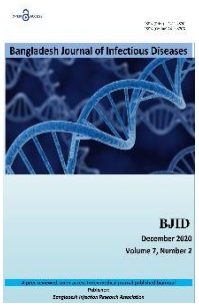
OPEN ACCESS Freely available online
http://www.banglajol.info/index.php/BJID/index
Original Article
Bangladesh Journal of Infectious Diseases
December 2021, Volume 8, Number 2, Page 75-81
ISSN (Online) 2411-670X
ISSN (Print) 2411-4820
DOI: https://doi.org/10.3329/bjid.v8i2.59633



Socio-Demographic Characteristics and Clinical Profiles of Children with Enteric Fever: Experience at a Tertiary Care Hospital of Bangladesh

Fahmida Zabeen[1], M. Quamrul Hassan[2], Chowdhury Farheen[3], Sabina Sultana[4], Abu Sayeed Mohammad Iqbal[5], Badrun Nessa[6], Sadia Khan[7], Najia Ferdoush[8], Farzana Nahid[9], M. Istiaque Hossain[10]

[1]Consultant, Pediatrics and Neonatology, Evercare Hospital, Dhaka, Bangladesh; [2]Senior Consultant, Pediatrics and Neonatology, Evercare Hospital, Dhaka, Bangladesh; [3]Project Physician, Urban Health Clinic Project, UNICEF, Dhaka, Bangladesh; [4]Senior Consultant, Pediatrics and Neonatology, Evercare Hospital, Dhaka, Bangladesh; [5]Senior Consultant, Pediatrics and Neonatology, Evercare Hospital, Dhaka, Bangladesh; [6]Associate Consultant, Pediatrics, Evercare Hospital, Dhaka, Bangladesh; [7]Associate Consultant, Pediatrics, Evercare Hospital, Dhaka, Bangladesh; [8]Associate Consultant, Pediatrics, Evercare Hospital, Dhaka, Bangladesh; [9]Clinical Associate, Pediatrics, Evercare Hospital, Dhaka, Bangladesh; [10]Senior Consultant, Pediatrics and Neonatology, Evercare Hospital, Dhaka, Bangladesh

[Received: 12 September 2021; **Accepted:** 3 November 2021; **Published:** 1 December 2021]

Abstract

Background: The clinical features are nonspecific, vary by community, and can be difficult to distinguish clinically from other febrile illnesses. **Objective:** The purpose of this study was to present the socio-demographic factors and clinical features of enteric fever in children. **Methodology:** This hospital-based cross-sectional study was conducted at the Department of Pediatrics in Evercare Hospital, Dhaka, Bangladesh from January 2014 to July 2018. It included 260 hospitalized children aged 2 months to 15 years with either positive blood culture (Salmonella typhi or paratyphi) or fourfold titre in Widal test. **Results:** Majority were under 5 with Female to male ratio of 1:0.9. About 65% household purified water by both boiling and filter; 32.7% children took outside food. Above 94% children did not receive typhoid vaccine while 90% parents lack knowledge about the vaccination. Highest prevalence of enteric fever recorded in the month of May- October. The commonest symptoms were fever, diarrhea, abdominal pain and anorexia; coated tongue and hepatomegaly were prominent signs. **Conclusion:** Enteric fever mostly affects under-5 children and lacks specific symptoms and signs with peak prevalence in May to October. [*Bangladesh Journal of Infectious Diseases, December 2021;8(2):75-81]*

Keywords: Enteric fever; children; urban; Bangladesh

Correspondence: Dr. Fahmida Zabeen, Consultant, Department of Pediatrics and Neonatology, Evercare Hospital, Dhaka, Bangladesh; **Email:** fahmida.zabeen@hotmail.com; **Cell no.:** +88 01713445281; **ORCID ID:** https://orcid.org/0000-0002-3523-7273.
Conflict of interest: The authors declares that they have no competing interests
Funding agency: No
Contribution to authors: FZ: Conceptualization, collecting data, literature search and writing manuscript; MQH: Conceptualization and editing; CF: Literature search and writing manuscript; SS, ASMI, BN, SK, NF, FN, MIH: Review and editing
How to cite this article: Zabeen F, Hassan MQ, Farheen C, Sultana S, Iqbal ASM, Nessa B, Khan S, Ferdoush N, Nahid F, Hossain MI. Socio-Demographic Characteristics and Clinical Profiles of Children with Enteric Fever: Experience at a Tertiary Care Hospital of Bangladesh. Bangladesh J Infect Dis 2021;8(2):75-81

