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Enteric Fever in Children aged 1–14 years Socio-demographic Insights, Clinical Manifestations, and Outcomes from a 2-year Hospital-based Study

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ABSTRACT

Background: Enteric fever remains a major public health issue in developing countries, especially among children aged 1–14 years. The disease, mainly caused by *Salmonella enterica* serovars Typhi and Paratyphi, poses diagnostic and therapeutic challenges due to nonspecific symptoms, limited diagnostic tools, and rising antimicrobial resistance.

Methods: This hospital-based retrospective study was conducted to evaluate the medical records of 110 children admitted with a diagnosis of enteric fever between December 2022 and December 2024 at a tertiary care hospital were reviewed. Data on demographics, symptoms, laboratory results, diagnostics, treatment, and clinical results were collected and analysed using Stata version 15.1.

Results: The mean age was 7.8 ± 3.9 years; 62.7% were male. Most (73.6%) were from middle socio-economic strata. Fever (98.18%), vomiting (38.18%), and diarrhoea (29%) were the most common symptoms; pallor (27.2%) and hepatomegaly (17.27%) were frequent signs. Eosinopenia (61.81%), anaemia (44.54%), and elevated CRP (72.7%) predominated in labs. Blood cultures were positive in 27.3%, with high nalidixic acid and ciprofloxacin resistance but complete sensitivity to ceftriaxone, meropenem, cotrimoxazole, and piperacillin–tazobactam. Hepatitis (12.7%) was the most common complication. All patients recovered; average hospital stay was seven days.

Conclusion: The study has concluded that the high prevalence of enteric fever among school-aged children, particularly those from middle socio-economic backgrounds. It emphasizes the dominance of fever, vomiting, and eosinopenia as key clinical features, with a concerning rise in antibiotic resistance, especially to ciprofloxacin and nalidixic acid.

Key-words: Enteric fever, Typhoid, Children, Salmonella Typhi, Socio-demographic factors, Antimicrobial resistance

INTRODUCTION

Enteric fever, encompassing typhoid and paratyphoid fever, remains an important public health apprehension in low- and middle-income countries, particularly affecting children and adolescents. Caused predominantly by *S. enterica* serovars Typhi and Paratyphi A, B, and C, enteric fever is transmitted mainly via the faecal-oral route through contaminated food and water, a reflection of poor sanitation and inadequate access to clean drinking water [1]. Overall, it is estimated that more than 9 million cases of typhoid fever occur annually, with around 110,000 associated deaths, the majority of which occur in South Asia and sub-Saharan Africa [2]. Children constitute a susceptible population, with a high frequency observed in the 1–14-year age group due to their immature immune systems, close contact behaviours, and increased exposure in unsanitary environments [3].

India contributes suggestively to the global problem of enteric fever. A community-based surveillance study in India estimated a frequency of 377 cases per 100,000 person-years among children aged 5–15 years, and an

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even higher problem among younger children [4]. The disease burden is compounded by factors such as overfilling, low socioeconomic status, poor hand hygiene practices, and low maternal education, which contribute to increased exposure and delayed treatment-seeking behaviours [5]. These socio-demographic determinants are serious in considering the epidemiological pattern of the disease and implementing targeted interventions.

Enteric fever in children often presents nonspecifically, risking misdiagnosis or delay. Symptoms include prolonged fever, malaise, anorexia, abdominal pain, and altered bowel habits; severe cases may cause haemorrhage, perforation, encephalopathy, hepatitis, or death [6]. Atypical signs in younger children [7] and similarity to other febrile illnesses necessitate microbiological confirmation.

Despite advances in diagnostic modalities, blood culture remains the gold standard for confirming enteric fever, although its sensitivity is limited by prior antibiotic use and the small volume of blood often drawn from paediatric patients [8]. Other diagnostic tools like the Widal test and Typhidot have lower sensitivity and specificity and are not uniformly dependable, mainly in endemic regions [9]. Polymerase chain reaction (PCR)-based diagnostics and rapid diagnostic tests have shown promise but remain cost-prohibitive and inaccessible in resource-limited situations [10]. Thus, clinicians frequently rely on clinical judgment supported by basic laboratory tests, including complete blood count and liver function tests, which can suggest but not definitively diagnose enteric fever.

