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Research paper

Occurrence of typhoid among the local population of district Dir Lower: A laboratory based study

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Abstract

Introduction: Typhoid fever, a bacterial disease caused by *Salmonella typhi* (*S. typhi*) remains a major health problem in the Asian sub-continent due to poor hygienic conditions.

Aim: Our aim was to determine the prevalence of Typhoid fever among the general population of district Lower Dir, Pakistan in order to describe the disease occurrence and distribution.

Material and methods: This was a descriptive-epidemiological study. 1076 subjects were enrolled; with presentation of common symptoms of typhoid at the Fazal-Rahim Clinical Laboratory as inclusion criteria. Typhidot test was performed for all participants. Data were analyzed using Chi-square test and *P*-values less than 0.05 were considered significant. PHStat software was used for statistical analyses.

Results and discussion: The study comprised of 414 males and 662 females; 37.26% of total cases were found positive. Females (62.64%) were more affected compared to males (37.4%). Furthermore, the IgM antibodies were detected in 353 (88.02%) patients while IgG antibodies were present in only 48 (19.98%). Age group 20–40 years recorded the highest incidence of cases 242 (60.34%); also March recorded the highest incidence of cases 67 (50.38%). Overall, typhoid is a common disease in the local population of Lower Dir, it is dominant in females with the highest burden recorded in the economically-productive age group 20–40 years.

Conclusions: Further studies are recommended to determine the antibiotic susceptibility pattern; there is need to launch effective programmes for the eradication of the disease and promote safe drinking water and food through public enlightenment and education.

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1. INTRODUCTION

Typhoid fever is a rising public health issue in under-developed countries and areas where unsafe drinking water and poor sanitation system still abound.[1] Enteric fever still remains a major public health problem in the Asian subcontinent and parts of sub-Saharan Africa where hygienic conditions are not good.[2,3] Typhoid fever has some non-specific symptomology such as low grade fever, nausea, vomiting, malaise, abdominal pain, headache, constipation leading to diarrhea and hepatosplenomegaly. In some cases complicated conditions occurs, i.e., intestinal perforation in distal ileum, intestinal hemorrhage, septicemia, diffuse peritonitis, cholecystitis and encephalitis. The transmission of enteric fever is through the 'fecal-oral' route. Typhoid fever occurs usually in populations due to poor personal hygiene. This disease is therefore common in places where there is lack of or poor sanitation system, however enteric fevers are especially caused by water supply contaminated by human excreta. The typhoid fever incubation period is about 10 to 14 days.[4] The typhidot test is used for the detection of *Salmonella typhi* IgM and IgG antibodies. It has undergone full scale globally due to clinical estimation of its diagnostic value.[5] In case of secondary infection, both IgM and IgG are detected.[6] The main source of transmission of enteric fever is through contaminated drinking water and ingestion of contaminated food with *S. typhi*. Every year approximately 2 100 000 people are infected and 217 000 deaths were occurred worldwide due to typhoid fever. However, this is an estimate because the available data on the base of diagnostic testing surveillance is within limit and the load of enteric is unknown in underdeveloped countries. The highest load of enteric fever was seen in the south-eastern Asia and south-central Asia.[7] Recently, a large population base surveillance study was done in five Asian countries (Pakistan, China, India, Indonesia and Vietnam) and have confirmed the high incidence enteric on the region.[8] The enteric fever incidence in sub-Saharan Africa is poorly discussed or described. Historically, enteric fever within the region has been thought to occur in the form of outbreaks rather than been an endemic disease. However, population-based surveillance studies done in Kenya found that the high number of cases arising in the specified population in specific time period (incidence) of children living in the cities (urban) with the rates similar to that recorded in south-eastern Asia and south-central Asia.[9]

2. AIM

The aim of this study was to determine the prevalence of typhoid fever among the general population of district Lower Dir, Pakistan. Our secondary aim was to describe the occurrence and distribution of the disease.

