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COVID-19 vaccination, clinical presentation and 14-day outcomes in Cumilla, Bangladesh: a cross-sectional study

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Abstract

Background

Community evidence from Bangladesh on how vaccination, clinical presentation and short-term outcomes intersected during the early COVID-19 vaccine rollout is limited. We assessed test positivity, clinical characteristics, vaccination status and 14-day outcomes among people tested for suspected COVID-19 in six upazilas of Cumilla district.

Methods

Cross-sectional study of 320 adults tested between 1 April and 31 May 2021, with a retrospective day-by-day 14-day symptom history and outcome assessment for the 86 test-positive cases. Test results (reverse transcription polymerase chain reaction [RT-PCR], n = 286; rapid antigen, n = 34) came from laboratory records; other data were collected by structured telephone interview. We estimated odds ratios, fitted a multivariable logistic regression for positivity, and described symptom trajectories and outcomes.

Results

Eighty-six participants tested positive (26.9%; 95% CI 22.3–32.0); cases had a mean age of 42.5 years, 54.7% were men and 90.7% were symptomatic. In the adjusted model (n = 297), symptomatic presentation (adjusted odds ratio [aOR] 8.18; 95% CI 3.64–18.41) and recent contact with a confirmed case (aOR 2.73; 1.50–4.97) were associated with positivity; age, sex, comorbidity and smoking were not. At least one vaccine dose was reported by 38.4% of cases and 51.7% of test-negative participants (aOR 0.55; 0.31–0.97), but this estimate was imprecise, attenuated in sensitivity analyses (RT-PCR-only aOR 0.75; 0.40–1.38) and does not represent vaccine effectiveness. At 14 days, 56 cases (65.1%) remained in home isolation, 15 (17.4%) were hospitalized without oxygen, 8 (9.3%) needed oxygen, 5 (5.8%) intensive care and 2 (2.3%; 95% CI 0.6–8.1) died.

Conclusions

Symptoms and recent exposure were the strongest correlates of a positive test, but symptoms alone had poor specificity, so testing remained essential. About one in three cases was hospitalized or died within 14 days. The observational design, mixed testing methods and recalled symptom histories preclude causal inference about vaccination.

Background

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in late 2019, spread rapidly and was declared a pandemic in March 2020 [1, 2]. Its clinical spectrum ranges from asymptomatic infection and mild respiratory illness to severe pneumonia, thrombotic and multiorgan complications, and death [3–6]. Fever, cough, fatigue and loss of smell or taste were among the most frequently reported manifestations in the early phases of the pandemic, while older age and chronic conditions such as diabetes, hypertension, cardiovascular disease and chronic respiratory illness were repeatedly associated with poorer outcomes [5–9].

Bangladesh experienced repeated waves of SARS-CoV-2 transmission while facing uneven public knowledge, attitudes and practices [10, 11], barriers to testing described in global reviews, such as uncertainty about access, symptom interpretation and the consequences of a positive result [12], and limited health-service capacity with unequal distribution of resources [13]. Control relied on testing, isolation, contact tracing, movement restrictions, masking and physical distancing [14, 15], measures that were difficult to sustain in densely populated, resource-constrained settings.

Vaccination changed the public-health response. Vaccination is among the most effective strategies for reducing infectious-disease morbidity and mortality [16, 17], yet uptake depends on confidence, convenience, perceived risk, misinformation and trust in health systems [18–24], with misinformation playing a notable role [25, 26], and the World Health Organization has listed vaccine hesitancy among the leading threats to global health [27, 28]. Bangladesh began vaccinating in early 2021, relying mainly on the Oxford–AstraZeneca vaccine produced by the Serum Institute of India [29–32]. By early May 2021, about 5.8 million people had

received a first dose and 3.1 million a second dose, and first-dose administration was curtailed from late April because of supply interruptions [31, 32]. Studies in Bangladesh and South Asia described both willingness to vaccinate and substantial hesitancy, alongside concerns about safety, effectiveness, registration and access [33–38].

Randomised and observational studies have shown that COVID-19 vaccines reduce symptomatic infection and severe disease, although protection varies by vaccine, dose schedule, time since vaccination and variant [39–44]. Protection from the ChAdOx1 vaccine was lower against the Beta (B.1.351) variant [45] and the Delta variant [46], and sequencing in south-western Bangladesh found that Beta (B.1.351) accounted for most sequenced spike proteins among samples collected in March–April 2021, including from immunized patients [47]. Such studies establish the broad value of vaccination but do not replace locally grounded descriptions of how vaccination status, symptoms, exposure and outcomes appeared in everyday health-service settings, particularly where hospital-based series under-represent mild and home-managed infections.

Bangladeshi clinical reports have largely described hospitalized patients early in the pandemic [48, 49], while community studies have focused on knowledge, attitudes and practices [10, 11, 50]. Few have combined test results, symptom profiles, vaccination status, daily symptom progression and short-term outcomes in a community-oriented sample that includes home-managed cases. We therefore examined people tested for suspected COVID-19 in six upazilas of Cumilla district during the early phase of the national vaccination programme. We assessed sociodemographic and clinical characteristics, exposure, comorbidity and vaccination status in relation to test result and, among test-positive cases, described 14-day symptom trajectories and clinical outcomes.

Methods

Study design and setting

This was a cross-sectional study of people tested for suspected COVID-19, combined with a retrospective, interviewer-collected day-by-day symptom history and outcome assessment covering 14 days from sample collection for test-positive participants. Data were collected from 1 April to 31 May 2021 in six upazilas of Cumilla district, Bangladesh: Adarsha Sadar, Burichang, Daudkandi, Debidwar, Monohargonj and Muradnagar. The study is reported according to the STROBE guideline [51]. The study upazilas are predominantly rural, with upazila-level towns, and are served by public facilities (upazila health complexes, the district hospital and Cumilla Medical College Hospital) and private diagnostic centres; no participants were from Cumilla City Corporation.

