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ASSESSMENT OF CRP IN PATIENTS WITH TYPHOID FEVER

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Abstract. A total of seventy-nine cases of patients with age range 1-75 suffering from intestinal disturbance suspected to be Typhoid infected examined during the period between October / 2025 to January / 2026, patients were attending an outpatient clinic in AL-Najaf province, Iraq. The present data indicated that the prevalence of 79 febrile cases was insignificantly higher (P=0.36) among females (41, 1.9%) and significantly elevated (P=0.001) in the 1-15 year age bracket (27.8%), but for Salmonella, individuals aged 61-75 exhibited a considerable susceptibility (P=0.001). Nevertheless, 23 (29.2%) of the feverish patients tested positive for typhoid, whereas the CRP positivity rates were 29.2% for general febrile individuals and 5.1% for those with positive Salmonella. The CRP distribution was markedly (P=0.04) elevated in females compared to males. Seropositivity for Salmonella and CRP in febrile patients was comparable at 29.2%, although the incidence of acute salmonella infection was 5.1%.

Keywords: Typhoid fever, CRP, Salmonella, Seropositivity, Gastrointestinal, Fibrile

Introduction

Typhoid fever, frequently referred to as enteric fever, is an important bacterial disease that is typically observed in various regions with developing economies. The primary causative agent of the illness is Salmonella Typhi, while Salmonella Paratyphi represents another important etiological agent, with humans serving as the primary reservoir. [1,2]. Millions of individuals continue to be affected by typhoid fever annually, Especially in economically disadvantaged nations where insufficient sanitation and limited access to clean water facilitate the spread of diseases [3].

Salmonella Typhi is a moving Gram-negative rod known for having flagella all around it and the capacity to create hydrogen sulfide, resulting in black-centered colonies on selective culture media such as SS agar [4]. The primary causes of infection are food and water contaminated with S. typhi. Salmonella typhi has the capability to invade the gastrointestinal tract and the circulatory system or infiltrate body organs and emit endotoxins; moreover, it is exhibiting a growing resistance to many commonly utilized antimicrobial medications [6]. C-reactive protein contributes to the early immune defense mechanisms against Salmonella infection and reflects the inflammatory response during the acute phase of disease. [7], In individuals suffering from Salmonella typhi infections, there was a significant elevation in the acute phase protein known as CRP, which acts as an important diagnostic tool for identifying acute enteric fever [8]. CRP is linked to rapid systemic inflammation and is therefore regarded as a critical marker for assessing inflammatory responses [9].

The frequency of occurrence is a crucial factor influencing decision-making regarding the distribution of scarce resources for the management and prevention of infectious diseases. Proactive monitoring of those experiencing unidentified febrile symptoms could provide a clearer assessment of the epidemiological effects of typhoid fever [10]. Numerous research studies on typhoid fever have been conducted both in Iraq and outside Iraq, producing inconsistent findings regarding demography, sexual status, age groups, and CRP positive. This is why the current research was designed to establish the incidence of typhoid fever among residents of Al-Najaf province and the possible association between the disease and variables like age, sex, and CRP positive.

Methods

Subject

The entire study involved 79 feverish patients experiencing problems with their intestines from October 2025 through January 2026. The patients for the study were selected from outpatient clinics in Al-Najaf Province in Iraq. Their age varied from 1 to 75 years. Permission was sought from all patients involved in the study, and the methodology was conducted following the 2013 Helsinki Declaration.

Blood Samples

Blood samples were gathered from the patients and centrifuged, after which the obtained sera were utilized for the detection of Salmonella seropositivity and CRP.

Salmonella Diagnosis

Salmonella infection was diagnosed serologically using a rapid test kit (ENTEROCHECK-WB, Tulip Diagnostics Ltd., India) corresponding to the manufacturer's instructions.

C-Reactive Protein

The CRP was qualitatively identified serologically using the slide latex agglutination test, following the manufacturer's guidelines (SPINREACT, Spain).

