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Original Article

Prevalence of Typhoid Fever in Loralai District, Balochistan, Pakistan: A Case Study of Two Hospitals

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Abstract

Salmonella enterica serotype Typhi (*Salmonella* Typhi) causes significant health issues globally, particularly in developing countries like Pakistan. We examined the prevalence of typhoid fever in the Loralai district, Balochistan, Pakistan using secondary data from Civil Hospital Loralai and Combined Military Hospital Loralai. We analyzed 710 (89.1%) from Civil Hospital and 86 (10.8%) from CMH Loralai. Among the collected samples, 448 (56.2%) were from male patients, and 348 (43.7%) from female patients. Total of 310 (38.9%)samples tested serologically positive for typhoid fever, including 171 (55.1%) males and 139 (44.8%) females, with no significant gender association ($p = 0.61$). A significant correlation was found between age and typhoid ($p = 0.02$). ANOVA (Tukey HSD: Multiple Comparisons) showed a significant mean difference between age groups at the 0.05 level. The highest prevalence (16.96%) was observed in the the11-20 years' age group, while the 50^{+} age group was least affected (0.88%). It is concluded that typhoid fever affects all ages, but the 11-20 age group is most vulnerable. To reduce the number of typhoid cases in Loralai City, we need to improve our lifestyle, switch to fresh and pure drinking water, ensure proper hygiene and cooked food, include sanitation measures, and promote vaccination to protect us from typhoid.

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Keywords: Balochistan, Hospital, Loralai, Salmonella Typhi, Typhoid fever

INTRODUCTION

Salmonella enterica serotype Typhi (Salmonella Typhi) is a pathogenic strain of bacterial disease induced by the gram-negative, facultative anaerobic bacterium Salmonella enterica. These bacteria can result in a significantly severe and occasionally life-threatening systematic infection known as typhoid fever. Salmonella typhi belongs to S. enterica and is divided into two groups; S. enterica serovar typhi, which is responsible for typhoid fever, and S. enterica serovar Paratyphi A, B, and C, which induce a similar condition known as paratyphoid fever. These diseases are transmitted through ingestion of contaminated food and water, commonly causing symptoms such as high-grade fever, headache, diarrhea, constipation, and loss of appetite (Crump et al., 2004; Siddiqui et al., 2006; CDC, 2013).

Typhoid fever is a significant public health issue in developing countries (Mogasale et al., 2014; Antillon et al., 2017). Proper sanitation, food safety, and improving water quality are necessary to control such diseases as typhoid fever (Qadri et al., 2021). To reduce the morbidity and mortality of such diseases, vaccination, and anti-microbiocidal treatment are essential, as anti-microbiocidal treatment also reduces the fecal-carrying capacity of such diseases (Crump et al., 2015). For these control strategies to be effective, both global and regional policymakers should implement them comprehensively, which demands a detailed understanding of the distribution and epidemiology of typhoid fever.

Typhoid fever is an enteric disease responsible for almost 11-20 million infections and causing

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around 128,000-161,000 deaths annually worldwide. The death rate for this disease is particularly in developing countries notably in regions of Africa and Asia (Qamar et al., 2020; Wierzba, 2019). Globally typhoid fever accounted for 11 million cases in 2017 (Stanaway et al., 2019). Earlier studies have reported an elevation of cases i.e., 21 million cases in 2000 (Crump et al., 2004) 12 million in 2010 (Mogasale et al., 2014; Kim et al., 2017), and 17.8 million cases in 2015 (Antillon et al., 2017).

The research was conducted in Balochistan, Pakistan on the spatiotemporal study of typhoid (Khan et al., 2013; Tareen, 2016; Fatima et al., 2023; Shezad et al., 2023). However, there is limited information is available on a cross-sectional survey of typhoid fever in District Loralai, Balochistan, Pakistan. In this study, we focus on a population-based surveillance of typhoid fever in District Loralai, Balochistan, Pakistan.

METHODOLOGY

Ethical Approval

The protocol of the present study was approved by the ethical committee of the Department of Zoology University of Loralai (Reg/UoI/24420).

Study Area

The present study was conducted at the Civil Hospital (30.37932° N, 68.60036° E) and the Combined Military Hospital (30.36058° N, 68.60813° E) in the district of Loralai, Balochistan, Pakistan. Data collection took place from January 2021 until July 2023. Geographic coordinates for each collection site were logged using a(GPS), and the resultant data was processed using Microsoft Excel 2013 (Microsoft 365®). We utilized the information to generate a study map using ArcGIS version 10.3.1 (Fig 1).