Participants

The source population comprised adults who underwent SARS-CoV-2 testing at three laboratories (Cumilla Medical College Laboratory, District Hospital Laboratory and a private diagnostic laboratory). Of 320 participants (age 18–76 years), 274 (85.6%) were registered as new suspected cases and 46 (14.4%) as contacts of confirmed cases. Eligible participants were adults aged 18 years or older who had been tested at one of these laboratories between 1 April and 31 May 2021 with a recorded result, could be reached by telephone and gave verbal consent. Participants were enrolled consecutively from the laboratory registers of the three testing sites during the study period. Of 480 eligible people approached, 320 agreed to participate (response rate 66.7%); the remaining 160 could not be reached or did not take part. No formal sample-size calculation was performed before data collection; the sample comprised the eligible people who could be reached and agreed to participate during the two-month study period. Precision is reflected in the confidence intervals reported throughout (for example, test positivity 26.9%, 95% CI 22.3–32.0).

Laboratory testing

Test results and testing information were obtained from laboratory records. Of the 320 participants, 286 (89.4%) were tested by real-time reverse transcription polymerase chain reaction (rRT-PCR) and 34 (10.6%) by rapid antigen test. rRT-PCR testing was performed at each of the three laboratories using the same Bio-Rad iTaq kit, and results were confirmed by the RT-PCR laboratory of Cumilla Medical College. A participant with a positive result by either method was classified as a confirmed case, and those with a negative result formed the comparison (test-negative) group. Rapid antigen testing used the SD Biosensor STANDARD Q COVID-19 Ag kit.

Data collection

Sociodemographic characteristics, current symptoms (fever or chills, cough, shortness of breath, fatigue, muscle or body aches, headache, loss of taste, loss of smell, sore throat, congestion or runny nose, nausea or vomiting, diarrhea), previous COVID-19, potential exposure (contact with a confirmed case, travel and healthcare-facility visits in the preceding 14 days), underlying conditions, smoking status and vaccination status were collected through a structured telephone questionnaire after verbal informed consent. Vaccination data comprised the number of doses and the dates of the first and second doses. Telephone interviews were conducted in Bengali by 10 trained interviewers (public health graduates), who received 2 hours of training on the questionnaire and consent procedure. The questionnaire was pilot-tested with 30 participants, and minor wording changes were made. Interviews were conducted a median of 15 days after the test result was reported. Vaccination status and dose dates were recorded as reported to the interviewers.

Symptom history and outcomes of confirmed cases

For all 86 confirmed cases, the presence or absence of each of the 12 listed symptoms on each of the 14 days after sample collection was recorded during the telephone interview, which took place after the follow-up window had closed (median 15 days after the test result), so the daily symptom history relies on participant recall. Outcomes at day 14 were categorized as home isolation, hospitalization without oxygen support, hospitalization with oxygen support, intensive care unit (ICU) admission, or death. Length of hospital stay was recorded when available. Symptom histories were complete for all 86 cases. Hospital admission, oxygen or ICU use and death were checked against hospital records. For the two cases who died, symptom information was provided by family members. Day 1 corresponded to the date of sample collection. The date of death was not recorded; for the two deaths, diary entries after the last day with recorded symptoms were not counted.

Definitions

A confirmed case was a participant with a positive RT-PCR or rapid antigen result. Vaccination status was classified by the number of doses received before sample collection: two doses (fully vaccinated), one dose (partially vaccinated) or none (unvaccinated); receipt of at least one dose was the main binary exposure. The interval between the last dose and sample collection was calculated from the recorded dates. Clinical severity was described by the level of care required: mild disease (managed at home, with or without symptoms), moderate disease (hospitalization without supplemental oxygen) and severe disease (oxygen-supported hospitalization or ICU admission); death was reported separately. “Home isolation” therefore denotes absence of escalation to hospital care by day 14 and is reported separately for cases who were asymptomatic and symptomatic at baseline; it does not imply that symptoms persisted at day 14.

Statistical analysis

Continuous variables are summarized as means and standard deviations or medians and interquartile ranges (IQR), and categorical variables as numbers and percentages, with 95% Wilson confidence intervals for key proportions. Test-positive and test-negative participants were compared using the Pearson chi-square test (Fisher’s exact test when any expected count was below 5), the Welch t-test for age and the Mann–Whitney test for symptom counts, and unadjusted odds ratios (OR) with Wald 95% confidence intervals were calculated. To estimate independent associations with test positivity we fitted a multivariable logistic regression model including age (per 10 years), sex, any comorbidity, current smoking, contact with a confirmed case, symptomatic presentation, vaccination (at least one dose) and test method (82 events for 8 predictors); participants with unknown contact status (n = 23) were excluded from this model. Sensitivity analyses (i) retained participants with unknown contact status as a separate category; (ii) restricted the sample to RT-PCR-tested participants; (iii) restricted it to symptomatic participants; (iv) classified doses received less than 14 days before sampling as unvaccinated or excluded these participants; (v) modelled the number of doses; (vi) used standard errors clustered by upazila (six clusters; interpreted with caution); (vii) omitted symptomatic presentation, which may lie on the pathway between vaccination and the test result; (viii) additionally adjusted for sample month and health-worker occupation; and (ix) included upazila fixed effects. Because vaccination status was compared between test-positive and test-negative participants who were tested for suspected infection, vaccination estimates were treated as exploratory associations and not as vaccine effectiveness [52]. The sensitivity and specificity of symptomatic presentation and of recent contact were calculated against the test result. Daily symptom prevalence was summarized among survivors, and the first

symptom-free day among survivors who were symptomatic on day 1. All tests were two-sided with $p < 0.05$ considered statistically significant, without adjustment for multiple comparisons. Analyses were performed in R version 4.6.0 (tidyverse, readxl, sandwich and lmtest packages; glm() for logistic regression and prop.test() for Wilson intervals) and in Python version 3.12.3 (pandas 3.0.6, SciPy 1.18.1, statsmodels 0.15.0, matplotlib 3.11.2).

Ethical considerations

Ethical approval and consent

procedures are described under Declarations.

Use of large language models. A large language model (Claude, Anthropic) was used to assist for language editing and formatting of the manuscript. All analyses, outputs and text were reviewed by the authors, who take full responsibility for the content.

