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Original Research Article

Socioeconomic and Environmental Risk Factors Associated with Pediatric Typhoid Fever in a Tertiary Care Hospital

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Abstract

Background: Typhoid fever remains an important infectious disease among children, particularly in settings with inadequate access to safe drinking water, sanitation and hygiene. Socioeconomic and environmental conditions may play an important role in the transmission of *Salmonella Typhi*. The present study was conducted to assess socioeconomic and environmental factors associated with pediatric typhoid fever in a tertiary care hospital.

Methods: A hospital-based observational study was conducted in the Department of Paediatrics of a tertiary care teaching hospital over a period of 12 months. A total of 100 children aged 1–18 years diagnosed with typhoid fever were included. Sociodemographic, socioeconomic, water and sanitation characteristics, hygiene practices, food-related exposures, clinical findings and laboratory results were recorded using a structured proforma. Data were analyzed using appropriate statistical tests, with $p<0.05$ considered statistically significant.

Results: Among the 100 children, 56% were male and 44% were female. The largest proportion belonged to the 6–10-year age group (32%), and 63% were from rural areas. Lower and lower-middle socioeconomic groups accounted for 80% of participants. Half of the households (50%) reported no regular drinking-water purification. Inadequate sanitation was reported in 32%, while irregular handwashing before meals was reported in 39%. Consumption of food from outside the home and street-vended food was reported in 57% and 46% of children, respectively. Laboratory confirmation was available in 62% of cases. Lack of regular water purification ($p=0.015$), inadequate sanitation ($p=0.027$) and irregular handwashing ($p=0.044$) were significantly associated with laboratory-confirmed typhoid fever.

Conclusion: The study highlights the important role of modifiable environmental and hygiene-related factors in pediatric typhoid fever. Strengthening safe drinking-water practices, household sanitation, hand hygiene and food safety, together with appropriate vaccination and health education, may help reduce the burden of typhoid fever among children.

Keywords: Typhoid fever; *Salmonella Typhi*; children; socioeconomic factors; drinking water; sanitation; hand hygiene; environmental risk factors.

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Introduction

Typhoid fever is a systemic bacterial infection caused predominantly by *Salmonella enterica* serovar Typhi. It is transmitted mainly through the fecal–oral route by ingestion of food or water contaminated with fecal material from infected individuals or chronic carriers. Typhoid fever remains an important public health problem, particularly in low- and middle-income countries where inadequate access to safe drinking water, sanitation and hygiene facilities facilitates continued transmission [1,2].

Globally, typhoid fever contributes substantially to morbidity and mortality, particularly in populations living in areas with poor water and sanitation infrastructure. Children constitute an important vulnerable group and may present with prolonged fever, headache, malaise, abdominal pain, diarrhea or constipation. Severe disease can result in gastrointestinal bleeding, intestinal perforation, encephalopathy, septicemia and death [3,4].

The transmission of typhoid fever is strongly influenced by environmental conditions. Contamination of drinking-water sources with human fecal material is an important mechanism of transmission. Inadequate water treatment, poor sanitation and unsafe disposal of human waste can

facilitate the spread of *S. Typhi* within households and communities [5].

Socioeconomic conditions may also influence exposure to typhoid fever. Families belonging to lower socioeconomic groups may have limited access to safe water, sanitation, healthcare and health education. Household crowding and poor housing conditions may further facilitate transmission of enteric pathogens [6].

Food-related exposures are also important in the epidemiology of typhoid fever. Consumption of food prepared or handled under unhygienic conditions, particularly street-vended food, may increase the risk of exposure to *S. Typhi*. Previous studies have identified food consumption patterns and household environmental conditions as important factors associated with enteric fever [7,8].

Children may have increased exposure because of school attendance, outdoor activities and consumption of food and beverages outside the home. Poor handwashing practices before meals and after toilet use may further facilitate fecal–oral transmission. A pediatric cohort study from North India demonstrated the relevance of water, sanitation, hygiene and food practices in relation to enteric fever among children [9].

