

Prevalence and epidemiological findings of MDR (Multi-Drug Resistant) *Typhoid bacillus* in district Swat KPK, Pakistan

Abstract

Typhoid fever remains an imperative public health matter in many developing countries and prevails in areas with poor hygiene, which aids its spread and diligence in the human population. During this study the prevalence of typhoid fever was recorded different with respect to season, months, age and gender among patients visiting the different hospitals and health care centers of selected area. The clinical data collected from the patients were recorded and designated based on age, gender, marital status, monthly occurrence and seasonal occurrence. During year 2012, 2252 were diagnosed for typhoid out of which 346 were positive for typhoid. The occurrence ratio observed high in age group 45-60 (64.16%) while lowest in 0-15 (0. 58%) while gender wise prevalence shows male predominance among all cases (162 female and 184 male). Out of 346 patients, 272 (78.6%) patients were married and 74 (21.4%), monthly occurrence was recorded higher in June, July and August (11.85%, 16. 90%, 17.34%) respectively. The seasonal prevalence was high in summer (55.79%) while it gradually decreases in spring (18.20%), autumn (17.63%) and winter (8.38%). This study was conducted for the first time in district swat to find out the prevalence rate, risk factors associated with typhoid occurrence, to suggest prophylactic measures to local community and give recommendations to Public Health Department to ensure the prevention and control of this fatal disease.

Keywords: clinical findings, epidemiology, typhoid fever, district swat

Introduction

Typhoid is a severe, contagious and life-threatening disease associated with fever that is most often caused by the typhoid bacillus, *Salmonella enterica*, serovar *Typhus*. Typhoid fever is transmitted by ingestion of food, including dairy products, or water contaminated by excreta from patients or chronic by infected persons. It mostly affects school-age children. In adults and older people, typhoid is less frequent but much more severe. It has various names, such as gastric fever, abdominal typhus, infantile remittent fever, slow fever, nervous fever, and pathogenic fever. However, *Salmonella Typhus* and *Salmonella Paratyphoid* do not have animal reservoir, therefore infection can be happened by eating the improperly handled food by infected individuals.¹ Enteric fever (typhoid or paratyphoid fever) is a potentially fatal systemic infection. Typhoid fever is caused by *Salmonella enterica*, serovar *Typhus* (S. *Typhi*) and paratyphoid fever is caused by *Salmonella enterica*, serovar *Paratyphoid* (S. *Paratyphi*) A, B, or C. These organisms cause disease specifically in humans. Paratyphoid fever is usual “typhoid” was given by Louisin1829, as a derivative from typhus in brief, *Salmonella* is facultative anaerobe, and gram negative flagellated rod-shaped Bacteria.² It is among the most commonly isolated food borne pathogens associated with fresh fruits and vegetables. In recent years, the incidence of fresh fruits and vegetables has increased and become a great concern in industrialized countries. Out breaks of salmonellas is have been linked to a wide variety of fresh fruits and vegetables including apple, cantaloupe, alfalfa sprout, mango, lettuce, cilantro, un-pasteurized orange juice, tomato, melon, celery and parsley.³

An estimated 21.6 million new cases of typhoid fever with about 216, 510 deaths occurred globally in 2000. Paratyphoid fever caused about 5.4 million illnesses in the same year.⁴ Most cases occur in the

Volume 4 Issue 5 - 2017

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Received: August 04, 2017 | **Published:** October 16, 2017

middle-income and low-income countries where sanitation is poor and water supply is in adequate.⁵ Endemic enteric fever is common in the Indian subcontinent, South-East and Far East Asia, Africa, Central and South America, and the Mediterranean region.⁶ Typhoid fever was reported to be endemic in Far East Asia, Middle East, Central and South America. It remains a serious problem in Zimbabwe.⁷ Various reports on pathogenesis of typhoid fever have been made and molecular pathogenesis of *Salmonella enteric* serotype *typhimurium* was also studied by Zhang et al.⁸