Results

Participants and test positivity

Of 480 eligible people approached, 320 (66.7%) participated. Of these 320 participants, 86 tested positive (26.9%; 95% CI 22.3–32.0), of whom 74 were detected by RT-PCR and 12 by rapid antigen test; 234 (73.1%) tested negative. Positivity ranged from 16.0% in Monohargonj to 34.4% in Daudkandi, without a statistically significant difference between upazilas ($p = 0.23$; Additional file 1: Table S1). Confirmed cases had a mean age of 42.5 years (SD 11.8; range 18–69), and 47 (54.7%) were men. Most were symptomatic at presentation (78/86; 90.7%).

Symptomatic presentation was more frequent among participants who tested positive than among those who tested negative (90.7% vs 56.8%; OR 7.40, 95% CI 3.42–16.03; $p < 0.001$), as was recent contact with a confirmed case (42.7% vs 23.3% of those with known status; OR 2.46, 1.43–4.22; $p < 0.001$) (Table 1). Comorbidity was more common among positive participants (39.5% vs 27.4%; OR 1.74, 1.03–2.92; $p = 0.036$), whereas the proportion reporting at least one vaccine dose was lower (38.4% vs 51.7%; OR 0.58, 0.35–0.96; $p = 0.034$). Positivity decreased with the number of doses: 31.9% (53/166) among unvaccinated, 25.6% (21/82) among one-dose and 16.7% (12/72) among two-dose participants ($p = 0.049$). The p-values for comorbidity and vaccination were borderline: they were 0.050 and 0.047 with continuity correction. Age, sex, smoking, previous COVID-19, test method and registration as a contact-tracing referral did not differ significantly between groups. In an exploratory comparison, positivity varied by occupation ($p = 0.045$; from 8.1% in farmers to 42.1% in retired participants and teachers; Additional file 1: Table S1), but categories were small (19–37 participants) and no adjustment was made for multiple comparisons, so this finding is hypothesis-generating only.

Table 1
Characteristics of participants according to SARS-CoV-2 test result

Characteristic	Positive (n = 86)	Negative (n = 234)	Unadjusted OR (95% CI)	p-value
Age, years, mean (SD)	42.5 (11.8)	41.6 (13.9)	–	0.549 □
Male sex	47 (54.7)	122 (52.1)	1.11 (0.67–1.82)	0.690
Symptomatic at testing	78 (90.7)	133 (56.8)	7.40 (3.42–16.03)	< 0.001
Any comorbidity	34 (39.5)	64 (27.4)	1.74 (1.03–2.92)	0.036
Current smoker	21 (24.4)	42 (17.9)	1.48 (0.81–2.68)	0.197
Contact with confirmed case, prior 14 days □	35/82 (42.7)	50/215 (23.3)	2.46 (1.43–4.22)	< 0.001
Previous COVID-19 episode	8 (9.3)	21 (9.0)	1.04 (0.44–2.45)	0.928
Registered as contact-tracing referral	15 (17.4)	31 (13.2)	1.38 (0.71–2.71)	0.343
Tested by RT-PCR (vs rapid antigen)	74 (86.0)	212 (90.6)	0.64 (0.30–1.36)	0.242
Vaccinated (≥ 1 dose)	33 (38.4)	121 (51.7)	0.58 (0.35–0.96)	0.034
Unvaccinated	53 (61.6)	113 (48.3)	Reference	0.049 □
One dose	21 (24.4)	61 (26.1)	0.73 (0.41–1.33)	
Two doses	12 (14.0)	60 (25.6)	0.43 (0.21–0.86)	

Values are n (%) unless stated. OR, odds ratio of a positive test. p-values are unadjusted: Pearson chi-square except □ Welch t-test and □ chi-square with 2 degrees of freedom. □ Percentages use participants with known contact status (contact status unknown for 4 positive and 19 negative participants). For comorbidity and vaccination, p = 0.041 and 0.043 by Fisher's exact test.

Factors independently associated with a positive test

In the multivariable model (297 participants, 82 events), symptomatic presentation (adjusted OR [aOR] 8.18; 95% CI 3.64–18.41) and recent contact with a confirmed case (aOR 2.73; 1.50–4.97) remained strongly associated with a positive test (Table 2, Fig. 1). Comorbidity was no longer significantly associated (aOR 1.57; 0.86–2.88), and age, sex, smoking and test method were not associated with positivity. Reporting at least one vaccine dose was associated with lower odds of a positive test (aOR 0.55; 0.31–0.97). This estimate was sensitive to specification (Additional file 1: Table S2): it was 0.75 (0.40–1.38) among RT-PCR-tested participants, 0.61 (0.33–1.13) among symptomatic participants, 0.62 (0.35–1.12) when doses received within 14 days of sampling were classified as unvaccinated, and 0.55 (0.24–1.25) with upazila-clustered standard errors. Omitting symptomatic presentation (aOR 0.57; 0.33–0.97), adding sample month (0.55; 0.31–0.98) or health-worker occupation (0.54; 0.30–0.95) left the estimate essentially unchanged, whereas including upazila fixed effects widened the interval to include 1 (0.59; 0.33–1.06). The association with two doses was stronger (aOR 0.39; 0.18–0.85) than with one dose (aOR 0.71; 0.36–1.39).

Table 2
Multivariable logistic regression of factors associated with a positive SARS-CoV-2 test (n = 297; 82 positive)

Variable	Adjusted OR	95% CI	p-value
Age (per 10 years)	1.12	0.89–1.40	0.335
Male sex	1.06	0.57–1.95	0.857
Any comorbidity	1.57	0.86–2.88	0.144
Current smoker	1.37	0.63–2.96	0.429
Contact with confirmed case	2.73	1.50–4.97	0.001
Symptomatic at testing	8.18	3.64–18.41	< 0.001
Vaccinated (≥ 1 dose)	0.55	0.31–0.97	0.040
Tested by RT-PCR (vs antigen)	0.74	0.32–1.70	0.474

Participants with unknown contact status (n = 23) were excluded; including them as a separate category gave similar estimates (Additional file 1: Table S2).