Statistical Analysis

Data evaluation was performed using version 26 of the IBM SPSS Statistics software. Variations in categorical variables were analyzed through the Chi-square test. A P-value of 0. 05 or less was considered statistically significant.

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Results and Discussion

Typhoid and Sex

Among the 79 febrile patients enrolled in this study, females constituted 51.9% of the cases, while males represented 48.1%. In terms of enteric fever seropositivity, 23 cases (29.2%) tested positive whereas 56 cases (70.8%) tested negative. Despite a slightly elevated ratio of females compared to men, the difference was not statistically important (P=0.36), as seen in Figure 1.

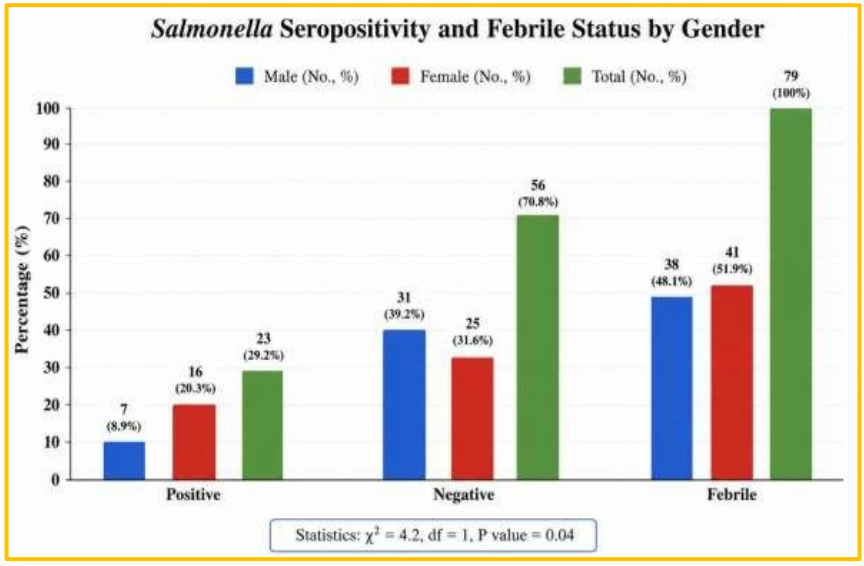

Figure 1. Classification of patients with fever based on Salmonella seropositivity and gender

The present research revealed that there is a negligible correlation between the onset of typhoid and gender, with febrile symptoms occurring more frequently in females than in males, whereas disparities in typhoid seropositivity distribution were observed.

According to the above research, the percentage of seropositivity of Salmonella from fever cases in AL-Najaf governorate hospitals is 29.2%, a figure that can be compared with a similar study [11] which recorded 35.47% of patients to have typhoid fever. Approximately 60% of the typhoid patients at Baghdad Teaching Hospital were male. In a separate investigation [13], it was determined that sex does not affect antibody titers against Salmonella. In contrast to the research conducted in [13], a greater incidence of enteric fever was seen among women.

Typhoid and Age

The ages of the participants in this study varied from 1 to 75 years. The participants in this research were categorized into five age brackets (1-15, 16-30, 31-45, 46-60, 61-75). The most febrile demographic is aged 1-15 years (27.8%), succeeded by those aged 16-30 years (25.3%). Nonetheless, the peak incidence of Salmonella seropositivity was noted in the 61-75 year cohort (12.7%), exhibiting a statistically important variance (P=0.001), as illustrated in Figure 2.