Typhoid fever is characterized by high fever, paradoxical bradycardia, and rose-colored rash out of which the most common complaints were headache, abdominal pain and diarrhea. Patient suffering from typhoid fever may develop the symptoms like digestive hemorrhages, ileocaecal perforation, encephalitides, myocarditides, enter bacterial super infections,⁹ ilea perforation,¹⁰ pancreatitis, acute pancreatitis,¹¹ intestinal perforation,¹² bowel perforation, infarction abscess,¹³ hepatic dys function and hepatic abscess.¹⁴ It causes septicemia of digestive origin that can cross the placenta resulting in chorioamnionitis maternal fetal infection with *S. typhi* can lead to miscarriage fetal death, neonatal infection as well as diverse maternal complication.¹⁵ Hydatid disease of the liver complicated by Salmonellosis¹⁶ and Cerebral *S. typhi* muriumabscessina patient with stroke have been reported.¹⁷ *S. typhi* infection in children younger than five years of age has also been done.¹⁸ The complications of typhoid fever in children include generalized edema.¹⁹

The samples used to detect *salmonella* organism are blood, urine, stool and bone marrow. The gold standard of bacteriological confirmation of typhoid fever is the bone marrow culture, which is positive in 85 to 96% of cases, even when the patients have received antibiotics. Typhoid fever had been diagnosed earlier by

blood culture and widal test. Widal test remained the common test for typhoid detection. Serological diagnosis of typhoid infection has been also reported.²⁰ Since 1990, multidrug resistant variety of typhoid fever had been prevalent in many parts of India, caused by *S. typhi* resistant to Chloramphenicol, Ampicillin Trimethoprim and Sulphamethoxazole.²¹

The Centre for Disease Control and Prevention has identified immunization as the most important public health advance of the 20th century. Vaccination is an easy and highly effective way to keep travelers healthy.²² Despite effective treatment of typhoid fever, the increasing report of MDRST make it necessary for vaccine to be used as public health tool in developing countries.²³ Considerable progress has been made in the last decade to develop vaccines against the enteric infections which are of greatest public health importance. Two vaccines against typhoid fever (Parenteral Vipolysaccharide and oral Ty21a) have been licensed in many countries.²⁰ A new typhoid vaccine composed of the Vi capsular polysaccharide has been reported.²⁴

Material and methods

Area selection

District Swat was selected for research on the prevalence of Typhoid because no such work was done in this area. For this purpose the data were collected from Dr. Khan Shahed (D. K. S. M) Hospital Matta, Dispensary of Gowali and Parrow District Swat. In the Dispensary of Golari and Parrow no proper diagnosed infected patients were found. So, for the further study, the data were analyzed for those patients who visited the DKSM Hospital for diagnosis during the year of 2012. The D. K. S. M Hospital is located at Matabazaar Matta Swat. It is having well-furnished wards, well qualified staff, doctors and well equipped laboratories for diagnosis of typhoid. Prior permission was taken from the hospital administration to have an access to the clinical data. The OPD was used for primary data collection because it is accessible for most of the patients and most of the patients were diagnosed by the doctors in the Outpatient Department (OPD) and in patient Department (IPD). The data were collected in which different types of information of the patients were recorded and designed in such a manner that names, age, gender, marital status, monthly occurrence of the patients of typhoid were recorded for analysis.

Data analysis

The data of the year 2012 were collected from the D. K. S. M Hospital Matta, Dispensary of Parrow, & Gwalerai Swat. The analysis of data was only done for the patients of Typhoid. The following parameters were analyzed in the data.

- I. Age wise occurrence of typhoid:** The total patients were divided into different groups based on the irages such as (0-15), (15-30), (30-45), (45-60), and (60+). The percent age were calculated for each group.
- II. Gender wise occurrence of typhoid:** The patients were divided into two groups based on the ir sexes, i. e. male and female. The percentage of male and female was calculated and for each group.
- III. Marital status of typhoid fever patients:** The calculation was also done for the marital status of the patient's i. e. married and unmarried. The percentage was sorted out for the se.

