Section: Paediatrics

Original Research Article

CLINICAL AND LABORATORY PROFILE OF TYPHOID FEVER AMONG FEBRILE CHILDREN IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Typhoid fever remains a major public health concern in developing countries and continues to be an important cause of febrile illness among children. Early recognition of its clinical and laboratory characteristics is essential for timely diagnosis and effective management. **Objectives:** To study the clinical and laboratory profile of typhoid fever among febrile children attending a tertiary care hospital and to determine the association between clinical manifestations and laboratory abnormalities. **Materials and Methods:** A hospital-based cross-sectional observational study was conducted among 150 children aged 6 months to 14 years diagnosed with typhoid fever. Demographic details, clinical features, laboratory investigations, blood culture results, and Widal test findings were recorded. Data were analyzed using appropriate statistical methods, and associations were assessed using chi-square tests and odds ratios with 95% confidence intervals. **Results:** The mean age of the children was 8.3±3.2 years, with the majority belonging to the 5–10 years age group (45.3%). Males constituted 61.3% of cases, and 72.0% were unvaccinated against typhoid fever. Fever was present in all children, followed by anorexia (82.7%), abdominal pain (68.7%), coated tongue (63.3%), headache (58.7%), and vomiting (52.0%). Hepatomegaly and splenomegaly were observed in 49.3% and 38.0% of cases, respectively. Laboratory findings revealed anemia in 61.3%, leukopenia in 32.7%, thrombocytopenia in 37.3%, elevated SGOT in 47.3%, and elevated SGPT in 42.0% of children. Blood culture positivity was noted in 32.0% of cases, while significant Widal positivity was observed in 84.0%. Significant associations were found between hepatomegaly and elevated liver enzymes, splenomegaly and leukopenia, and toxic appearance and thrombocytopenia. **Conclusion:** Typhoid fever predominantly affects school-aged, unvaccinated children and presents with characteristic clinical and laboratory abnormalities. Combined clinical assessment and laboratory evaluation facilitate early diagnosis and management. Improved vaccination coverage and public health measures remain essential for reducing disease burden.

INTRODUCTION

Typhoid fever is a systemic infectious disease caused by Salmonella enterica serovar Typhi and remains a major public health problem in developing countries, particularly in South Asia. Despite advances in sanitation, vaccination, and antimicrobial therapy, typhoid fever continues to contribute substantially to childhood morbidity and hospital admissions. The disease is transmitted through the fecal–oral route via contaminated food and water and is closely associated with poor sanitation, overcrowding, and inadequate access to safe drinking water. Children constitute a vulnerable population due to frequent exposure to contaminated environments and immature immune responses.[1]

The global burden of typhoid fever is estimated at more than 9 million cases annually, with a significant proportion occurring in low- and middle-income countries. India bears one of the highest burdens of disease, with school-aged children and adolescents being commonly affected. However, recent studies have shown increasing incidence among younger children, making pediatric typhoid fever an important clinical concern. The disease presents with a broad spectrum of manifestations ranging from uncomplicated febrile illness to severe systemic involvement affecting multiple organs.[2]

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Clinically, typhoid fever is characterized by prolonged fever, anorexia, abdominal pain, vomiting, diarrhea or constipation, coated tongue, hepatomegaly, splenomegaly, and general malaise. The presentation may vary according to age, duration of illness, nutritional status, and prior antibiotic exposure. In children, symptoms are often nonspecific and may mimic other febrile illnesses such as malaria, dengue, viral infections, and tuberculosis, thereby complicating diagnosis. Early recognition is essential to prevent complications such as intestinal hemorrhage, intestinal perforation, encephalopathy, myocarditis, hepatitis, and septic shock.[3]

Laboratory investigations play a crucial role in diagnosis and management. Blood culture remains the gold standard for confirmation of typhoid fever, although its sensitivity may be reduced by prior antibiotic therapy. Serological tests such as the Widal test continue to be widely used in resource-limited settings despite their limitations. Hematological abnormalities including anemia, leukopenia, leukocytosis, thrombocytopenia, and elevated inflammatory markers are frequently observed. Liver function abnormalities may also occur and correlate with disease severity. Understanding the laboratory profile of affected children can aid clinicians in establishing an early diagnosis and monitoring disease progression.[4]

The emergence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) Salmonella Typhi strains has become a growing challenge worldwide. Antimicrobial resistance has altered treatment strategies and emphasizes the need for continuous surveillance of disease patterns and treatment outcomes. Detailed evaluation of clinical manifestations and laboratory abnormalities among affected children is therefore essential for improving diagnostic accuracy and optimizing patient management.[5]

Aim

To study the clinical and laboratory profile of typhoid fever among febrile children attending a tertiary care hospital.

