Characteristic of *Salmonella* Infection among Pediatric Age Group in a Tertiary Care Hospital, Saudi Arabia

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Abstract

Background: *Salmonella* is a rod-shaped, gram-negative bacterium that frequently causes meningitis, bacteremia and gastroenteritis. A variety of other illnesses, such as typhoid and non-typhoid diseases, have also been linked to it. While humans are the only natural host and reservoir for *Salmonella typhi*, animals (pets) are a significant reservoir for nontyphoidal *Salmonella*. Globally, gastroenteritis is primarily caused by infections with *Salmonella*.

Aim of the Study: To look for symptoms associated with *Salmonella* infection in the younger age group.to determine which *Salmonella* infection types are more prevalent. To identify the most typical problems and its complications.

Ascertain who and how will require therapy. To determine the risk variables for both a serious case of *Salmonella* and a CNS infection.

Method: A retrospective cohort analysis was carried out at King Abdulaziz Medical City, NGHA in Jeddah, Saudi Arabia, and included all pediatric patients who were diagnosed with *Salmonella* infection between January 2020 and December 2022. Data gathered from Best Care's electronic medical records were arranged in an excel spreadsheet and evaluated using JMP analysis.

Result: Of the 74 kids who took part in the study, 46 (62.2%) were boys, and over half of them were younger than a year old. Diarrhea and fever were the most prevalent symptoms of the illness (60.0%). Twelve (16.2%) of the cases had positive blood and stool cultures. Six instances (8.1%) had positive GI multiplex results, out of the 93.2% of positive stool cultures. About 45% of patients had *Salmonella enterica* isolated type, according to positive stool culture results.

The majority of our patients (75.7%) did not have any chronic illnesses, and 50 individuals (67.6%) received IV treatment. Ceftriaxone was the most often used therapy (45.9%).

Regarding treatment option and duration, there was a significant difference (P < 0.05) in the length of duration per route. The group receiving both IV and oral had a higher median duration. Table 6 and 7 showed the relationship between the age of the children and a few chosen attributes. Ages categorized as < 1 year and > 1 year were significantly (P < 0.05) correlated with chronic diseases, therapy, and length of stay. Compared to children under a year old, those older than a year old had a higher likelihood of chronic illnesses and lengthier hospital stays.

Conclusion: The American Academy of Pediatrics recommendation and guidelines for treating high-risk groups with non-typhoid *Salmonella* only as a disease in other groups are self-limiting, despite the fact that non-typhoidal *Salmonella* typically causes gastroenteritis. *Salmonella* can also become invasive and cause septicemia; our review indicates that the risk of invasive non-typhoid *Salmonella* is 16%, most likely group B.

Keywords: Salmonella; Non Typhoid Salmonella; Characteristics; Pediatric; Invasive; High Risk Group

Introduction

Salmonella is a rod-shaped, gram-negative bacterium that frequently causes meningitis, bacteremia, and gastroenteritis. A variety of other illnesses, such as typhoid and non-typhoid diseases, have also been linked to it. Many *Salmonella* enterica serovars can cause non-typhoid salmonellosis, which is typically a less severe form of the disease. *Salmonella enterica serovar typhi* is the pathogen that causes typhoid salmonellosis, a potentially fatal systemic illness [1]. In contrast to non-typhoid salmonellosis symptoms, which include fever, diarrhea, and abdominal cramps, typhoid salmonellosis symptoms include fever, headache, abdominal discomfiture, diarrhea and nausea. Complications from salmonellosis might include sepsis, bacteremia and dehydration.

Salmonellosis is a worldwide health concern, with *S. enterica serovars typhi* and *paratyphi* causing an estimated 21.2 million cases of typhoid fever and 5.4 million cases of para typhoid fever per year. *S. enteritidis* and *S. typhimurium* are the most frequent serovars of *S. enterica* that cause non-typhoid salmonellosis, accounting for an estimated 1.2 million cases of non-typhoid salmonellosis worldwide each year [2]. Although underdeveloped nations have the highest overall burden of salmonellosis, locally acquired instances of non-typhoid salmonellosis are increasingly being documented in developed countries.