Prevention of typhoid fever requires a combination of vaccination and improvements in water, sanitation and hygiene. Typhoid conjugate vaccines are recommended as an important preventive intervention in endemic areas, particularly among children [2,10]. However, vaccination needs to be complemented by measures that reduce environmental contamination and improve access to safe water.

Safe drinking water is particularly important because contaminated water can serve as a vehicle for transmission of *S. Typhi*. The WHO guidelines emphasize the importance of maintaining microbiologically safe drinking water and appropriate water-treatment practices to prevent waterborne disease [11,12].

Yadgiri district of Karnataka has a substantial rural and semi-urban population with varying socioeconomic circumstances and access to water and sanitation facilities. Local assessment of socioeconomic and environmental characteristics among pediatric typhoid patients may help identify potentially modifiable factors relevant to prevention.

Therefore, the present study was conducted to assess the socioeconomic and environmental factors associated with pediatric typhoid fever among children attending a tertiary care hospital in Yadgiri, Karnataka.

Materials and Methods

Study Design and Setting: The present study was designed as a hospital-based observational study to assess the socioeconomic and environmental risk factors associated with pediatric typhoid fever. The study was conducted in the Department of Paediatrics of a tertiary care teaching hospital over a period of one year.

Study Population: The study included children diagnosed with typhoid fever who attended the pediatric outpatient department or were admitted to the pediatric wards during the study period. A total of 100 pediatric patients fulfilling the predefined eligibility criteria were enrolled in the study.

Study Duration: The study was conducted over a period of 12 months.

Sample Size: A total sample size of 100 children diagnosed with typhoid fever was included in the study based on the feasibility and availability of eligible cases during the study period.

Inclusion Criteria

Children were included if they fulfilled the following criteria:

- Children aged 1–18 years.
- Clinically suspected and/or laboratory-confirmed cases of typhoid fever.
- Children attending or admitted to the Department of Pediatrics during the study period.
- Parents or legally authorized guardians willing to participate in the study and provide informed consent.

Exclusion Criteria

The following children were excluded:

- Children with incomplete clinical or socioeconomic information.
- Children with severe underlying chronic systemic diseases that could significantly influence the study variables.
- Children whose parents or guardians did not provide consent for participation.
- Children previously enrolled in the study during the same illness episode.

Data Collection: After obtaining informed consent from the parents or legal guardians, relevant information was collected using a pre-designed and structured data collection proforma.

The following variables were recorded:

- Age and sex of the child
- Residence and locality
- Family size
- Parents' educational status
- Parents' occupation

- Socioeconomic status
- Type and condition of housing
- Source of drinking water
- Method of drinking-water purification
- Availability of household sanitation facilities
- Type of toilet facility
- Handwashing practices
- Food-handling and food-storage practices
- Consumption of food from outside/home-prepared food
- Waste disposal practices
- Exposure to potentially contaminated water or food
- History of similar illness among family members
- Previous history of typhoid fever
- Relevant clinical features and laboratory findings

Assessment of Socioeconomic Status: The socioeconomic status of the child's family was assessed using a standardized socioeconomic classification appropriate for the Indian population. Information regarding parental education, occupation, family income, family size and other relevant socioeconomic parameters was collected and categorized accordingly.

Assessment of Environmental Risk Factors: Environmental risk factors were assessed through a structured questionnaire administered to the parents or guardians. Particular emphasis was placed on drinking-water sources, water purification practices, sanitation facilities, toilet availability, hand hygiene, household waste disposal, food hygiene and exposure to potentially contaminated food or water. Where feasible, information regarding household environmental conditions was also verified through direct observation.

Diagnosis of Typhoid Fever: Diagnosis was based on the clinical presentation supported by laboratory investigations as per institutional practice. Relevant investigations included complete blood count and appropriate microbiological/serological investigations. Blood culture, where performed, was considered the microbiological reference for confirmation of enteric fever. Laboratory investigations were interpreted in conjunction with the clinical findings.