Clinical presentation of confirmed cases

Confirmed cases reported a median of five current symptoms (IQR 4–6), compared with one (IQR 0–3) among test-negative participants (p < 0.001). Fever or chills was the most frequent symptom (65.1%), followed by cough (62.8%), fatigue (54.7%), muscle or body aches (52.3%) and headache (46.5%); sore throat was reported by 36.0%, loss of smell and congestion or runny nose each by 29.1%, shortness of breath by 26.7% and loss of taste by 23.3%. Nausea or vomiting (14.0%) and diarrhea (7.0%) were less frequent (Table 3, Fig. 2). Symptomatic presentation had a sensitivity of 90.7% (95% CI 82.7–95.2) and a specificity of 43.2% (37.0–49.6) for a positive test, with a positive predictive value of 37.0% (30.7–43.7) and a negative predictive value of 92.7% (86.2–96.2). Recent contact with a confirmed case had a sensitivity of 42.7% (32.5–53.5), a specificity of 76.7% (70.7–81.9), a positive predictive value of 41.2% (31.3–51.8) and a negative predictive value of 77.8% (71.8–82.9) among participants with known contact status.

Table 3
Current symptoms among confirmed COVID-19 cases (n = 86)

Symptom	n	%
Fever or chills	56	65.1
Cough	54	62.8
Fatigue	47	54.7
Muscle or body aches	45	52.3
Headache	40	46.5
Sore throat	31	36.0
New loss of smell	25	29.1
Congestion or runny nose	25	29.1
Shortness of breath or difficulty breathing	23	26.7
New loss of taste	20	23.3
Nausea or vomiting	12	14.0
Diarrhea	6	7.0

Comorbidities, vaccination and previous infection among confirmed cases

Thirty-four confirmed cases (39.5%) had at least one recorded comorbidity; hypertension (17.4%) and diabetes mellitus (10.5%) were most common (Table 4). Twenty-one cases (24.4%) were current smokers and eight (9.3%) reported a previous COVID-19 episode. Thirty-three cases (38.4%) had received at least one vaccine dose (21 one dose, 12 two doses); the median interval from the last dose to sample collection among vaccinated cases was 28 days (IQR 18–53), and four vaccinated cases had received their last dose less than 14 days before sampling. These figures describe vaccination status among confirmed cases and are not a measure of vaccine effectiveness.

Table 4
Selected clinical risk factors and vaccination status among confirmed cases (n = 86)

Characteristic	n	%
Hypertension	15	17.4
Diabetes mellitus	9	10.5
Asthma	5	5.8
Chronic obstructive pulmonary disease	3	3.5
Chronic kidney disease	3	3.5
Interstitial lung disease	2	2.3
Chronic liver disease	2	2.3
Cancer	1	1.2
Any comorbidity	34	39.5
Current smoking	21	24.4
Previous COVID-19 episode	8	9.3
Vaccinated (≥ 1 dose)	33	38.4
One dose	21	24.4
Two doses	12	14.0

Clinical outcomes at 14 days

At 14 days, 56 confirmed cases (65.1%; 95% CI 54.6–74.3) had remained in home isolation without escalation, comprising eight cases who were asymptomatic and 48 who were symptomatic at baseline. Fifteen (17.4%) were hospitalized without oxygen support, eight (9.3%) required oxygen-supported hospitalization, five (5.8%) required ICU care and two (2.3%; 95% CI 0.6–8.1) died, both in hospital; neither had been vaccinated or had a recorded comorbidity (Table 5, Fig. 3). Overall, 30 of 86 cases (34.9%; 95% CI 25.7–45.4) were hospitalized or died, and 15 (17.4%; 10.9–26.8) reached oxygen-supported hospitalization, ICU admission or death; the two deaths represent 6.7% of the 30 hospitalized cases. Among the 28 surviving hospitalized cases with documented length of stay, the median stay was six days (IQR 4–9.25; range 2–18). Hospitalization or death occurred in 14/33 vaccinated (42.4%) and 16/53 unvaccinated cases (30.2%; Fisher p = 0.26), and oxygen support, ICU or death in 6/33 (18.2%) and 9/53 (17.0%; p = 1.00) (Additional file 1: Table S3); numbers were too small for adjusted analysis.

Table 5
Fourteen-day outcomes among confirmed COVID-19 cases (n = 86)

Outcome	n	%	95% CI
Home isolation, asymptomatic at baseline	8	9.3	4.8–17.3
Home isolation, symptomatic at baseline	48	55.8	45.3–65.8
Hospitalization without oxygen support	15	17.4	10.9–26.8
Hospitalization with oxygen support	8	9.3	4.8–17.3
Hospitalization with ICU care	5	5.8	2.5–12.9
Death	2	2.3	0.6–8.1

Fourteen-day symptom course

Based on participant recall, reported symptom prevalence among the 84 survivors declined slowly during the first week and then fell sharply. On day 1, 75 survivors (89.3%) had at least one symptom, 63 (75.0%) on day 7, 38 (45.2%) on day 9, 26 (31.0%) on day 10 and 16 (19.0%) on day 11; no symptoms were recorded from day 12 to day 14 (Table 6, Fig. 4). Among the 75 survivors who were symptomatic on day 1, the median first symptom-free day was day 10 (IQR 8–11; range 2–12). Participant-reported symptom episodes lasted a median of 12 days (IQR 11–14; range 4–15) from onset to remission. The two cases who died had symptoms recorded until days 7 and 10 and were excluded from the daily denominators (date of death not recorded).

Table 6
Symptom status over the 14 days after sample collection among surviving confirmed cases (n = 84)

Day	Any symptom, n	Any symptom, %	Symptom-free, n	Symptom-free, %
1	75	89.3	9	10.7
2	74	88.1	10	11.9
3	74	88.1	10	11.9
4	73	86.9	11	13.1
5	70	83.3	14	16.7
6	67	79.8	17	20.2
7	63	75.0	21	25.0
8	55	65.5	29	34.5
9	38	45.2	46	54.8
10	26	31.0	58	69.0
11	16	19.0	68	81.0
12	0	0.0	84	100.0
13	0	0.0	84	100.0
14	0	0.0	84	100.0

Two cases who died (symptomatic until days 7 and 10) are excluded. Day 1 = date of sample collection. Symptom status is based on participant recall at interview.