3. MATERIAL AND METHODS

3.1. Study area

District Lower Dir is located with longitudes and latitudes of 34°37' N to 35°07' N and 71°31' E to 72°14' E respectively approximately 2700 feet (820 m) above from ocean level. The annual rain fall is usually about 1468.8 mm in March and 253.7 mm in December. Dir Lower connected from northern side by Upper Dir is connected to district Chitral and Bajaur and Afganistan is situated on the western side, while in the southern side district Malakand and eastern side district Swat. The Panjkora is a very famous river of district Lower Dir (Figure 1).[10]

3.2. Study design and place

A descriptive epidemiological study was designed from January 1 to July 31, 2015. The laboratory work was performed at Fazal Rahim Clinical Laboratory Timergara District Lower Dir.

3.3. Collection of data

The data were collected from all the patients who presented with common symptom of typhoid at the Fazal Rahim Clinical Laboratory Timergara District Lower Dir.

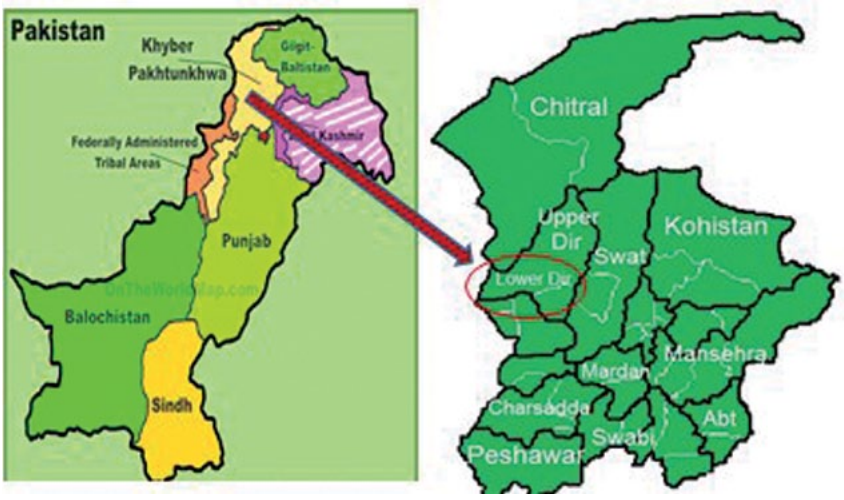

Figure 1. Map of study area modified from Health Facility Assessment, 2012.

3.4. Protocol of typhidot test

The typhidot test is used for the detection of human antibodies IgM and IgG. The typhidot ICT kit consist of two wells. Specimen from typhoid suspected patients were taken and the samples were centrifuged to produce serum. Serum (20 μL) was poured using a micropipette on one well of the kit and also 1 μL of typhoid regent was poured into the other well of the kit. The test was recorded as negative if a single line was observed on examination but if a double line is observed the test is recorded as positive. The ICT kits used have high sensitivity; in which they are able to detect very minute levels of infectious agents thus limiting the occurrence of false negatives it is due to sensitivity.

3.5. Demographic information

The demographic information of all the suspected patients were recorded including date of entry, patients address, name, gender and age.

3.6. Inclusion and exclusion criteria

Those patients who were enrolled at Fazal Rahim Clinical Laboratory during January 1 to July 31, 2015 were included in the current study while those patients who enrolled in government or private laboratory were excluded from the current study.

3.7. Study limitation

Only typhidot test were performed for suspected cases, no other test were performed like Widal test, polymerase chain reaction and culture test for the diagnosis of typhoid. Hence we could not determine the degree of resistance to typhoid fever in the study area.

3.8. Prevalence rate

The prevalence rate (%) was found using the following formula:

$$\text{Prevalence rate} = \frac{\text{Total No. of postive cases}}{\text{Total No. of diagnosed cases}} \times 100$$

3.9. Statistical analysis

The collected data were analyzed for percentage and simple proportional ratio using Microsoft Office Excel 2007. The data were also analyzed for gender-, age- and month-wise distribution. The collected data were analyzed statistically using PHStat2 software for windows applied χ^2 test. P value less than 0.1 were considered as significant.

3.10. Ethical considerations

Before the commencement of the study, the research proposal was approved by the Board of Study (BoS), Department of Microbiology, Hazara University, Mansehra and further permission was granted by the Advanced Studies and Research Board (ASRB). Informed consents were obtained from study participants and confidentiality was observed and maintained throughout the study.