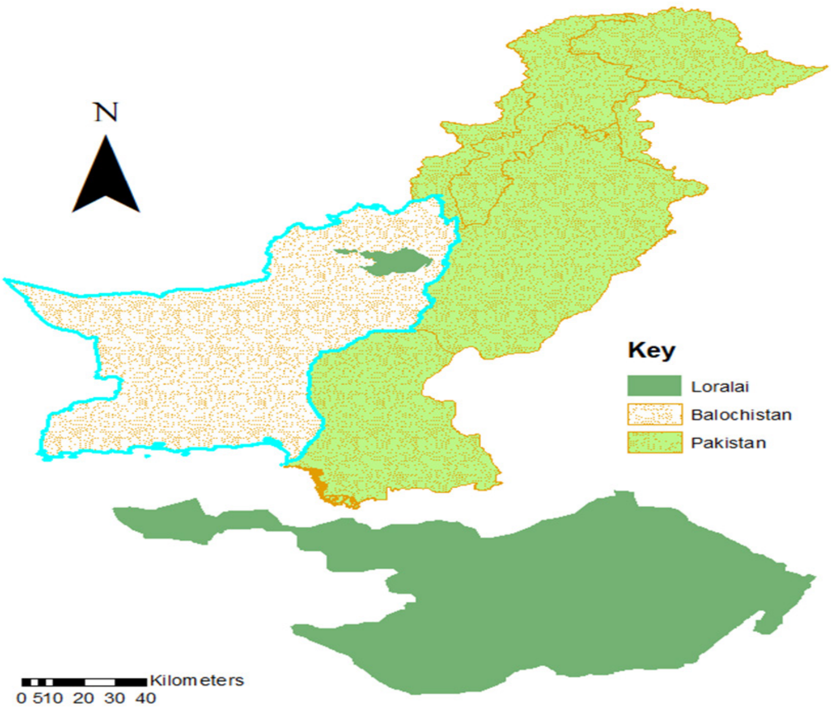

Fig. 1. The map shows the study site was created using ArcGIS v 10.3.1.

Sample Collection

In the present study, a cross-sectional survey was conducted on a total of 796 patients, aged from 1 year to 50 years. This sample represented both genders and encompassed individuals presenting with a fever of 38°C or above for approximately two weeks. Additionally, the examining patients showed at least one of the following symptoms vomiting, nausea, abdominal pain, or headache. The demographic statistics, including age and gender, were obtained from each participant. Subsequently, 5 ml of blood samples were collected from each patient using a disposable sterile syringe. Then, 5 ml of blood was collected from each patient using a disposable sterile syringe and transferred to a gel tube. After proper clotting, the blood was centrifuged at 3500 rpm, and the serum was separated for Widal and Typhidot tests to diagnose typhoid fever, according to the protocol of Ayub et al. (2015).

Analysis

The collected data were analyzed by using Statistical Package for the Social Sciences like

SPSS. The analysis utilized three tests: The Phi and Cramer's V tests, the Point Biserial correlation test, and ANOVA (Analysis of Variance).

RESULTS & FINDINGS

In the current study, we collected 796 blood samples from patients. Of these, 710 (89.1%) were from Civil Hospital, and 86 (10.8%) were from the Combined Military Hospital Loralai. From the total collection, 448 patients (56.2%) were male, and 348 patients (43.7%) were female. Upon testing, we found that 310 patients (38.9%) tested serologically positive for typhoid fever. Among these patients, 171 (55.1%) were male, and 139 (44.8%) were female. The prevalence of typhoid was highest in the age group of 11-20 years at 16.96%, followed by 21-30 years at 13.57%, 31-40 years at 5.53%, and 41-50 years at 2.53%. The age group of 1-10 years recorded a rate of 0.38%, and the rate for those 50 years and older was 0.88% (Table 4).

Table 1

Prevalence of typhoid, according to gender and location

Variable s	Category	Frequency	Percentage
Typhoid	Negative	486	61.06
	Positive Cases	310	38.94
Gender	Male	448	56.28
	Female	348	43.72
Hospitals	CMH	86	10.8
	DHQ	710	89.2

Fig. 1. The negative and positive cases of typhoid fever among the different genders.

