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Prevalence of Enteric Fever in the Local Population of Rawalpindi And Islamabad Pakistan

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Abstract

Enteric fever is a massive bacterial disease in global and caused by *Salmonella typhi*. It is considered humans are the only natural host and reservoir for *S. typhi*. Transmits the infection through the fecal-oral route by the ingestion of contaminated water and food. The prevalence rate was high in South Central and South-East Asian countries recorded (>100/100,000) cases per year. The aim of designing of the present study, there is no specific epidemiology report present at Rawalpindi and Islamabad. A total of 500 blood samples were collected from patients showing signs and symptoms of enteric fever. Sample collected from different government and private hospitals, medical laboratories, and health organizations from November 2013 to April 2014. Immuno chromatographic technique (ICT) was used for the detection of enteric fever through a typhoid test kit. Out of 500 samples, 368 (73.6 %) patients were found serologically negative while 132 (26.4%) were positive. Among the positive samples, 42 (31.8%) were adult samples that included 25 IgM, 12 IgG, and 5 both IgM and IgG infection. Infected children of 13-15 years were 30 (22.72%) with 19 IgM infection, 8 IgG, and 3 both IgM and IgG. Thirty-one (31) samples were positive among the children of 5-12 years, 15 were IgM positive, 10 IgG, and 6 both IgM and IgG infection. Furthermore, 29 (21.96 %) samples were IgG positive among 1-4 years children. The high incidence of enteric fever among susceptible outdoor patients and laboratories patient shows that enteric fever is a serious health problem in Rawalpindi-Islamabad. Preventive measures such as vaccination, maintaining food hygiene and awareness campaign are required in the twin cities of Rawalpindi-Islamabad for the eradication of enteric fever.

Keywords: Enteric Fever; *Salmonella Paratyphi*; Salmonella Typhi; Pakistan; Prevalence

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1. INTRODUCTION

Enteric fever is the massive bacterial disease in the world. Its etiological agent is *Salmonella typhi*. *S. typhi* is a motile facultative anaerobic rod-shaped Gram-negative bacterium, closely related to *Escherichia coli* and belongs to family *Enterobacteriaceae*[1]. This clinical disorder caused by *Salmonella* in humans are generally characterized into two groups: dissemination of enteric fever occurred due to contaminated food and water by both *S. Typhi* and *S. paratyphi*[2].

In the past outbreak of 424-430 BC, people believed that one-third of the Athens population were died because of enteric fever, including has leaders, noble and has power shifted to Sparta. Thus, the Golden age of Athens came to end in the ancient world[3]. Enteric fever is a massive bacterial infection in the world, causing by *Salmonella* species. In Asia, the ratio of enteric fever is very high than south-eastern and south-central regions of world. Estimated that around hundred cases per hundred thousand (100 cases / 100,000 cases) occur due to poor sanitation, however, better sanitation and good health care are thought to reduce the infection of enteric fever[4]. Worldwide, about 21 million people are affected from enteric with mortality of rate of 200,000[5].

Currently there are 2,463 serotypes of Salmonella bacteria. The nomenclature concept proposed by the Kauffmann for the salmonella genus, initially has developed from one serotype-one species based on the serologic identification of H (flagellar) and O (osmatic) antigens. Individual serotype was considered a distinct species, for instance (*S. Enteritidis, S. Newport, and S. Paratyphi A*). Based on the clinical role of a strain further taxonomic classification have been proposed, on biochemical characteristics that classified serotypes into subgenera, and eventually, on genomic similarity. The seven subgenera of Salmonella bacteria were referred to as subspecies such as (I, II, IIIa, IIIb, IV, V, and VI), proposed by Le Minor and Popoff in 1987. Because of biochemical reactions and genomic similarities, the subgenus III was further divided into IIIa and IIIb. In 1979 Rohde integrated all *Arizona* serotypes into the Kauffmann-White[6].

