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Infection dynamics of COVID-19 in children of Bangladesh

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Abstract

COVID-19 pandemic poses severe health-related threats where children are considered to be vulnerable due to the unavailability of vaccines under 12 years of age in Bangladesh for a long-time during the pandemic. Moreover, as children are not developing many severe symptoms, they did not get priority in empirical studies regarding their COVID-19 infection dynamics. Therefore, this web-based cross-sectional study was conducted aimed to explore the COVID-19 infection status and associated factors among the 372 children in Bangladesh by snowball sampling approach. Adjusted and Unadjusted Odds Ratio (95% CI) were calculated for the specified exposures and a multivariate logistic regression model was used for the analytical exploration. The study revealed that 53.5% of subjects were RT-PCR test positive and 12.9% test negative while 33.6% were found suspected/healthy who did not perform any confirmatory test. Among the asymptomatic cases, 9.4% found tested positive. In addition, children with mild (6.7%) moderate (7.3%), and severe (0.8%) symptoms did not undergo any test. Alarmingly, three of the 30 cases with severe symptoms were found not to do any confirmatory test and suffered much and needed oxygen or ventilation support. Test-positive infection status was found significant among the children with lower educated mothers (AOR/P= 2.74/0.05; 95% CI: 0.97- 7.67) and those who got contact with an unidentified source of infection (AOR/P=3.49/0.02; 95% CI: 1.22-9.98) or suspected family members (AOR/P=1.87/0.27; 95% CI: 0.62- 5.70). Finally, the unique findings portray an alarming scenario for the children in Bangladesh during the current pandemic. It indicates the reluctance of guardians which may be due to a lack of screening support from health care facilities. Policymakers need to be much more concerned about such issues through the implementation of specific intervention programs on the basis of empirical findings from the studies regarding such health problems. Therefore, the health security of children can be achieved and the fatal consequences of the recent pandemic may be combated through such strategies.

Keywords: Infection; dynamics; COVID-19; Children; Bangladesh

1. Introduction

Severe acute respiratory syndrome corona virus 2 (SARS-Cov-2) caused a most devastating pandemic named COVID-19 compared to other epidemics in the past centuries. Although a lot of preventive measures including vaccination has been availed, the burden of the disease is still posing such alarming threats among the human being globally and also causing a severe burden on healthcare services [1]. From the beginning one of the important strategies of halting transmission of COVID-19 was remaining the schools closed. As children are the most vulnerable group and it is difficult to maintain preventive measure by themselves in an effective manner, so that their schools remained closed for their health safety. COVID-19 status among the children in low- and middle-income countries including Bangladesh addressed some vital issues such as poor vaccination rates as well as mental health issues, domestic violence and child

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labor. Therefore, separate guidelines have been developed for the treatment purpose of pediatric patients with COVID-19 in Bangladesh. This is furthermore international guidelines developed to upgrade the management of children with COVID-19 in pediatric intensive care units in both high- and low-income countries [2]. Statement from four low- & middle-income countries (LMICs) with poor maternal, neonatal and children health evidence suggests that corona virus pandemic focused approach could lead to more than 30% additional maternal and newborn deaths due to declined access to appropriate essential services such as family planning, antenatal care and adequately supervised community and facility-based deliveries. Besides, current pandemic core approach is likely to cause additional public health crisis for mothers and children especially for the low- and middle-income countries by disrupting access to usual healthcare services [3]. Fortunately, children and adolescents tend to have more mild disease rather than adults. Most people who are infected with the SARS-CoV-2 virus have respiratory problem. They start to feel a little bit unwell, they will have a fever, and they may have a cough or a sore throat or sneeze.