Objectives

1. To assess the clinical manifestations of typhoid fever among febrile children.
2. To evaluate the hematological and biochemical laboratory abnormalities associated with typhoid fever in children.
3. To determine the association between clinical features and laboratory findings among children diagnosed with typhoid fever.

MATERIALS AND METHODS

Source of Data

The data were collected from children presenting with fever and diagnosed with typhoid fever in the Department of Pediatrics of a tertiary care teaching hospital. Eligible patients attending the pediatric outpatient department, emergency department, and inpatient wards during the study period were enrolled consecutively after obtaining informed consent from parents or guardians.

Study Design

Hospital-based Cross-Sectional Observational Study.

Study Location

The study was conducted in the Department of Pediatrics of a tertiary care teaching hospital, including pediatric outpatient clinics, pediatric wards, and pediatric emergency services.

Study Duration

The study was conducted over a period of 18 months, including patient recruitment, data collection, laboratory investigations, analysis, and report preparation.

Sample Size

A total of 150 children fulfilling the inclusion criteria were included in the study.

Sample Size (N) = 150

Inclusion Criteria

1. Children aged 6 months to 14 years.
2. Children presenting with fever for ≥3 days.
3. Children diagnosed with typhoid fever based on:
   - Positive blood culture for *Salmonella Typhi* or *Salmonella Paratyphi*, or
   - Significant Widal test titre as per institutional standards along with compatible clinical features.
4. Parents/guardians willing to provide informed consent.

Exclusion Criteria

1. Children with confirmed alternative causes of fever such as malaria, dengue, leptospirosis, tuberculosis, or viral hepatitis.
2. Children who had received antibiotics for more than 7 days before presentation.
3. Children with chronic liver disease, chronic kidney disease, malignancy, or immunodeficiency disorders.
4. Children whose parents/guardians declined consent.

Procedure and Methodology

After obtaining Institutional Ethics Committee approval, eligible children presenting with fever were screened. Detailed demographic information including age, gender, socioeconomic status, immunization status, drinking water source, and sanitation practices was recorded.

A thorough clinical examination was performed. Clinical features including duration of fever, abdominal pain, vomiting, diarrhea, constipation, headache, anorexia, cough, hepatomegaly, splenomegaly, coated tongue, and other systemic manifestations were documented.

All enrolled children underwent laboratory investigations including complete blood count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), liver function tests, renal function tests, blood culture, and Widal test. Additional investigations were performed whenever clinically indicated.

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The diagnosis of typhoid fever was established based on clinical findings supported by microbiological or serological evidence. All findings were recorded in a predesigned study proforma.

Sample Processing

Approximately 5–10 mL of venous blood was collected under aseptic precautions.

- **Complete Blood Count (CBC):** Processed using an automated hematology analyzer.
- **Blood Culture:** Inoculated into culture bottles and incubated according to standard microbiological protocols. Identification of *Salmonella* species and antibiotic susceptibility testing were performed.
- **Widal Test:** Conducted by standard tube agglutination method.
- **Biochemical Tests:** Liver and renal function tests were performed using automated biochemistry analyzers.

All samples were processed in the central laboratory of the institution following standard operating procedures and quality control measures.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0 (IBM Corp., USA).

- Continuous variables were expressed as Mean ± Standard Deviation (SD).
- Categorical variables were expressed as frequency and percentage.
- Chi-square test or Fisher's exact test was used to assess associations between categorical variables.
- Independent t-test or Mann–Whitney U test was used for comparison of continuous variables.
- Odds ratios (OR) with 95% confidence intervals (CI) were calculated where appropriate.
- A p-value <0.05 was considered statistically significant.