Purpose of the Study

The purpose of this study is to look into clinical characteristics of *Salmonella* infections in children aged 14 and younger, with a focus on the kinds of *Salmonella* that cause gastroenteritis, meningitis and bacteremia. A retrospective cohort investigation will be carried out to determine the prevalence of *Salmonella* infection as the clinical presentation and fate of those infections.

Method

A retrospective cohort study that will include all pediatric patients presented with *Salmonella* infection from January 2020 to December 2022 conducted at King Abdulaziz Medical City, NGHA in Jeddah, Saudi Arabia. Data collected from electronic medical records Best Care were organized in an excel sheet and analyzed using JMP software. Categorical variables were presented in frequency and percentage, continuous variables were presented in means and SD. Association and differences between study variables were examined using appropriate statistical tests. A p value of less than or equal 0.05 was considered significant.

Result

Table 1 presents the basic characteristics of participants, out of 74 children included in the study (62.2%) were males, about half of participants were less than one year old (52.7%), less than 3 months (14.7%) and (47.3%) were two years or older. The means and SD of the blood parameters were reported in table 1. Signs and symptoms of the disease were illustrated in figure 1, diarrhea and fever were the common signs of the disease (60.0%). Other (32.9%) have cough and decrease oral intake. Blood and stool culture were categorized in table 2, (16.2%) of cases were positive blood culture. The percentage of positive stool culture was (93.2%) while (8.1%) were positive GI multiplex. The CSF analysis done in (17.7%) were negative. The types of *Salmonella* based on positive stool culture were shown in figure 2, 45% of patients were *Salmonella enterica* isolated. Chronic diseases and treatment variables shown in table 4, most cases (75.7%) had no chronic diseases, 19 patients with chronic illness and most likely to have malignancy in 15 patients (8 patients have acute lymphoblastic leukemia and 2 patients have sickle cell anemia). In regard to treat option (67.6%) patients were IV rout. The common treatment was ceftriaxone (45.9%). In regards the complication (95.9%) had no complication. (4.1%) patients developed complication as *Salmonella* septic shock, rash due to ceftriaxone and sever dehydration. Table 5 reported significant difference (P < 0.05) in length of duration by rout, higher median of duration was found in the group of both IV and oral. The association between the age of children and selected characteristics was presented in table 6 and 7. Chronic diseases, treatment, and length of stay were significantly (P < 0.05) associated with age classified as < 1 year and > 1 year. Children age more than one year were more likely to have chronic diseases and longer length of stay compared to children less than one year (Table 6).

Variable	N = 74
Gender	
Female	28 (37.8)
Male	46 (62.2)
Age	
1 years and less	39 (52.7)
2-4 years	20 (27.0)
More than 4 years	15 (20.3)
Hb	11.3 ± 1.7
Platelet	322.4 ± 153.6
WBC	9.5 ± 5.3
Neutrophil	4.9 ± 3.4
CRP	61.6 ± 72.7
Procalcitonin	2.4 ± 5.2
Na	135.7± 2.5
K^+	4.3 ± 0.62
Creatinine	39.3 ± 8.7
Urea	3.8 ± 2.6

Table 1: Basic characteristics of participants.
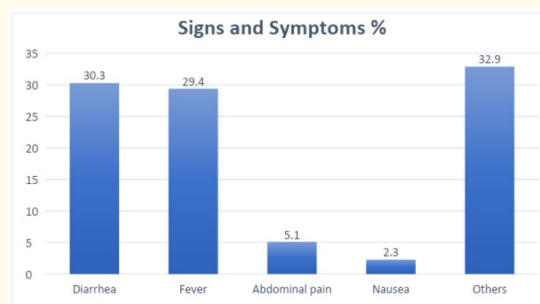
Figure 1: Signs and symptoms.