4. RESULTS

In the current study a total of 1076 subject were analyzed for the presence of typhoid. In the total studied cases 414 were male subject and 662 were female subject. In total, 401 cases was found typhoid positive. Further results showed that IgM antibodies were detected in 353 (88.02%) patients, while IgG antibodies were found only in 48 (19.98%) patients (Table 1).

The data was also analyzed for the month-wise distribution; the results show that in January 86 cases were studied: 33 (38.38%) were positive and 53 (61.62%) were negative. The IgG and IgM ratio was 7 (21.21%) and IgM 26 (78.78%), respectively. In February 77 cases were tested: 34 (44.16%) were positive and 43 (55.84%) were negative. In positive cases 32 were IgM (72.72%) and 2 (18.18%) were IgG. In March, 133 cases were studied: 67 (50.38%) were positive and 66 (49.62%) were negative. In positive tested cases 54 (80.60%) were IgM and 13 (19.40%) were IgG. In April 208 cases was reported: 90 (43.29%) cases were positive and 118 (56.73%) were negative. In positive suspected cases 80 were IgM (88.89%) and 10 (11.11) were IgG. In May 197 cases were diagnosed: 128 (64.98%) were negative and 69 (35.02%) were positive. In positive cases 60 (86.96%) were IgM and 9 (13.04%) were IgG. In June 246 cases were tested: only 73 (29.78%) cases were positive

Table 1. Month-wise distribution of IgG and IgM.

Months	Total cases	IgM +ve	IgG +ve
January	86	26	7
February	77	32	2
March	133	54	13
April	208	80	10
May	197	60	9
June	246	67	6
July	129	34	1
Total	1076	353	48

$P = 0.080801$

Table 2. Gender-wise distribution of IgM and IgG.

Gender	Total cases	IgM	IgG
Male	414	126	24
Female	662	227	24
Total	1076	353	48

$P = 0.054628$

Table 3. Age-wise distribution of IgM and IgG cases.

Age groups (Years)	<20	20–40	41–60	>60	Total
IgM	88	215	42	8	353
IgG	11	27	8	2	48
Total	99	242	50	10	401

$P = 0.658557$

and 173 (70.32%) cases were negative. In the positive cases 67 (91.78%) were IgM and 7 (8.12%) were IgG. In July 129 cases were reported: only 35 (27.13%) were positive and 94 were negative. In these positive cases 29 (82.86%) IgM and 6 (17.14%) were IgG.

In total, 353 (88.02%) cases were IgM positive. Male to female ratio was 126 (35.70%) to 227 (64.30%). IgG positive individuals were 48 (11.98%), male 24 (50%) and female 24 (50%) as describe in Table 2.

For age-wise analysis the typhoid positive patients was divided into four different groups: 0–20 years, 21–40 years, 41–60 years and more than 60 years. The disease rate was notified high in age group 2 (242 cases, 60.34%) followed by age group 1 (99 cases, 24.68%), age group 3 (50 cases, 12.49%) and age group 4 (10 cases, 2.50%) were reported as shown in Table 3.

5. DISCUSSION

Pakistan is a low income country; where the ratio of infectious diseases is high compared to developed countries. Similarly, typhoid is one of the most significant health issues. The present study was undertaken to determine the occurrence of typhoid fever among the general population of district Lower Dir, Khyber Pakhtunkhwa, Pakistan. In our study, the overall prevalence of typhoid fever among the suspected cases was found high (37.26%). Age is one of the most important factors in epidemiology of disease. On the basis of age-wise occurrence the high number of cases was notified in the age group 20–40 years.