Discussion

In this community-oriented sample of 320 people tested for suspected COVID-19 in six upazilas of Cumilla during April–May 2021, 26.9% tested positive. Symptomatic presentation and recent contact with a confirmed case were the strongest independent correlates of a positive test. Most confirmed cases were managed at home, but 34.9% were hospitalized or died within 14 days, and symptoms resolved in all survivors by day 12. At least one vaccine dose was recorded for 38.4% of cases and 51.7% of test-negative participants; the adjusted association with a positive test was imprecise and sensitive to specification.

The dominance of fever, cough, fatigue and body aches is consistent with early clinical reports from Bangladesh and elsewhere [4, 6, 7, 48, 49]. Loss of smell (29.1%) and taste (23.3%) were less frequent than fever and cough but occurred in about one in four cases. The current sample extends earlier hospital-based series [48, 49] to a setting that included home-managed cases.

Symptoms were strongly associated with a positive test, but they were a poor discriminator: specificity was 43.2% and the positive predictive value 37.0%, because more than half of test-negative participants also reported symptoms, while 9.3% of cases were asymptomatic. Symptom screening is therefore useful for prioritizing testing, with a high negative predictive value (92.7%), but not as a substitute for testing. Recent contact with a confirmed case was an independent correlate of positivity, consistent with respiratory transmission through close contact [14], but its sensitivity was only 42.7%, so a negative contact history should not exclude infection. Given the barriers to testing described in the literature [12] and the unequal distribution of testing and health-care capacity in South Asia [13], combining symptom assessment, exposure history and accessible testing remained important.

The 26.9% positivity should not be interpreted as community prevalence. Participants were tested because infection was suspected, 14.4% were registered contacts of confirmed cases, and positivity depends on testing criteria, transmission intensity, healthcare-seeking behaviour and timing. Mixed testing methods are a further consideration: 10.6% of participants were tested by rapid antigen, which is less sensitive than RT-PCR, so false-negative misclassification among antigen-tested participants cannot be excluded. Test method was not associated with positivity, and the main associations were similar in RT-PCR-only analyses.

Comorbidity was more frequent among confirmed cases in unadjusted analysis, but the association weakened after adjustment (aOR 1.57; 0.86–2.88). Hypertension and diabetes were the most common conditions, and these and other chronic conditions have repeatedly been linked to severe COVID-19 [5, 6, 8]. Comorbidity is better understood here as a marker of vulnerability after infection than as a determinant of acquiring infection, and the small number of severe outcomes precluded testing this directly.

Vaccination must be interpreted in its historical context. In April–May 2021 Bangladesh was still expanding a programme whose nationwide campaign had launched on 7 February 2021 and was constrained by supply interruptions [31, 32], and uptake was shaped by availability, registration, access, trust and hesitancy [33–37]. In our sample, 48.1% of participants reported at least one dose, a substantial proportion given national coverage at the time.

Participants who reported at least one dose had lower odds of testing positive (aOR 0.55; 0.31–0.97), and positivity was lowest among those with two doses (16.7%), but this estimate was not robust: the confidence interval included 1 in analyses restricted to RT-PCR-tested or symptomatic participants, when doses within 14 days of sampling were reclassified, with cluster-robust standard errors, and with upazila fixed effects (aOR 0.59; 0.33–1.06). Even if real, the association cannot be equated with vaccine effectiveness. Vaccination was not randomly assigned and may be correlated with exposure, healthcare-seeking and the likelihood of being tested; vaccine product and dose timing were incompletely captured; and the same selection mechanisms that govern who is tested apply to test-positive and test-negative participants alike [52]. The vaccine used in Bangladesh at that time, ChAdOx1, has shown high efficacy in trials [39] but reduced efficacy against Beta [45], and Beta (B.1.351) predominated among sequenced samples from south-western Bangladesh in March–April 2021 [47]. Our crude comparison of severe outcomes by vaccination status showed no difference, with wide uncertainty. Contemporaneous cohort studies and later test-negative analyses have shown substantial protection against severe disease, but with variation by regimen, time since vaccination and variant [40–44]; they cannot be used to retroactively attribute an effect size to this cohort.

The recorded vaccination data also raise plausibility concerns. Dates were retained as recorded, but six first doses were dated before the nationwide campaign began on 7 February 2021, and the recorded interval between doses (median 27.5 days; range 21–35; under 8 weeks for all 72 two-dose participants) was shorter than the 8–12-week schedule used in the national programme at the time. The proportion of participants recorded as vaccinated (48.1%) was far higher than national coverage, which may reflect prioritization of older adults, health workers and other groups, and selective testing. Dose-timing analyses should therefore be interpreted cautiously.

The reported 14-day course suggests that illness was not trivial for many. Symptom prevalence stayed above 75% through day 7 and fell steeply thereafter, with all survivors symptom-free by day 12. The abrupt end reflects that all participant-reported symptom episodes ended within 15 days of onset and that day 1 (sample collection) fell a few days after symptom onset; it should not be read as complete clinical recovery. Because symptoms were recalled about two weeks after the test result, the exact day of resolution is uncertain, and the findings are best read as an approximate pattern (symptoms lasting about 12 days from onset in most cases) rather than precise durations; hospital outcomes, by contrast, were checked against hospital records. In addition, symptom ascertainment was limited to 12 listed symptoms, hospitalized patients stayed up to 18 days, and post-acute symptoms were not assessed.

The proportion hospitalized or dead (34.9%) and the proportion needing oxygen, ICU care or dying (17.4%) are relevant for health-system planning, because severe COVID-19 strains oxygen supply, referral pathways and critical care. The in-hospital death proportion (2 of 30 hospitalized cases) was lower than the 9–10% reported in early hospital series from Dhaka [48, 49], although both estimates are imprecise, our cases were identified through testing rather than admission, and the periods differ. South Asian analyses have emphasized unequal distribution of health resources and the need to strengthen diagnostic and treatment capacity outside major urban centres [13].

The findings also underline the importance of trust and communication. Vaccine acceptance and preventive behaviour are influenced by perceived risk, confidence in services, misinformation and socioeconomic context [22, 33–36, 50], and improving access without clear communication that responds to local concerns may be insufficient.