The emergence of antimicrobial resistance has complicated treatment. First-line drugs such as chloramphenicol, ampicillin, and co-trimoxazole were replaced by fluoroquinolones and third-generation cephalosporins due to rising resistance. Now, fluoroquinolone resistance is widespread in South Asia, with growing cephalosporin resistance [11]. Inappropriate empirical antibiotic use furthers resistance, obscures presentation, and delays diagnosis, underscoring the urgent need for antimicrobial stewardship and real-time resistance surveillance.

While death from enteric fever has deteriorated with the availability of antibiotics and improved supportive care, morbidity remains substantial, especially in hospitalised paediatric populations. Difficulties such as septicaemia, shock, and ileal perforation are more common in children who present late, are undernourished, or belong to socioeconomically disadvantaged backgrounds [12]. Hospital-based studies have shown that early diagnosis and appropriate antibiotic therapy can suggestively reduce the duration of hospitalisation and prevent difficulties. However, this is only feasible if children have timely access to healthcare and if diagnostic and treatment protocols are uniformly applied.

Understanding the socio-demographic patterns, clinical presentation, and outcomes of enteric fever in children can help refine public health methods, optimise clinical management, and support the deployment of newer typhoid conjugate vaccines. The World Health Organisation has recommended the introduction of TCVs in endemic regions, including among children aged 6 months and older, given the high problem and early age of infection [13]. Surveillance data from hospital situations remains a precious tool in shaping these policies and gauging the real-world impact of vaccination programs.

This study was conducted to assess the socio-demographic characteristics, clinical spectrum, and results of children aged 1–14 years hospitalised with enteric fever over two years. By focusing on this age group, we aim to contribute to the growing body of evidence necessary for designing targeted involvements that discourse both the biomedical and social determinants of this preventable disease.

MATERIALS AND METHODS

Study design- The study was a retrospective, hospital-based observational design conducted from December 2022 to December 2024 at a tertiary care centre. It aimed to evaluate the socio-demographic characteristics, clinical features, laboratory results, treatment outcomes, and complications in children aged 1–14 years diagnosed with enteric fever. By analyzing case records, the study assessed trends in disease presentation, antimicrobial resistance, and patient recovery. The inclusion criteria focused on children with symptoms compatible with enteric fever and positive laboratory results, including blood cultures and rapid diagnostic tests. This design allowed for efficient data collection from existing medical records, providing insights into the clinical management of enteric fever without the need for a control group. The study aimed to contribute to understanding the epidemiology of enteric fever, particularly in terms of socio-economic factors, clinical

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progression, and resistance patterns, essential for improving diagnosis and treatment strategies.

Inclusion and Exclusion Criteria- The inclusion criteria for the study were based on the clinical presentation of enteric fever, which included signs and symptoms consistent with the disease and laboratory confirmation via blood culture showing the presence of *Salmonella* or positive rapid diagnostic tests, such as Typhidot IgM (with a sensitivity of 84% and specificity of 79%) or a positive Widal test (TO titer >1:160 or TH titer >1:160). The exclusion criteria were patients who did not meet the above clinical and diagnostic criteria, as well as those who were unwilling to participate in the study and provide informed consent.

Procedure- The procedure for data collection involved reviewing the medical records of the patients admitted with a diagnosis of enteric fever during the study period. Data were systematically extracted, which included socio-demographic details (such as age, gender, and socio-economic status), presenting complaints, laboratory results, treatment administered, and clinical outcomes. All data were compiled using Microsoft Excel for further analysis. Detailed records of the signs and symptoms observed in each patient were collected, with a particular focus on common manifestations such as fever, abdominal pain, vomiting, and diarrhoea.
Additionally, laboratory data, including the results of blood cultures, Widal tests, Typhidot IgM, and other routine investigations (e.g., complete blood count, liver function tests, and C-reactive protein levels), were collected to support the diagnosis and monitor the clinical progression of the disease. Data on complications such as hepatitis, encephalopathy, and bronchopneumonia were also included in the study.