There have also been concerns with the misinformation regarding the management of COVID-19. This includes issues with hydroxychloroquine, lopinavir/ritonavir, remdesivir and ivermectin, with robust studies notified limited clinical benefit, with that systematic reviews have suggested remdesivir can accelerate clinical betterment. Concerns with misinformation have resulted in groups, including the World Health Organization and the British Medical Journal, providing evidence-based guidance. Children in LMICs are suffer from other comorbidities like respiratory tract infections, including pneumonia as well as malnutrition and HIV, which may complicate the overall diagnosis of COVID-19 [4]. In the past, we had faced many constraints, but the human race could overcome those with inventions of vaccines, adopting appropriate policies and timely interventions. Children seem less susceptible to fatal infection caused by SARS-CoV-2 has yet to be spelled out. It has been theorized that the ACE2 (the binding protein for SARS-CoV-2) in children is not as functional as it is in adults, and so that SARS-CoV-2 is less infectious [5]. Pediatrics being an established area and it is already known that children are solitary in their requirement of fluid and electrolytes, oxygen delivery as well as medicinal dose. Indirectly COVID-19 outbreaks adversely affect the condition of children like disruption to their healthcare, nutrition, protection, education and overall mental wellbeing, vaccinations and preventive and curative services. Globally, in the pandemic era it was massively found that the level of knowledge plays an important role in enhancing the transmission of corona virus [6]. The primary reports of COVID-19 infection notify that the rarity of sickness in infants, including only 9 young people under the age of 14. It has been sort out that children with fluctuating degrees of severity are also affected by COVID-19. Epidemiological studies have consistently shown that children are at lower risk of producing severe side effects or opposing and adult simple sickness [7].

As there is a scarcity of available large data among the children regarding this issue our study was intended to explore a new dimension of COVID-19 infection status among the children along with the associated predictors. The valid outcome of this novel approach will facilitate the guidance for specific initiatives focusing the child health safety in the context of Bangladesh. The findings of the study may influence the government to undertake a sustainable policy with the aim to handle such sudden pandemic & its health-related issues among the children. In addition, it will also facilitate to update treatment guidelines with testing protocols.

2. Material and methods

2.1. Study design

This cross-sectional study was carried out during the epidemic situation of COVID-19 from August 2021 to September 2021 to delineate the infection dynamics among children of Bangladesh.

2.2. Study participants, sample size and sampling

A total of 372 subjects were recruited in this study following exponential non-discriminative snowball sampling strategy. The first respondent was recruited to the sample group provides multiple referrals. Each new referral was explored until primary data from sufficient number of samples were collected. Any member of a family with at least one child aged between 0 to 16 years and with at least one member diagnosed with COVID-19 were included in this study. The total sample was calculated by using the formula " $n = Z^2pq/d^2$ " where p (average infection rate of COVID-19) was considered 0.20 [8] and d was considered as 0.05. The final sample size was calculated as 372, where with the calculated number 246, 5% of non-reported cases, 40% of asymptomatic cases [9] and 5% of missing cases due to web-based data collection will be added.

2.3. Data collection

Data were gathered by self-administered method through using a structured and anonymous online questionnaire. Study information of anyone amongst the COVID-19 confirmed family members and anyone amongst the children of

that respective family was collected. The participants were invited electronically followed the social distancing recommendation by the Bangladesh Government to minimize face-to-face interaction among people. The web link of online survey was '<http://bd.healthsurvey.link/>' which took only 10 to 15 minutes to complete by the respondents.

2.4. Questionnaire design

The online questionnaire was developed by using Google forms. Prior to conduct the survey, the questionnaire was pretested among 10 respondents. Experience from the pre-testing was adjusted during finalization of the questionnaire. The questionnaire comprised of several segments: (i) identification of COVID-19 in children (ii) demographic information of both children and family: age, gender, parity, parental education, monthly family income & financial status (iii) information related to COVID-19 in children: contact history, diagnosis status, physical symptoms, level of severity of presentation, level of medical care (iv) information on co-morbidity status of children.

2.5. Data analysis

Data were entered, checked for quality, and analyzed utilizing the Statistical Package for the Social Sciences (SPSS) software, v.22. Study characteristics were subjected to descriptive statistics (frequency and proportions) to summarize the obtained data. A multinomial logistic regression analysis was performed, including pre-specified confounders age, gender, parental education, income, symptoms, co-morbidities and contact tracing. Adjusted Odds Ratio (AOR) and Unadjusted Odds Ratio (COR) with 95% confidence intervals (95% CI) with respect to COVID-19 status, i.e., COVID test positive, COVID test negative and suspected/ healthy test not done (Dummied the two groups: test positive in one group and test negative/suspected/ healthy test not done in another group) were calculated for the specified exposures. A Chi-square test was used to observe the association.