Introduction

High incidence of *Salmonella* infections is still lingering in developing countries, offering a constant challenge to healthcare professionals. Typhoid and paratyphoid fevers are typically known as enteric fevers causing systemic infection with the *Salmonella enterica* subspecies serovars Typhi and Paratyphi A, B, and C[1]. *Salmonella* Typhi is estimated to cause 76.0% of enteric fever globally[2]. The organisms are transmitted by direct contact with the feces of an infected individual[3]. When this bacterium enters the circulation; it invades numerous organs, including the digestive system, before being eliminated in infected people's feces. After one to two weeks, symptoms such as headache, fever, splenomegaly, stomach pain, relative bradycardia, and leucopenia appear, and they can last up to six weeks. Patients may also have body aches, constipation, diarrhea, and a lack of appetite, which, if left untreated, can result in intestinal perforation or bleeding[4].

Blood culture is the most effective way to confirm a diagnosis by isolating the pathogen. A systemic literature review revealed that blood culture and sensitivity possess only 61.0% sensitivity for enteric fever detection[5]. A negative blood culture does not rule out the possibility of enteric fever. This poor sensitivity may be caused by age, antibiotic pre-treatment, fever duration, a small sample volume, and a low circulating bacterial load in the blood[6–8]. Blood culture is most sensitive in the 1st week of illness and becomes less effective with the advancement of the disease[9].

The Widal test is a serological test that detects antibodies against the pathogen. These serological tests depend on the rising antibody titer in paired samples at an interval of 10 to 14 days[10]. Up to 30.0% cases of enteric fever cases can be false negative even after being culture-positive due to the poor specificity of the test[11]. This test is widely used in Bangladesh due to its cost-effectiveness.

Enteric fever is endemic across the Indian subcontinent, the Middle East, and South Asia[12]. Despite advances in reducing enteric fever in various regions of the world, the disease continues to be a significant public health concern in South Asia. Each year, over seven million individuals in South Asia are infected, with approximately 75,000 deaths[13]. The global case fatality rate from enteric fever is 0.95 (95% CI 0.54 to 1.53), with higher estimates for children, the elderly, and those living in low-income countries[1]. Bangladesh and other lower-middle-income nations suffer the most due to improper WASH (water access, sanitation, and hygiene) practices and the intake of unsafe/contaminated street food from roadside vendors[14]. A study conducted in an urban slum of Bangladesh showed that children of preschool age are 8.9 times more prone to *Salmonella* Typhi infection than adults in highly disease-endemic areas[15]. While there is no enough research conducted on hospitalized children in any super-specialized facility till now. Hence, Tis present study was undertaken to find out the factors associated with the enteric fever and age-specific clinical profile of children in a super specialized tertiary hospital.

Methodology

Study Settings and Population: This is a cross sectional study conducted at pediatrics department of Evercare hospital, Dhaka. Evercare is 425 seated super specialized tertiary care hospital. Data collection started from January 2014 and continued up to July 2018. We selected a total number of 260 admitted children who had either confirmed blood culture either *Salmonella typhi* or *Salmonella paratyphi* or positive Widal agglutination test on blood serology with the age between 2 months to less than 15 years and patient who gave informed consent to participate in the study.

Data collection tool: A semi structured questionnaire was developed. Variables like age, sex, residence, socioeconomic status, water purifying system, vaccination status of children and family members, food source of affected children, knowledge of parents about typhoid fever and immunization schedule and sign symptoms of the enteric fever included into the study. A pilot study was conducted in the same department for 20 patients before commencement of data collection.