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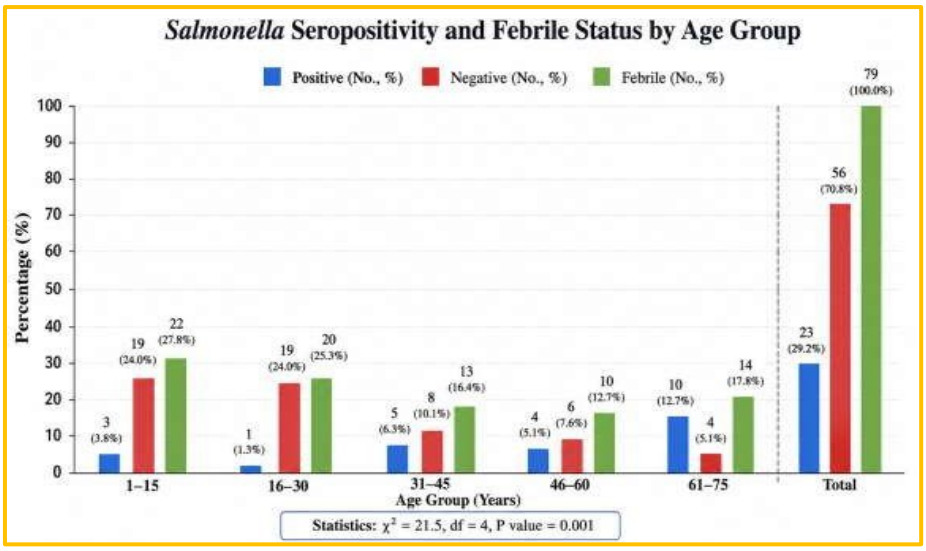

Figure 2. The categorization of patients with fever based on their salmonella seropositivity and different age brackets.

The current study indicated that the age group 1–15 years had the highest proportion of febrile cases (27.8%), followed by the 16–30 year group, while the highest typhoid seropositivity rate was found among individuals aged 61–75 years (12.7%). Kumar et al. [14] observed that typhoid fever occurred more commonly in subjects aged 11–20 years, followed by the 21–30 year group. On the other hand, Allu et al. [11] reported that individuals aged 21–30 years were the most affected by typhoid fever. Such variations in findings and case distribution could be attributed to differences in study design and population type.

Typhoid and CRP

This research employed quick screening methods to qualitatively identify typhoid infection as well as serum CRP levels. The results indicated that 23 individuals, accounting for 29. 2% of the febrile patients, tested positive for CRP, while only 4 (5.1%) Salmonella-positive febrile patients were associated with positive CRP results, with no significant difference detected (P=0.14), as presented in Figure 3.

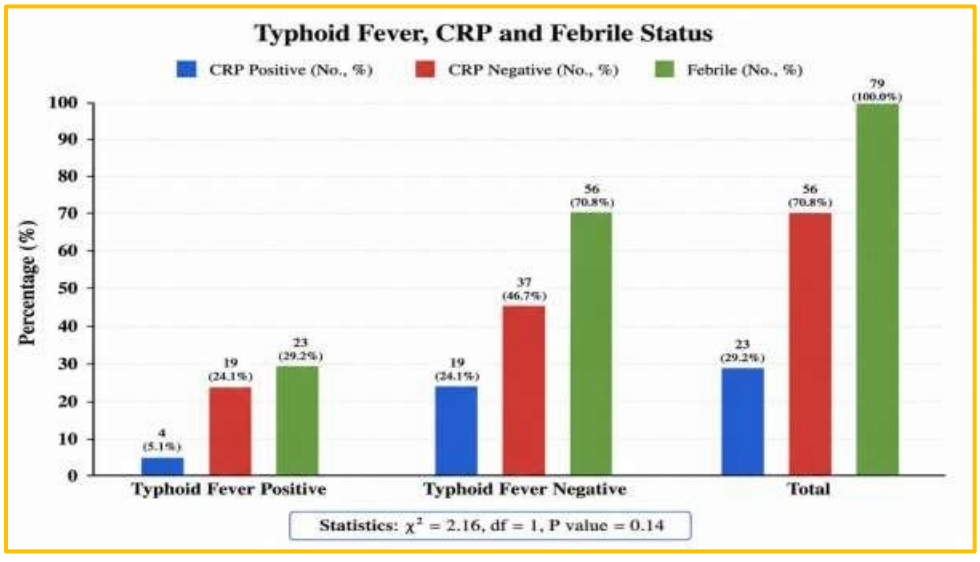

Figure 3. Distribution of patients with fever based on CRP positivity and typhoid illness.