Statistical Analysis- The data collected from the medical records were analyzed using Stata version 15.1. Descriptive statistics were used to summarize the socio-demographic characteristics, clinical features, laboratory findings, treatment regimens, and outcomes. The chi-square test and other statistical tools were employed to identify significant associations between variables, such as age, gender, socio-economic status, and clinical outcomes. p-values were considered significant if they were less than 0.05.

Ethical Considerations- Ethical approval was obtained from the hospital's committee. Informed consent was taken from parents/guardians after explaining the study's purpose, procedures, and potential risks. All patient data were anonymized to ensure confidentiality during collection and analysis.

RESULTS

An analysis of case records of children discharged with a diagnosis of enteric fever was done, and 110 children falling in the age category of between one and 14 years were included in this study. The average age at presentation was 7.8 +/- 3.9 years. 76% of the kids fall within the six to 14 years bracket. The age-wise distribution is provided in Fig. 1. The breakup of boys and girls was 62.7% and 37.2, respectively, and the male-to-female ratio was 1.66:1. Socio-economic classes were broken as 73.6% comprised middle socio-economic status (SES), whilst 22.7% were low, and 5.45% were in the higher group. A seasonal variation pattern where the peak was from January to June was experienced (Fig. 2).

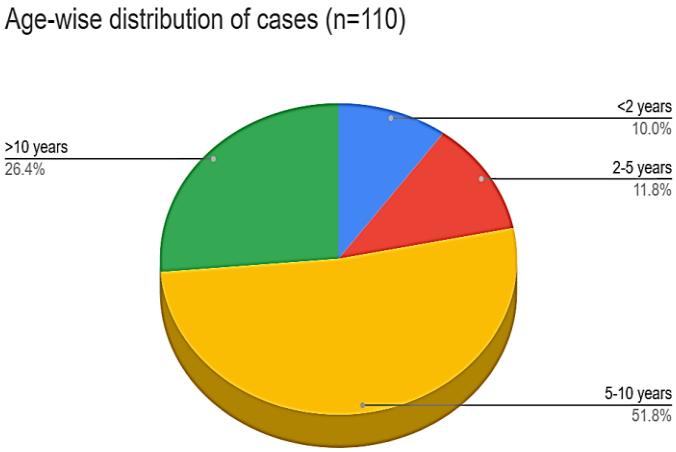

Fig. 1: Age-wise distribution of cases

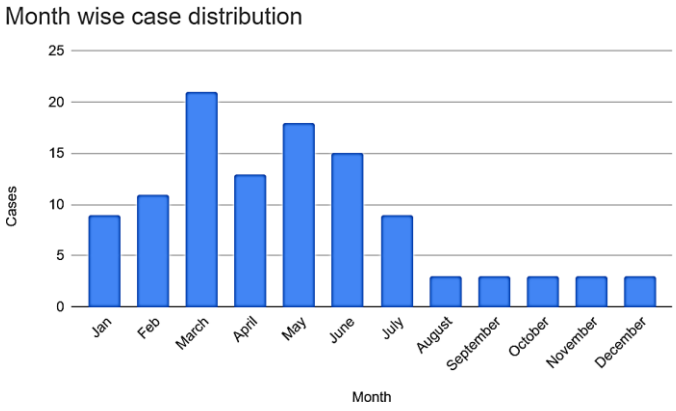

Fig. 2: Month-wise case distribution

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The most common symptom observed in the patients was fever, present in 108 cases (98.18%). Vomiting was reported in 42 cases (38.18%), followed by diarrhoea in 32 cases (29%). Pain in the abdomen was noted in 23 patients (20.9%), and anorexia was present in 17 patients (15.45%). Other symptoms included cough (19.09%) and headache (8.18%). As for the signs, pallor was the most frequent, observed in 30 cases (27.2%), followed by hepatomegaly (17.27%) and icterus (11.8%). Splenomegaly was found in 9 cases (8.18%), while a coated tongue was noted in just 3 cases (2.7%) (Table 1).

