, perceptions and practices around COVID-19 in Sierra Leone: a nationwide, cross-sectional survey. *BMJ Open* 2020;10:e040328.
- Handebo S, Adugna A, Kassie A, *et al*. Determinants of COVID-19-related knowledge and preventive behaviours among students



- in reopened secondary schools: cross-sectional study. *BMJ Open* 2021;11:e050189.
- 38 Nogrady B. What the data say about asymptomatic COVID infections. *Nature* 2020;587:534–5.
- 39 Singh AK, Agrawal B, Sharma A, *et al.* COVID-19: assessment of knowledge and awareness in Indian Society. *J Public Aff* 2020:e2354.
- 40 Jawed F, Manazir S, Zehra A, *et al.* The novel coronavirus disease (COVID-19) pandemic: knowledge, attitude, practice, and perceived stress among health care workers in Karachi, Pakistan. *Med J Islam Repub Iran* 2020;34:132.
- 41 Ferdous MZ, Islam MS, Sikder MT, *et al.* Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: an online-based cross-sectional study. *PLoS One* 2020;15:e0239254.
- 42 Ranasinghe CD, Ranasinghe P, Jayawardena R, *et al.* Physical activity patterns among South-Asian adults: a systematic review. *Int J Behav Nutr Phys Act* 2013;10:116–11.
- 43 Siddiquea BN, Shetty A, Bhattacharya O, *et al.* Global epidemiology of COVID-19 knowledge, attitude and practice: a systematic review and meta-analysis. *BMJ Open* 2021;11:e051447.
- 44 Saadatjoo S, Miri M, Hassanipour S, *et al.* Knowledge, attitudes, and practices of the general population about coronavirus disease 2019 (COVID-19): a systematic review and meta-analysis with policy recommendations. *Public Health* 2021;194:185–95.
- 45 Hager E, Odetokun IA, Bolarinwa O, *et al.* Knowledge, attitude, and perceptions towards the 2019 coronavirus pandemic: a bi-national survey in Africa. *PLoS One* 2020;15:e0236918.
- 46 Roy D, Tripathy S, Kar SK, *et al.* Study of knowledge, attitude, anxiety & perceived mental healthcare need in Indian population during COVID-19 pandemic. *Asian J Psychiatr* 2020;51:102083.
- 47 Bangladesh Bureau of Statistics. *District statistics 2011, 2013.*
- 48 Nwagbara UI, Osual EC, Chireshe R, *et al.* Knowledge, attitude, perception, and preventative practices towards COVID-19 in sub-Saharan Africa: a scoping review. *PLoS One* 2021;16:e0249853.
- 49 Myers C, Hamilton JF. Social media as primary source: the narrativization of twenty-first-century social movements. *Media History* 2014;20:431–44.
- 50 Sarria-Guzmán Y, Fusaro C, Bernal JE, *et al.* Knowledge, attitude and practices (KAP) towards COVID-19 pandemic in America: a preliminary systematic review. *J Infect Dev Ctries* 2021;15:9–21.
- 51 Abaluck J, Kwong LH, Styczynski A. Normalizing community mask-wearing: a cluster randomized trial in Bangladesh. Working paper. *National Bureau of Econ Res* 2021.
- 52 Allcott H. Social norms and energy conservation. *J Public Econ* 2011;95:1082–95.
- 53 Oster E, Thornton R. Determinants of technology adoption: peer effects in menstrual cup take-up. *J Eur Econ Assoc* 2012;10:1263–93.
- 54 van Eck PS, Jager W, Leeftang PSH. Opinion leaders' role in innovation diffusion: a simulation study. *J Prod Innov Manage* 2011;28:187–203.
- 55 Ariely D, Bracha A, Meier S. Doing good or doing well? image motivation and monetary incentives in behaving prosocially. *Am Econ Rev* 2009;99:544–55.
- 56 Karlan D, McConnell M, Mullainathan S, *et al.* Getting to the top of mind: how reminders increase saving. *Manag Sci* 2016;62:3393–411.
- 57 Miller G, Mobarak AM. Learning about new technologies through social networks: experimental evidence on nontraditional stoves in Bangladesh. *Market Sci* 2015;34:480–99.
- 58 Chetty R, Saez E, Sándor L. What policies increase prosocial behavior? An experiment with referees at the *Journal of Public Economics*. *J Econ Persp* 2014;28:169–88.