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Original Article

Prevalence of Typhoid Fever among Different Socio-Demographic Groups in District Bahawalnagar, Pakistan

Abir Ishtiaq[1*], Sidra Khalil[1], Samina Khalil[2], Farhan Ahmed[3], Bilal Ahmad[1], Abdul Ghaffar[4], Muhammad Khalid[5], Sheikh Muhammad Azam[6] and Muhammad Imran[7]

[1]Department of Zoology, The Islamia University of Bahawalpur, Bahawalnagar Campus, Bahawalnagar, Pakistan
[2]School of Chemistry, University of The Punjab, Lahore, Pakistan.
[3]CMH Multan Institute of Medical Sciences, Multan, Pakistan.
[4]Department of Zoology, The Islamia University of Bahawalpur, Bahawalpur, Pakistan.
[5]Department of Zoology, Govt Graduate Millat College Multan, Punjab, Pakistan.
[6]Department of Zoology, Division of Science and Technology, University of Education Lahore, Punjab, Pakistan.
[7]Department of Statistics, Bahauddin Zakariya University Multan, Punjab Pakistan.

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***Corresponding Author:**
Abir Ishtiaq
Department of Zoology, The Islamia University of Bahawalpur, Bahawalnagar Campus, Bahawalnagar, Pakistan
abir.ishtiaq@iub.edu.pk

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ABSTRACT

Typhoid is an infectious disease caused by a bacterium *Salmonella typhi* and this bacterium spreads so fast in non-hygienic conditions. This disease is abundantly found in areas where hygienic conditions are poor. **Objective**: To evaluate the prevalence of typhoid among different socio-demographic groups and gender from the populace of different tehsils of district Bahawalnagar (Pakistan). **Methods:** The blood samples of suspected patients were collected from the suspected patients belonging various tehsils of Bahawalnagar (Pakistan) during April to July, 2022. A rapid serological test for detection of IgG/IgM against typhoid bacteria was performed using test kit. A questionnaire was also used to collect information from all the suspects with questions related to age, gender, month, socioeconomic status, area, source of water for drinking purpose, and source of food. **Results:** Results showed 66.39% positive cases for *S. typhi* from a total of 360 suspected patients with apparent symptoms of typhoid fever belonged to various regions of district Bahawalnagar (Pakistan). Significant difference was found in gender-based data, showing significantly ($p<0.05$) higher occurrence of typhoid fever in females (51.46%) than males (48.54%). Population consuming homemade food was significantly ($p<0.05$) most affected with the *S. typhi.* **Conclusions:** Higher prevalence of typhoid fever was recorded in the females of district Bahawalnagar (Pakistan). An alarming percentage (54.07%) of positive cases for typhoid fever among the populace was also found, consuming water from the local water-filtration-plants of the studied region.

INTRODUCTION

The estimated global incidence typhoid fever is known to have 11-21 million cases per year, and causing deaths in range of 1,20,000 to 1,60,000 people [1-3]. Earlier it was in the range of 16 million cases with almost 6,00,000 deaths with decreased fatal rate. The cases of suffering patients with typhoid fever are 93% of global episodes occurring in Southeast Asia [4]. According to epidemiological study, this disease is found to be highly prevalent in areas like those parts of South and Central America, India, and Africa where there is not much cleaned water and are very crowded [5]. This fever is predominantly affecting children and its main source of spreading is feces excretion of *typhi*

