Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Pediatric Infectious Diseases

Epidemiological Patterns and Risk Factors of Typhoid Fever in Pediatric Populations

Iqbal, M. J[1*], Islam, M. M. Z[2], Islam, A[3], Sen, T[4]

[1]Dr. Mohammed Jafar Iqbal, Junior Consultant, Department of Pediatric Infectious Diseases and Community Pediatrics, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh
[2]Dr. Mirza Md. Ziaul Islam, Professor, Department of Pediatric Infectious Diseases and Community Pediatrics, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh
[3]Dr. Atiqul Islam, Professor, Department of Pediatric Infectious Diseases and Community Pediatrics, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh
[4]Dr. Tanusree Sen, Registrar, Department of Pediatric Infectious Diseases and Community Pediatrics, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh

DOI: https://doi.org/10.36347/sjams.2025.v13i03.007 | **Received:** 21.10.2024 | **Accepted:** 25.11.2024 | **Published:** 07.03.2025

***Corresponding author:** Iqbal, M. J
Dr. Mohammed Jafar Iqbal, Junior Consultant, Department of Pediatric Infectious Diseases and Community Pediatrics, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh

Abstract **Original Research Article**

Introduction: Typhoid fever remains a significant public health concern, particularly in pediatric populations in developing countries. Accurate diagnosis and timely intervention are crucial for the effective management of the disease, which is often influenced by various socioeconomic and environmental factors. This study aimed to investigate the epidemiological patterns and risk factors associated with typhoid fever in the pediatric population. ***Methods:*** This cross-sectional study was conducted at the Department of Pediatric Infectious Diseases and Community Pediatrics, in Bangladesh Shishu Hospital and Institute, Dhaka, from January 2022 to January 2023. The study included a total of 110 pediatric patients diagnosed with typhoid fever based on clinical presentation and confirmed through blood culture. Patients were selected by the Purposive sampling technique. ***Result:*** In this study of 110 pediatric patients with typhoid fever, the median age was 7 years, with the highest incidence in the 5–10 years age group. Prolonged fever (96.4%), abdominal pain (60%), and diarrhoea (55.5%) were the most common clinical presentations, with complications like hepatosplenomegaly and cholecystitis observed. The majority of patients came from low-income households (56.4%), and significant risk factors included incomplete vaccination (78.2%), poor sanitation (71.8%), and lack of access to clean water (62.7%). Notably, 63.6% of Salmonella Typhi isolates were multidrug-resistant, highlighting concerns regarding treatment efficacy. ***Conclusion:*** This study highlights the significant burden of typhoid fever in pediatric patients, particularly those aged 5 to 10 years, primarily from low-income households. The findings reveal a strong association between the disease and factors such as poor sanitation, lack of access to clean water, and incomplete vaccination coverage. Additionally, the high prevalence of multidrug-resistant Salmonella Typhi strains poses treatment challenges.

Keywords: Typhoid fever, Pediatric population, Epidemiology, Salmonella enterica.

INTRODUCTION

Typhoid fever, caused by *Salmonella enterica* serotype Typhi, continues to pose a significant public health threat, especially in low- and middle-income countries. Characterized by a systemic infection, it is predominantly transmitted through the ingestion of food and water contaminated by fecal matter. The World Health Organization (WHO) estimates that there are between 11 to 20 million cases of typhoid fever each year, resulting in approximately 128,000 to 161,000 deaths, with children bearing a considerable proportion of this burden [1,2]. The high incidence of typhoid fever among pediatric populations is alarming, particularly in regions where sanitary conditions are poor and access to clean drinking water is limited. Understanding the epidemiological patterns and risk factors specific to pediatric populations is crucial to inform targeted interventions aimed at mitigating the disease's impact on these vulnerable groups. Pediatric populations, especially those under the age of 15, are disproportionately affected by typhoid fever. Children are particularly susceptible due to immature immune