2.6. Ethical Considerations

The study complied with the Declaration of Helsinki and was approved by the Ethical Review Committee, Department of Public Health, Northern University Bangladesh, Dhaka, Bangladesh (memo no. NUB/DPH/EC/2021/06). Participation of the respondents was anonymous and voluntary. Written Informed consent was obtained from the parents or guardians of the respondents at the beginning point, as the age of the respondents was below 18 years. During the online data collection period, participants were allowed to provide data about their children after providing consent through the questionnaire link generated using google form.

3. Results

3.1. Participant's COVID-19 infection status

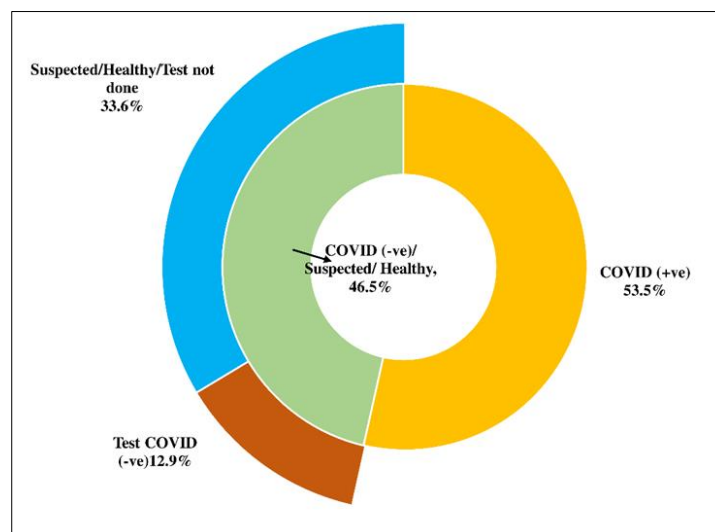


Figure 1 This is the COVID-19 infection status of the respondents (n= 372)

Data from over 372 respondents revealed that, more than half (53.5%) of them were tested (RT-PCR) positive for COVID-19 infection. However, 46.5% considered as COVID-19 test negative or suspected or healthy group among which,

12.9% were confirmed negative by RT-PCR test and rests (33.6%) found suspected or apparently in healthy state who did not perform any test for confirmation. (Figure 1)

3.2. Test status and severity of COVID-19 symptoms among respondents

Interestingly, study revealed a significant association between severity of clinical manifestations and RT-PCR test result among the respondents. It was surprising to observed that 9.4% (35/372) asymptomatic children and 23.4% (87/372) children with mild symptoms were tested RT-PCR positive. In addition, though having mild symptoms 6.7% (25/372) and moderate symptom 7.3% (27/372) subjects found to be reluctant in performing any confirmatory test. Most alarming fact was observed that, instead of having severe symptoms 3 (0.8%) respondents out of 30 did not do any test. Study revealed 7 COVID positive children were needed ICU support during treatment. In addition, 25 children required O₂ support for the recovery among which 23 found COVID positive infection. Moreover, 4 children needed mechanical ventilator support among which 3 found COVID-19 positive infection. (Figure 2)