Blood Culture Procedure: About 5 to 10 ml blood was withdrawn under sterile precaution and transferred to the lab within 2-4 hours of the collection. Specimens were processed by using standard methods with in-tube lysis centrifugation plated on blood and MacConkey agar and incubated at 37°C for 16 to 18 hours. *Salmonella Typhi* and paratyphi isolated from blood culture media considered as confirmed enteric fever case.

Widal Agglutination Test: Blood was taken from the patient under sterile conditions and put in a slide. It was combined with antisera and agglutination was observed. The Widal test is an

agglutination test that detects antibodies (agglutinins) against two antigens (O & H) of the bacterium Salmonella enterica in a blood sample. When a particulate antigen interacts with its antibody in the presence of optimal circumstances for antigen-antibody interaction, a visible clumping of particles occurs. The antigens utilized in the test include Salmonella Typhi antigens "H" and "O," as well as S. paratyphi antigen "H." A fourfold increase in antibody titer indicates a positive case of enteric fever.

Statistical Analysis: Data was entered in Excel 2010 then analyzed in software of IBM Statistical Package for the Social Sciences (SPSS), version 26. Frequency and percentages were done for the socio demographic and other variables. Chi square test was used to see the association of clinical feature and age. P-Value < 0.05 was considered statistically significant.

Ethical Consideration: The study participant was under the age of 18 years, so parents were explained briefly for the purposes of the study's objectives and method. Informed consent was obtained from their parents, and interviews were held maintaining privacy and confidentiality. Study was approved by the Ethical Review Committee of Ever Care Hospital.

Results

This study was performed on 260 confirmed enteric fever patients with age between 2 months to 15 years.

Table 1: Distribution of Study Participants by Mode of Diagnosis (n=260)

Mode of Diagnosis	Frequency	Percent
Culture Positive	96	36.9
Widal Test Positive	89	34.2
Both Tests Positive	75	28.8

The socio-demographic characteristics of the patient showed about half the children belong to the under 5years age group. More than half of the children in our study were female. Nine out of ten children were from urban areas. Nearly sixty percent of the participants were from the family with monthly salary above 1 lac, followed by 50,000 to 1 lac (41.2%) and less than 50,000 (1.5%) (Table 2). The parents' knowledge about enteric fever, its possible transmission route and vaccination knowledge were recorded.

Table 2: Distribution of Children by Socio-Demographic Profiles

Variables	Frequency	Percent
Age Group		
• Less Than 5 years	129	49.6
• 5 to 10 years	79	30.4
• 11 to 15years	52	20.0
Gender		
• Male	124	47.7
• Female	136	52.3
Ratio	1:1.1	
Residence		
• Urban	242	93.1
• Rural	18	6.9
Monthly Income (Taka)		
• More Than 100,000	149	57.3
• 50,000 to 100,000	107	41.2
• Less Than 50,000	4	1.5

Majority (93.8%) of the parents had knowledge about what enteric fever is. Half of the parents were unaware about the transmission process and majority (85%) mentioned outside food as the source of the disease.

Table 3: Parents' Knowledge and Practice on Prevention of Enteric Fever

Variables	Frequency	Percent
Parents' Correct Knowledge on		
What is Enteric Fever		
• Yes	244	93.80
• No	16	6.20
How Enteric Fever Spreads?		
• Yes	130	50
• No	130	50
Food as a Probable Source		
• Outside food	85	32.7
• Street food	8	3.10
• Don't know	167	64.2
Vaccine against Enteric Fever Exists		
• Yes	27	10.4
• No	233	89.6
Vaccine Needs to repeat		
• Yes	3	1.2
• No	257	98.8
Parents' Water Purification Practice in House		
• Boiling	60	23
• Filter	29	11.2
• Boiling and Filter	169	65
• Others (Unsure)	02	0.8

Most (90.0%) of the parents had no knowledge about the typhoid vaccination and very few (1.0%) parents were aware about the repeat dose of vaccination.