Table 1: Signs and Symptoms of the patients

Symptoms	N	%
Fever	108	98.18
Pain abdomen	23	20.9
Vomiting	42	38.18
Cough	21	19.09
Anorexia	17	15.45
Diarrhoea	32	29
Headache	9	8.18
Signs		
Splenomegaly	9	8.18
Hepatomegaly	19	17.27
Pallor	30	27.2
Coated tongue	3	2.7
Icterus	13	11.8

The most prevalent laboratory finding was eosinopenia, observed in 68 patients (61.81%), followed by anemia in 49 cases (44.54%) and raised C-reactive protein (CRP) in 80 patients (72.7%). Thrombocytopenia was found in 17 patients (15.54%), while leucocytosis was noted in 23 patients (20.9%). Other abnormalities included transaminitis (29.09%), hyponatremia (13.63%), hypokalemia (10%), and leucopenia (10%). Pancytopenia was identified in 9 cases (8.18%) (Table 2).

Table 2: Laboratory diagnosis results of the patients in this study

Investigations	N	%
Thrombocytopenia	17	15.54
Eosinopenia	68	61.81
Anemia	49	44.54
Transaminitis	32	29.09
Leucopenia	11	10
Hyponatremia	15	13.63
Hypokalemia	11	10
Leucocytosis	23	20.9
Pancytopenia	9	8.18
Raised C-reactive protein	80	72.7

Among the complications, hepatitis was the most common, affecting 14 patients (12.7%). Bronchitis was observed in 7 cases (6.4%), while encephalopathy and bronchopneumonia were each found in 3 patients (2.7%). This indicates that complications were relatively uncommon, with hepatitis being the most frequently observed (Table 3).

Table 3: Complications found in the patients

Complications	N	%
Hepatitis	14	12.7
Encephalopathy	3	2.7
Bronchitis	7	6.4
Bronchopneumonia	3	2.7

The antibiotic sensitivity data revealed a significant resistance to ciprofloxacin, with 25 cases (78.1%) resistant to the drug, while only 7 cases (21.9%) were sensitive. Meropenem, ceftriaxone, cotrimoxazole, and piperacillin + tazobactam showed no resistance, as all 32 isolates were sensitive to these drugs (100%). Nalidixic

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acid resistance was seen in all 32 isolates (100%), while 9 isolates (9%) were resistant to levofloxacin, leaving 21 isolates (21%) sensitive. This highlights a significant resistance issue, particularly with ciprofloxacin and nalidixic acid (Table 4).

Table 4: Antibiotic sensitivity pattern

Drug	Sensitive	Resistance
Ciprofloxacin	7	25
Merapenem	32	0
Nalidixic acid	0	32
Ceftriaxone	31	0
Cotrimoxazole	31	0
Piperacillin + Tazobactum	31	0
Levofloxacin	9	21

DISCUSSION

This hospital-based study assessed the socio-demographic profile, clinical presentation, laboratory features, antimicrobial resistance patterns, and results of enteric fever in children aged 1–14 years over two years. The results are important movements reliable to, and in some examples divergent from, earlier national and international studies.

An important proportion of affected children belonged to lower socio-economic strata, with poor sanitation and limited access to clean drinking water being dominant risk factors. This association has been echoed by studies such as Khan *et al*., which identified low income, crowded households, and unsafe water ingestion as important determinants of typhoid fever risk in children in urban Pakistan [5]. Similarly, a surveillance study in India by John *et al.* emphasised the higher problem of typhoid among children from low-income households, suggesting that enteric fever continues to prosper in environments lacking infrastructure for hygiene and safe water [14].

The age distribution in our study indicated the highest occurrence among school-aged children (5–10 years), which is even with data from Antillon *et al.*, who found a peak incidence in children aged 5–14 years across multiple endemic regions [2]. However, our study also reported a non-negligible number of cases in children under five, supporting the WHO's policy on the need for early immunisation with typhoid conjugate vaccines [13].

Clinically, the most consistent finding was persistent high-grade fever, followed by abdominal pain, diarrhoea, vomiting, and hepatosplenomegaly. These symptoms align with those reported by Parry *et al.*, who documented fever with gastrointestinal disturbances as hallmark symptoms in paediatric enteric fever [15]. However, atypical presentations such as isolated headache, mild rash, or only low-grade fever were also observed in a small subset of our patients, mainly those younger than five. This is reliable with results from Bhutta, who noted that clinical diagnosis in younger children may be difficult due to non-specific symptomatology [16].