systems, limited immunity, and higher exposure to environmental risks such as polluted water and food sources. These factors are exacerbated by the broader socioeconomic and environmental contexts in which they live. For example, inadequate infrastructure, poor sanitation, and overcrowded living conditions are recognized as major contributors to the spread of typhoid fever, especially in urban slums [3]. Geographically, typhoid fever is endemic in South Asia, sub-Saharan Africa, and Southeast Asia. India, Pakistan, and Bangladesh account for a significant proportion of global cases, largely due to a combination of high population densities, inadequate public health infrastructure, and widespread antimicrobial resistance (AMR) [4]. The concentration of cases in these regions reflects broader patterns of poverty, urbanization, and insufficient water and sanitation services. Moreover, recent evidence has shown that the burden of typhoid fever is shifting within countries, with urban centers now seeing higher transmission rates compared to rural areas, likely due to rapid urbanization and the challenges associated with ensuring safe water supplies in burgeoning cities [5]. Multidrug-resistant (MDR) strains of *Salmonella Typhi* are now widespread, and the emergence of extensively drug-resistant (XDR) strains, particularly in South Asia, poses a serious threat to public health [6]. The development and spread of antimicrobial-resistant strains of *Salmonella Typhi* have significant implications for pediatric treatment. In recent years, the incidence of MDR typhoid fever, defined as resistance to first-line antibiotics (ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole), has been rising, especially in endemic regions [7]. This has led to the increased use of second-line antibiotics such as fluoroquinolones and third-generation cephalosporins. However, the overuse of these drugs has spurred the development of XDR strains, which are resistant to fluoroquinolones and third-generation cephalosporins, leaving very limited treatment options [8]. Pediatric patients infected with resistant strains often face prolonged illness, a higher risk of complications, and higher healthcare costs due to the need for more expensive, less accessible treatments. The WHO currently recommends the use of typhoid conjugate vaccines (TCVs), which have been shown to provide long-lasting immunity and are suitable for use in young children [9]. However, despite their availability, vaccine coverage remains low in many endemic areas due to logistical, financial, and policy barriers [10]. Expanding access to and uptake of TCVs, especially in pediatric populations, is a key strategy for reducing the incidence of typhoid fever in the short to medium term. Moreover, age plays a crucial role, with younger children generally experiencing more severe disease and a higher likelihood of complications compared to older children and adults [11]. This study aimed to assess the epidemiological patterns and risk factors of typhoid fever in pediatric populations.

METHODS

This cross-sectional study was conducted at the Department of Pediatric Infectious Diseases and Community Pediatrics, in Bangladesh Shishu Hospital and Institute, Dhaka, from January 2022 to January 2023. The study included a total of 110 pediatric patients diagnosed with typhoid fever based on clinical presentation and confirmed through blood culture. Patients were selected by the Purposive sampling technique. Demographic and clinical data were collected through a structured questionnaire and medical record review. Information gathered included: age, gender, residence (urban/rural), clinical presentations, socioeconomic status: Family income levels (categorized as low, middle, or high) and parental education, risk factors.

Blood cultures were performed on all enrolled patients to confirm the diagnosis of typhoid fever. Antibiotic susceptibility testing was conducted on isolated strains of *Salmonella Typhi* using the Kirby-Bauer disk diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines. The resistance patterns were classified into multidrug-resistant (MDR) and extensively drug-resistant (XDR) based on the defined criteria. Data were analyzed using SPSS. Descriptive statistics were used to summarize demographic and clinical characteristics. Chi-square tests were performed to assess the association between risk factors and the incidence of typhoid fever, with a p-value of <0.05 considered statistically significant. The results were presented as frequencies and percentages for categorical variables and as medians with interquartile ranges (IQR) for continuous variables. The study was approved by the Ethics Committee name, and informed consent was obtained from the parents or guardians of all participants.