IV. Monthly occurrence of typhoid: The patients had different number and value in different month of the year. The table and figure was made for simplification of data to easily understand able.

V. Seasonal occurrence of typhoid: The occurrences of typhoid patient were different in the four season of the year 2012. For the proper understanding the raw data were converted to tabulated form and made table for four seasons of the year of 2012.

VI. Comparison of indoor & outdoor patient at D. K. S. M hospital matta: Comparison of indoor and outdoor patient was determined. That the outdoor patient was greater or indoor patient in D. K. S. M Hospital Matta Swat, The percentage was sorted out for the se.

VII. Age and gender wise occurrence of typhoid: The collected data were analyzed for the age and gender wise infection of *salmonella typhi*. The table and figure were drawn for the presentation of infected peoples. The data were analyzed statistically for each parameter. The results obtained have been presented in the form of tables and graphs using online statistical software, prism and demo.

Results

The present study was conducted to evaluate the occurrence of typhoid in District Swat. The recorded clinical data were collected from Dr. Khan Shahed Memorial Hospital (DKSMH) Matta Swat, Dispensary of Parrow and Gowaleri and analyzed for different parameters. In the dispensary of parrow and Gowaleri 85 and 97 suspected patients were present respectfully but no infected patients were found. Infected patients were absent because there is lake of suitable Health care facility like clinical laboratory. Forth is reason, most of the peoples went to DKSM Hospital for proper diagnosis. So, for the further study the patients of DKSM Hospital were proposed. Only those patients were considered in the present study for further analysis who visited Dr. Khan Shaheed Hospital Matta and were positive diagnosed for Typhoid. The results were recorded and have been presented as follow;

Occurrence of typhoid in district swat

The collected data was only confined to the year of 2012. In year of 2012total of 2552 people visited the DKSM Hospital for the diagnosis of Typhoid. Out of 2552, 346 were diagnosed positive for Typhoid. Only the typhoid patients were considered for further study. The occurring ratio of typhoid patients was 13.56% in District Swat during the year of 2012. The results were analyzed for following parameters.

- I. Age wise occurrence of typhoid:** During the study work, 2552 people visited the DKSM. Hospital Matta for the diagnosis of typhoid. Among these, only 346 (13.56% patients were diagnosed positive for typhoid. The patients were divided into different age groups on the basis of their ages. Out of 346(13.56%) patients, there were 2 (0.58%) patients in the age group of 0-15 year, 15(4.34%) patients in the age group of 15-30years, 59(17.05%) patients in the age group of 30-45 years, 222(64.16%) patients in the age group of 45-60 years, 48(13.88%) patients in the age group of +60 years as shown in the Table 1 & Figure 1.
- II. Gender wise occurrence of typhoid:** 346 patients were diagnosed positive for typhoid in the total of 2552 at DKSM

Hospital Matta swat. Out of 346 patients, 162 (46.82%) patients were male and 184 (53.18%) patients were female (Figure 2). The results showed high rate of occurrence in female (53.18%) than male (46.82%) (Table 2).

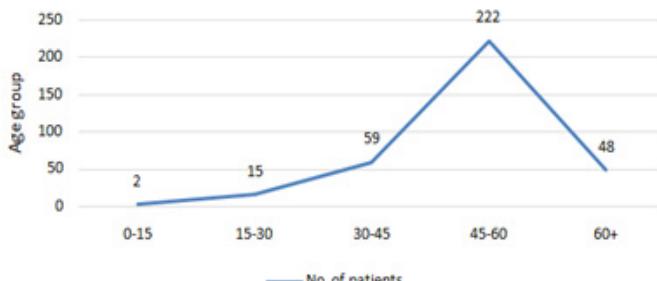


Figure 1 Age wise occurrence of Typhoid (n=346).