Strengths include the combination of test-positive and test-negative participants from the same setting, a complete day-by-day 14-day symptom history for all confirmed cases, structured collection of vaccination dates and exposure history, and the inclusion of home-managed cases that hospital series omit. We also report the main associations with confidence intervals, adjusted models and sensitivity analyses.

Limitations

First, the observational design precludes causal conclusions about vaccination or other exposures; residual confounding by exposure, healthcare-seeking and the reasons for being tested is likely, and 86 cases limited the number of covariates. Second, participants were people who were tested, including 14.4% contact-tracing referrals, from six upazilas of one district, so results cannot be generalized to the general population or to other districts; participants were enrolled consecutively and the response rate was 66.7% (320/480), so people who could not be reached or declined may differ from those who participated. Third, 10.6% of participants were tested by rapid antigen rather than RT-PCR; the methods differ in performance, false-negative misclassification among antigen-tested participants cannot be excluded and no cycle-threshold data were available. Fourth, sociodemographic, exposure and symptom information was collected by telephone and relied on self-report; vaccination dates were taken as recorded and were in places implausible (dates preceding the start of the national campaign and dose intervals shorter than the national schedule), vaccine product was not recorded, and 16.2% of vaccinated participants had received their last dose less than 14 days before sampling. Fifth, no formal sample-size calculation was performed, which limits precision, and with only 15 severe outcomes and 2 deaths, outcome comparisons are imprecise, and with only six upazilas, cluster-robust standard errors are unreliable and were interpreted cautiously (upazila fixed effects were also examined). Sixth, the daily symptom history and outcomes were collected retrospectively at interview, a median of 15 days after the test result, and are therefore subject to recall error, particularly for the day-by-day timing of symptom resolution (hospital outcomes, by contrast, were checked against hospital records); the history covered 12 listed symptoms, did not capture post-acute symptoms, and entries after death were not counted. Seventh, the study reflects April–May 2021, before Delta predominance and during circulation of the Beta variant, with no genomic or cycle-threshold data; variants, population immunity, treatment and vaccination schedules have since changed, so the findings should be interpreted as a record of that period rather than generalized to later phases. Finally, many comparisons were exploratory, and some p-values were borderline.

Conclusions

In this early-rollout community sample, symptomatic presentation and recent contact with a confirmed case were the strongest independent correlates of a positive SARS-CoV-2 test, but symptom screening had low specificity, so laboratory testing remained

essential. Most confirmed cases reported being symptom-free within 12 days, yet about one in three was hospitalized or died within 14 days. A lower proportion of vaccinated participants tested positive, but this association was imprecise, sensitive to analytic choices and cannot be interpreted as vaccine effectiveness. The results support combining vaccination with accessible testing, timely recognition of clinical deterioration and effective referral systems in resource-constrained settings. Larger, geographically diverse studies with verified vaccination histories and adjusted analyses are needed.

Abbreviations

aOR
adjusted odds ratio
CI
confidence interval
COVID-19
coronavirus disease 2019
ICU
intensive care unit
IQR
interquartile range
OR
odds ratio
RT-PCR
reverse transcription polymerase chain reaction
SARS-CoV-2
severe acute respiratory syndrome coronavirus 2
SD
standard deviation
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
WHO
World Health Organization

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board/Ethics Review Committee of the Bangladesh Center for Health Studies (protocol number 2021/BCHS/IRB/0099; date of approval 6 January 2021). Verbal informed consent was obtained from all participants before the telephone interviews.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

QT, AI, and SAM contributed to the conceptualization and design of the study. IH, FS, AT, and AM contributed to data collection and data management. ZT, SER, AKD, and MAK contributed to data interpretation and critical review of the manuscript. SAM coordinated the manuscript preparation and served as the corresponding author. All authors reviewed and approved the final manuscript

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Data Availability

Data are available, including the R analysis code to the corresponding author upon request.