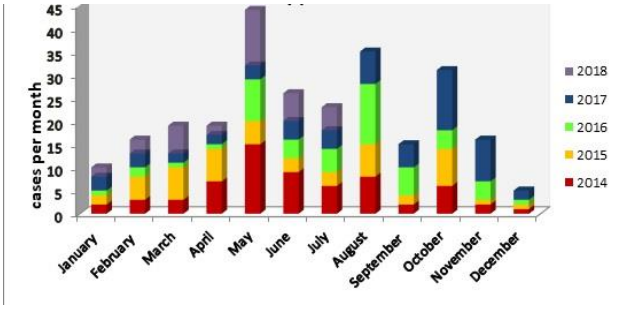


Figure I: Monthly Distribution of Enteric Fever Cases over Study Period

The majority of the participants (65.0%) purified their drinking water by both boiling & filtering, whereas only 23.0% and 11.2% had followed the boiling and filtering method respectively for purifying drinking water at home (Table 3). In figure I, this chart is demonstrating the trends of enteric fever with seasonal variation from the year of 2014 (Jan) to 2018 (July). In this study it is evident that enteric fever is highly prevalent around the month of May and October. Data regarding clinical presentations among different age categories of children is presented in table 4. All the participants reported fever; most of them were suffering from high grade fever (>103^0 F) of different duration. Children less than five years were mostly presented with high grade fever (64.3%), poor feeding (67.4%), coated tongue (52.7%) and hepatomegaly (79.1%). Whereas children of 5 to 10 years had frequently reported fever (65.0%), abdominal pain (42.0%), vomiting (49.4%) and on examination 66.0% and 60.0% children had hepatomegaly and epigastric tenderness respectively.

Table 4: Distribution of Children with Enteric Fever by Age and Clinical Features

Variables	Age Group			P value
	<5 Years (n=129)	5 to 10 Years (n=79)	11 to 15 Years (n=52)	
Fever				
• Up to 103F	46(35.7)	28(35.4)	10(19.2)	0.08
• More than 103F	83(64.3)	51(64.6)	42(80.8)	
Clinical Features				
Fever Duration before Admission				
• 1 to 10 Days	114(88.4)	75(94.9)	46(88.5)	0.38
• 11 to 20 Days	13(10.1)	4(5.1)	6(11.5)	
• 21 to 30 Days	2(1.6)	-	-	
Body ache	2(1.60)	3(3.80)	5 (9.60)	0.04*
Diarrhea	49(38.0)	32(40.5)	20 (38.5)	0.94
Constipation	9 (7.0)	5(6.30)	1(1.90)	0.41
Abdominal pain	31(24.0)	33(41.8)	17(32.7)	0.03*
Nausea	14(10.9)	23(29.1)	19(36.5)	0.001*
Vomiting	47(36.4)	39(49.4)	22(42.3)	0.19
Poor feeding	87(67.4)	50(63.3)	33(63.5)	0.79
Generalized weakness	8(6.2)	5(6.3)	9(17.3)	0.04*
Cough	45(34.9)	29(36.7)	15(28.8)	0.64
Cold	26(20.2)	12(15.2)	4(7.7)	0.12
Coated tongue	68(52.7)	39(49.4)	38(73.1)	0.02*
Hepatomegaly	102(79.1)	52(65.8)	35(67.3)	0.07
Splenomegaly	9(7.0)	6(7.6)	5(9.6)	0.83
Hepatic tenderness	26(20.2)	25(31.6)	16(30.8)	0.12
Epigastric tenderness	63(48.8)	47(59.5)	35(67.3)	0.06
Rash	4(3.1)	2(2.5)	5(9.6)	0.01*
Hospital Stay in duration				
Mean ±SD (Days)	6.0±1.66			

Among 11 to 15years age group high grade fever (81%), coated tongue (73.1%), poor feeding (63.5%), epigastric tenderness (63.1%) found. The average staying duration in hospital was 6days. There was significant association found with body ache, abdominal pain, nausea, weakness, coated tongue and rash (Table 4).