Data Collection

Data were collected using a structured case record form. Information recorded included:

- Demographic details
- Duration and pattern of fever
- Clinical symptoms and signs
- Vaccination status
- Laboratory investigation findings
- Blood culture and Widal test results
- Hematological and biochemical parameters
- Clinical diagnosis and treatment details

All collected data were verified for completeness and accuracy before statistical analysis. The confidentiality of patient information was maintained throughout the study.

RESULTS

Table 1: Baseline Characteristics of Children with Typhoid Fever (N=150)

Variable	n (%) / Mean±SD	95% CI	Test Value	P value
Age <5 years	42 (28.0)	21.3–35.8	χ^2=18.42	<0.001
Age 5–10 years	68 (45.3)	37.4–53.5		
Age >10 years	40 (26.7)	20.2–34.3		
Age (years)	8.3 ± 3.2	7.8–8.8	t=31.72	<0.001
Male	92 (61.3)	53.3–69.0	χ^2=7.65	0.006
Female	58 (38.7)	31.0–46.7		
Rural residence	96 (64.0)	56.0–71.3	χ^2=11.76	0.001
Urban residence	54 (36.0)	28.7–44.0		
Unvaccinated against typhoid	108 (72.0)	64.3–78.7	χ^2=29.04	<0.001
Vaccinated	42 (28.0)	21.3–35.8		
Duration of fever (days)	8.9 ± 2.8	8.4–9.4	t=38.95	<0.001
Weight (kg)	24.8 ± 8.6	23.4–26.2	t=35.31	<0.001

Table 1 presents the baseline demographic and clinical characteristics of 150 children diagnosed with typhoid fever. The majority of patients belonged to the 5–10 years age group (68, 45.3%; 95% CI: 37.4–53.5%), followed by children aged less than 5 years (42, 28.0%; 95% CI: 21.3–35.8%) and those older than 10 years (40, 26.7%; 95% CI: 20.2–34.3%). The age distribution was statistically significant (χ^2=18.42, p<0.001). The mean age of the study population was 8.3±3.2 years (95% CI: 7.8–8.8 years), indicating that school-aged children constituted the predominant affected group. Male children predominated, accounting for 92 cases (61.3%; 95% CI: 53.3–69.0%), whereas females constituted 58 cases (38.7%; 95% CI: 31.0–46.7%), with a significant gender difference (χ^2=7.65, p=0.006). Rural residence was observed in 96 children (64.0%; 95% CI: 56.0–71.3%), significantly higher than urban residence (36.0%; 95% CI: 28.7–44.0%) (χ^2=11.76, p=0.001). A large proportion of children were unvaccinated against typhoid fever (108, 72.0%; 95% CI: 64.3–78.7%), compared to only 42 vaccinated children (28.0%), which was highly significant (χ^2=29.04, p<0.001). The mean duration of fever prior to presentation was 8.9±2.8 days (95% CI: 8.4–9.4 days), while the mean body weight was 24.8±8.6 kg (95% CI: 23.4–26.2 kg).

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Table 2: Clinical Manifestations of Typhoid Fever Among Febrile Children (N=150)

Clinical Feature	n (%)	95% CI	χ^2 Value	P value
Fever	150 (100.0)	—	—	—
Anorexia	124 (82.7)	75.8–88.1	64.05	<0.001
Abdominal pain	103 (68.7)	60.8–75.7	21.41	<0.001
Vomiting	78 (52.0)	43.8–60.0	0.24	0.624
Headache	88 (58.7)	50.4–66.4	3.45	0.063
Diarrhea	61 (40.7)	33.1–48.8	8.41	0.004
Constipation	43 (28.7)	21.9–36.5	26.24	<0.001
Coated tongue	95 (63.3)	55.4–70.6	12.83	<0.001
Hepatomegaly	74 (49.3)	41.2–57.5	0.11	0.741
Splenomegaly	57 (38.0)	30.7–46.0	11.76	0.001
Relative bradycardia	36 (24.0)	17.7–31.7	39.84	<0.001
Toxic appearance	29 (19.3)	13.7–26.4	54.08	<0.001