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[6]. In 2007, it was reported that most notorious focal points overall the world for typhoid fever are Pakistan, Indonesia, Peru, India, Nepal, Egypt, and Mexico [7]. The commonness of the typhoid fever is very less in the countries, which are highly developed such as the United States and Canada. However, typhoid is a minor problem in developed country the United States [8, 9]. Typhoid fever is abundantly infecting Pakistan as it is a developing country. Children with age above five years suffer most complications as compare to one third of the patients suffering from intestinal fever [10]. A review led in 2003 which described that water borne diseases guarantee two hundred and fifty thousand passings every year in Pakistan among which typhoid fever is the main source [11]. As per concentrate on in 2013 in pediatric patients in Quetta revealed 18.6% patients were positive serologically for typhoid [4]. A study conducted in Islamabad of Pakistan depicted that 48% females and 42% of males were positive for both IgM and IgG of the total tests conducted in 12 months period [12]. Typhoid fever can be a significant mark of financial state of populace like other Asian countries [13]. Intestinal fever is an intense febrile ailment that occur by intake of the bacterium *Salmonella enterica* serotype *Typhi (S. Typhi)* or serotype *Paratyphi* A, B or C, frequently through food or water defiled with human excrement [14, 15]. This bacterium is a gram negative, flagellated, rod shaped that caused typhoid fever. The term "typhoid fever" was termed by Pierre Louis [16]. *Salmonella typhi* find humans as their host [17]. It is an irregular sickness. It can likewise create a periodic point-source pandemic [18]. The typhoid fever starts with common cold. Then the temperature starts to rise up gradually every day that can be as high as 103–104 °F (39–40 °C) and pulse rate starts to be slow [19]. It also leads to dehydration and diarrhea. Shivering and delirium are also observed. It starts with gentle sickness with poor quality fever, uneasiness, dry cough, to extreme clinical signs with stomach uneasiness and numerous inconveniences [20]. It is also observed that the typhoid fever is also associated with many other complications in 10-15% of patients. Most of complications have been studied but most common are typhoid encephalopathy, intestinal perforation, relapse, and gastrointestinal hemorrhage. The patient gets prolonged passiveness, toxemia, myocarditis, anemia, confusion, typhoid intestinal perforation (TIP), gastrointestinal hemorrhage, pneumonia, hepatitis, disorientation, diarrhea, and followed by coma. It can cause damage to various organs in the body if not cured [21-23]. Mouth is the mode of entrance of *Salmonella typhi* infection, via the sources of fecal contaminated food or water [24]. The bacterium gets transferred through ingestion of water or food that has been polluted by dung or less usually, pee of contaminated people [1]. This infectious fever is observed to occur mostly in the months of September, October and in months of July and August after monsoon rains [4]. According to an Indonesian study, improper hygiene is extremely a clear factor of getting typhoid [25]. Therefore, it is addressed in schools that it is necessary to wash hands after stool and urine excretion. Flies are also a major cause of spreading the bacteria to food [26]. Fecal typhi from stool are transferred to the water sewage system through the flushes and toilet pipes and then polluting the ground and surface water [20]. According to research held in South Asia it was observed that typhoid is more common in rural areas of developing South Asia as compared to urban areas. Also, according to this research, both of sexes are affected equally [27]. Typhoid fever is treated with antimicrobial therapy. Before the invention of antibiotics, the mortality rate from infection of typhoid fever was round about 15% all over the world [28]. Typhoid fever can also be treated by vaccination either in injection or in capsule form. World Health Organization (WHO) suggested a programmed utilization of these two vaccines (ViPS and Ty21) for prevention from the outbreak of typhoid in 2008 [29]. As, there was no previous study data available on the prevalence of infection from typhoid fever in the population of District Bahawalnagar in Pakistan. Thus, the purpose of the research was to study the prevalence of typhoid fever among different socio-demographic groups and genders from the populace of different tehsils of district Bahawalnagar (Pakistan).

METHODS

An observational, cross-sectional study was conducted at the Islamia University of Bahawalpur (Bahawalnagar Campus), Bahawalnagar (Pakistan) after taking ethical approval. A total of 360 blood samples were collected from the suspected patients with apparent symptoms of typhoid fever belonged to district Bahawalnagar, Punjab, Pakistan including all its five tehsils i.e., Bahawalnagar, Chishtian, Haroonabad, Minchanabad, and Fort Abbas, during April to July 2022, adopting stratified random sampling technique. Sample size was calculated by using online sample size calculator (www.calculator.net) having confidence level of 95% with 5.2% of margin of error and 50% of population proportion. Both suspected males and females for typhoid fever of any age groups and socio-economic backgrounds having symptoms and signs (like fever > 99° F, relative bradycardia, abdominal discomfort, headache, diarrhea, weakness etc.) from all 5 tehsils of Bahawalnagar were enrolled. While, participants suffering from any other life-threatening disease (like carcinoma) or with multiple comorbid like chronic kidney disease, diabetes mellitus and ischemic heart disease were excluded. Moreover, non-

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consenting patients were also excluded from the study. A questionnaire, including the information like their gender, age groups, month of infection, their source of water, source of food, economic status, and region, were being filled by them. 5ml of venous blood was withdrawn from participants after obtaining written informed consent by the routine method under septic measures. The blood samples were centrifuged immediately after collection at 4000 rpm for fifteen minutes to get the serum. Obtained clear and non-hemolyzed serum specimens were used to perform tests using a kit (Acu-Check, RAPID Diagnostic Test) following the instructions of the company. One full drop of serum (approximately 30µl) was taken at test kit and one drop of buffer (approximately 40µl) was also added on the serum drop. The results were checked immediately after 15 minutes and interpreted noticing the appeared bands on the kit following the company's instructions.