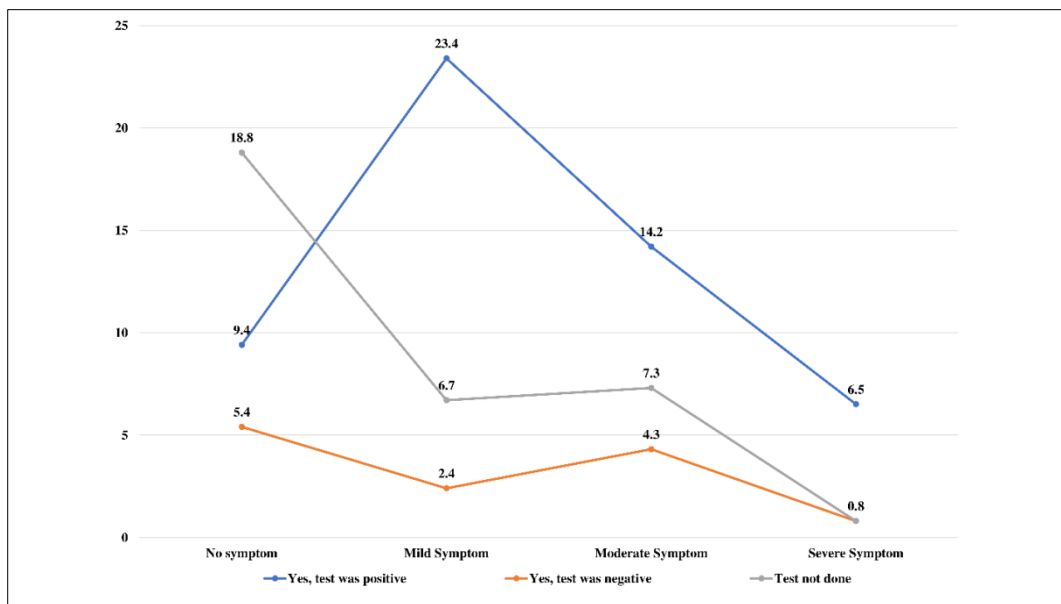


Figure 2 This is the COVID-19 Symptom status among the respondents (n=372)

3.3. Characteristics of the respondents determining COVID-19 infection status of the children

Results of multivariate (cross table) analysis revealed that out of 372 children, greater part of infected children were found from the age group 5-10 years. Exploring the proportion of children's infection status and performing confirmatory test, it was found that parental educational (Father's education, $p < 0.01$; Mother's education, $p < 0.01$) background plays a significant role on children's infection status through performing test. This present study shows that parents with primary level education (father's education 10.8% & mother's education 13.2%) reported more positive RT-PCR test result of their children (9.4% & 11.3% respectively) compared to other educational background. Here, majority of respondent's father and mother (72% & 41.4% respectively) were graduated and highest proportion of negative test result (38.2% and 23.7% respectively) were found among them compared to the other parents with other educational backgrounds. Moving towards economic status, more significant ($p < 0.01$) test negative report (24.2%) was observed among subjects from higher income group (42.2%). However, comparative scenario indicates that more positive test result found among the lower income groups (<BDT 25000 and BDT 25000 - <50000). Outcome of this study also shows that, symptomatic status of the children portrays a significant scenario with their test positive infection status. Here, majority of the children who developed mild (38.9%) and moderate (49%) symptoms were observed mostly tested RT-PCR positive (21.5% & 35.2% respectively), which shows a strong association ($p < 0.01$) as well. Furthermore, study revealed a significant ($p < 0.01$) association between RT-PCR test status and contact tracing of COVID-19. Likewise, proportion of positive test result found highest (38.5%) among children who came in contact with test positive family members (62.8%). It was more annoying to reveal that 17.4% test positive cases could not identify their source of infection as contact tracing (19.4%). This scenario suggests that special attention is needed even when children come in contact with any suspected or unidentified cases. (Table 1)

Table 1 Characteristics of the respondents determining children's COVID-19 infection status (n=372)