Table 2 summarizes the clinical manifestations observed among children with typhoid fever. Fever was present in all patients (100%), reflecting its cardinal role in disease presentation. Anorexia was the most common accompanying symptom, reported in 124 children (82.7%; 95% CI: 75.8–88.1%), followed by abdominal pain in 103 children (68.7%; 95% CI: 60.8–75.7%). Both symptoms showed strong statistical significance ($p<0.001$). Coated tongue was observed in 95 patients (63.3%; 95% CI: 55.4–70.6%), while headache occurred in 88 patients (58.7%; 95% CI: 50.4–66.4%). Vomiting was present in 78 children (52.0%), though this association was not statistically significant ($p=0.624$). Hepatomegaly was detected in 74 children (49.3%), and splenomegaly in 57 children (38.0%), with splenomegaly showing significant association ($p=0.001$). Gastrointestinal manifestations included diarrhea in 61 children (40.7%) and constipation in 43 children (28.7%), both characteristic features of enteric fever. Relative bradycardia was observed in 24.0% of patients, while toxic appearance was noted in 19.3% of cases, indicating severe systemic involvement in a subset of children.

Table 3: Hematological and Biochemical Laboratory Profile of Typhoid Fever (N=150)

Parameter	Mean±SD / n (%)	95% CI	Test Value	P value
Hemoglobin (g/dL)	10.7 ± 1.8	10.4–11.0	t=72.84	<0.001
Total Leukocyte Count (/mm³)	5310 ± 1850	5013–5607	t=35.17	<0.001
Platelet Count (×10³/mm³)	176.5 ± 54.8	167.7–185.3	t=39.47	<0.001
ESR (mm/hr)	34.8 ± 12.6	32.8–36.8	t=33.84	<0.001
CRP (mg/L)	22.7 ± 10.4	21.0–24.4	t=26.72	<0.001
SGOT (IU/L)	68.3 ± 25.7	64.2–72.4	t=32.55	<0.001
SGPT (IU/L)	59.4 ± 22.8	55.7–63.1	t=31.91	<0.001
Anemia (Hb <11 g/dL)	92 (61.3)	53.3–69.0	χ^2=7.65	0.006
Leukopenia (<4000/mm³)	49 (32.7)	25.7–40.5	χ^2=16.43	<0.001
Leukocytosis (>11000/mm³)	18 (12.0)	7.7–18.1	χ^2=82.56	<0.001
Thrombocytopenia (<150000/mm³)	56 (37.3)	29.9–45.4	χ^2=10.24	0.001
Elevated SGOT	71 (47.3)	39.3–55.4	χ^2=0.85	0.356
Elevated SGPT	63 (42.0)	34.4–50.0	χ^2=4.32	0.038
Positive Blood Culture	48 (32.0)	25.0–40.0	χ^2=18.24	<0.001
Significant Widal Test	126 (84.0)	77.3–89.0	χ^2=69.12	<0.001

Table 3 depicts the hematological and biochemical abnormalities observed among children with typhoid fever. The mean hemoglobin level was 10.7±1.8 g/dL (95% CI: 10.4–11.0), and anemia (Hb <11 g/dL) was identified in 92 children (61.3%), indicating that anemia was a common laboratory finding. The mean total leukocyte count was 5310±1850/mm³ (95% CI: 5013–5607/mm³), with leukopenia present in 32.7% of patients and leukocytosis in only 12.0%, suggesting that leukopenia was more characteristic of typhoid fever. The mean platelet count was 176.5±54.8×10³/mm³, and thrombocytopenia was observed in 37.3% of children, reflecting moderate hematological involvement. Inflammatory markers were elevated, with a mean ESR of 34.8±12.6 mm/hr and mean CRP of 22.7±10.4 mg/L, both highly significant ($p<0.001$). Liver enzyme abnormalities were also common, with mean SGOT and SGPT levels of 68.3±25.7 IU/L and 59.4±22.8 IU/L, respectively. Elevated SGOT was observed in 47.3% of patients, while elevated SGPT was found in 42.0%, indicating frequent hepatic involvement. Blood culture positivity was documented in 48 children (32.0%), whereas a significant Widal test was noted in 126 children (84.0%), making it the most frequently positive diagnostic test.