Statistical Analysis

Percentages and frequencies were used to express the data. Chi-squared test was performed to compare the observed frequencies of positive tests for each parameter against the expected frequencies, using IBM SPSS Statistics 23.0 for Windows.

RESULTS

Results revealed a total of 66.39% positive cases for S. typhi from 360 suspected patients with apparent symptoms of typhoid fever belonged to various regions of district Bahawalnagar, (Pakistan). Table 1 provides the results of analysis of typhoid fever among age groups of all tehsils of Bahawalnagar (Pakistan). No significant difference ($p>0.05$) in prevalence of typhoid fever was observed among different age groups. However, number of suspected individuals with apparent symptoms of typhoid fever were found the highest in the age group being 21-30 years, and hence showing the highest positive cases (28.45%) among different studied age groups.

Table 1: Prevalence of typhoid fever among the population of different age groups from five tehsils of Bahawalnagar, Pakistan

Pain intensity rating scale								
Age groups	Total No. of Tests perfor-med	Bahaw-alnagar	Haroon-abad	Fort-Abbas	Mancha-nabad	Chish-tian	Total No. of Positive tests (%)	p-Value
Less than 1 year	40	5	0	5	5	1	16 (6.70%)	0.6725
1-10 Year	39	9	0	8	3	3	23 (9.62%)	
11-20 years	50	2	8	5	5	14	34 (14.23%)	
21-30 years	90	14	19	10	17	8	68 (28.45%)	
31-40 years	52	11	11	4	9	8	43 (17.10%)	
41-50 +years	38	6	7	4	6	7	30 (12.55%)	
51-60 years	28	5	0	5	4	4	18 (7.53%)	
61-70 years	10	0	0	1	1	0	2 (0.84%)	
>70 years	13	1	0	0	3	1	5 (2.09%)	
Total	360	53	45	42	53	46	239 (66.39%)	

Cumulatively gender wise prevalence of typhoid fever from the population of Bahawalnagar (Pakistan) showed significant higher positive cases (51.46%, $p<0.05$) of typhoid fever in females than males Table 2.

Table 2: Cumulatively gender wise prevalence of typhoid fever from the population of Bahawalnagar (Pakistan)

Gender	Total No. of Positive Tests	Frequency (%)	p-value
Female	239	123 (51.46%)	0.0012
Male		116 (48.54%)	

Monthly prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), during April-July, 2022 is depicted in Table 3. Although, no significant difference ($p<0.05$) was found among frequencies of positive typhoid cases during the studied months, however an increasing trend in number of suspected patients and hence the percentage of positive cases was observed from April to July.

Table 3: Monthly prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), during April-July, 2022

Month	No. of Tests Performed	Frequency of Positive Tests (%)	p-value
April	55	35 (14.64%)	0.2467
May	67	42 (17.57%)	
June	93	68 (28.45%)	
July	145	94 (39.33%)	

In the present study, the highest number of suspected patents were observed in the population belong to lower class, followed by middle and higher class. But no significant difference ($p>0.05$) was found among frequencies of positive cases for typhoid fever among the three studied socioeconomic classes, as showed in Table 4.

Table 4: Prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), depending on socio-economic levels

Socioeconomic Level	No. of Tests . Performed	Frequency of Positive Tests (%)	p-value
Lower Class	147	110 (46.02%)	0.5676
Middle Class	122	90 (37.66%)	
High Class	91	39 (16.31%)	

Prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), depending on urban/rural areas

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is presented in Table 5, representing no significant difference (p>0.05) between urban and rural population.

Table 5: Prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), depending on urban/rural area

Area	Total No. of Positive Tests	Frequency (%)	p-value
Urban	239	97 (40.5%)	0.1965
Rural		142 (59.40%)	

Significant difference (p<0.05) in the frequencies of positive tests was found among the groups depending on source of drinking water (Mineral water, tap water and Water from local water filtration-plants), as shown in Table 6. Population depending upon local water-filtration-plants (54.07%) was highly affected (p<0.05) than consuming the water from tap water (25.32%) and mineral water (20.60%), in 233 positive tests (excluding six newborn cases from 239 positive cases).

Table 6: Prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), depending on source of drinking water

Source of water	No. of Tests . Performed	Frequency of Positive Tests (%)	p-value
Mineral water	83	48 (20.60%)	0.0002
Tap water	89	59 (25.32%)	
Local Water Filtration-Plant	188	126 (54.07%)	
Total	360	233 (100.0%)	

Table 7 provided the results of prevalence of typhoid fever by source of food from all Tehsils of District Bahawalnagar (Pakistan). In this table percentage was derived from a total of 222 positive tests, as 17 newborn and toddlers' samples were excluded from total of 239 positive samples. Results showing that people consuming homemade food found significantly (p<0.05) the most affected (63.51%) with the S. typhi.

