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# Association of food habits and seasonal variation with typhoid infection: A prospective study in a tertiary care centre

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**Abstract**

**Background and Objective** Typhoid fever, caused by Salmonella enterica serovar typhi, is a severe foodborne illness causing 33 million disability-adjusted life years and 600 million cases in 2010, posing a significant threat to global public health and society. The study investigates the seasonal pattern of enteric fever by identifying peak times, quantifying variation, and evaluating food habits that increase the risk of typhoid infection. **Material Method** From 2020-2021, a study at Mahatma Gandhi Memorial Medical College in India involved 140 blood samples from suspected enteric fever cases, with 26 *salmonella* species isolates enrolled. Blood samples from children and adult patients with suspected enteric fever are received in labs. Samples are incubated at 37°C for 18-24 hours, followed by blind subculture on solid agar media. Daily checks for growth indicators and flagging on automated blood culture bottles are conducted. Blood culture bottles must be monitored for seven days. **Result** In this study, 140 clinically suspected cases of enteric fever were includedand 26 (18.6%) of them were found to be blood culture positive for *Salmonella* Typhi species. Amongst 26 species of *Salmonella enterica*, all the 26 serovars were identified as *S.*typhi (100%) and no *S.* paratyphi A or *S.* paratyphi B. Out of 140 suspected cases, only 27.3% of children and 52.3% of adults had an outside food habit, with a significant p value. **Conclusion** Understanding seasonal *Salmonella* isolate distribution helps determine control measures for enteric fever. An epidemiological disease control system must be implemented in addition to offering safe drinking water and detecting long-term bacterial carriers.

**Key words:** *Salmonella* typhi, food habits, blood culture, seasonal variation

## Introduction

Typhoid fever is an acute febrile illness caused by *Salmonella* enterica serovar typhi, transmitted through fecal contamination of food or water in humans [1,2]. A major cause of illness and death across all age groups, foodborne diseases pose a threat to global public health and impede progress in society. The World Health Organisation (WHO) calculated that 33 million disability-adjusted life years (DALYs) and around 600 million cases or (nearly one in ten) were recorded in 2010 as a result of contaminated food [3, 4]. The epidemiology of *salmonella* is also affected by seasonal variations [5, 6]. In India, the peak incidence of *Salmonella* typhi occurs between the months of April and June (dry season), followed by July and September (monsoon season) [7]. The risk of contracting typhoidal *Salmonella* is highest in countries with low to middle incomes with endemic cases, inadequate sanitation, and limited access to healthy food and water [8]. The small intestine is first colonised by *Salmonella* typhi infection, and then the gastrointestinal mucosa is invaded. The spleen, liver, and bone marrow are subsequently affected by the illness.1,7 The infection's severity is determined by the initial infective dose, virulence, and the host's immune response [9,10]. This study aims to investigate the seasonal pattern of enteric fever by determining the peak time, quantifying variation, and assessing food habits which enhance the chance of typhoid infection.

## Material and method

The present study was carried out from 2020 to 2021 in the department of microbiology at Mahatma Gandhi Memorial Medical College, Indore, Madhya Pradesh, central India. Blood samples were received from suspected cases of enteric fever in the department of microbiology. A total of 140 blood samples were taken, out of which 26 isolates found to be *salmonella* species were enrolled in this study.

**Inclusion criteria** Clinical specimens of suspected cases of enteric fever received in the department.

**Exclusion criteria** Non-typhoidal isolates, *Salmonella* isolates from environmental samples like food, water, etc.

**Sample collection and processing** Collect two millilitres to five millilitres of venous blood from children and five millilitres to ten millilitres of blood from adult patients who have suspected enteric fever. Blood samples were received in the laboratory in automated blood culture (BacTalert) bottles or brain heart infusion (BHI) broth bottles. For 18 to 24 hours, incubate the BHI bottle at 37°C, and then continue for 7 days.

After 18 to 24 hours of incubation, do the first blind subculture on solid agar media, such as blood agar and MacConkey agar. Continue this process on alternate days until day 7. Every day, check the BHI broth bottle for any obvious growth indicators, such as clotting, gas production, pellicle formation, hemolysis, or turbidity. Check for flagging on automated blood culture bottles at least once a day. If it flags positively, proceed with gram staining, culture, and identification. Additionally, automated blood culture bottles must be monitored for seven days.

**Statistical analysis** The data were analysed using SSPS version 22. Frequencies and percentages were used to describe the categorical variables in this study. The results were presented as proportion ratios with a 95% confidence interval. Statistical significance was set if p-value <0.05.

**Result**

In this study, 140 clinically suspected cases of enteric fever were included and 26 (18.6%) of them were found to be blood culture positive for *Salmonella* Typhi species. Amongst 26 species of *Salmonella enterica*, all the 26 serovars were identified as *S.* typhi (100%) and no *S.* paratyphi A or *S.* paratyphi B.

**Table 1 Distribution based on food habits. (n=140)**

| | **Outside Food Habits** | | | | **Total** | |
|---|---|---|---|---|---|---|
| | **No** | | **Yes** | | | |
| | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| Children (1-19yrs) | 24 | 72.7% | 9 | 27.3% | 33 | 100.0 % |
| Adult (20- >50yrs) | 56 | 52.3% | 51 | 47.7% | 107 | 100.0 % |
| Total | 80 | 57.1% | 60 | 42.9% | 140 | 100.0 % |

Pearson Chi-Square = 4.282, df = 1, p value = .039, Significant
Fisher's Exact Test = .045