It is known that humans are the only natural host and reservoir for S. *Typhi* and transmits enteric fever through the fecal-oral route by the ingestion of contaminated water and food[8]. Therefore, preventive strategies against enteric fever include provision of hygienic water supply; proper sanitary disposal of human urine and feces, sterile manufacture of drinks and foods, maintenance of hygiene and cleanliness while cooking at home and proper hand-washing facilities where food is handling. Furthermore, barring of patients of enteric fever from food handling tasks and awareness of public about appropriate hand washing, consumption of unhygienic foods and drinks are also important for the prevention of enteric fever. Currently, the South Africa Government has adopted procedures for achieving some of the above-mentioned strategies. For instance, authorized and governmental frameworks have been put in place to give all South African residents access to basic water supply and cleanliness. Health education programs have been initiated to make community awareness about the consumptions of contaminated foods and drinks[9]. Enteric fever has a major socio-economic impact because several months are required for a patient to recover his health to become healthy. Although, the causative agents and transmission of malaria and enteric fever are different, but both share similar sign and symptoms [10].

The risk factors, involved in individual level are unhygienic water supply and contaminated food, utilization of spoil vegetables, fruits, and keep in a contact with other patients or chronic carriers. Risk factors on community-level are consists of inhabitants' density, rainfall, river level, temperature, and proximity to water sources[11].

Chronological examination data recommend that enteric fever was prevalent in North America and Western Europe. To continuously minimize with the initiation of municipal water management, dairy products pasteurization, and the excretion of human feces from food production. Currently, enteric fever hindrance focuses on developing of proper sanitation; provide safe cuisine, supply of clean drinking water, control of persistent vectors of *S. typhi,* and use of typhoid vaccines to decrease the vulnerability of hosts to

disease[12]. The aim of the current study is to determine the prevalence of enteric fever in the local population of twin cities of Rawalpindi Islamabad to find out the age group at risk towards *S. typhi* bacteria.

2. MATERIALS AND METHODS

2.1 Study area

A field survey was conducted in District Rawalpindi and Islamabad to get comprehensive information about the causes and prevalence of enteric fever in pre-school aged; school-aged children and adults. Data were collected from different sources like government and private hospitals, clinics, medical laboratories, health organizations, Pakistan Institute of Medical Sciences Islamabad, Polyclinic Hospital Islamabad, Shifa International Hospital Islamabad, National Institute of Health Islamabad, District Head Quarter Hospital Rawalpindi, Hearts International Hospital Rawalpindi, Railway Hospital Rawalpindi, Benazir Bhutto Hospital Rawalpindi, Bilal Hospital Rawalpindi (BH), Combined Military Hospital Rawalpindi, Islamabad Diagnostic Center, Ali Medical Center Islamabad, Bio Care Lab Islamabad and Computerized Innovative Tests and Investigation Lab Rawalpindi.

2.2 Data collection and processing

A questionnaire was prepared to collect information from the patients of different hospital, medical laboratories, and various health settings of Rawalpindi and Islamabad, Pakistan. Information was collected through pre-formed questionnaires from suspected patients of different age groups i.e. children of pre-school; school-aged and adults who were showing and symptoms of enteric fever.

2.3 Sample collection and storage

Sterilized the area surrounded by the median cubital vein of the arm through alcoholic swab and tourniquet is placed around the upper arm for pressure of the blood. Through the vein puncture technique, about 3 millilitres of blood were drawn from each suspected patient.

2.4 Laboratory procedure

Blood samples were centrifuged at 3000 rpm for 5 minutes for serum separation and stored at 2-8 °C for up to 3 days. For long-term storage, the samples were placed at -20°C. The sample was thawed, mixed well, and brought to room temperature for detection of *S. typhi.* Orient Gene Biotech (www.orientgene.com) the Typhoid IgG/IgM Rapid Test Kit was used for the diagnosis of enteric fever. Briefly, 50-µL sera was loaded on the kit through pipette dropper followed by addition of 1-2 drops of the buffer. Waited up to 2-5 minutes for antigen-antibody complex formation until produces the color band on the ICT strip. In addition to the Control band (C), the IgM and IgG bands indicating that positive infection of both IgM/IgG antibody against *S. typhi.* Both IgM/IgG bands show infection while only the control band shows no infection.