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The present study demonstrated no significant association (P=0.14) between CRP positivity and typhoid seropositivity among febrile patients. Study [15] reported elevated CRP levels in patients with Salmonella-related gastroenteritis compared with viral infections such as rotavirus. This implies that the CRP marker can help in differentiation between the two forms of the disease, despite more laboratory experiments being needed for identification of the pathogens. Another experiment
[16] revealed that cases of serious systemic infection with Salmonella had significantly elevated CRP levels compared to those of self-limiting gastroenteritis.

Gender and CRP

Regarding the link between gender and CRP presence in patients with fever, this research showed that 23 (29. 2%) people tested positive for CRP, while 56 (70. 8%) had negative results. The rate was significantly greater in females when compared to males (P=0. 04), as illustrated in Figure 4.

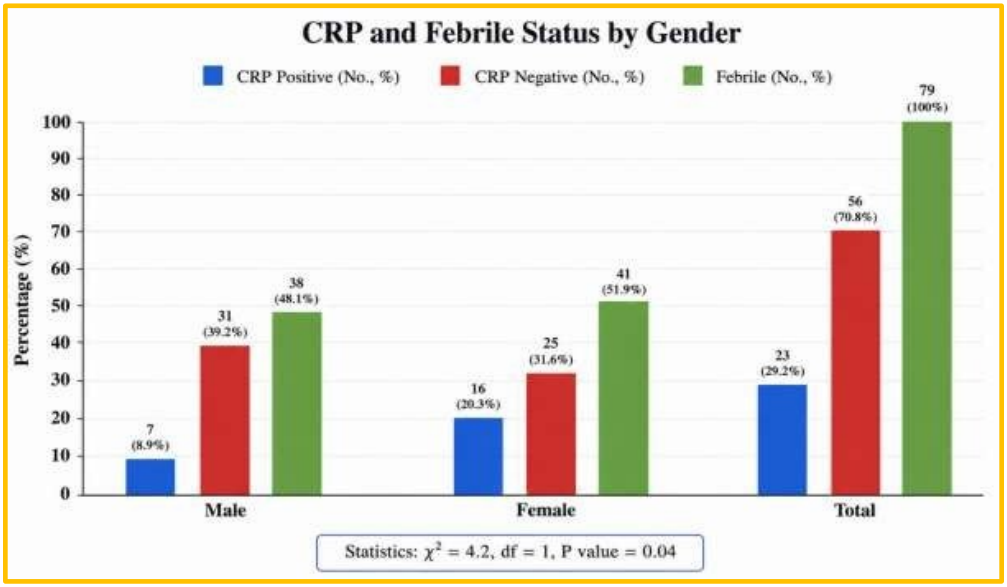

Figure 4. Spread of patients with fever based on CRP positivity and gender.

It is crucial to consider the link between gender, positivity for CRP, and fever symptoms when conducting clinical research on infections and inflammatory diseases. The assessment of the impact of gender on CRP levels and fever response in different clinical settings can help improve diagnostic and therapeutic strategies.

According to the present study, there was no significant difference in the prevalence of fever cases among male (48.1%) and female (51.9%) subjects. It may be due to the fact that fever being an extremely common symptom for both infectious and inflammatory diseases, is not gender-specific in this particular study, i.e. it is not directly affected by gender. This finding supports previous findings suggesting that fever responses can be similar in both male and female patients in case of certain infectious diseases, though variations in fever severity among genders have been observed in some studies [17].