Clinical Assessment: Each enrolled child underwent a detailed clinical assessment. History regarding duration of fever, fever pattern, gastrointestinal symptoms, vomiting, abdominal pain, diarrhea or constipation, headache, weakness and other associated symptoms was recorded.

Physical examination included assessment of general condition, temperature, pulse rate, respiratory rate, hydration status and systemic examination. Relevant complications and treatment received during hospitalization were also documented.

Data Management and Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate, while categorical variables were expressed as frequencies and percentages. The association between socioeconomic/environmental risk factors and selected clinical or demographic characteristics was assessed using the Chi-square test or Fisher's exact test for categorical variables and appropriate parametric or non-parametric tests for continuous variables. A p-value <0.05 was considered statistically significant.

Results and Observations: A total of 100 pediatric patients with typhoid fever were included in the present observational study conducted in the Department of Paediatrics of a tertiary care teaching hospital. The socioeconomic and environmental characteristics of the participants were analyzed to identify factors potentially associated with pediatric typhoid fever.

Table 1: Age-wise distribution of study participants (n=100)

Age group	Number (n)	Percentage (%)
1–5 years	18	18.0
6–10 years	32	32.0
11–14 years	28	28.0
15–18 years	22	22.0
Total	100	100.0

The majority of children belonged to the 6–10 years age group (32%), followed by 11–14 years (28%).

Table 2: Sex-wise distribution of study participants

Sex	Number (n)	Percentage (%)
Male	56	56.0
Female	44	44.0
Total	100	100.0

There was a slight male predominance, with males accounting for 56% of the study population.

Table 3: Sociodemographic characteristics of the study population

Variable	Category	n	%
Residence	Rural	63	63.0
	Urban	37	37.0
Family size	≤4 members	39	39.0
	5–6 members	42	42.0
	>6 members	19	19.0
Mother's education	Primary or below	38	38.0
	Secondary	40	40.0
	Higher secondary/graduate	22	22.0
Father's education	Primary or below	31	31.0
	Secondary	43	43.0
	Higher secondary/graduate	26	26.0

A higher proportion of children were from rural areas (63%). Families with 5–6 members constituted the largest group (42%).

Table 4: Socioeconomic status of study participants

Socioeconomic category	N	%
Lower	48	48.0
Lower-middle	32	32.0
Middle	16	16.0
Upper-middle	4	4.0
Upper	0	0
Total	100	100.0

Nearly half of the children (48%) belonged to the lower socioeconomic category, while 32% belonged to the lower-middle category.

Table 5: Source of drinking water

Source of drinking water	N	%
Public tap/piped water	38	38.0
Borewell/hand pump	34	34.0
Well water	16	16.0
Tanker/other sources	12	12.0
Total	100	100.0

Public tap/piped water was the most commonly reported source of drinking water (38%), followed by borewell/hand-pump water (34%).

Table 6: Drinking-water purification practices

Water purification method	n	%
Boiling	18	18.0
Filtration	24	24.0
Chlorination	8	8.0
No regular purification	50	50.0
Total	100	100.0

Half of the participating households (50%) reported that they did not regularly use any method of drinking-water purification.

Table 7: Household sanitation and hygiene practices

Environmental factor	Category	n	%
Toilet facility	Sanitary household toilet	68	68.0
	Shared/open defecation	32	32.0
Handwashing before meals	Regular	61	61.0
	Irregular	39	39.0
Handwashing after toilet use	Regular	66	66.0
	Irregular	34	34.0
Household waste disposal	Appropriate	64	64.0
	Inappropriate	36	36.0

Inadequate sanitation and hygiene practices were observed in a considerable proportion of households. Irregular handwashing before meals was reported in 39% of participants.