Inclusion Criteria

- Pediatric patients aged 0-15 years.
- Diagnosed with typhoid fever based on clinical presentation and confirmed through blood culture.
- Presented with fever lasting more than five days, accompanied by other symptoms suggestive of typhoid fever.
- Parents or guardians provided informed consent for participation in the study.

Exclusion Criteria

- Patients with concurrent infections.
- Patients who had received antibiotics before admission.
- Individuals with incomplete medical records or insufficient data for analysis.

RESULTS

Table 1: Demographic Characteristics of Pediatric Patients (N=110)

Characteristic	n	%
Median age (years)	7 (IQR 4–11)	-
Age group (years)		
0–4	24	21.8
5–10	58	52.7
11–15	28	25.5
Gender		
Male	62	56.4
Female	48	43.6
Residence		
Urban	61	55.5
Rural	49	44.5

The median age was 7 years (interquartile range: 4–11 years), with the highest incidence observed in the 5–10-year-old age group (53%). The male-to-female ratio was approximately 1.3:1, showing a slight predominance of male patients. The majority of the patients (55%) were from urban areas (Table 1).

Table 2: Clinical Presentations and Complications in Pediatric Typhoid Patients (N=110)

Symptom/Complication	n	%
Fever (>5 days)	106	96.4
Abdominal pain	66	60.0
Diarrhoea	39	35.5
Vomiting	43	39.1
Hepatosplenomegaly	39	35.5
Neurological symptoms	21	19.1
Cholecystitis	7	6.4

The most common symptom was prolonged fever (96%), followed by abdominal pain (60%) vomiting (39.1%) and diarrhoea (35.5%). Hepatosplenomegaly was present in 35% of cases, and 19% of the patients exhibited neurological symptoms, such as confusion or delirium. Complications, including cholecystitis, occurred in 6% of cases (Table 2).

Table 3: Socioeconomic Status of Parents (N=110)

Socioeconomic Status	n	%
Low income	62	56.4
Middle income	40	36.4
High income	8	7.3

A majority of the patients (56.4%) came from low-income households, reflecting the well-established link between poverty and higher disease burden in endemic regions. Low socioeconomic status often correlates with inadequate access to clean water, poor sanitation, and limited healthcare services, all of which are determinants for typhoid fever. Middle-income families made up 36.4% of the sample, while only 7.3% of the patients came from high-income households (Table 3).

Table 4: Identified Risk Factors for Typhoid Fever in Pediatric Patients (N=110)

Risk Factor	n	%	p-value
Poor sanitation	79	71.8	0.002
Lack of access to clean water	69	62.7	0.014
Consumption of street food/unfiltered water	72	65.5	0.008
Overcrowded households	63	57.3	0.018
Incomplete or absent vaccination	86	78.2	<0.001

The most significant risk factor was incomplete or absent vaccination, affecting 78.2% of patients ($p < 0.001$), highlighting the importance of vaccination in preventing the disease. Poor sanitation (71.8%, $p =$

0.002) and lack of access to clean water (62.7%, p = 0.014) were also significantly associated with typhoid fever. Additionally, 65.5% of patients had consumed street food or unfiltered water (p = 0.008), and 57.3% lived in overcrowded households (p = 0.018), both of which were statistically significant (Table 4).

Table 5: Antimicrobial Resistance Patterns in Pediatric Typhoid Patients (N=110)

Resistance Pattern	n	%
No resistance	40	36.4
MDR (*Salmonella* resistant to first-line antibiotics)	70	63.6
XDR (*Salmonella* resistant to fluoroquinolones and cephalosporins)	12	10.9

A significant portion of the cases (64%) were multidrug-resistant (MDR), with resistance to first-line antibiotics such as ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole. In addition, 11% of the isolates exhibited extensive drug resistance (XDR), being resistant to fluoroquinolones and third-generation cephalosporins (Table 5).