The results of our study were found in line with others who also reported high number of cases in productive and economically important age groups.[1,11] The study by Ochai et al.,[12] was carried out in four different countries including Pakistan (Karachi), India (Kalkata), Indonesia (North Jakarta) and China (Hechi city). In that study, the high infected age group was 2–16 in Karachi (Pakistan) and two other countries Kalkota (India) and North Jakarta (Indonesia), found typhoid infection in all age of groups while in Hechi city (China) the typhoid fever was found in age 5.0–60.9. So the result of this study shows contrast especially in Pakistan (Karachi). This may be due environmental conditions of the study area and Karachi, as both are very different. This study shows the positive results in all age groups in remaining three countries in this study shows in all age of groups. The higher incidence rates were reported of typhoid fever in age group of 26–45 years; this is in agreement with the report of Farooqui et al.[13] The study carried out by Kothari et al.,[14] reported that a high number of positive cases were found in the age group of 7–19 years in Indonesia and high number of incidence *S. typhi* was in age group of 0–4 years in India while a high number of cases were reported in age group of 5–9 years in Vietnam. This is in contrast to our study, because the high number of cases was found in age group of 20–40 years. The logical reason may be that we designed our study for a whole population of the selected area (2008) while Kothari et al.,[14] specifically determined the incidence of typhoid only in children. The high number of typhoid fever was found out in age group of 21–40 years the result of which study shows similarities to our one.[15] The study of Akmm et al.[16] shows the result that the higher incidence occurs among the school-age children, which is in contrast to our study. Our study was designed for the whole population but this study focused only on children. The study conducted by Naheed et al.[17] in Dhakha showed the high number of cases reported in age group under 5 years. This result also contrasts to our findings. The study performed by Parry et al.[18] in Vietnam observed a high incidence of typhoid fever in children while Umar et al.[19] conducted a similar study in Zaria Nigeria and reported that a higher number of age group was affected as compare to 6–10 years. Another study by Ibegbulam et al.,[20] reported that a high frequency was found in the age group of 26–45 years which is also comparable to our result. The study conducted by Chalya et al.[21] on the base of age group observed that the higher prevalent group of 10–20 years; thus this study was deviated to our results.; the higher number of cases were in age group of 10–20 years and then 20–30. The higher rates were observed in age group of 6–9 which contrast to our study. The possible reason is that the children are closely in contact with raw food consumption, low personal hygiene, poor sanitation and quality of drinking water. The study carried out by Khan et al.[22] in South Africa reported that higher number of cases was reported in adult in age group (15–45 years) this is in agreement with our study. In contrast, Saddiqui et al.[23] reported a higher incidence in the age group of 5–10 years in Karachi (Pakistan). The study carried out by Ganesh et al.[24] in the South India Channai showed that the number of cases occurs in the age group of 2–5 years this ia also in deviance to our study. Another possible reason for this could be that the immunity systems of the children are weak compared to adults. The study was conducted by Weyesa et al.[25] at tertiary care center Addis Ababa (Ethiopia). The result shows that the higher incidence rate was found in the age group of 20–40 years; both studies show similarity to the current study.

In our study the disease ratio was recorded high among the females (62.60%) as compared to males (37.40%). A study conducted by Ayub et al.,[26] at Islamabad reported high ratio of disease in female subject. Another study carried out by Sharma and Malakar[27] at Lakhimpur District of Assam (India) recorded that 52.3% female patients was found positive through Widal test. The study was carried out by Shah and Poudel[15] in the base of gender. The results shows that the high incidence was reported high in male as compare to female which contrast to our study because in this study high number of male patients were examined as compare to female. In the study carried out by Muhammad et al.[28] in LRH Peshawar, the total 176 cultures test was performed and the result of 106 was positive. The result of this study shows that the higher number of male patient was infected by *S. typhi* as compare to female; so this study was deviated to our study as in this study the higher number of male was examined as compare to female. The study by Parry et al.[18]

in Vietnam showed that typhoid had a higher incidence in male as compare to female. This study also contrasts to our study due to the higher number of samples were taken from the male subject in this study. Umar et al.[19] in a study conducted in Zaria (Nigeria); observed higher number in male subject as compare to female. This study was in contrast to our study because in our study the prevalent subject was female. In this study higher male population was tested, so in our study the higher number was tested as the possible reason of high cases in female in our study. Also, Ibegbulam et al.[20] performed agglutination test in Nigeria and which showed that the higher frequency was found in female as compared to male; this showed similarity to our study. In the study carried out by Chayla et al.[21] the incidence of typhoid fever was observed to be high in the male as compare to female; these results contrast to our study. The reason may that the male has higher risk of exposure to typhoid fever resulting from longer time and consuming more food outdoors, that may lead to more frequent contact with the *S. typhi*. This is in contrast to Waheed et al.[29] in Islamabad that observed that high incidence rate was found in male as compare to female. The higher incidence was reported by Khan et al.[22] in female as compare to male also showing similar results to our study. The study conducted by Ganas et al.[24] in South India Channai showed that the high incidence rate was found in male as compare to female which is in contrast to this study. The disease was high in female probably due to weak immune system as compared to male, low level of awareness, low access to health facilities and ignorance; these are key factors to spread the disease actively. The immune system of females is weak which put them in a high risk to get infected. Contaminated water and poor hygienic condition is another factor contributing to spread the disease actively.