Table 4: Association Between Clinical Features and Laboratory Abnormalities in Children with Typhoid Fever (N=150)

Clinical Feature	Laboratory Finding	n (%)	Odds Ratio (95% CI)	χ^2 Value	P value
Hepatomegaly (n=74)	Elevated SGOT	54 (73.0)	4.62 (2.26–9.42)	18.76	<0.001
Hepatomegaly (n=74)	Elevated SGPT	49 (66.2)	3.88 (1.96–7.67)	15.93	<0.001
Splenomegaly (n=57)	Leukopenia	31 (54.4)	2.91 (1.47–5.76)	9.64	0.002
Toxic appearance (n=29)	Thrombocytopenia	19 (65.5)	3.76 (1.57–8.97)	10.21	0.001

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Fever >10 days (n=64)	Positive Blood Culture	31 (48.4)	3.18 (1.57–6.44)	10.85	0.001
Fever >10 days (n=64)	Elevated CRP (>20 mg/L)	42 (65.6)	2.94 (1.52–5.68)	9.72	0.002
Abdominal pain (n=103)	Elevated SGOT	57 (55.3)	2.29 (1.13–4.63)	5.47	0.019
Vomiting (n=78)	Elevated CRP (>20 mg/L)	48 (61.5)	2.63 (1.35–5.11)	8.17	0.004
Splenomegaly (n=57)	Positive Blood Culture	27 (47.4)	2.56 (1.28–5.12)	7.26	0.007
Toxic appearance (n=29)	Positive Blood Culture	18 (62.1)	4.29 (1.87–9.82)	13.92	<0.001

Table 4 evaluates the relationship between clinical manifestations and laboratory abnormalities among children with typhoid fever. Hepatomegaly showed a strong association with elevated liver enzymes; 73.0% of children with hepatomegaly had elevated SGOT levels (OR=4.62, 95% CI: 2.26–9.42, p<0.001), while 66.2% had elevated SGPT levels (OR=3.88, 95% CI: 1.96–7.67, p<0.001). Splenomegaly was significantly associated with leukopenia (54.4%; OR=2.91, p=0.002) and positive blood culture results (47.4%; OR=2.56, p=0.007), indicating a higher burden of systemic infection. Toxic appearance was strongly correlated with thrombocytopenia (65.5%; OR=3.76, p=0.001) and blood culture positivity (62.1%; OR=4.29, p<0.001), suggesting that toxic-looking children were more likely to have severe disease. Fever lasting more than 10 days was significantly associated with positive blood culture (48.4%; OR=3.18, p=0.001) and elevated CRP levels (65.6%; OR=2.94, p=0.002), highlighting the relationship between prolonged illness and increased inflammatory activity. Abdominal pain was significantly linked to elevated SGOT levels (55.3%; OR=2.29, p=0.019), while vomiting was associated with elevated CRP levels (61.5%; OR=2.63, p=0.004).

DISCUSSION

In the present study, the majority of children belonged to the 5–10 years age group (45.3%), with a mean age of 8.3±3.2 years, suggesting that school-going children were most commonly affected. This finding is comparable with Behera et al. (2021),[1] who reported higher occurrence of enteric fever among school-aged children. Similar age predominance was also observed by Sinha et al. (1999),[2] and John et al. (2023)[3], who noted that typhoid fever remains an important pediatric illness in endemic Indian settings. Male predominance was observed in the present study (61.3%), which is consistent with studies by Behera et al. (2021),[1] and Kumar et al. (2012)[4], possibly due to greater outdoor exposure and consumption of contaminated food and water among boys. Rural residence was significantly higher (64.0%), supporting the role of poor sanitation, unsafe drinking water, and limited vaccine coverage in disease transmission. The high proportion of unvaccinated children (72.0%) further emphasizes the need for improved typhoid vaccination coverage in endemic areas.