Table 7: Prevalence of typhoid fever among the population of Bahawalnagar (Pakistan), depending on food source

Source of food	No. of Tests . Performed	Frequency of Positive Tests (%)	p-value
Homemade	201	141 (63.51%)	0.0002
Mostly Homemade	71	49 (22.07%)	
Homemade & Hotels	50	18 (8.1%)	
Often Hotels	38	14 (6.30%)	
Total	360	222 (100.0%)	

DISCUSSION

Typhoid fever has been indicated as the most infectious disease of the South Asian Countries like Pakistan as it is causing great level of morbidity and mortality in Pakistan. A number of cases reported every year across the country. It is dominant in those areas, which suffer lack of safe drinking water and the lack of hygienic food. Typhoid fever, like other Asian countries, is dependent on many socio-economic conditions [12]. In the present study, no significant difference (p>0.05) in prevalence of typhoid fever was observed among different age groups. But, higher positive cases of typhoid fever were found in the age group being 11-50 years, representing the occurrence of disease in higher rates usually in school and college going age groups and in jobholders. Among these age groups, age group of 21-30 years was most affected with typhoid fever, and the findings also supported by some other study by Ghosh et al., [30]. It could be due to many reasons as this is age of poor hygienic practices as adults in this age eat junk foods in restaurants and by other ways where hygienic practices are not prioritized. Most of the gender wise studies showed that typhoid is more prevalent in males than females. For instance, according to a study conducted by Medhat and Aljanabay [31] in Iraq, males were affected more than females. It could be due to many reasons like males spend most of the time outside the house than females so they may have greater chance of being affected [32, 33]. On contrary, Butler et al., [34] reported higher prevalence rate of typhoid fever in females. Findings of the present study also revealed that females were affected significantly higher than males. This might be due to the fact that most of the rural region females work outside the homes in the fields to cope with economical demands in the under-developed district. The prevalence rate data obtained according to monthly variation showed no significant difference among the studied months but an increasing trend in positive cases of typhoid fever was observed from April to July, with the highest positive cases during the month of monsoon (July). Due to heavy rains in monsoon season, there is a greater chance of contamination in surface water so people closer to water bodies are at high risk of getting the infection and prevalence rate increases during this duration [35]. Moreover, typhoid is more prevalent in summer as compare to other seasons [4]. It is the fact that Salmonella typhi is typically spread through contaminated food or water. In the present study, statistically higher ration of typhoid fever prevalence in the people consuming home-made food might be related to poor sanitation, unhygienic conditions or use of unsafe water for cooking purpose. Moreover, it was threating to observe that frequency of positive tests was found statistically higher in the populace of the studied region, depending on local water filtration-plants for drinking water, followed by tap water and mineral water. A recent published study conducted by Majeed et al., [36] on safety assessment of water purification plants of Lahore (Pakistan) has also revealed presence of typhoid in the majority of residents of some suburban areas of Lahore as total coliform counts was greater than 20 per 100 ml. As, most of the population of Bahawalnagar (Pakistan) rely on local purification plants for drinking water, hence it is dire need to manage the purification plants properly.

CONCLUSIONS

The study concluded that the most of the typhoid fever cases were reported in people with age between 21 to 30

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years. Typhoid fever significantly more affected females than males. It was affecting both men and women with significant higher ratio in females in the studied area. Typhoid spread fast in the months of monsoon i.e., July. Its rate was higher in lower class and rural areas than upper class and urban areas respectively in Bahawalnagar district. Moreover, it was more abundant in people who were exposed to unhygienic conditions and often drink unfiltered water. To the best of our knowledge, it is the first study describing the association of water purification plants and prevalence of typhoid fever in Bahawalnagar (Pakistan). Hence, regular maintenance to check the adequate hygiene and contamination status of water purification plants specially from coliform bacteria is recommended, to avoid waterborne infections, including typhoid fever. Further studies are required to study the presence of coliform bacteria, especially *Salmonella typhi*, in water supply of purification plants. Awareness campaigns on water-borne diseases and use of clean drinking water must be launched and proper administration on adequate sanitation system and water management should be emphasized.

Authors Contribution

Conceptualization: AI, AG
Methodology: SK[1], SK[2], FA
Formal analysis: SK[1], BA, MI, SMA
Writing, review and editing: AI, AG, FA, MK, SMA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The author declares no conflict of interest.

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