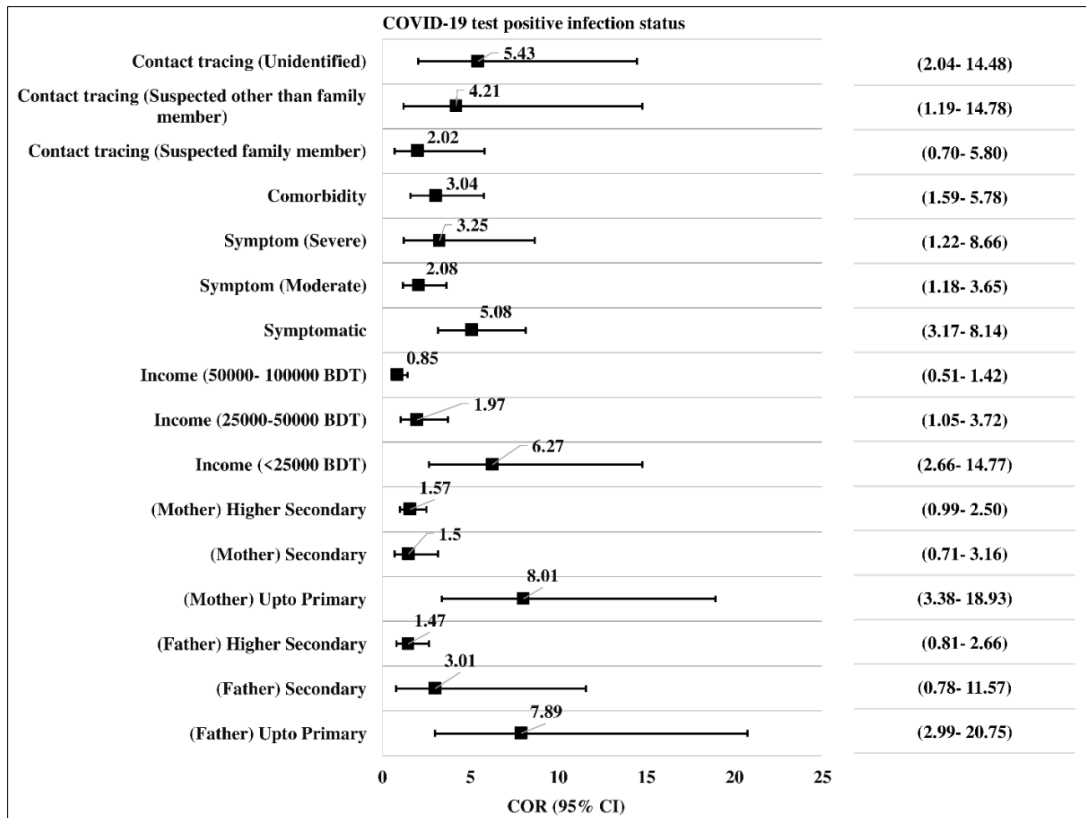
Characteristics	Number of participants n (%)	COVID-19 infection status		
		Test Positive n (%)	Suspected, Test negative and Healthy n (%)	p-value (≤ 0.05)
Age group				
0 - < 1month	18 (4.8)	14 (3.8)	4 (1.1)	0.09
1 month - <1 year	36 (9.7)	22 (5.9)	14 (3.8)	
1 year - <5 year	104 (28)	48 (12.9)	56 (15.1)	
5 year - <10 year	118 (31.7)	61 (16.4)	57 (15.3)	
10 year - <16 year	96 (25.8)	54 (14.5)	42 (11.3)	
Father's Education				
Primary	40 (10.8)	35 (9.4)	5 (1.3)	0.01*
Secondary	11 (3)	8 (2.2)	3 (0.8)	
Higher Secondary	53 (14.2)	30 (8.1)	23 (6.2)	
Graduation and above	268 (72)	126 (33.9)	142 (38.2)	
Mother's Education				
Primary	49 (13.2)	42 (11.3)	7 (1.9)	0.01*
Secondary	34 (9.1)	18 (4.8)	16 (4.3)	
Higher Secondary	135 (36.3)	73 (19.6)	62 (16.7)	
Graduation and above	154 (41.4)	66 (17.7)	88 (23.7)	
Monthly Family Income (BDT)				
<25000	52 (14)	44 (11.8)	8 (2.2)	0.01*
25000 - <50000	71 (19.1)	45 (12.1)	26 (7)	
50000 - <100000	157 (42.2)	67 (18)	90 (24.2)	
1000000 or more	92 (24.7)	43 (11.6)	49 (13.2)	
Existing Co morbidities				
Yes	56	42 (11.3)	14 (3.8)	0.01*
No	316	157 (42.2)	159 (42.7)	
Symptoms				
Asymptomatic	125 (33.6)	35 (9.4)	90 (24.2)	0.01*
Symptomatic	247 (66.4)	164 (44.1)	83 (22.3)	
Symptoms Types				
Mild	96 (38.9)	53 (21.5)	43 (17.4)	0.01*
Moderate	121 (49)	87 (35.2)	34 (13.8)	
Severe	30 (12.1)	24 (9.7)	6 (2.4)	
Contact tracing of COVID-19				
Test positive family member	155 (62.8)	95 (38.5)	60 (24.3)	0.01*

Suspected family member	21 (8.5)	16 (6.5)	5 (2)
Contact with suspected case other than family member	23 (9.3)	20 (8.1)	3 (1.2)
Unidentified source of infection	48 (19.4)	43 (17.4)	5 (2)

