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An Investigation into the Critical Public Health Issue: The Incidence of Enteric Fever (Typhoid Fever) among Febrile Patients

Original Article

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Abstract

Enteric fever, like typhoid, had the highest morbidity in Asia, accounting for nearly 93% of global cases. Poor hygiene, sanitation, sewerage systems, and population are the key contributing factors. The precise epidemiological data regarding typhoid fever in Islamabad are currently unavailable; thus, this study was conceived considering this knowledge gap. One thousand clinical isolates, irrespective of age and gender, were obtained from typhoid fever suspects who visited Mufti Mahmood Memorial Teaching (MMMT) Hospital between July 2024 and December 2024. Immunochromatographic tests (ICT) were conducted to identify acute (IgM) and chronic (IgG) stage antibodies in the serum of suspected patients. The results indicated that 314 (81%) patients tested positive for IgM antibodies, 70 (18%) for both IgM and IgG, and, notably, no samples were positive for IgG alone. Seropositivity for IgM by gender was 129 (37%) males and 219 (63%) females. Among individuals with both IgG and IgM positive antibodies, 31 (42%) were male and 43 (48%) were female. The significant prevalence of typhoid fever among febrile patients attending the hospital signifies that it is a critical public health issue within the spectrum of febrile illnesses in Dera Ismail Khan. Preventive measures, including immunization programs, enhanced sanitary standards, clean water supply, and adequate sewage systems, should be prioritized for typhoid management in metropolitan areas such as Dera Ismail Khan.

Keywords: Typhoid Fever, Salmonella, IgG, IgM, Immunochromatographic Tests.

Introduction

Enterica *Salmonella*, the bacteria responsible for infectious disease include serotype Typhi and, to a lesser degree, serotypes A, B, and C. It is a potentially fatal illness that is contracted by fecal-oral contact. A major factor in the spread of Salmonella Typhi is consuming raw or undercooked food as well as drinking water that is contaminated. Typhoid fever is the most prevalent symptom, with a maximum temperature of (39–40°C) to 103–104°F. Other symptoms may include headache, fatigue, cough, and abdominal discomfort changes in bowel habits, decreased appetite, and the potential development of rose-colored spots in some individuals (Vanderslott, Kumar, Adu-Sarkodie, Qadri, & Zellweger, 2023).

At-risk populations encompass impoverished communities lacking access to clean water, which is essential for vulnerable groups, including children and immunocompromised individuals. The vaccination process vaccines comprise Typhoid Conjugate Vaccines (TCVs) for children under two years, purified antigens for children over two years, and live attenuated oral vaccines for individuals aged five and older (Tharwani *et al*., 2022).

After the emergence of COVID-19 in Pakistan, healthcare workers' primary objective shifted to controlling the spread of the virus. The transmission of Typhoid was notably influenced, evidenced by the increase in XDR cases; Karachi reported 14,360 cases from January 2017 to June 2021, in contrast to 864 new cases recorded from June 2021 to August 14, 2021 (Ahmad *et al.*, 2021). No prior study data was available regarding the prevalence of typhoid fever infections in the population of District Dera Ismail Khan, Pakistan. The objective of this research was to examine the prevalence of typhoid fever across various socio-demographic groups and genders within the population of different tehsils in the Dera Ismail Khan district of Pakistan.

Literature Review

It is estimated that each year, typhoid leads to 11 to 21 million cases and kills over 120,000 to 160,000 individuals. The number of cases once reached 16 million, while deaths stood at around 6 lac, but the fatal rate fell. Typhoid fever is responsible for 93% of all cases occurring in Southeast Asia. An investigation of the problem reveals that it is particularly common in South and Central America, India and Africa where lots of people live together and water is not clean (Ishtiaq *et al*., 2023). Many women in Pakistan encounter challenges in getting healthcare, so more assistance is needed. Typhoid fever (TF) affects between 12 and 27 million people worldwide every year. Since it is a common infection, each year Typhoid Fever is responsible for about 128,000 to 161,000 deaths. About 216,500 people in Asia lose their lives to Typhoid Fever each year. Some patients infected with Typhoid Fever travel outside their own countries without proper vaccination or medication. Even though there are options for monitoring and treating typhoid, researchers do not explore the effect that cultural habits have on increasing the risk among fragile groups (Afzal *et al*., 2025).