Table 1 Showing age wise occurrence of Typhoid

Age group	Number of patients	% Age
0 to 15	2	0.58%
15 to 30	15	4.34%
30 to 45	59	17.05%
45 to 60	222	64.16%
60	48	13.88%
Total	346	100%

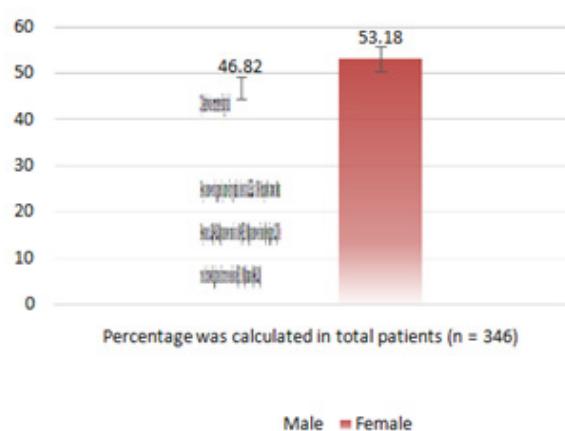


Figure 2 Gender wise occurrence of Typhoid in Matta swat.

Table 2 Showing the gender wise prevalence of typhoid in the study area (n=346)

Gender	No. of +ve cases	Prevalence (%)
Male	162	46.82%
Female	184	53.18%
Total	346	13.55%

III. Marital status of typhoid patients: In the analyzed data, 346 patients were positive for Typhoid. These patients were divided into two groups based on their marital status. Out of 346 patients, 272 (78.6%) patients were married and 74 (21.4%) patients were unmarried. It showed that Typhoid was high in married people as compared to unmarried (Figure 3).

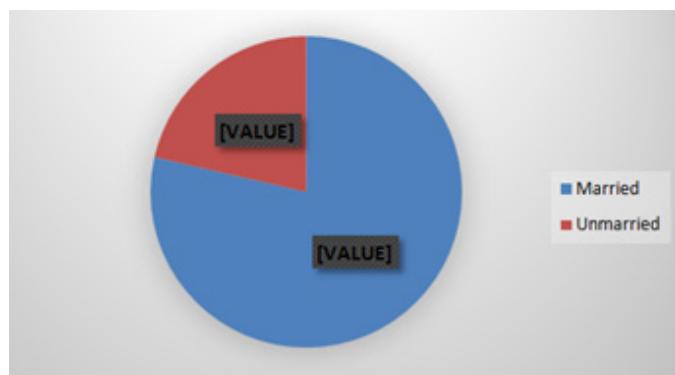


Figure 3 Marital status of Typhoid patients (N = 346).

Table 3 Monthly occurrence of Typhoid

Month	No. of patient	Percentage (%)
January	5	1.45%
February	8	2.31%
March	11	3.17%
April	22	6.36%
May	30	8.67%
June	36	10.40%
July	41	11.85%
August	56	16.90%
September	60	17.34%
October	37	10.70%
November	24	6.93%
December	16	4.62%
Total	346	100%

IV. Monthly occurrence of typhoid: There were 346 patients of Typhoid, out of these 5 (1.45%) in January, 8 (2.32%) in February, 11 (3.17%) in March, 22 (6.36%) in April, 30 (8.67%) in May, 36 (10.40%) June, 41 (11.85%) July, 56 (16.90%) in August, 60 (17.34%) in September, 37 (10.70%) in October, 24 (6.93%) in November and 16 (4.62%) in December. The results showed that the number of patients were greater in August, September and October, but gradually decrease from November to January (Table 3) & (Figure 4).

V. Seasonal occurrence of typhoid patients: Prevalence of Typhoid was high in summer season, i. e. 193 (55.79%), inspiring the number to decrease 63 (18.20%), in the autumn the occurrence of Typhoid patient were decrease further 61 (17.63%), but in the winter the recorded cases were less from all the seasons 29 (8.38%). The results showed that the *salmonella* infected people was more in summer. The percentage was calculated in the total of 346 (Table 4) & (Figure 5).