Table 2

Symmetric Measures in Table 2 of gender and typhoid

Measure	p-value
Phi	0.01
Cramer's V	0.01
Number of valid cases	796

A significant association between gender and typhoid was reported. The results with a p-value of 0.61 using Phi and Cramer's V tests (Table 2), reveal that there is no statistically significant association between gender and typhoid was recorded.

Table 3

Point Biserial Correlation Analysis

Hypothetical test	Typhoid
Pearson Correlation	p-value
	0.08*
	0.02

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 reveals a statistically significant difference among the ages of sampled Typhoid cases in terms of positive and negative results.

Table 4

Tukey HSD for age groups in typhoid cases

Comparison of ages in years	Mean Difference (I-J)	Std. Error	p-value
11-20 vs 21-30	0.22	0.04	0.00
11-20 vs 31-49	0.21	0.05	0.00
21-30 vs 11-20	-0.22	0.04	0.00
31-49 vs 11-20	-0.21	0.05	0.00

The age of the sampled Typhoid cases was found to be statistically significant. The age groups were categorized to explore the most affected group. The results of ANOVA (Multiple Comparisons) are presented in Table 4. Significant differences were observed between the age groups 11-20, 21-30, and 31-49 years (p-values < 0.05). Detailed comparisons among the age groups can be found in the Supplementary Table.

Supplementary Table

Comparison of age groups	Mean Difference (I-J)	Std. Error	p-value
1-10 vs 11-20	-0.35	0.12	0.06
1-10 vs 21-30	-0.13	0.12	0.9
1-10 vs 31-49	-0.14	0.13	0.88
1-10 vs 41-50	-0.2	0.15	0.76
1-10 vs 50^+	-0.18	0.16	0.88
11-20 vs 1-10	0.35	0.12	0.06
11-20 vs 21-30	0.21*	0.04	0
11-20 vs 31-49	0.21*	0.05	0
11-20 vs 41-50	0.15	0.09	0.5
11-20 vs 50^+	0.17	0.11	0.68
21-30 vs 1-10	0.13	0.12	0.9
21-30 vs 11-20	-0.21*	0.04	0
21-30 vs 31-49	-0.01	0.05	1
21-30 vs 41-50	-0.07	0.09	0.98
21-30 vs 50^+	-0.05	0.11	1
31-49 vs 1-10	0.14	0.13	0.88
31-49 vs 11-20	-0.21*	0.05	0
31-49 vs 21-30	0.01	0.05	1
31-49 vs 41-50	-0.06	0.09	0.99
31-49 vs 50^+	-0.04	0.12	1
41-50 vs 1-10	0.2	0.15	0.76
41-50 vs 11-20	-0.15	0.09	0.5
41-50 vs 21-30	0.07	0.09	0.98
41-50 vs 31-49	0.06	0.09	0.99
41-50 vs 50^+	0.01	0.14	1
50^+ vs 1-10	0.18	0.16	0.88
50^+ vs 11-20	-0.17	0.11	0.68
50^+ vs 21-30	0.05	0.11	1
50^+ vs 31-49	0.04	0.12	1
50^+ vs 41-50	-0.01	0.14	1