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Figures

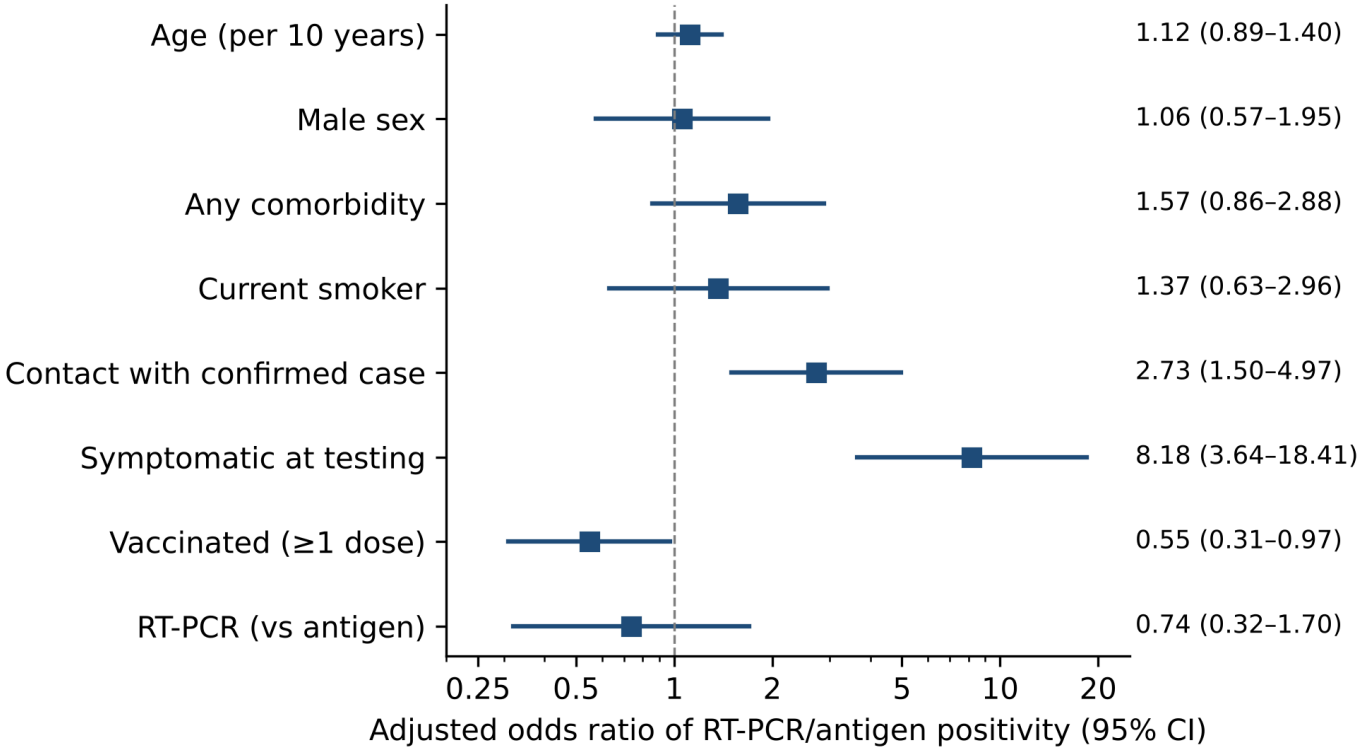


Figure 1

Adjusted odds ratios (95% CI) for factors associated with a positive SARS-CoV-2 test.

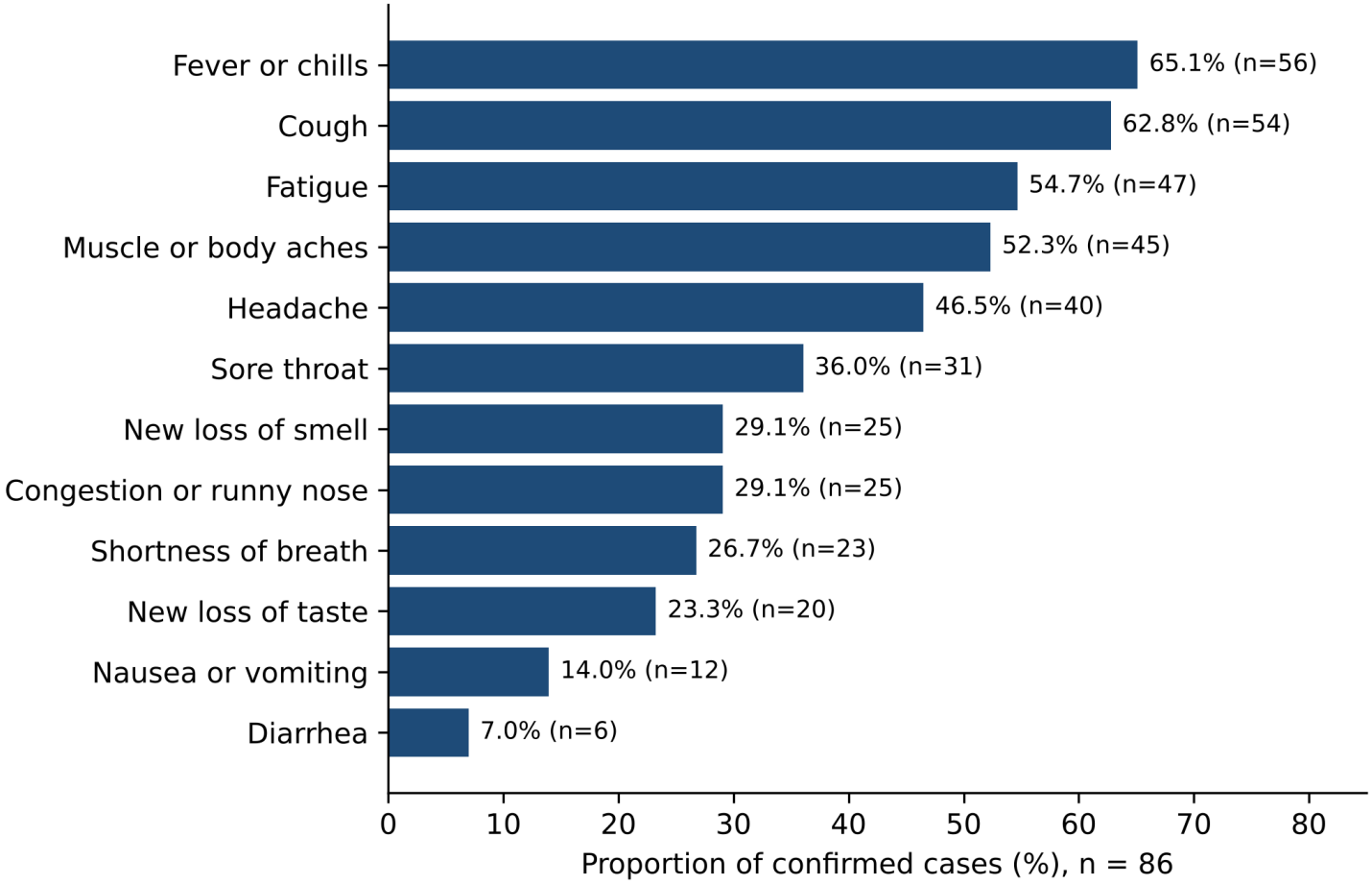


Figure 2

Prevalence of current symptoms among confirmed COVID-19 cases.