VI. Comparison of indoor and outdoor patient of typhoid at D. K. S. H Mata: There were 346 patients of Typhoid visited to D. K. S. H Mata out of them 240 (69.37%) was outdoor and 106 (30.35%) was admitted, no death occurs in admitted patient during the year 2012. The result showed that the infection of

salmonella was severe in the indoor patient and outdoor were not severe but greater in number. The percent age was calculated in total of 346 (Table 5).

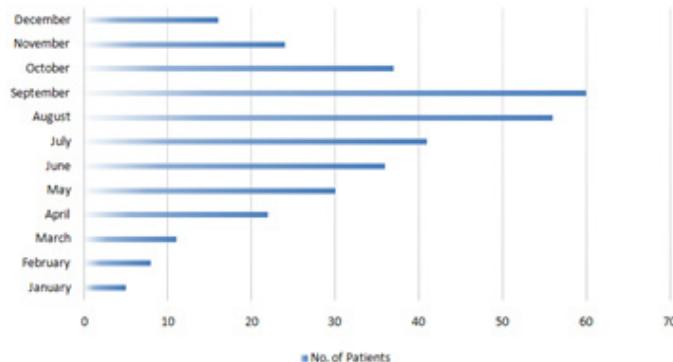


Figure 4 Monthly occurrence of Typhoid.

Table 4 Showing seasonal occurrence of Typhoid

Seasons	No. of patients	Percentage (%)
Spring	63	18.20%
Summer	193	55.79%
Autumn	61	17.63%
Winter	29	8.38%
Total	346	100%

Percentage was calculated in total patients (n=346)

Table 6 Age and gender wise occurrence of Typhoid

Age group	Number of patients	Percentage (%)	Number of male	Percentage (%)	Number of female	Percentage (%)
0-15	2	0.58%	0	0%	2	2.58%
15-30	15	4.34%	5	1.45%	10	2.90%
30-45	59	17.05%	29	8.38%	30	8.70%
45-60	222	64.16%	100	28.90%	122	35.26%
60+	48	13.88%	28	8.09%	20	5.80%
Total	346	100%	162	46.82%	184	54.24%

Percentage was calculated in total patients (n=346)

Discussion

Typhoid fever is one of the most common infectious disease in developing countries including Pakistan. The disease is present especially in areas where healthcare facilities are limited and peoples are illiterate, living in unhygienic surroundings, drink raw-water from tube-wells and not habitual of hand-washing after toilet by soap. Symptoms and signs of the disease are non-specific and laboratory tests are essential for diagnosis. Early and reliable diagnosis of the disease is not only important in relieving patients suffering, but also



Figure 5 Showing seasonal occurrence of Typhoid.

Table 5 Comparison of indoor and outdoor patients

Patient type	No. of Patient	Percentage (%)
In door	106	30.35%
Out door	240	69.37%
Total	346	100%

Percentage was calculated in total patients (n=346)

VII. Age groups and gender wise occurrence of typhoid: There were 346 patients, out of these, 2 (0.58%) were in the age group of 0-15 years in which no (0) were male 2 (0.58%) were female. 15 (4.34%) patients were in the age group of 15-30 years, out of which, 5 (1.45%) were male and 10 (2.9%) were female. 59 (17.05%) patients were in the age group of 30-45 years, out of 59 (17.05%) patients, 29 (8.38%) were male and 30 (8.7%) were female. In the age group of 45-60 years there were 222 (64.16%) patients, out of these, 100 (28.90%) were male and 122 (35.26%) patients were female. In the age group of +60 there were 48 (13.88%) patients, out of these 28 (8.09%) patients were male and 20 (5.8%) patients were female. The results showed that the adults were highly affected with Typhoid. Results also showed that the occurrence rate of Typhoid was high in female than male as shown in Table 6.