In 2016 to 2019, during the Surveillance for Enteric Fever in Asia Project, the observed adjusted number of S. Typhi cases in Pakistan's public facilities was 176 and 103 (per 100 000 person-years) for years 2016-2017 and 2018-2019, respectively, while the same figure was 23 and 1 (per 100 000 person-years) in the private hospitals. In Pakistan, 64% of all S. Typhi cases detected during the SEAP study period were XDR typhoid (Yousafzai *et al*., 2020). Pakistani kids suffer from this illness more than any other, with 1000 cases reported for every 100,000 children living in Karachi annually. Researchers say that two-thirds of Pakistan's population depend on unsafe water, as they cannot get enough of the safe variety. Today, typhoid perforation claims the lives of many in Pakistan, especially in the more remote parts of Sindh (Daud *et al*., 2017).

In Pakistan, waterborne diseases in drinking water are mostly caused by dumping wastewater from municipalities and industries and not treating the water at treatment plants. Information from this strategy concludes that forty percent of all communicable diseases in Pakistan are water related. Among the waterborne issues in Pakistan are typhoid, infections by giardia, worms in the intestines, diarrhea, cryptosporidium and gastroenteritis. The IUCN reports that Pakistan has the highest proportion of babies who die from water-related diarrhea and this amounts to 60 percent in the country (Fida, Li, Wang, Alam, & Nsabimana, 2023).

India, Bangladesh and Pakistan have higher rates of typhoid infections. Based on estimates, Pakistan has the highest number of cases of Typhoid in the region with 493.5 being recorded per every 100,000 people in 2018. The number of cases in Pakistan increased a lot after an XDR typhi outbreak began in Hyderabad, Sindh in 2016. Since the Treatment with Chloramphenicol, Ampicillin, Co-trimoxazole, Fluoroquinolones and Third-generation Cephalosporin no longer worked, treating the infection required stronger drugs; Carbapenems, Tigecycline and Azithromycin (Tharwani *et al*., 2022).

Materials and Methods

Dera Ismail Khan, a notable city in Khyber Pakhtunkhwa, Pakistan, is located at an elevation of 173m on the west bank of the Indus River within the Khyber Pakhtunkhwa province. Most patients were from DI Khan city and its adjacent regions. This study was organized in the Department of Chemical and Life Sciences Laboratory at Qurtuba University of Science and IT, Dera Ismail Khan, and executed at MMMT Hospital and Laboratory from January 2024 to June 2024. Without contemporary diagnostic tools such as blood culture, the only methods employed for diagnosing typhoid disease were Widal and Immunochromatographic tests, specifically Typhidot. Patients exhibiting clinical features including reduced white blood cell (WBC) count, fever lasting 2–3 days, nausea, diarrhea, and respiratory symptoms were evaluated. With a mean age of 35, the study comprised both boys and females in every age group, from 0 to 10 years old to 70 years old. Three milliliters of pure blood were properly collected, transferred to gel tubes to cause clotting and then the tubes were spun at 3,000 r/min for 5 minutes. From there, clear serum was gathered and utilized for the Widal test or the Typhidot test. The Widal and Typhidot tests were followed by protocols from Reszon, Salanger, Malaysia and HiMedia Laboratories Pvt. Limited to detect antibodies present in a patient's serum. Using a 25 µL drop of patient serum, each of the four test wells was inoculated and then combined with a 25 µL dose of antigen for *Salmonella typhi* O, *Salmonella typhi* H, *Salmonella paratyphi* AH and *Salmonella paratyphi* BH. A drop of Salmonella typhi H antigen was also added to each of the two cells along with the 25 µL positive and negative controls. It is a quick test that lets you check for antibodies IgG and IgM. A drop of serum (50 µL) was added to the well on the device, followed by a drop of buffer with caution to prevent bubble formation. A sterile stir was employed at each step of the solution mixing process. Results were seen within 10-15 minutes. The data for age, gender, and month were statistically evaluated using the techniques listed above and displayed in both tabular and graphical representations using Microsoft Excel and other tools (Ayub *et al*., 2015).