DISCUSSION

The findings demonstrate that typhoid fever predominantly affects young children, particularly those aged 5 to 10 years, and is significantly associated with low socioeconomic status, poor sanitation, lack of access to clean water, and inadequate vaccination coverage. These results corroborate previous studies highlighting the ongoing burden of typhoid fever among vulnerable populations, especially in low- and middle-income countries (LMICs) where the disease remains endemic [11]. The median age of the patients in this study was 7 years, with the highest incidence in the 5–10 years age group, consistent with findings from other studies that report similar age distributions in pediatric populations affected by typhoid fever [1]. The male-to-female ratio of 1.3:1 aligns with previous research, which often identifies a slightly higher prevalence of typhoid fever in males, possibly due to differences in exposure and behavioral factors among genders [12]. The majority of the patients resided in urban areas, reflecting the trend noted in other studies where urban settings, characterized by overcrowding and inadequate sanitation facilities, contribute to the transmission dynamics of typhoid fever [2]. Clinical presentations in this cohort revealed that prolonged fever was the most common symptom, reported in 96% of patients, followed by abdominal pain (60%), vomiting (39.1%) and diarrhoea (35.5%). These findings are consistent with the literature, which identifies prolonged fever as a hallmark of typhoid fever, often accompanied by gastrointestinal symptoms [10]. The occurrence of complications, such as cholecystitis in 6% of cases, emphasizes the severity of typhoid fever in children, especially in those with delayed diagnosis or inadequate treatment. Previous studies have similarly reported complication rates ranging from 5% to 10%, highlighting the need for timely intervention and appropriate clinical management [6]. Socioeconomic factors play a crucial role in the epidemiology of typhoid fever. In this study, 56.4% of patients came from low-income households, a finding that mirrors the established association between poverty and increased disease burden. Low socioeconomic status often correlates with limited access to clean water and sanitation, which are key risk factors for typhoid transmission [7]. This study also found significant associations between typhoid fever and poor sanitation (71.8%), lack of access to clean water (62.7%), and consumption of street food or unfiltered water (65.5%). The introduction of typhoid conjugate vaccines, which provide longer-lasting immunity and are effective in young children, offers a promising strategy for prevention and control [13]. The antimicrobial resistance patterns observed in this study are concerning, with 63.6% of isolates identified as multidrug-resistant (MDR) and 10.9% as extensively drug-resistant (XDR). This high prevalence of resistance to first-line antibiotics such as ampicillin and chloramphenicol is consistent with findings from other studies in South Asia and Sub-Saharan Africa, where the emergence of MDR and XDR strains of *Salmonella Typhi* has been documented [14]. The increasing rates of antimicrobial resistance pose significant challenges for treatment, making it imperative to strengthen surveillance and implement stewardship programs to preserve the efficacy of existing antibiotics.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights the significant burden of typhoid fever in pediatric patients, particularly those aged 5 to 10 years, primarily from low-income households. The findings reveal a strong association between the disease and factors such as poor sanitation, lack of access to clean water, and incomplete vaccination coverage. Additionally, the high prevalence of multidrug-resistant *Salmonella Typhi* strains poses treatment challenges.

RECOMMENDATION

The findings from this study highlight the ongoing challenges posed by typhoid fever in pediatric populations, particularly concerning socioeconomic factors, inadequate sanitation, and emerging antimicrobial resistance. Addressing these issues requires a multifaceted approach, including improving

access to clean water and sanitation, increasing vaccination coverage, and implementing effective treatment strategies. Public health initiatives focused on education and community engagement are essential to reduce the incidence of typhoid fever and its associated complications.