essary to avoid life threatening complications including perforation of the intestine.²⁵ The present study was conducted to evaluate the occurrence of typhoid in District Swat. The recorded clinical data was collected from Dr. Khan Shaheed Memorial Hospital (DKSM) Matta Swat; Dispensary of Parrow and Gowaleri and analyzed for different parameters. In the dispensary of parrow and Gowaleri 85 and 97 suspected patients were present respectfully but no infected patients were found. Infected patients were absent because there is lack of suitable Health care facility like clinical laboratory. For this reason, most of the people went to DKSM Hospital for proper

diagnosis. So, for the further study the patients of DKSM Hospital were proposed. Only those patients were considered in the present study for further analysis who visited Dr. Khan Shahed Hospital Matta and were positive diagnosed for Typhoid. The results were recorded.

Jawad K et al.²⁶ studied 235 Typhoid patients in which the frequency distribution of typhoid fever cases per age groups of patients ranged from less than first year to sixteen years old, the age-group (>12-14 years old) of patient shows the highest frequency (24.2%) with typhoid fever ed. In the current study the age group 45-60 shows the highest frequency 222 (64.16%). According to Rahman AKMM et al.²⁷ out of 84, prevalence of Typhoid fever was highest 54 (56.25%) among the school age (5-10 year) patients followed by adolescents. But in the present study total was 336 Typhoid patients in which the prevalence was highest 222 (64.16%) in young peoples, the age group of 45-60. The finding of Rahman AKMM et al.²⁷ is not in correlation. This may be since in this area the working age group 45-60 who are exposed to infection early in the community. During the study work, 2552 people visited the DKSM Hospital Matta for the diagnosis of typhoid. Among these, only 346 (13.56%) patients were diagnosed positive for typhoid. The patients were divided into different age groups based on their ages. Out of 346 (13.56%) patients, there were 2 (0.58%) patients in the age group of 0-15 years, 15 (4.34%) patients in the age group of 15-30 years, 59 (17.05%) patients in the age group of 30-45 years, 222 (64.16%) patients in the age group of 45-60 years, 48 (13.88%) patients in the age group of +60 years.

The research work of Anand PK & Ramakrishnan R²⁸ evaluated that the attack rate of disease was 104 cases per 1000 population i.e. 95.45 and 114 cases per 1000 population in male and female respectively. In present study, 46.82% male and 53.18% female were typhoid patients. The percentage of typhoid in female was greater than male. Therefore, the result of current study is in favor with the study of Anand PK & Ramakrishnan R²⁸. In the current work 346 patients were in consideration in which 162 (46.82%) patients were male and 184 (53.18%) patients were female as shown. The results showed high rate of occurrence in female (53.18%) than male (46.82%). Waris et al.²⁹ studied 97 Typhoid patients. Among the 50 (51%) were married and 47 (48.5%) unmarried. In the present research, the frequency of married patients was higher than unmarried. So, present research work is in agreement with the work of Waris Qidwai et al.²⁹ The reason may be that, the overall number of married people is greater than single. In the analyzed data, 346 patients were positive for Typhoid. These patients were divided into two groups on the basis of their marital status. Of these 272 (78.6%) patients were married and 74 (21.4%) patients were unmarried. It showed that Typhoid was high in married people as compared to unmarried.

The incidence of typhoid fever in Matta Swat, as seen retrospectively for the year 2012 in the Dr. Khan Shaheed Memorial Hospital (DKSMH) records, showed monthly and seasonal variations. The peak incidence of typhoid infection in Matta Swat coincided with the beginning of the rainy season which is June-September each year. The result showed that 56.49% of all typhoid cases occurred now. This finding is most likely associated with increased microbial (bacterial) contamination of flowing surface water at this period of the year. Similarly, the finding that typhoid fever occurs twice as often in the rainy season in the dry season can be linked to the transmission of *Salmonella typhi* through water contamination during the rainy season. Poor sewage disposal contributes to these findings. In most parts of Swat, sewage disposal is indiscriminate. Sewage is usually washed into water sources mainly the surrounding streams and rivers.