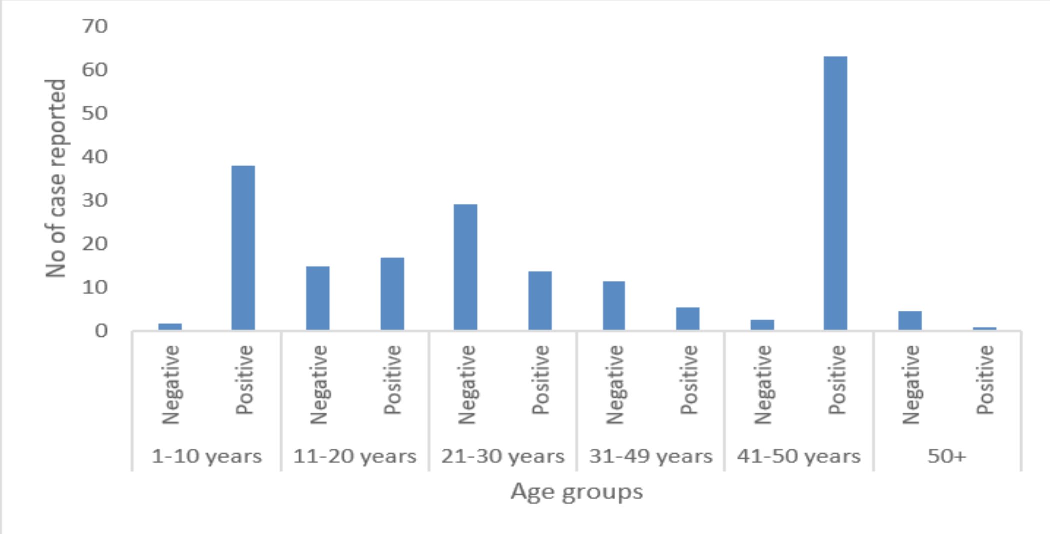

Figure 2 shows that individuals in the age group of 11-20 years are more likely to be affected by Typhoid fever. On the other hand, individuals in the age group of 21-30 years are less likely to be affected by Typhoid fever.

Discussion

Typhoid poses a significant public health challenge in developing nations, particularly in Southeast and South-Central Asian countries, where the highest incidence rates exceed 100 cases per 100,000 people per year (Paul 2024). Globally, it is estimated there exist approximately 2.16 million typhoid cases. Over 90% of fatal circumstances occur in Asia, culminating in 216,000 fatalities (WHO, 2023). Specific to Pakistan, typhoid emerges as the sixth leading cause of death, boasting an annual prevalence rate of 412 cases per 100,000 populaces (Tareen 2016). The high prevalence of Typhoid fever is attributed to overcrowding, illiteracy, poverty, poor sanitation, and inadequate access to safe drinking water. A blood culture and serology-based survey conducted in Karachi, Pakistan, revealed an incidence rate of 170 and 710 per 100,000, respectively (Siddiqui et al., 2006).

The current study aimed to enhance the understanding of the prevalence of Typhoid in Balochistan, considering the lack of comprehensive documentation. Previous studies have largely focused on certain districts and explored the medical and economic implications of such diseases (Malik 2016; Alied et al., 2023). Such prevalence studies hold significance in determining disease abundance in specific geographical areas and in monitoring long-term changes in population trends. However, it is noteworthy that these areas have received limited research attention, particularly regarding the prevalence of typhoid fever. To procure reliable data on the prevalence of Typhoid fever, this study employed a cross-sectional was used in this study.

In our sample of 796 cases, 486 (61.06%) were negative and 310 (38.94%) were positive. Of these, 448 (56.28%) were males and 348 (43.72%) were females. A majority, 710 (89.20%) of cases, were collected from Civil Hospital Loralai, while the remaining 86 (10.80%) were collected from CMH (Combined Military Hospital) Loralai. The p-value of 0.611, which resulted from the Phi and Cramer's V tests, indicates that there is no statistically significant association between gender and typhoid indicators. The output from the ANOVA (Multiple Comparisons) demonstrates that the data collected does not show a statistically significant association between Gender and Typhoid indicators. However, viewed from the perspective of age, a statistically significant difference was discerned in the cases of Typhoid. Consequently, to investigate which age group was predominantly affected, the ages of the sampled cases were divided into categories.

Significant differences were observed between the age groups 11-20 years, 21-30 years, and 31-49 years (p-values > 0.05). Individuals within the 11-20-year age group showed a higher likelihood of being affected by Typhoid fever. Conversely, individuals aged 50 and above demonstrated a lower risk of contracting Typhoid fever. These findings are also aligned with the results of Sinha (et al., 1999), Lin (et al., 2000), and Rafiq (et al., 2009) reported 44%, 11%, and 17% of typhoid cases among preschool-age groups in India, Vietnam and Pakistan respectively (Sinha et al., 1999; Lin et al., 2000; Rafiq et al., 2009). However, according to Levi et al and Ferric et al typhoid fever in children under five years is uncommon and under subclinical conditions (Levine et al., 1997; Ferreccio et al.,1984). This study is limited by certain factors such as short-term study design on prevalence and data collection, which may not adequately include other hospitals. For a more comprehensive understanding of the prevalence and molecular analysis of S. typhi in other regions, it is recommended that future studies build upon the framework created by this research.

CONCLUSION

It is concluded that our study area presents a substantial health risk for typhoid fever, particularly in the age group of 11-20 years. To address this health-related issue, there is a need to propose impactful public health strategies such as changing the daily lifestyle such as to ensuring the intake of clean drinking water, handling proper food, and improving sanitation measures. It is also recommended that further in-depth studies should be carried out in other districts of Balochistan to broaden our understanding of this health issue.

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Competing Interests

The authors did not declare any competing interest.

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