Data are presented as frequency (n), percentage (%); *Statistical significance at p value ≤0.05. Chi-square test was used to observe the association

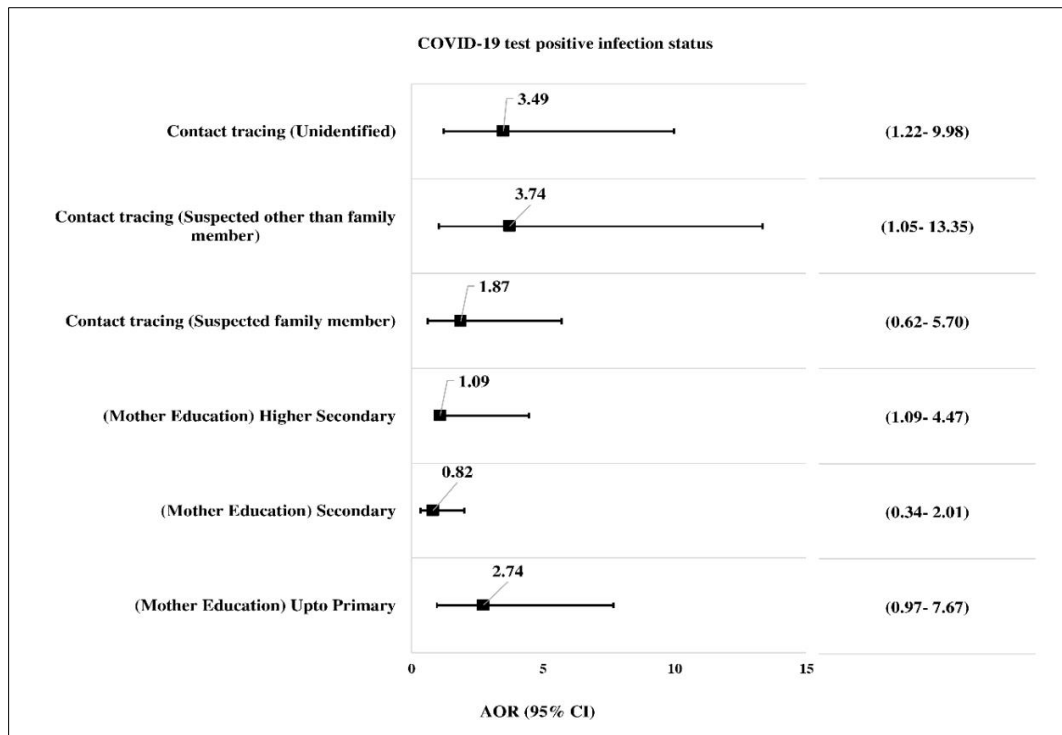
3.4. Predictors influencing the COVID-19 infection status of the respondents:

Initial binary regression analysis of this study revealed significant predictors associated with COVID-19 test positive infection status. Parents with lower educational quantification were more reluctant to carry out confirmatory test for COVID-19 of their children with higher odds compared to other parents. Two-fold greater odds with test positive infection status were found among the children whose parents had up to primary level education [Mother education (COR/p= 8.01/0.01; 95% CI: 3.38 - 18.93) & fathers' education (COR/p= 7.89/0.01; 95% CI: 2.99 - 20.75)] compared to others. Concerning economic status as predictor, significant higher odds for test positive infection of children was found among lower monthly income group (<25000 BDT) (COR/p= 6.27/0.01; 95% CI: 2.66 - 14.77). Observing clinical manifestation as predictors study reveals that, symptomatic children (COR/p= 5.08/0.01; 95% CI: 3.17 - 8.14) specially those who had severe symptoms (COR/p= 3.25/0.02; 95% CI: 1.22 - 8.66) and comorbidities (COR/p= 3.04/0.02; 95% CI: 1.59 - 5.78) were found to have significant test positive infection compare to other groups. Furthermore, predictors as contact tracing it was significantly found that, unknown source of infection (COR/p= 5.43/0.01; 95% CI: 2.04 - 14.48) had higher odd for positive infection status which is much alarming for the transmission of COVID-19. (Figure 3)