Variable	N = 74
CFS analysis	
Positive	0 (0)
Negative	13 (17.7)
Not done	61 (82.3)
Blood Culture	
Positive	12 (16.2)
Negative	55 (74.3)
Not done	7 (9.5)
Stool Culture	
Positive	69 (93.2)
Negative	2 (2.7)
Not done	3 (4.0)
GI Multiplex	
Positive	6 (8.1)
Negative	1 (1.4)
Not done	67 (90.5)

Table 2: Blood and stool culture.

Stool Culture		Blood Culture		Total	P-value
	Positive	**Negative**	**Not Done**		0.008*
Positive	8 (66.7)	54 (98.2)	7 (100)	69	
Negative	2 (16.6)	0 (0)	0 (0)	2	
Not Done	2 (16.6)	1 (1.8)	0 (0)	3	
Total	12	55	7	74	

Table 3: *Association between blood and stool culture.*

*Significant association.
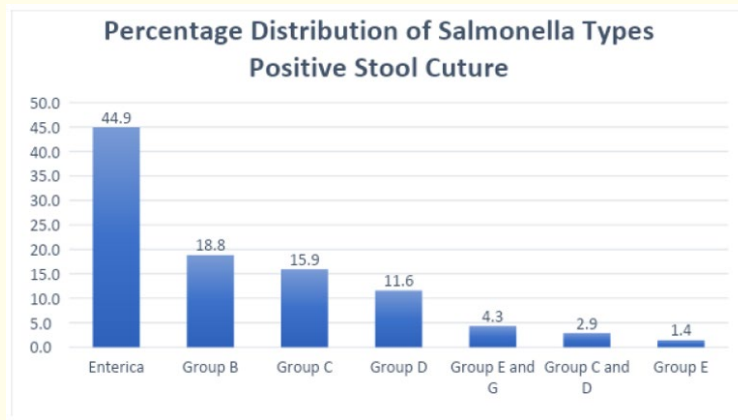
Figure 2: *Types of Salmonella positive stool culture.*

Variable	N=74
Chronic disease	
None	55 (75.3)
Acute lymphoblastic leukemia	8 (10.8)
Neuroblastoma	4 (5.4)
Acute myeloid leukemia	1 (1.3)
Burkitt lymphoma	2 (2.7)
Sickle cell anemia	2 (2.7)
CGPD	2 (2.7)
Rout	
None	16 (21.6)
IV	50 (67.6)
Oral	4 (5.4)
Both IV and Oral	4 (5.4)
Treatment	
None	16 (21.6)
Ceftriaxone	34 (45.9)
Ciprofloxacin	3 (4.1)

Cefotaxime	7 (9.5)
Augmentin	2 (2.7)
Tazocin	4 (5.4)
Meropenem	3 (4.1)
Ceftriaxone and Ciprofloxacin	2 (2.7)
Ceftriaxone and Cefixime	1 (1.3)
Ceftriaxone and Azithromycin	1 (1.3)
Meropenem and Ciprofloxacin	1 (1.3)
Complications	
Yes	3 (4.1)
No	71 (95.9)

Table 4: *Chronic diseases, treatment, and rout.*

Rout	Median	IQR	P-value
IV	8.0	4.2	0.018*
Oral	8.0	2.2	
Both IV and Oral	13.0	7.5	

Table 5: *Length of duration by rout.*

*Significant difference.

Variable	< 1-year	>1-year	P-value
Gender			
Female	14 (50.0)	14 (50.0)	0.716
Male	25 (54.4)	21 (45.6)	
Chronic disease			
No	35 (62.5)	21 (37.5)	0.003*
Yes	4 (22.2)	14 (77.8)	
Treatment			
No	12 (75.5)	4 (25.0)	0.044*
Yes	27 (46.6)	31 (53.4)	
Length[1]	4.0 (7.0)	6.0 (10.0)	0.046*

Table 6: *Age (< 1-year vs > 1-year) by Salmonella factors.*

[1]Median (IQR); *Significant association or difference.