Women tend to show increased CRP concentrations in comparison to men in the presence of different inflammatory stimuli including viral infections [18]. This gender difference may partially be due to the effect of estrogen that is known to increase immunologic activity. On the other hand, testosterone, predominantly present in men, is linked with the immunosuppressive actions leading to decreased CRP concentrations in men [20].

Conclusion

About 5.1% of people having fever were found seropositive for Salmonella and CRP; however, usually, febrile diseases are more frequent among women and younger patients, while Salmonella seropositivity is more frequent among men and elderly individuals.

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Conflicts of Interest

No conflict of interest.

References

[1] A. A. J. Aljanaby and H. M. R. J. Alhasnawi, "Phenotypic and molecular characterization of *Klebsiella pneumoniae* isolated from different clinical infections in Al-Najaf Province-Iraq," *Iraqi J. Sci.*, vol. 58, no. 3B, pp. 1508–1519, 2017, doi: 10.24996/ijs.2017.58.3B.15.

[2] M. Y. Teferi, Z. El-Khatib, E. A. Alemayehu, H. T. Adane, A. T. Andualem, Y. A. Hailesilassie, *et al.*, "Prevalence and antimicrobial susceptibility level of typhoid fever in Ethiopia: A systematic review and meta-analysis," *Prev. Med. Rep.*, vol. 23, Art. no. 101670, 2021, doi: 10.1016/j.pmedr.2021.101670.

[3] D. A. Galgallo, Z. G. Roka, W. G. Boru, K. Abill, and J. Ransom, "Investigation of a typhoid fever epidemic in Moyale sub-county, Kenya, 2014–2015," *J. Health Popul. Nutr.*, vol. 37, no. 1, Art. no. 5, 2018, doi: 10.1186/s41043-018-0132-z.

[4] C. Masuet-Aumatell and J. Atouguia, "Typhoid fever infection-antibiotic resistance and vaccination strategies: A narrative review," *Travel Med. Infect. Dis.*, vol. 40, Art. no. 101946, 2021, doi: 10.1016/j.tmaid.2020.101946.

[5] S. Brockett, M. K. Wolfe, A. Hamot, G. D. Appiah, E. D. Mintz, and D. Lantagne, "Associations among water, sanitation, and hygiene, and food exposures and typhoid fever in case-control studies: A systematic review and meta-analysis," *Am. J. Trop. Med. Hyg.*, vol. 103, no. 3, pp. 1020–1031, 2020, doi: 10.4269/ajtmh.19-0814.

[6] K. F. Nassir, B. M. Ali, Z. H. Ibrahim, Z. J. Qasim, S. G. Mahdi, N. M. Mustafa, *et al.*, "Prevalence and antimicrobial resistance profile of *Salmonella Typhi* infection in Iraq, 2019–2021," *Med. J. Malaysia*, vol. 79, no. 1, pp. 74–79, 2024.

[7] A. J. Szalai, J. L. VanCott, J. R. McGhee, J. E. Volanakis, and W. H. Benjamin Jr., "Human C-reactive protein is protective against fatal *Salmonella enterica* serovar Typhimurium infection in transgenic mice," *Infect. Immun.*, vol. 68, no. 10, pp. 5652–5656, 2000, doi: 10.1128/IAI.68.10.5652-5656.2000.

[8] K. E. Choo, T. M. Davis, R. L. Henry, and L. P. Chan, "Serum C-reactive protein concentrations in Malaysian children with enteric fever," *J. Trop. Pediatr.*, vol. 47, no. 4, pp. 211–214, 2001, doi: 10.1093/tropej/47.4.211.

[9] M. Moutachakkir, A. Lamrani Hanchi, A. Baraou, A. Boukhira, and S. Chellak, "Immunoanalytical characteristics of C-reactive protein and high sensitivity C-reactive protein," *Ann. Biol. Clin. (Paris)*, vol. 75, no. 2, pp. 225–229, 2017, doi: 10.1684/abc.2017.1232.