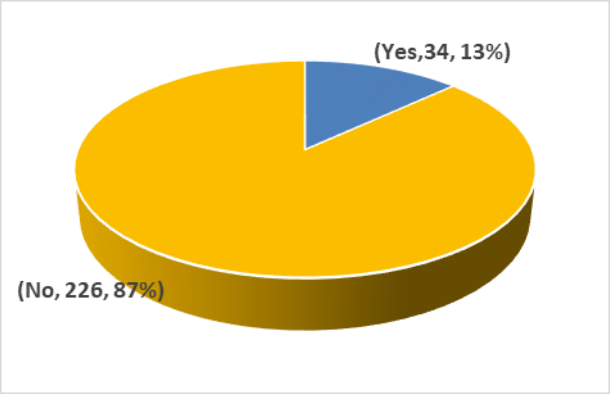


Figure II: History of Enteric Fever among Study Population (n=260)

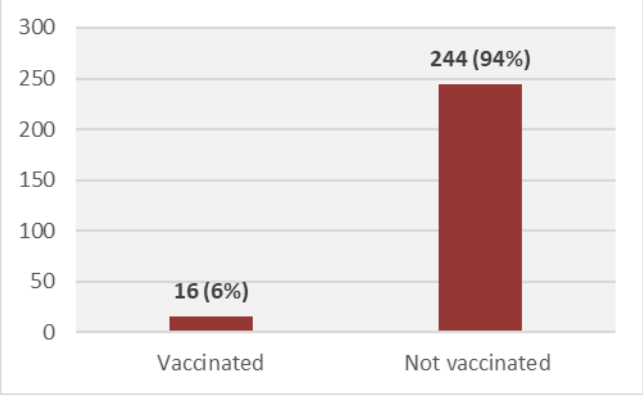


Figure III: Typhoid Vaccination Status of Study Subjects (n=260)

Figure II and III showing the data of past history of enteric fever and typhoid fever vaccination status of our study subjects respectively. In this study, 13.0% children had previous history of enteric fever and 94.0% never received typhoid vaccination.

Discussion

Enteric fever still considered as serious public health concern in Bangladesh despite of significant development in the country. In this study, we observed that half of the children with enteric fever were under the age of five. Typhoid affects children disproportionately, with the peak incidence rate reported in 5-year-old children[16]. Hospital-based research in Delhi found comparable outcomes where 44.0% of children were under the age of five. In Africa, the least number of instances (24.0%) was seen in those aged under 5 years, followed by 36.0% in those aged 5 to 9 years. This variation reflects the difficulties of detecting enteric fever in children. The high number of other non-specific diseases in this age range, the difficulty in collecting appropriate quantities of blood for culture, the impact of breastfeeding and vaccination status on immunity might contribute to the heterogeneity in diagnosis among children[17].

In this study, we found that females were predominantly suffering from enteric fever than the male. In comparison, another finding revealed that the number of male patients was higher (54.5 %) in their study[18]. The present study demonstrates that enteric fever affected a small number of persons from rural areas with poor socioeconomic status. A similar conclusion was found in a research, in which 87.2% of participants were from the urban area and 44.0% of patients suffering from enteric fever belonged to the upper class[19]. According to another study, enteric fever is highly endemic in urban communities[20]. This ambiguity may be due to almost all the previous studies being urban-based. Furthermore, this study was carried out at a private hospital, where a significant proportion of patients came from privileged backgrounds. It could be another reason why children were affected by enteric fever in urban than in rural regions[19].

This research also found that 65.0% of affected children treated drinking water by both boiling and filtering. Unsafe and contaminated water is one of the risk factors of enteric fever. It is proven in a study that improving chlorination of the municipal water supply or disinfecting drinking water at the household level may dramatically reduce the risk of enteric fever[21]. So, in this study, water purification may not be the only source of contamination among children. While asking parents about the probable food source, most of them were unsure. On the other side, 33% reported having food from outside. Research in Chittagong found that wet food and poultry products had been predominantly infected with salmonella[22]. A study in Pakistan revealed that 9.1% cases of street food handlers carry *Salmonella*[23]. So outside food can be the source of infection in some cases.

In this study, seasonal variation was quite evident. The majority of the cases were recorded between May to October. A study found similar findings where the peak season May to October[16]. Another study also revealed that December to February had low case prevalence. They also discovered that the

monsoon (June to October) enhances the spread of water-borne diseases into surface water[24].