Variable	< 3 months	> 3 months	P-value
Gender			
Female	4 (14.3)	24 (85.7)	0.913
Male	7 (15.2)	39 (84.8)	
Chronic disease			

No	10 (17.9)	46 (82.1)	0.275
Yes	1 (5.6)	17 (94.4)	
Treatment			
No	1 (6.3)	15 (93.7)	0.437
Yes	10 (17.2)	48 (82.8)	
Length1	7.0 (8.0)	4.0 (9.0)	0.691

***Table 7:** Age (< 3 months vs > 3 months) by Salmonella factors.*

Discussion

Salmonella is one of the most common causes of gastroenteritis in humans globally and the high disease burden is associated with high morbidity and mortality [3]. Seventy-four isolates were identified from non-duplicative patients with *Salmonella* infections during the study period (January 2020 to December 2022). Sixty-nine (93.2%) of isolates were taken from stool samples, 12 (16.2%) were taken from blood samples, 0 (0%) from CSF. We analyzed various characteristics of these cases such as age, sex, underlying disease, case management and outcome.

We found more male to be affected by this infection than females 62.2% versus 37.8%. The available literature was different than in our study with a more female predominance. One population study done in Pakistan, the incidence of *Salmonella* infection in the female population was significantly higher than in males, 54.5% versus 45.5% [4].

Young age and immunosuppression were important risk factors for invasive Salmonellosis. As observed in this study most of the patients had a condition which affected their immunity. Similar studies found comparable results where *Salmonella* infection prevalence was found to be higher in people with low immunity [5]. Eighteen patients 24.3% had underlying diseases including leukemia seen in nine cases 12.1%, neuroblastoma in four cases 5.4%, lymphoma in two cases 2.7% and sickle cell disease in two patients 2.7%.

Bacteremia is the most common systemic complication in children with Non-typhoidal *Salmonella* gastroenteritis [6]. Immunosuppression and young age (particularly less than 3 months) are risk factors for bacteremia and focal infection [7]. Among the different serotypes reported in our study, we found 44.0% of infections caused by *Salmonella enterica*, 18.8% caused by *Salmonella* group B, 15.9% caused by *Salmonella* group C, 11.6% caused by *Salmonella* group D. Among these patients, we found 11 patients less than three months of age who developed bacteremia and received treatment through intravenous route as recommended by guidelines.

Management recommendations for non-typhoidal *Salmonella* (NTS) gastroenteritis and invasive non-typhoidal *Salmonella* (iNTS) vary significantly in the literature [8]. Current recommendations suggest that infants < 3 months of age and those who are not immunocompromised should receive empirical antibiotic treatment for NTS gastroenteritis, whereas it is generally not recommended for older and otherwise healthy children [9]. Children with suspected or confirmed NTS bacteraemia or invasive disease should receive antibiotics. The management in our study followed the recommendations in the guidelines and literature. Intravenous route was used in 67.6% of patients. Ceftriaxone was used for the treatment in 34 (45.9%) cases, cefotaxime in 7 (9.5%) cases, tazocin in 4 (5.4%), ciprofloxacin and meropenem in 3 cases each (4.1%), augmentin in 2 (2.7%), the combination of ceftriaxone and ciprofloxacin was used in 2 (2.7%) cases, the combination of ceftriaxone and cefixime, ceftriaxone and azithromycin, meropenem and ciprofloxacin were used in 1 (1.3%) case each.

Conclusion

Although non typhoidal *Salmonella* generally produce gastroenteritis, *Salmonella* can become invasive and cause septicemia, invasive non typhoidal *Salmonella* risk from our review is 16%, most likely group B. We also observed from our data that the American Academy of Pediatrics recommendations and guidelines for treating high-risk individuals with non-typhoid *Salmonella* exclusively as a self-limiting illness in other groups apply to the management of *Salmonella* gastroenteritis.

During the study periods, there were no serious problems seen, no CNS infections, and no increased risk of relapse or recurrence.

Acknowledgments

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