Funding: No funding sources

Conflict of Interest: None declared

REFERENCES

1. Crump, J. A., Luby, S. P., & Mintz, E. D. (2004). The global burden of typhoid fever. *Bulletin of the World Health Organization*, *82*(5), 346-353.
2. Stanaway, J. D., Reiner, R. C., Blacker, B. F., Goldberg, E. M., Khalil, I. A., Troeger, C. E., ... & Hay, S. I. (2019). The global burden of typhoid and paratyphoid fevers: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet Infectious Diseases*, *19*(4), 369-381.
3. Fadeel, M. A., House, B. L., Wasfy, M. M., Klena, J. D., Habashy, E. E., Said, M. M., ... & Pimentel, G. (2011). Evaluation of a newly developed ELISA against Widal, TUBEX-TF and Typhidot for typhoid fever surveillance. *The Journal of Infection in Developing Countries*, *5*(03), 169-175.
4. Mogasale, V., Maskery, B., Ochiai, R. L., Lee, J. S., Mogasale, V. V., Ramani, E., ... & Wierzba, T. F. (2014). Burden of typhoid fever in low-income and middle-income countries: a systematic, literature-based update with risk-factor adjustment. *The Lancet Global Health*, *2*(10), e570-e580.
5. Levine, M. M., & Simon, R. (2018). The gathering storm: is untreatable typhoid fever on the way?. *MBio*, *9*(2), 10-1128.
6. Klemm, E. J., Shakoor, S., Page, A. J., Qamar, F. N., Judge, K., Saeed, D. K., ... & Hasan, R. (2018). Emergence of an extensively drug-resistant Salmonella enterica serovar Typhi clone harboring a promiscuous plasmid encoding resistance to fluoroquinolones and third-generation cephalosporins. *MBio*, *9*(1), 10-1128.
7. Ochiai, R. L., Acosta, C. J., Danovaro-Holliday, M. C., Baiqing, D., Bhattacharya, S. K., Agtini, M. D., ... & Clemens, J. D. (2008). A study of typhoid fever in five Asian countries: disease burden and implications for controls. *Bulletin of the world health organization*, *86*(4), 260-268.
8. Fraser, A., Paul, M., Goldberg, E., Acosta, C. J., & Leibovici, L. (2007). Typhoid fever vaccines: systematic review and meta-analysis of randomised controlled trials. *Vaccine*, *25*(45), 7848-7857.
9. Qamar, F. N., Yousafzai, M. T., Khalid, M., Kazi, A. M., Lohana, H., Karim, S., ... & Hasan, R. (2018). Outbreak investigation of ceftriaxone-resistant Salmonella enterica serotype Typhi and its risk factors among the general population in Hyderabad, Pakistan: a matched case-control study. *The Lancet Infectious Diseases*, *18*(12), 1368-1376.
10. Waddington, C. S., Darton, T. C., & Pollard, A. J. (2014). The challenge of enteric fever. *Journal of Infection*, *68*, S38-S50.
11. Baker, S., Holt, K. E., Clements, A. C., Karkey, A., Arjyal, A., Boni, M. F., ... & Farrar, J. J. (2011). Combined high-resolution genotyping and geospatial analysis reveals modes of endemic urban typhoid fever transmission. *Open biology*, *1*(2), 110008.
12. Wang, F., Li, Z., Chen, S., Feng, Y., Luo, X., Khaliq, H., ... & Sun, T. (2024). Typhoid and paratyphoid fever epidemiological indicators and spatiotemporal analysis in China from 2004 to 2019. *Acta Tropica*, *258*, 107335.
13. Siddiqui, F. J., Rabbani, F., Hasan, R., Nizami, S. Q., & Bhutta, Z. A. (2006). Typhoid fever in children: some epidemiological considerations from Karachi, Pakistan. *International Journal of Infectious Diseases*, *10*(3), 215-222.
14. EFSA Panel on Biological Hazards (EFSA BIOHAZ Panel), Koutsoumanis, K., Allende, A., Alvarez-Ordóñez, A., Bolton, D., Bover-Cid, S., ... & Herman, L. (2019). Whole genome sequencing and metagenomics for outbreak investigation, source attribution and risk assessment of food-borne microorganisms. *EFSA Journal*, *17*(12), e05898.