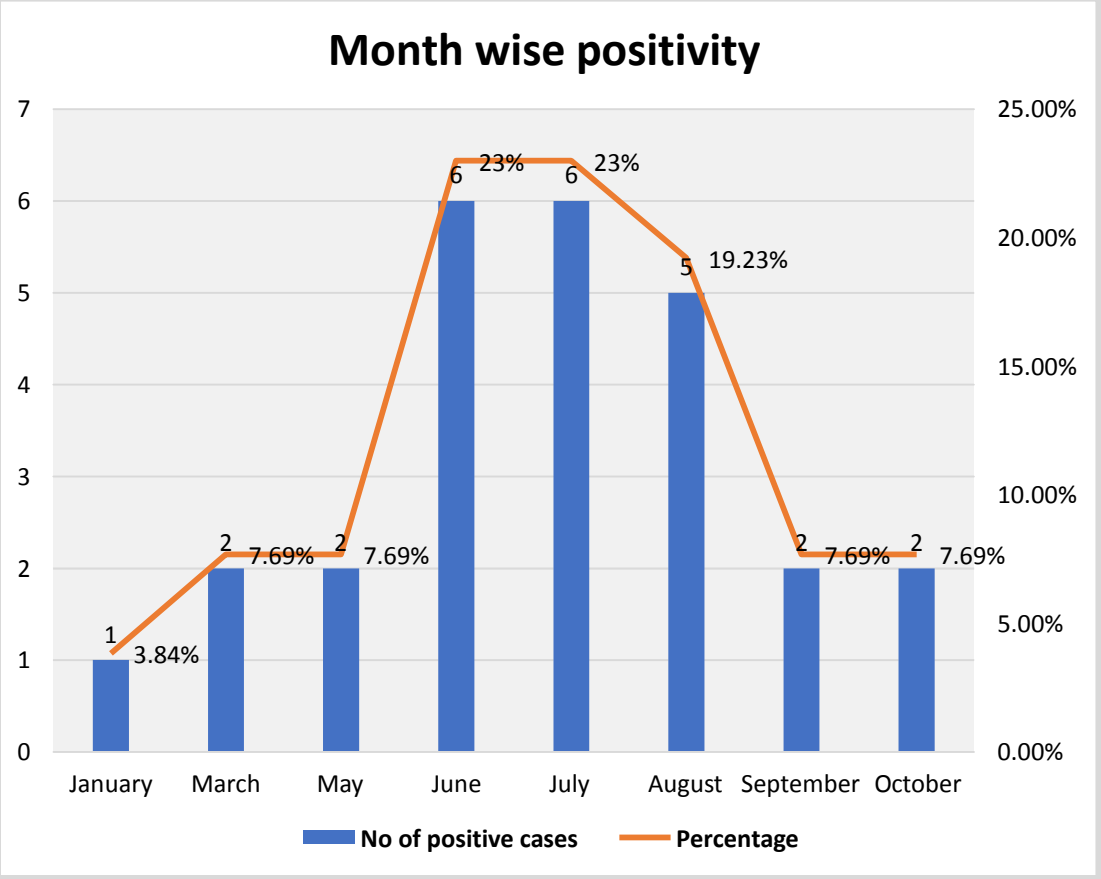
Out of 140 suspected cases, 33 were children, of whom only 9 (27.3%) had an outside food habit, and 107 were adults, of whom 56 (52.3%) had an outside food habit, and the p value was found to be significant (table 1)

**Table 2 Distribution based on food habits & culture positive typhoid fever cases.**

| | **Outside Food Habits** | | | | **Total** | |
|---|---|---|---|---|---|---|
| | **Yes (n=19)** | | **No (n=7)** | | | |
| | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| Children (n=8) (1-19yrs) | 2 | 25.0% | 6 | 75.0% | 8 | 100.0% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Adult (n=18)<br>(20- >50yrs) | 17 | 94.4% | 1 | 5.6% | 18 | 100.0% |
| Total | 19 | 73.1% | 7 | 26.9% | 26 | 100.0% |

Pearson Chi-Square = 13.576, df = 1, p value = .000, Significant
Fisher's Exact Test = .001
Out of 26 blood culture-positive cases, 8 were children, of whom 2 (25%) had an outside food habit and were culture-positive; 18 were adults, of whom 17 (94.4%) had both outside food habits and were culture-positive. The p value was found to be significant (table 2).




## Discussion

Enteric fever is known to have seasonal variation, with a peak incidence around the end of dry season. Mohanty *et al* in his study observed a peak incidence of typhoid fever around April to June followed by July to September [5]. In this study maximum cases were reported to be *S.* Typhi culture positive (65.23%) between June to August followed by March, May, September, October (8.3%) with the least number of culture positive cases in January (3.84%).

Throughout the dry season, as the temperature rises, the water level gradually drops, grows more stagnant, and loses its palatability [11]. Salmonella contamination of water is highly likely to be consumed under these circumstances [12].

Location of snack shops significantly influences food and beverage cleanliness, with roadside locations increasing typhoid fever risk. Dust and other vectors can penetrate tainted food, while unhygienic handling can lead to contaminated water and *Salmonella* typhi infection.

In this study we found that overall, 73% of the culture positive cases had a history of having food from street vendors. Amongst those 73%, 25% were children and 94.4% were found to be adults. This study shows significant association ($p < 0.05$) between eating habits and *Salmonella* positivity in adults.

The findings of our study for typhoid fever match previous research that suggests eating food sold on the street or obtained outside the home increases the risk of contracting foodborne illnesses [13,14]. Food handlers may actually spread *S*. typhi to a large number of customers over an extended period of time due of the possibility of asymptomatic lifelong carriage and shedding [15,16]

## Conclusion

Determining the proper control measures needed to avoid enteric fever is facilitated by understanding the seasonal distribution of Salmonella isolates in certain geographic areas. In addition to providing safe drinking water and identifying long-term bacterial carriers, the implementation of an epidemiological disease control system is necessary.

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