It is always difficult to diagnose enteric fever in children because of many other non-specific childhood illnesses at this age. In our study, all 260 children presented with fever where the majority of them were suffering from high-grade fever (>103^0 F). A similar finding was identified by Sinha et al. children less than five years were less symptomatic than the younger and older children[25]. A systemic analysis in 2015 revealed that older children had (5 to 10 years) more classical features than the younger children. Similar to our study finding, hepatomegaly (50.0%) is the most prominent feature in the 0 to 5years age group[26].

In the present study, only 6.2% of children took the typhoid vaccine. Furthermore, most of the parents knew enteric fever but on the contrary minority of parents had very little knowledge about the vaccine. A study in Nepal comparable to our finding suggested that 82.0% of parents knew what enteric fever is but the majority (82.0%) were unaware of the typhoid vaccine[27].

There are few limitations of this study. Despite having a good sample size, this present study has some limitations including cross-sectional design as well as being a single-centered study in an urban tertiary care hospital. Hence, the result may not reflect the national scenario of this endemic infection. Still, the results highlight the important aspects of the disease and need for some well-designed multi centered national study.

Conclusion

In conclusion enteric fever is endemic throughout the year with high prevalence from May to October. Under-5 children are mostly affected. The disease lacks specific symptoms and signs for clinical diagnosis and hence, suspicion and laboratory support are essential. There are gaps in knowledge and practice among the public on healthy food and hygiene practice as well as on use of vaccination to prevent enteric fever. Focused health education on food safety, food hygiene, safe drinking water and vaccine is essential for prevention of this endemic disease. Availability of free or subsidized vaccine throughout the country should be a cost-effective national strategy to reduce burden of the disease.

References

1. Stanaway JD, Reiner RC, Blacker BF, Goldberg EM, Khalil IA, Troeger CE, et al. The global burden of typhoid and paratyphoid fevers: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet Infectious Diseases. 2019;19(4):369-81.
2. Basnyat B, Qamar FN, Rupali P, Ahmed T, Parry CM. Clinical update: Enteric fever. The BMJ. 2021;372.
3. Akullian A, Ng'eno E, Matheson AI, Cosmas L, Macharia D, Fields B, et al. Environmental transmission of typhoid fever in an urban slum. PLoS Neglected Tropical Diseases. 2015;9(12):e0004212.
4. Talwani R, Gilliam BL, Howell C. Infectious diseases and the liver. Clinics in liver disease. 2011;15(1):111-30.
5. Mogasale V, Ramani E, Mogasale VV, Park J. What proportion of Salmonella Typhi cases are detected by blood culture? A systematic literature review. Annals of clinical microbiology and antimicrobials. 2016;15(1):1-8.
6. Wain J, Diep TS, Ho VA, Walsh AM, Hoa NT, Parry CM, White NJ. Quantitation of bacteria in blood of typhoid fever patients and relationship between counts and clinical features, transmissibility, and antibiotic resistance. Journal of clinical microbiology. 1998;36(6):1683-7.
7. Antillon M, Saad NJ, Baker S, Pollard AJ, Pitzer VE. The relationship between blood sample volume and diagnostic sensitivity of blood culture for typhoid and paratyphoid fever: a systematic review and meta-analysis. The Journal of Infectious Diseases. 2018;218(suppl_4):S255-67.
8. Voysey M, Pant D, Shakya M, Liu X, Colin-Jones R, Theiss-Nyland K, et al. Under-detection of blood culture-positive enteric fever cases: the impact of missing data and methods for adjusting incidence estimates. PLoS Neglected Tropical Diseases. 2020;14(1):e0007805.
9. Ananthanarayan R, Panikar CJ. Ananthnarayana Microbiology.7th edition. Chennai: Orient Longman Private Limited; 2005
10. Parry CM, Hoa NT, Diep TS, Wain J, Chinh NT, Vinh H, et al. Value of a single-tube Widal test in diagnosis of typhoid fever in Vietnam. Journal of clinical microbiology. 1999;37(9):2882-6.
11. Olopoenia LA, King AL. Widal agglutination test− 100 years later: still plagued by controversy. Postgraduate medical journal. 2000;76(892):80-4.
12. Essa F, Hussain SZ, Batool D, Usman A, Khalid U, Yaqoob U, et al. Study of Socio-Demographic Factors Affecting the Prevalence of Typhoid. Annals of Medical and Health Sciences Research. 2019;9(1).
13. Mogasale V, Maskery B, Ochiai RL, Lee JS, Mogasale VV, Ramani E, et al. Burden of typhoid fever in low-income and middle-income countries: a systematic, literature-based update with risk-factor adjustment. The Lancet Global health. 2014;2(10):e570-80.
14. Saha S, Uddin MJ, Islam M, Das RC, Garrett D, Saha SK. Enteric fever cases in the two largest pediatric hospitals of Bangladesh: 2013–2014. The Journal of Infectious Diseases. 2018;218(suppl_4):S195-200.
15. Brooks WA, Hossain A, Goswami D, Sharmeen AT, Nahar K, Alam K, et al. Bacteremic typhoid fever in children in an urban slum, Bangladesh. Emerging infectious diseases. 2005;11(2):326.
16. Saha SK, Baqui AH, Hanif M, Darmstadt GL, Ruhulamin M, Nagatake T, et al. Typhoid fever in Bangladesh: implications for vaccination policy. The Pediatric infectious disease journal. 2001;20(5):521-4.
17. Britto C, Pollard AJ, Voysey M, Blohmke CJ. An appraisal of the clinical features of pediatric enteric fever: systematic review and meta-analysis of the age-stratified disease occurrence. Clinical Infectious Diseases. 2017;64(11):1604-11.
18. Saha S, Saha S, Das RC, Faruque AS, Salam MA, Islam M, et al. Enteric fever and related contextual factors in Bangladesh. The American Journal of Tropical Medicine and Hygiene. 2018;99(3 Suppl):20.