Statistically significant predictor is considered at p ≤0.05. Reference category for father's and mother's education is graduation/above, for monthly family income is 100000 BDT or more, for clinical symptoms is asymptomatic and mild symptom, for comorbidity status is no comorbidity and lastly for contact tracing is unidentified source of infection

Figure 3 Predictors influencing the COVID-19 infection status (COR) of the respondents (n=372)



Statistically significant predictors identified from the adjusted regression model at $p \leq 0.05$. Reference category for mother's education is graduation/above, and for contact tracing is unidentified source of infection

Figure 4 Predictors influencing the COVID-19 infection status (AOR) of the respondents. (n=372)

Once modelling was done along with backward elimination process study reveals that source of infection and mother's education proved to be significant predictors for RT-PCR positive infection status among the study subjects. Surprisingly, study revealed that children who came in contact with those suspected cases who were not their family members found more likely (AOR/p=3.74/0.04; 95% CI: 1.05-13.35) to be tested positive compare to other categories of contact tracing [Suspected family members (AOR/P=1.87/0.27; 95% CI: 0.62- 5.70) or unidentified source (AOR/P=3.49/0.02; 95% CI: 1.22-9.98)]. Furthermore; as significant predictor study also revealed mother's education plays a vital role for highest COVID-19 infection status among their children. Here, mothers up to primary level education identified as final significant predictor for their children's RT-PCR positive infection status (AOR/P=2.74/0.05; 95% CI: 0.97- 7.67). (Figure 4)

4. Discussion

The world is currently experiencing the several waves of coronavirus infection in an interval basis termed as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The severity of such devastating disease found higher among the adult group of population compared to children. That is why children group did not get much concern for enough research on COVID-19 infections among them as well as associated factor especially in Bangladesh. However, this group also suffering much and they are still vulnerable for any severe consequences of COVID-19 as they are not included in vaccination program yet. Although, it is observed that most of the COVID-19 infected children are asymptomatic or mild symptomatic, the consequences might be worse in nature and can link to many NCDs or associated risks in future [10]. That is why, a total of 372 subjects were recruited in our study following exponential non-discriminative snowball sampling method to sort out the COVID-19 infection dynamics among the Bangladeshi children.

Study revealed that, 53.5% children were tested (RT- PCR) positive for COVID-19. The alarming issue is that only few cases 12.9% found confirmed negative by test where a good number (33.6%) did not perform any test for confirmation instead of being suspected or having positive family member. A previous pilot study carried out in Bangladesh reported maximum (94.2%) cases found confirmed positive with RT-PCR test in eight private & public hospitals which is much higher in number from our study [11]. The findings of our study showed that all the suspected cases are not performing confirmatory tests due to the reluctance of their caregivers. However, every suspected case must need to go for under testing facility with the motivation of the parents too. Another study of our country showed that, as frontline worker 6% of mass-media professionals did not perform any RTP-CR test in spite of being symptomatic or suspected on COVID-

19 infection [9]. It's again proved that even an important area like mass media concerns are also reluctant to do the confirmatory test which might be a contributing factor towards the COVID-19 infection status among children.

Surprisingly, though having mild symptoms 6.7% (25/372) and moderate symptom 7.3% (27/372) subjects found not to be concerned enough in performing any confirmatory test. More intense scenario is that, instead of having severe symptoms 3 respondents out of 30 did not go through any confirmatory test. Other studies showed the frequency of RT-PCR positive cases among asymptomatic and symptomatic cases and severity among the confirmed cases [12,13]. From that point of view our study found the unique outcome as the mild moderate and severe cases who did not performed any COVID-19 confirmatory test. These crucial finding is much alarming for the health security of this vulnerable group & government needs to pose importance on early testing capacity among the both symptomatic and asymptomatic suspected cases with proper contact tracing scrutiny.