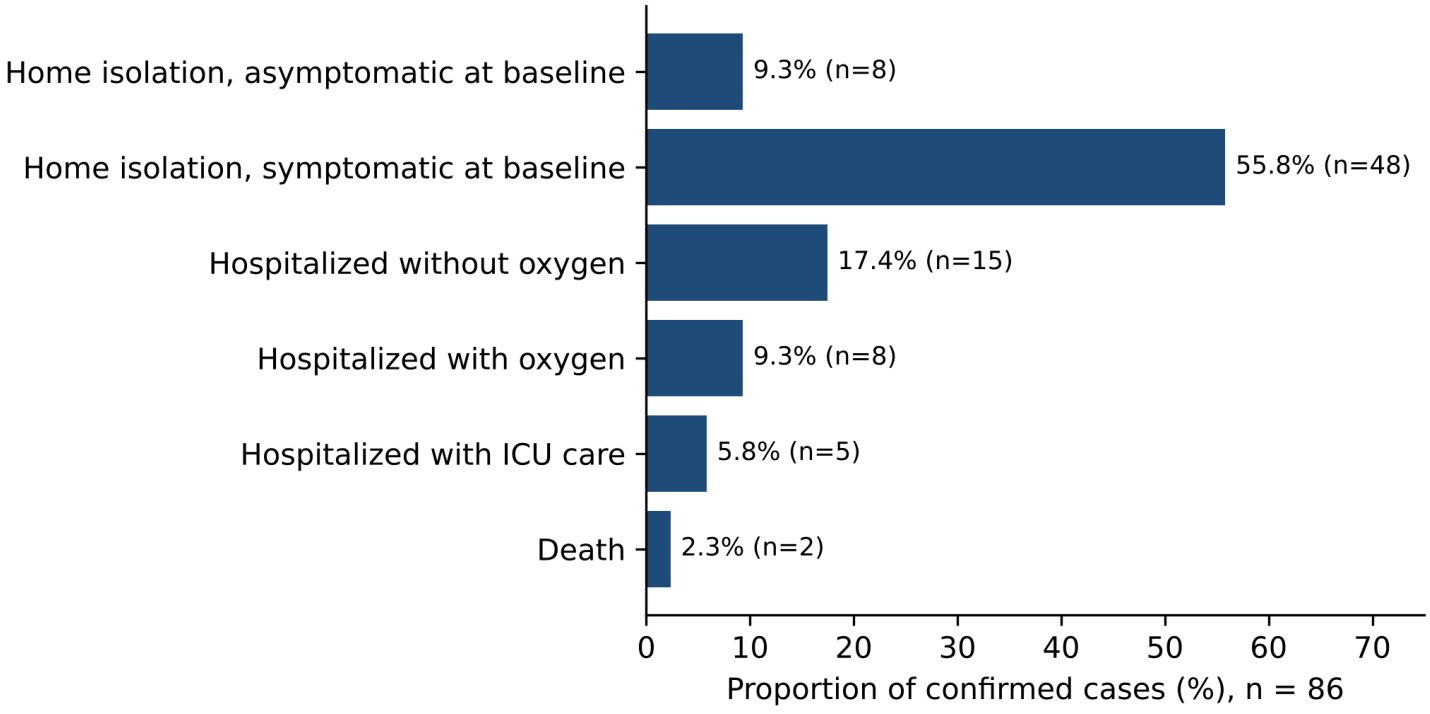


Figure 3

Distribution of 14-day clinical outcomes among confirmed COVID-19 cases.

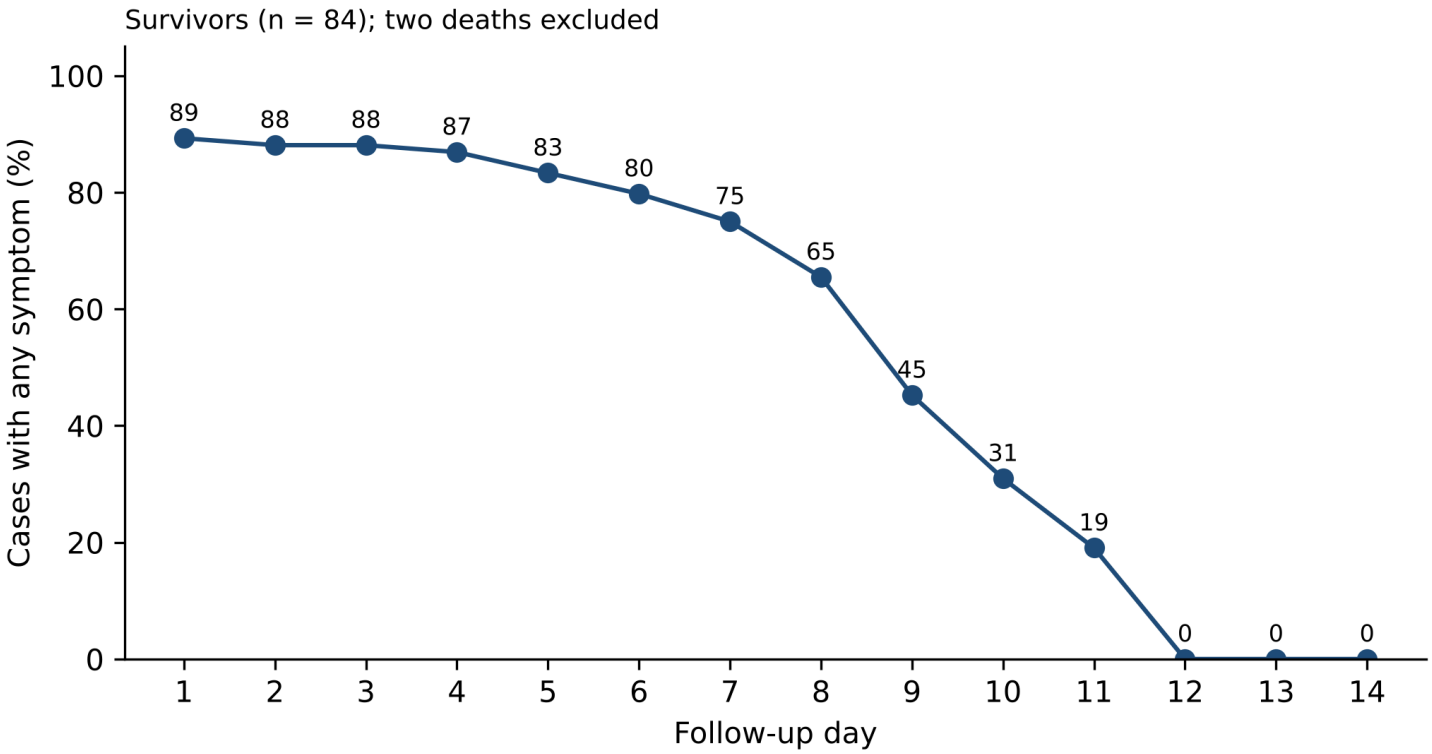


Figure 4

Change in symptom prevalence over the 14 days after sample collection among surviving confirmed cases.

Supplementary Files

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