2.5 Statistical analysis

Data were analyzed by using descriptive statistics test, and percentage. Data were expressed in tabular and chats forms.

3. RESULTS AND DISCUSSIONS

In the current study, 500 samples were selected on a clinical basis for the diagnosis of enteric fever. Typhidot test was used for all samples to diagnose typhoid fever in the suspected patients showing signs and symptoms of typhoid. Out of 500 suspected patients, 132 (26.4%) were typhoid positive, and 368 (73.6%) were typhoid negative on the ICT strip (Fig. 1).

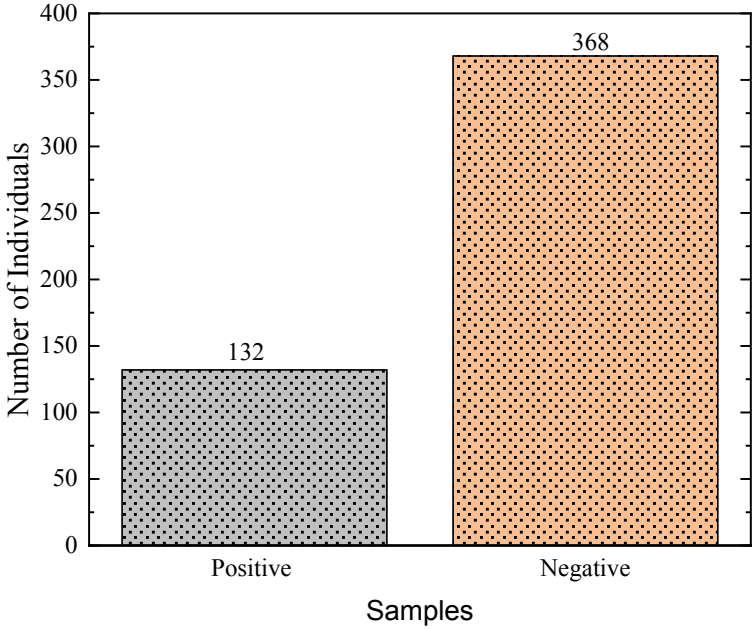

Fig. 1. Prevalence of positive sample of enteric fever in various age groups

Among the different age group, the incidence of enteric fever was highest among the adults 42 then 13-15 years 30 school-age children, 5-12 years 31 school-age children, and pre-school age children 29 (Fig. 2).