It is also likely that the perennial water supply problem evident in most parts of Swat explains the consistent incidence of typhoid fever. In other studies, similar assertions have been made, for example; In Lagos, Nigeria, three peak incidences of typhoid infection in April, July and November had been reported.³⁰ Similarly, Ozumba et al.³¹ reported a definite seasonal incidence with two peaks coinciding with two rainy seasons in Ghana.

Shah GJ & Poudel TP³² reported that the frequency of typhoid fever was high in summer season (May, June, and July) and in present study the number of typhoid patients was also high (55.79%) in summer. Therefore, the current work is in correlation with the work of Shah GJ & Poudel TP.³³ The reason may be the more rain fall in the summer that may increase the growth rate of *Salmonella typhi*. There were 346 patients, out of these, 2 (0.58%) were in the age group of 0-15 years in which the infection among male and females (0% and 0.58%). 15 (4.34%) patients were in the age group of 15-30 years, out of which, 5 (1.45%) were male and 10 (2.9%) were female. 59 (17.05%) patients were in the age group of 30-45 years, out of 59 (17.05%) patients, 29 (8.38%) were male and 30 (8.7%) were female. In the age group of 45-60 years there were 222 (64.16%) patients, out of these, 100 (28.90%) were male and 122 (35.26%) patients were female. In the age group of +60 there were 48 (13.88%) patients, out of these 28 (8.09%) patients were male and 20 (5.8%) patients were female. Sharma et al.³³ evaluated 112 patients of Typhoid, 80 (71.43%) were below the age group 30 years, of which 58 (51.78%) was male while 22 (19.64%) was female and the remaining 32 (28.57) were above from age 30 years, that showed same percentage of male & female. The present study the number was more in the age group 45-60 in which 28.90% was male & 35.26% was female. The finding of Sharma et al.³³ contrasts with the present study. The reason may be that Sharma et al.³³ studied the general population and the present study was conducted on only Typhoid Patients.

Conclusion

The above study shows that prevalence of enteric fever was found to be high and most commonly observed in young productive age group 45-60 females followed by 30-45 years age group. Enteric fever is commonest health problem in developing country like Pakistan. The occurrence of typhoid was high in summer season due to the high rainfall. Where water supplies and sanitation are sub-standard. Large numbers of bacterial organisms *Salmonella* species are excreted in urine and faecal specimens during the diseases. An infection is by ingestion of the *Salmonella* species in contaminated food or water or directly from faeces and contaminated fingers. Prevention of enteric fever is mainly by personal and domestic hygiene. The provision of clean piped water supplies and the safe disposal of faeces will be implemented as soon as possible in Swat valley.³⁴

Recommendation

There is lack of knowledge about this disease in the peoples of Matta Swat therefore it is recommended that:

- I. Government Public Health Department should have arranged such programs that give awareness to people about this life-threatening disease.
- II. Peoples should be properly educated, Electronic as well as printed media be used for this purpose. It is so recommended that the peoples should be used proper hygiene and wash hands after Toilet attendance.

- III. Moreover, further research should be done on high population to sort out the other risk factors.
- IV. Government should provide mobile teams to the infected areas so that proper checkup of infected patient becomes possible.
- V. Most of the people in the study area are poor so it is recommended that government should provide free medical facilities so that proper treatment of the disease becomes possible.

Acknowledgments

We are very thankful to Pathology department staff and laboratory technicians of Dr. Khan Memorial Hospital (DKMH) and Local health care centers of Matta Swat, for their assistance in collecting data.

Conflicts of interest

The authors have declared that no competing interests exist.

Author Contributions

Conceived and designed the experiments: SA, AAK

Performed the experiments: SA, AAK

Analyzed the data: AAK, IH, AK

Wrote the paper: AK, SK

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