Results and Findings

This study enrolled 1,000 patients suspected of typhoid, without regard to age or gender. The subjects' ages ranged from three to 66 years, with a median of 34.5 years. Serums from the suspected patient were analyzed for the presence of IgM and IgG antibodies related to typhoid fever, alongside symptoms of constipation/diarrhea, malaise, and anorexia. The test indicated that 314 (81%) individuals were positive for IgM antibodies, while 70 (18%) were positive for both IgM and IgG. Proper consent was obtained from each patient, and notably, no samples were found to be negative. Seropositivity for IgM by gender was 129 (37%) males and 219 (63%) females. Among individuals with both IgG and IgM positive antibodies, 31 (42%) were male and 43 (48%) were female. A total of 1078 suspected individuals were determined to be typhoid negative, with results presented in both tabular and graphical formats (Table No.1 & 2) and processed at 3000 rpm for 5 minutes.

Table 1
Anti-typhoid antibodies wise prevalence of Typhoid positive individuals

Anti-typhoid Antibodies	Patients Number	Percentage
IgM	314	81%
IgM+IgG	70	18%

Figure 1

Anti-typhoid antibodies-wise prevalence of Typhoid positive individuals

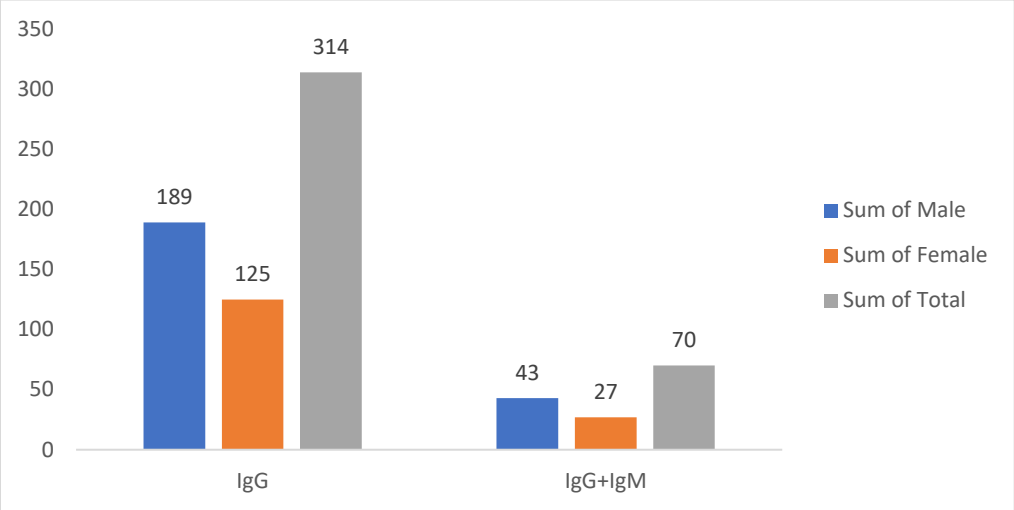


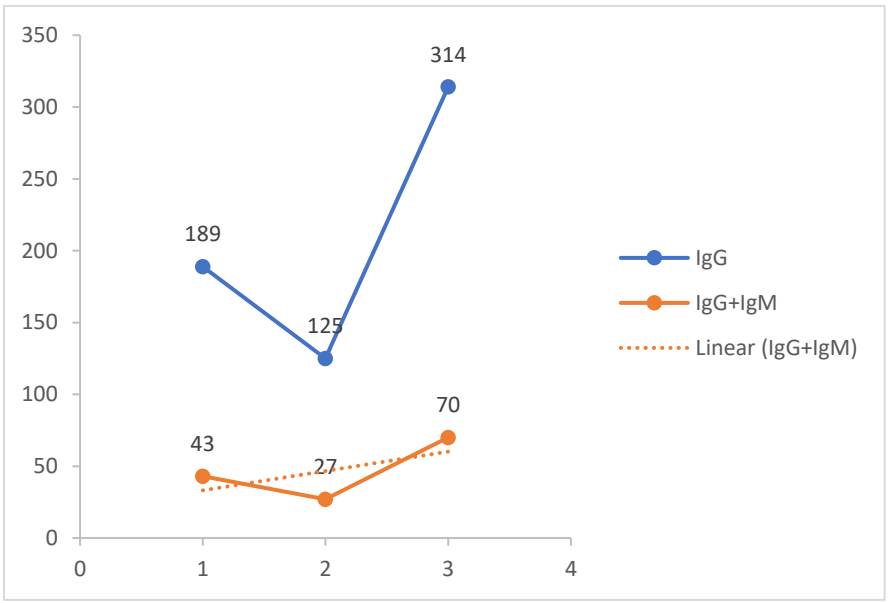
Table 2

Gender-wise Anti-typhoid antibodies Prevalence in Individuals

Anti-typhoid Antibodies	Male	Female	Total
IgG	189	125	314
IgG+IgM	43	27	70

Figure 2

Gender-wise Anti-typhoid antibodies Prevalence in Individuals



Discussion

Salmonella typhi is a bacterium that causes typhoid fever, an infection that can be lethal. The main ways that illnesses are spread through contaminated food and water. Typhoid is a severe health concern in developing countries, such as Pakistan (Radhakrishnan et al., 2018). Typhoid fever is prevalent in Pakistan, and important contributing causes to its high prevalence include Challenges such as illiteracy, poverty, overcrowding, inadequate sanitation, and insufficient access to safe drinking water facilities persist. Our study revealed an overall male (47.38%) to female (52.62%) ratio of 1:1, indicating that typhoid fever is not influenced by sex. It affects people of all ages and genders. We found the same thing as the researchers (Ja'afar Nuhu Ja'afar *et al*., 2013).This study identified the most frequently observed symptoms among patients, as detailed in Table 1. The predominant symptom was fever, reported in 99.7% of cases, followed by diarrhea at 98.42% and abdominal pain at 96.85%. Our findings align with those presented by Gamal *et al*. and Aatekah *et al* (Al-Ameri & Saif, 2014). Typhoid is commonly observed in infants, young children, and adults across Southeast Asia. Our findings indicate that typhoid was present across all age groups from 1 to 80 years. However, similar to other Southeast Asian countries, individuals up to 30 years of age, including children and young adults, exhibited a higher susceptibility (Rasul *et al*., 2017).