[10] P. Srikantiah, F. Y. Girgis, S. P. Luby, G. Jennings, M. O. Wasfy, J. A. Crump, *et al.*, "Population-based surveillance of typhoid fever in Egypt," *Am. J. Trop. Med. Hyg.*, vol. 74, no. 1, pp. 114–119, 2006.

[11] M. A. Allu, M. S. Assafi, R. F. Polse, and M. I. Al-Berfkani, "Present status of *Salmonella Typhi* in different age groups hospitalized patients in Duhok City, Iraq," *Zanco J. Pure Appl. Sci.*, vol. 31, no. 6, pp. 123–129, 2019, doi: 10.21271/zjpas.31.6.13.

[12] R. Asreah, S. Atta, and S. SarKo, "Clinical characteristics and antibiotics sensitivity of culture positive typhoid fever patients in Baghdad Teaching Hospital: A single center study," *Open Access Maced. J. Med. Sci.*, vol. 10, no. B, pp. 1846–1850, 2022, doi: 10.3889/oamjms.2022.10489.

[13] A. Ishtiaq, S. Khalil, S. Khalil, F. Ahmed, B. Ahmad, A. Ghaffar, *et al.*, "Prevalence of typhoid fever among different socio-demographic groups in District Bahawalnagar, Pakistan," *Pak. J. Health Sci.*, vol. 4, no. 1, pp. 138–143, 2023, doi: 10.54393/pjhs.v4i01.521.

[14] M. S. Kumar, G. S. Vivek, H. V. Prashanth, P. M. Rao, and E. R. Nagaraj, "Comparison of *Salmonella Typhi* and *Salmonella Paratyphi A* occurrence in a tertiary care hospital," *J. Clin. Diagn. Res.*, vol. 7, no. 12, pp. 2724–2726, 2013, doi: 10.7860/JCDR/2013/6719.3716.
[15] J. H. Lee, J. Kim, K. Kim, Y. H. Jo, J. E. Rhee, G. J. Suh, *et al.*, "Procalcitonin and C-reactive protein as diagnostic biomarkers for bacterial gastroenteritis: A retrospective analysis," *J. Clin. Med.*, vol. 14, no. 7, Art. no. 2135, 2025, doi: 10.3390/jcm14072135.
[16] J. A. Crump, M. Sjölund-Karlsson, M. A. Gordon, and C. M. Parry, "Epidemiology, clinical presentation, laboratory diagnosis, antimicrobial resistance, and antimicrobial management of invasive *Salmonella* infections," *Clin. Microbiol. Rev.*, vol. 28, no. 4, pp. 901–937, 2015, doi: 10.1128/CMR.00002-15.
[17] S. S. Evans, E. A. Repasky, and D. T. Fisher, "Fever and the thermal regulation of immunity: The immune system feels the heat," *Nat. Rev. Immunol.*, vol. 15, no. 6, pp. 335–349, 2015, doi: 10.1038/nri3843.
[18] S. L. Klein and K. L. Flanagan, "Sex differences in immune responses," *Nat. Rev. Immunol.*, vol. 16, no. 10, pp. 626–638, 2016, doi: 10.1038/nri.2016.90.
[19] D. Khan and S. Ansar Ahmed, "The immune system is a natural target for estrogen action: Opposing effects of estrogen in two prototypical autoimmune diseases," *Front. Immunol.*, vol. 6, Art. no. 635, 2016, doi: 10.3389/fimmu.2015.00635.
[20] K. K. Tsilidis, S. Rohrmann, K. A. McGlynn, S. J. Nyante, D. S. Lopez, G. Bradwin, *et al.*, "Association between endogenous sex steroid hormones and inflammatory biomarkers in US men," *Andrology*, vol. 1, no. 6, pp. 919–928, 2013, doi: 10.1111/j.2047-2927.2013.00129.x.