Table 8: Food-related environmental risk factors

Risk factor	Yes, n (%)	No, n (%)
Consumption of food from outside	57 (57.0)	43 (43.0)
Consumption of street-vended food	46 (46.0)	54 (54.0)
Consumption of untreated water outside home	41 (41.0)	59 (59.0)
History of questionable food hygiene	37 (37.0)	63 (63.0)
Recent history of similar illness in family	15 (15.0)	85 (85.0)

Consumption of food from outside the home was reported by **57%** of children, while 46% reported consumption of street-vended food.

Table 9: Clinical and laboratory characteristics

Characteristic	n	%
Fever	100	100.0
Abdominal pain	42	42.0
Vomiting	29	29.0
Diarrhea	31	31.0
Constipation	18	18.0
Headache	24	24.0
Weakness/fatigue	38	38.0
Laboratory-confirmed cases	62	62.0
Clinically diagnosed/supported cases	38	38.0

Fever was present in all enrolled children. Abdominal pain (42%) and weakness/fatigue (38%) were among the commonly reported associated symptoms.

Table 10: Association of selected risk factors with typhoid-related laboratory confirmation

Risk factor	Laboratory-confirmed n (%)	Other cases n (%)	p-value
Rural residence	43 (69.4)	20 (52.6)	0.086
Lower socioeconomic status	34 (54.8)	14 (36.8)	0.083
No regular water purification	37 (59.7)	13 (34.2)	0.015
Inadequate sanitation	25 (40.3)	7 (18.4)	0.027
Irregular handwashing	29 (46.8)	10 (26.3)	0.044
Street-food consumption	33 (53.2)	13 (34.2)	0.061
Outside-food consumption	39 (62.9)	18 (47.4)	0.136

Chi-square/Fisher's exact test; $p < 0.05$ considered statistically significant.

Discussion

The present hospital-based observational study evaluated socioeconomic and environmental factors among 100 pediatric patients with typhoid fever. The findings demonstrate that several potentially modifiable environmental and behavioral factors were common in the study population, particularly inadequate water purification, sanitation deficiencies and irregular handwashing.

The largest proportion of children belonged to the 6–10-year age group (32%), followed by 11–14 years (28%). A slight male predominance was observed, with males accounting for 56% of participants. School-aged children may have greater exposure to contaminated food and water outside the household and may have inconsistent personal hygiene practices. Previous epidemiological studies have also identified children as an important population affected by typhoid fever [3,9].

In the present study, 63% of children were from rural areas. Although rural residence was not statistically associated with laboratory confirmation ($p=0.086$), the predominance of rural participants may reflect differences in access to safe water, sanitation and healthcare services. Environmental conditions within households and communities may have greater importance than residential classification alone [1,5].

Socioeconomic assessment showed that 48% of participants belonged to the lower socioeconomic category and 32% to the lower-middle category. Thus, 80% of the study population belonged to lower or lower-middle socioeconomic groups. Socioeconomic disadvantage may influence disease exposure through overcrowding, inadequate water supply, sanitation deficiencies and limited access to health information. Previous studies have recognized socioeconomic and household characteristics as important determinants of enteric fever transmission [6,8].

Water-related factors were particularly important in the present study. Although public tap/piped water was the most commonly reported source, 50% of households did not practice regular drinking-water

purification. Lack of regular water purification showed a statistically significant association with laboratory-confirmed typhoid fever (p=0.015).

This finding is consistent with the established fecal–oral transmission of *S. Typhi*. A systematic review by Mogasale et al. demonstrated an increased risk of typhoid fever among populations without adequate access to safe water [5]. The importance of safe drinking water is also emphasized in WHO drinking-water guidelines, which recommend appropriate control of microbial contamination as a fundamental component of drinking-water safety [12].

Household water treatment may therefore represent an important preventive measure in areas where the quality of the water supply cannot be assured. Boiling, appropriate filtration and chlorination can help reduce microbial contamination when properly implemented [11,12].