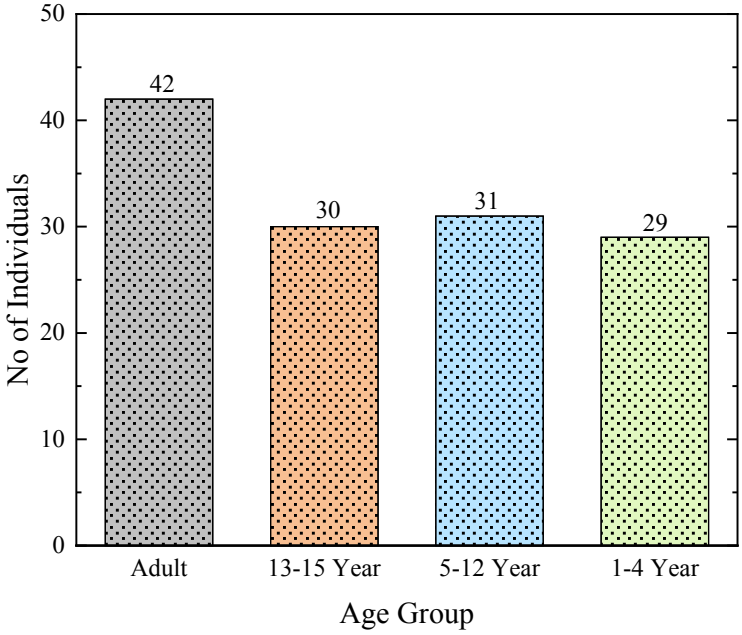

Fig. 2. Prevalence of positive sample of enteric fever in various age groups

Anti-typhoid IgM was found in 25 samples out of total and anti-typhoid IgG was determined in 12 samples whereas 5 samples were positive for both anti-typhoid IgG and IgG antibodies in the adult group. In the school-age children (13-15 years) group, 19 samples were positive for IgM, 8 samples were positive for IgG and 3 samples were positive for IgM/IgG. In the school-age Children (5-12 years) age group 15 samples were positive IgM positive, 10 IgG, and 6 both IgG and IgM. In children, (1-4) year age group, 29 samples were positive only for IgM, neither sample was found positive for IgG nor IgM/IgG (Fig. 3).

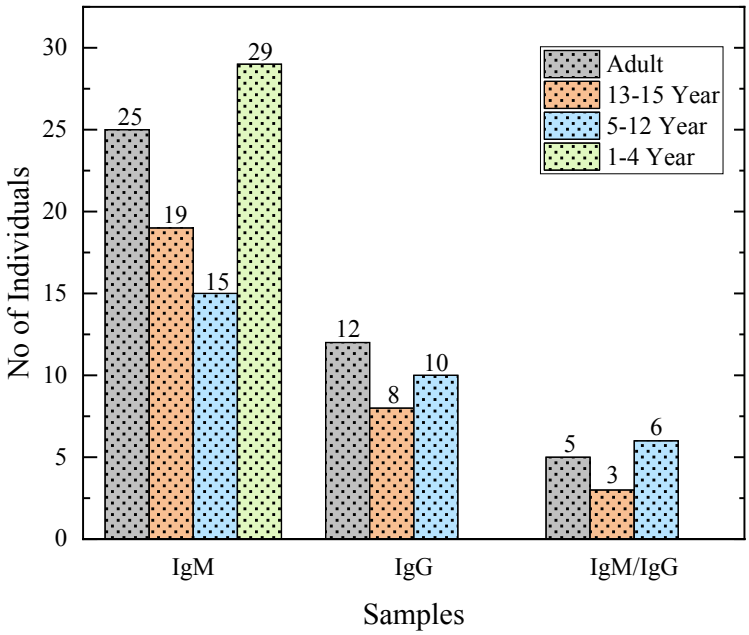

Fig. 3. Prevalence of IgM, IgG, and IgM/ IgG samples of enteric fever

IgM positive infection indicates early-stage or first-time infection of enteric fever while IgG positive indicates past infection. The study was not proceeded for further analysis i.e. ELISA, Polymerase Chain Reaction (PCR), and blood culture because of limited resources. Some earlier studies indicate the same finding[13]. Such outcomes may be because adults were more attracted to street foods while outing with friends and drink unsafe water and Juices.

Enteric fever is a serious public health issue in the world. The prevalence rate is high in South Central and South-East Asian countries recorded as (>100/100,000) cases per year[4]. In Pakistan, enteric fever is circulating, and a high incidence rate is occurred because of overpopulation, the lack of knowledge, poverty, poor drinking water, and inadequate facilities for sanitary waste. A survey collected from Karachi, Pakistan, via serology and blood culture shows the prevalence rate was 710 per 100,000 cases[2]. In the recent study, it has been observed that typhoid prevalence was low among preschool-aged children (1-4 years) and school-age children (5-12 years) as compared to adults. The finding of the current study is closely related to the observations of Sinha et al, Lin et al and Rafiq et al who reported 11%, 17%, and 44%, enteric cases in adult respectively, in Viet-Nam, India and Pakistan,[14,15,16].