In the context of, proportion of children's infection status and their background characteristics study revealed that parent's educational background plays a significant role in children's infection status and performing test. Study shows that parents with primary level education (father's education 10.8% & mother's education 13.2%) reported more positive RT-PCR test result of their children (9.4% & 11.3% respectively) compared to other educational background. There is no such study found regarding parent's educational status & its effect on doing RT-PCR test among their children. Despite that, it has been observed parent's educational background imposes crucial effects on their children's mental health during COVID-19 pandemic [14]. Here, majority of the children who developed mild (38.9%) and moderate (49%) symptoms were observed mostly tested RT-PCR positive (21.5% & 35.2% respectively), which shows a strong association ($p < 0.01$) as well. Similarly, a study from Italy showed that, 98 (75.4%) had an asymptomatic or mild disease, 11 (8.5%) had moderate disease, 11 (8.5%) had a severe disease, and 9 (6.9%) had a critical presentation [15]. So, our findings are valuable regarding giving special attention in every case irrespectively with or without symptoms.

To explore the predictors, initial binary regression analysis was performed and study revealed lower parental educational status [Mother education (COR/p= 8.01/0.01; 95% CI: 3.38 - 18.93) & fathers' education (COR/p= 7.89/0.01; 95% CI: 2.99 - 20.75)], lower monthly income (<25000 BDT) (COR/p= 6.27/0.01; 95% CI: 2.66 - 14.77), severe symptoms (COR/p= 3.25/0.02; 95% CI: 1.22 - 8.66), comorbidities (COR/p= 3.04/0.02; 95% CI: 1.59 - 5.78) and unknown source of infection (COR/p= 5.43/0.01; 95% CI: 2.04 - 14.48) as the influential group where COVID-19 positive infection status found significant. Once modeling done, after elimination of the confounders study finally revealed that source of infection and mother's education proved to be significant triggering factors for RT-PCR positive infection status among the respondents. In other words, it was found that mothers up to primary level education identified as final significant predictor for their children's RT-PCR positive infection status (AOR/P=2.74/0.05; 95% CI: 0.97- 7.67). Though there is a lack of empirical studies regarding this scenario, it is observed in another studies that decisions for children (i.e. COVID-19 vaccination) can vary on mother's knowledge and awareness. For instance, study of Nigeria revealed that receiving COVID-19 vaccine among children was significantly associated with the believe of their mother (AOR = 4.0. 95% CI:1.8-8.7). They also analyzed that the odds of receiving the Covid-19 vaccine were six times greater in those who were aware of someone that died from COVID-19 than in those who did not know about anyone who died from COVID-19 (AOR = 5.7, 95% CI: 2.1-15.8) [16]. Here, globally it is clear that mother's knowledge and education plays a significant role in all issues regarding their children which explored in our study as doing RT-PCR for the confirmation among the study subjects. In this context, a study from our country showed that lower monthly income (AOR=3.74) found significant predictor for poor knowledge and poor behavior on prevention of COVID-19 which is alarming for the COVID-19 infection among their children too [17].

One of the key strengths of this study lies in the richness of strong data and a large number of factors considered. A comprehensive questionnaire helped us to collect range of data regarding various aspects of infection dynamics of COVID-19 among children especially those who did not go through any confirmatory test instead of having mild, moderate or severe symptoms of COVID-19 infection. The study was conducted in a short time frame and data was collected through online using a self-administered questionnaire based on snowball technique; all these are the limitations of this study. The empirical and unique findings of this study can guide future researchers for the other large-scale studies to find out the countrywide COVID-19 status among the children. We could not include a large number of data due to lack of resources, funding & mostly it was peak of pandemic. Further follow-up of this study findings incorporating the gaps is needed with extensive research as pandemic is still ongoing.

5. Conclusion

The crucial outcome of this study indicates an alarming scenario that, 33.6% Bangladeshi children are found not to perform test, though having symptoms of COVID-19 infection and significant number of children needed mechanical ventilator support for their recovery. Contact tracing could not be identified in a remarkable number of infected

children, which is alarming and indicates the intensity of their vulnerability for such infection. Still COVID-19 vaccines are not available for the children group. From this perspective, government or policymakers needs to be more conscious on considering the preventive measures especially for this vital group of the whole population who are not still getting much concern. Effective and efficient interventions need to be implemented for this group which is still lacks in Bangladesh. This study can be mounting plot for future extensive research on such issue to increase the health security of this group.

Compliance with ethical standards

Acknowledgments

We strongly acknowledge the study participants.

Disclosure of conflict of interest

The authors have declared that no competing interests exist.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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