Blood culture, even though the diagnostic gold standard, was positive in only about 40% of our cases. This limited yield is probably due to prior antibiotic use and small-volume blood samples, both of which affect culture sensitivity, an issue corroborated by Mogasale *et al.*, who concluded that blood culture may detect only a fraction of actual cases in endemic settings [17]. Our study also found that the Widal test was used frequently, but its diagnostic reliability was uncertain. As previously reported by Olopoenia and King, the Widal test suffers from poor specificity in endemic regions due to cross-reactivity and background antibody titers [9].

A mainly about finding in our study was the high rate of antimicrobial resistance. Resistance to ciprofloxacin was noted in over 75% of culture-positive isolates, and there was emerging resistance to third-generation cephalosporins. These patterns mirror results from Klemm *et al*., who described the emergence of extensively drug-resistant *S. typhi* strains in South Asia harbouring plasmids resistant to multiple antibiotics [11]. Expected the widespread use of empirical antibiotics in febrile illnesses and the over-the-counter availability of antimicrobials in many parts of India, the propagation of resistant strains seems inevitable without stricter antimicrobial stewardship.

Treatment outcomes in our cohort were generally favourable with appropriate antibiotics and supportive care. However, severe difficulties such as intestinal perforation, hepatitis, and encephalopathy occurred in

children who presented late or had comorbid malnutrition. This finding is reliable with a study by Sinha *et al*., which showed higher rates of difficulties in undernourished children and those who received delayed care [18]. Significantly, the duration of hospital stays and recovery time was suggestively shorter among children who received early diagnosis and personalised antibiotic therapy.

Our study support the introduction of TCVs as an important public health measure. WHO recommends TCVs for all children older than six months in endemic regions, and studies such as those by Jin *et al*. have established their safety, immunogenicity, and long-term efficacy [19]. India's inclusion of TCV in the national immunisation schedule in selected states is a welcome step and should be scaled up to achieve broader disease control.

In spite of its assets, our study has limitations. Being hospital-based, it may understate milder community cases and overestimate the frequency of difficulties. Also, antimicrobial resistance patterns may not reflect those in peripheral or rural healthcare situations where different antibiotics may be in use. Finally, serotyping and molecular analysis of *Salmonella* strains were not performed, limiting our empathetic of strain diversity and resistance mechanisms.

Our study confirms enteric fever remains a major threat to Indian children, especially in marginalised communities. Vigilance, microbiological confirmation, rational antibiotic use, and preventive measures like WASH improvements and TCV deployment are essential. Future research should include community surveillance and resistance mapping to guide policy.

CONCLUSIONS

The study found a high prevalence of enteric fever among school-aged children, especially from middle socio-economic backgrounds. Fever, vomiting, and eosinopenia were key clinical features. Antibiotic resistance was notable, with all isolates resistant to nalidixic acid and most to ciprofloxacin, while complete sensitivity to meropenem, ceftriaxone, cotrimoxazole, and piperacillin–tazobactam was observed. Among 110 children aged 1–14 years, most were aged 6–14, with a male-to-female ratio of 1.66:1. Common symptoms included fever, abdominal pain, diarrhoea, and vomiting; laboratory findings showed high eosinopenia, anaemia, and elevated CRP. Complications were uncommon, hepatitis being the most frequent. These results highlight the need for antimicrobial stewardship, ongoing resistance surveillance, and rational antibiotic use. Effective treatment remains possible with appropriate antibiotics, but rising resistance underscores the importance of early diagnosis, targeted therapy, and preventive measures to reduce disease burden in vulnerable paediatric populations.

CONTRIBUTION OF AUTHORS

Research concept- Keyur B. Patel, Hemantbhai S. Patel
Research design- Keyur B. Patel
Supervision- Keyur B. Patel
Materials- Keyur B. Patel, Hemantbhai S. Patel
Data collection- Keyur B. Patel
Data analysis and interpretation- Keyur B. Patel
Literature search- Keyur B. Patel
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Critical review- Keyur B. Patel, Hemantbhai S. Patel
Article editing- Keyur B. Patel
Final approval- Keyur B. Patel, Hemantbhai S. Patel

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