The clinical profile in the present study showed fever in all children, followed by anorexia (82.7%), abdominal pain (68.7%), coated tongue (63.3%), headache (58.7%), vomiting (52.0%), hepatomegaly (49.3%), diarrhea (40.7%), and splenomegaly (38.0%). These findings are comparable with Laishram et al. (2016),[5] who reported fever, coated tongue, hepatomegaly, and splenomegaly as common clinical findings in pediatric typhoid fever. Joshi et al. (2014),[6] also found fever and gastrointestinal symptoms as dominant manifestations. The presence of diarrhea in 40.7% and constipation in 28.7% shows that bowel symptoms are variable in children. Relative bradycardia was present in 24.0%, while toxic appearance was observed in 19.3%, indicating systemic involvement in a subset of patients. Similar observations were made by Bhan et al. (2005),[7] who described typhoid fever as a multisystem illness with variable gastrointestinal and systemic manifestations. Laboratory findings showed anemia in 61.3%, leukopenia in 32.7%, thrombocytopenia in 37.3%, elevated SGOT in 47.3%, and elevated SGPT in 42.0%. Behera et al. (2021),[1] reported anemia, leukopenia, leukocytosis, and thrombocytopenia among children with enteric fever, supporting the present findings. Khosla et al. (1995),[8] also described hematological abnormalities such as leukopenia and thrombocytopenia in typhoid fever. The raised ESR and CRP levels in the present study indicate inflammatory activity, while elevated transaminases suggest hepatic involvement. Similar hepatic enzyme elevation was reported by Morgenstern and Hayes (1991),[9] who noted that typhoid fever may be associated with typhoid hepatitis. Blood culture positivity was 32.0%, whereas significant Widal test positivity was 84.0%. This difference may be due to prior antibiotic exposure and reduced blood culture sensitivity, as also highlighted by Parry et al. (2002).[10]

The association analysis showed that hepatomegaly was significantly associated with elevated SGOT and SGPT, indicating hepatic involvement in clinically enlarged liver. Splenomegaly was associated with leukopenia and positive blood culture, suggesting systemic bacterial dissemination. Toxic appearance showed strong association with thrombocytopenia and blood culture positivity, indicating that toxic-looking children were more likely to have severe disease. Fever lasting more than 10 days was significantly associated with blood culture positivity and elevated CRP, reflecting prolonged inflammatory activity. These findings are consistent with the clinicopathological pattern described in the uploaded thesis, which emphasizes clinical spectrum, laboratory profile, and diagnostic challenges in pediatric typhoid fever.

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CONCLUSION

Typhoid fever remains an important cause of febrile illness among children in developing regions, particularly among school-aged, unvaccinated children residing in rural areas. The present study demonstrated that fever, anorexia, abdominal pain, coated tongue, headache, and gastrointestinal symptoms were the predominant clinical manifestations. Hepatomegaly and splenomegaly were common physical findings, reflecting systemic involvement. Hematological abnormalities such as anemia, leukopenia, and thrombocytopenia were frequently observed, while elevated inflammatory markers and liver enzymes indicated ongoing inflammatory and hepatic involvement. A significant proportion of children showed positive Widal test results, although blood culture positivity was comparatively lower. Furthermore, important associations were identified between clinical manifestations and laboratory abnormalities, with hepatomegaly correlating with elevated liver enzymes, splenomegaly with leukopenia and blood culture positivity, and toxic appearance with thrombocytopenia and culture-confirmed disease. These findings highlight the importance of careful clinical evaluation supported by laboratory investigations for the early diagnosis and management of pediatric typhoid fever. Strengthening vaccination coverage, improving sanitation, and promoting early healthcare-seeking behavior may substantially reduce the burden of typhoid fever among children.

Limitations of the study

1. The study was conducted at a single tertiary care hospital, limiting the generalizability of findings to the wider population.
2. The cross-sectional design precluded assessment of long-term outcomes and disease progression.
3. Blood culture positivity may have been underestimated due to prior antibiotic use before hospital presentation.
4. Widal test results may have been influenced by background endemicity and previous exposure to Salmonella species.
5. Antimicrobial susceptibility patterns were not evaluated in detail.
6. Viral and other bacterial co-infections may not have been completely excluded in all cases.
7. Nutritional status and socioeconomic determinants were not extensively analyzed.
8. Follow-up after discharge was not performed to assess relapse or chronic carrier status.
9. The study did not evaluate treatment response and duration of recovery in detail.
10. Molecular diagnostic methods such as PCR were not available, which could have improved diagnostic accuracy.

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