19. Rahman SM, Akter A, Mostary KF, Ferdousi S, Ummon IJ, Mubdi-Un-Naafi S, et al. Assessment of knowledge, attitudes and practices towards prevention of coronavirus disease (COVID-19) among Bangladeshi population. Bangladesh Medical Research Council Bulletin. 2020;46(2):73-82.
20. Naheed A, Ram PK, Brooks WA, Hossain MA, Parsons MB, Talukder KA, et al. Burden of typhoid and paratyphoid fever in a densely populated urban community, Dhaka, Bangladesh. International Journal of Infectious Diseases. 2010;14:e93-9.
21. Ram PK, Naheed A, Brooks WA, Hossain MA, Mintz ED, Breiman RF, et al. Risk factors for typhoid fever in a slum in Dhaka, Bangladesh. Epidemiology & Infection. 2007;135(3):458-65.
22. Khan MS, Haque MR, Jhorna DE, Begum MR. Contamination of street food by Salmonella in Chittagong City. Journal of Food Science and Technology Nepal. 2013;8:81-3.
23. Siddiqui TR, Bibi S, Mustufa MA, Ayaz SM, Khan A. High prevalence of typhoidal Salmonella enterica serovars excreting food handlers in Karachi-Pakistan: a probable factor for regional typhoid endemicity. Journal of Health, Population and Nutrition. 2015;33(1):1-9.
24. Dewan AM, Corner R, Hashizume M, Ongee ET. Typhoid fever and its association with environmental factors in the Dhaka metropolitan area of Bangladesh: a spatial and time-series approach. PLoS Neglected Tropical Diseases. 2013;7(1):e1998.
25. Sinha A, Sazawal S, Kumar R, Sood S, Reddaiah VP, Singh B, et al. Typhoid fever in children aged less than 5 years. The Lancet. 1999;354(9180):734-7.
26. Azmatullah A, Qamar FN, Thaver D, Zaidi AK, Bhutta ZA. Systematic review of the global epidemiology, clinical and laboratory profile of enteric fever. Journal of global health. 2015;5(2).
27. Das S. Knowledge Regarding Typhoid Fever among Mothers of Under 5 Children in Selected Community of Bhaktapur, 2019. 2020;5(10):18.