Conclusion

In our study, Typhoid positive patients exhibited IgM positivity, as IgM is the initial immunoglobulin generated in response to foreign antigens, with IgG levels rising in chronic infections. No patients were found to be positive for IgG antibodies, likely due to the study's inclusion criteria, which restricted enrollment to febrile patients. The presence of IgG indicates patient recovery from the infection. A study on the sensitivity of Typhoid revealed that this test heavily depends on IgM results, as they manifest earlier than IgG during the progression of the illness. In conclusion, the spread of typhoid in Pakistan has been affected by several variables. Things like illiteracy, socioeconomic inequality, COVID-19 outbreaks, and XDR typhoid strains are all part of the problem.

Limitations and Future Research Directions

The significant prevalence of typhoid fever among febrile patients attending the hospital signifies that it is a critical public health issue within the spectrum of febrile illnesses in Dera Ismail Khan. Preventive measures, including immunization programs, enhanced sanitary standards, clean water supply, and adequate sewage systems, should be prioritized for typhoid management in metropolitan areas such as Dera Ismail Khan. Also, the study is restricted to a single tertiary care hospital; thus, the study's findings may not generalize to other health care centers in Pakistan. Producing further studies that would include prospective follow-up and multicenter data collection may strengthen the findings.

Declarations

Ethical Approval and Consent to Participate: This study strictly adhered to the Declaration of Helsinki and relevant national and institutional ethical guidelines. Informed consent was not required, as secondary data available on websites was obtained for analysis. All procedures performed in this study were by the ethical standards of the Helsinki Declaration.

Consent for Publication: Not Applicable

Availability of Data and Materials: Data for this study will be made available upon request from the corresponding author.

Competing Interest: The authors declare that they have no competing interests.

Funding: Not Applicable

Authors' Contribution: All three have actively participated in the conduct, writing, and submission to the journal.

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