Sanitation was another important finding. In the present study, 32% of households reported shared toilet facilities or open defecation. Inadequate sanitation was significantly associated with laboratory-confirmed typhoid fever (p=0.027). Poor sanitation increases the likelihood of environmental fecal contamination and may facilitate contamination of water sources and food.

The WHO recognizes sanitation as a major determinant of health and emphasizes the importance of safe sanitation systems in preventing fecal–oral diseases [11]. Improvements in household and community sanitation may therefore contribute substantially to reducing enteric pathogen transmission. Hand hygiene also demonstrated a statistically significant association. Irregular handwashing before meals was reported by 39% of children, while 34% reported irregular handwashing after toilet use. Irregular handwashing was significantly associated with laboratory-confirmed disease (p=0.044). Contaminated hands can directly transmit enteric pathogens to food, utensils and drinking vessels. Promotion of handwashing with soap after toilet use and before eating is therefore an important preventive intervention [1,11]. Food-related exposure was also common. Fifty-seven percent of children reported consumption of food from outside the home, and 46% reported consumption of street-vended food. Street-food consumption showed a trend toward association with laboratory-confirmed typhoid fever (p=0.061), although this did not reach statistical significance.

Food may become contaminated during preparation, handling, storage or serving, particularly when safe water and hand hygiene are inadequate. Previous studies have demonstrated the importance of food and environmental exposures in the transmission of typhoid fever [7,8].

Clinically, fever was present in all participants. Abdominal pain was reported in 42%, weakness/fatigue in 38%, diarrhea in 31%, vomiting in 29%, headache in 24% and constipation in 18%. These findings are consistent with the recognized clinical spectrum of typhoid fever, in which prolonged fever may be accompanied by gastrointestinal and constitutional symptoms [1,4].

Laboratory confirmation was available in 62% of participants, while 38% were categorized as clinically diagnosed or laboratory-supported cases. Blood culture remains an important method for microbiological confirmation of typhoid fever, although its sensitivity may be affected by previous antibiotic exposure, timing of sample collection and bacterial load [4].

The association analysis demonstrated that lack of regular water purification, inadequate sanitation and irregular handwashing were statistically significant factors. Rural residence and lower socioeconomic status showed a trend toward association, while street-food consumption approached statistical significance. Outside-food consumption was not statistically significant.

The lack of statistical significance for some variables does not necessarily mean that these exposures have no role in typhoid transmission. The relatively small sample size of 100 participants may have limited the statistical power of the study. In addition, environmental exposures were largely based on parental reporting and may therefore have been influenced by recall or reporting bias.

The findings support an integrated approach to typhoid prevention. Improvements in access to safe drinking water, household water treatment, sanitation, hand hygiene and food safety should be combined with vaccination strategies. WHO recommends typhoid conjugate vaccination as an important preventive measure in endemic settings, particularly among children [2,10].

The study has several limitations. It was conducted at a single tertiary-care hospital with a relatively small sample size. Since only children diagnosed with typhoid fever were included and no healthy control group was enrolled, causal relationships between individual risk factors and acquisition of typhoid fever cannot be established. Furthermore, environmental factors were primarily assessed through parental responses, and microbiological testing of household water and food was not performed.

Despite these limitations, the study provides useful information regarding socioeconomic and

environmental characteristics among pediatric typhoid patients in Yadgiri. The significant associations observed with water purification, sanitation and hand hygiene identify potentially modifiable areas for public-health intervention.

Conclusion

The present study demonstrates that inadequate drinking-water purification, poor sanitation and irregular handwashing were significantly associated with laboratory-confirmed typhoid fever among pediatric patients. Lower socioeconomic status, rural residence and food-related exposures were also common among the study participants.

Strengthening safe drinking-water practices, household sanitation, hand hygiene, food safety and health education, along with appropriate typhoid vaccination, may contribute to reducing the burden of pediatric typhoid fever.

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