Conversely, enteric fever among preschool-aged children is unusual and subclinical[17, 18]. This might be because of difficulty in taking samples from the infants for the cultured based diagnosis of enteric fever. The current study shows a comparable incidence of typhoid in preschool children and school-aged children while in adults it is relatively high. However, Crump et al, report the heavy burden of enteric fever in adolescents, children, and infants. The cuisines were prepared under unhygienic conditions such as ice creams and beverages in the streets can play a vital role in the incidence of enteric fever among adolescents and school-aged children[19].

Typhidot test is a rapid serological test for the detection of enteric fever. Though, its usefulness in terms of Specificity and sensitivity than Widal test. Typhidot test depends on the detection of antibodies that appear in detectable titers as the onset of 2-3 days of the infection. According to Yadav et al, the Typhidot test showed 85 percent of sensitivity and 100 percent specificity in blood culture-confirmed cases of enteric fever than the Widal test which has 45 percent sensitivity and 86 percent specificity. Typhidot test detects IgM and IgG antibodies against the *S. typhi* outer membrane protein (OMP). The Typhidot test is based on

the presence of IgM and IgG antibodies specific to 50KD (Kilo Dalton) OMP antigen, which is immobilized on nitrocellulose strips[20].

Detection of IgM antibody show acute typhoid (early infection phase) while the detection of both IgG and IgM antibodies indicates acute typhoid (middle infection phase). The detection of specific IgG antibody is high in highly endemic areas with high frequency of typhoid transmission. Since after the infection, the anti-typhoid IgG antibodies last for more than two years[21].

The proportion of infection caused by *S. paratyphi,* as compared to Salmonella Typhi, is highly variable and depending on the geographical background. It is believed that *S. paratyphi* is responsible for about one-fifth of cases of enteric fever[4]. The increasing prevalence of *S. paratyphi* infection over the past two decades was responsible for increase in the incidence of enteric fever in Asian countries, including Cambodia[22], Nepal[23], and China. According to Arndt et al, the maximum burden of paratyphoid fever has been reported from China, with an expected yearly occurrence of 150 cases/100 000 person-years. In Africa, the researcher's analysis shows that *S. Paratyphi* was accountable for less than two percent of enteric fever cases [24].

In South Central Asian countries, like Pakistan, enteric fever is the major infectious disease; it has been responsible for causing a high rate of mortality and morbidity in South East Asian countries. Numerous periodic or plague cases have been recorded all over the year across the country. In rural areas, enteric fever is still widespread infection due to the supply of pure drinking water, and consumption of contaminated food. Enteric fever can be a major indicator of the socio-economic situation of inhabitants in other Asian countries. Throughout the world, Pakistan, Nepal, India, Mexico, Egypt, Indonesia, and Peru are the mainly notorious hotspots for enteric fever[25]. This high prevalence of enteric fever in Pakistan is mostly added via continual poverty, less personal cleanliness, and unhygienic sanitary condition[26].

4. CONCLUSIONS

Enteric fever is endemic in the twin cities of Rawalpindi and Islamabad. In the present study, we conclude that; adults are more prone to salmonella infection, due to high exposure to unhygienic environmental factors than school-aged and pre-school aged children. Water quality, unhygienic food, unhygienic environment, and improper vaccination have a great impact on the burden of enteric fever in the population of Rawalpindi-Islamabad. To overcome the infection, clean drinking water and proper sanitation are the prime requirement of the community and educate the community about the prevention policies of enteric fever. But this is not sufficient; good planning and eradication programs are also required to overcome this infection not only in Rawalpindi, Islamabad but also in Pakistan.

5. LIMITATION

Samples were not further proceeded for ELISA, blood culture and PCR test, because of limited resources. Medical history was not taken from the patients such as their response towards various antibiotics and their treatment duration.

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CONFLICT OF INTEREST

All authors declare no conflict of interest regarding this article.

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