On the basis of seasonal variation, the disease progression was recorded high in March while found low in January. A study carried out by Soomro et al.,[1] recorded maximum number of cases in August. Another study showed high occurrence of disease in August while low frequency was observed in April.[27] The study carried out by Shah et al.,[15] showed that the higher incidence was reported in June and July in Nepal Ganj Medical Collage Hospital Nepal and higher incidence was reported in July and August on Zonal Hospital. The results of this study are in contrast to our study. This may be due to the hot weather which is suitable for the growth of microorganisms like *Salmonella*.[15] A study carried out by Naheed et al.[17] in the densely populated urban community of Dhaka; recorded the incidence rate of *salmonellosis* was high in April, August, and December. This result contrasts to our study due to climatic and environmental change like duration of monsoon. The study carried out by Umar et al.[19] in Zaria, Nigeria showed high incidence rate in December. In our study the incidence rate was reported high in March; several reports show that typhoid fever is directly linked to drinking water. December was the rainy season in Zaria Nigeria; so also in Pakistan March is also rainy season, so potable drinking water is not readily available. The study was carried out by Ganash et al.[24] in South India Channai, the incidence rate of disease was increasing from January to April but in our study the disease was reported high in March. So when we compare our result to this study, it is almost similar. However the higher number of cases was observed in May and October. This study was in contrast to our study. The reason is that the rainfall in May was high and then after in October in Ethiopia.

Ganesh et al.[24] showed there was no proper immunization against the typhoid fever. Our study area bears almost similar condition; so this study shows similarities to our study. The drinking water quality has significant effect on typhoid fever as reported by Farooque et al.[13] The partial cleaning of the water resulted in outbreak of the typhoid as drinking water of Nik village was polluted by impurities dumped in the bottom of water reservoir. In the study area the population mostly uses well water for drinking purpose. So water from well is also a possible reason of typhoid fever since in our study area usually the wells are not being cleaned on regular bases.

The questionnaire surveys conducted by Milsa et al.[30] in Tanzania; showed that 87.5% of population was aware on typhoid fever and 12.5% was not aware of typhoid fever in the survey. In this survey, on the base of signs and symptoms 72% was aware and 48% was not known about the sign and symptoms of typhoid fever as well as control and prevention as aware 47.5% and not aware 52.5%. In these bases of drinking water the 36% of population drink boiled water, 15% of population drinks chemically treated water and 69% of population drink untreated water. On the bases of transmission of disease 42.5% were aware and 57.5% were not aware. So when we compare our study to this we found similarities because in our study area the condition is same because the people do not boil or treat the drinking water. Akmm et al.[16] in a study among children in the semi urban area of Bangladesh found that the higher number of typhoid cases were positive in population which was drinking water without boiling. In our study area the average populations do not drink boiled water. So these studies show similarities. The *Salmonella* was widely distributed in the Universe and survive well in variety of foods. Poultry eggs dairy product is the most common vehicles of *salmonellosis*.[31] In recent years fresh produce like fruits and vegetable have gained concern as vehicles of transmission where contamination can multiple steps along with food chain Pui et al.[31] Naqqash et al.[32] reports that there are several factors involved in the breakdown of typhoid fever in Pakistan. These may include occupation, age, education, sanitary condition inside and outside the houses etc. Hygienic condition of houses and surrounding environment also play important roles on the incidence of typhoid fever infection.

6. CONCLUSIONS

From the current research it was concluded that the disease was prevalent in Lower Dir (Pakistan). The disease actively affected the most economically and productive age group

of 20–40 years and the disease was high in female patients. Further studies to determine the disease occurrence and antibiotic susceptibility pattern are recommended. There is an urgent need for the health authority and government to launch an effective programme for the eradication of the disease while public awareness and education about safe drinking water and food should be promoted to facilitate control of the disease.

Conflict of interest
None declared.

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