AN EPIDEMIOLOGICAL AND PREVALENCE STUDY OF SALMONELLA TYPHI AND SALMONELLA PARATYPHI WITH ANTIBIOTIC SENSITIVITY PATTERN OF DIFFERENT AGE GROUP PATIENTS IN DHAKA CITY, BANGLADESH

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ABSTRACT

The purpose of this study was to find out the prevalence, epidemiology and antibiotic sensitivity patterns of *Salmonella typhi* and *S. paratyphi* isolated from clinical samples, Dhaka, Bangladesh where 35.14% were found positive - *S. typhi* (81%) and *S. paratyphi* (19%). In case of genders, male patients- *S. typhi* (78%) and *S. paratyphi* (56%); and female- *S. typhi* (67%) and *S. paratyphi* (28%). The prevalent rate of Salmonella infections was significantly higher in males then the female patients. The frequency of S. typhi and S. paratyphi infections 0-10 years age group was the most prevalent group for *S. typhi* whereas, for *S. paratyphi*, 20-30 years age group was the most prevalent group. In case of indoor patients, *S. typhi* and *S. paratyphi* were 39% and 29%, respectively; and in case of out-door patients, *S. typhi* and *S. paratyphi* were 84% and 27%, respectively. Antibiotic sensitivity pattern study revealed that both *S. typhi* and *S. paratyphi* were sensitive (100%) against Gentamycin, Ciprofloxacin, Cefrtriaxone and Cefrixime; whereas resistant against Nalidixic acid and Azithromycin.

Key words: *Salmonella typhi*, *Salmonella paratyphi*, prevalence, antibiotics, sensitivity pattern.

INTRODUCTION

Enteric fever, major public health problem, a systemic infection caused by *Salmonella typhi (S. typhi*) and *Salmonella paratyphi* (*S. paratyphi*), is a major persistent global health problem and is predominantly reported in the developing countries (Kanungo et al 2008). *S. typhi* and *S. paratyphi* A are the predominant organisms involved in enteric fever (Jesudason and John 1992). With the emergence of chloramphenicol-resistant Salmonella isolates, fluoroquinolones (eg: ciprofloxacin) emerged as the drug of choice for the treatment of typhoid, owing to the oral mode of administration and cost-effectiveness (Tankhiwale et al 2003, Sood et al. 1999). But uncontrolled use of quinolones resulted in increased resistance against them, especially ciprofloxacin, which in turn may be due to sequential mutations in genes (gyr A, gyr B, and par C, par E) encoding DNA gyrase and topoisomerase IV or enhanced active efflux mechanisms (Bhatia et al 2007, Mandal et al 2004, Gupta et al 2009). Increased resistance to fluoroquinolone led to increased use of third-generation cephalosporins (eg: ceftriaxone, cefotaxime, cefixime) and azithromycin in South Asia (Choudhary et al 2013). However, discontinuation/reduction of chloramphenicol use and the use of other drugs for the treatment of enteric fever resulted in roll back to sensitivity against chloramphenicol (Choudhary et al 2013, Monica et al 2014). This re-emergence of chloramphenicol-sensitivity may be possibly due to loss of plasmids encoding resistance to chloramphenicol and other first-line drugs like ampicillin, co-trimoxazole or due to the emergence of susceptible isolates in the absence of drug pressure. Hence, this study was undertaken to investigate the antimicrobial susceptibility pattern of chloramphenicol and other anti-typhoid drugs against Salmonella (including *S. typhi* and *S. paratyphi*) isolates obtained from patients in Dhaka city, Bangladesh. The current study was undertaken to evaluate the sensitivity pattern of anti-typhoid drugs along with the prevalence of *S. typhi* and *S. paratyphi* among the different ages and sexes.

Materials and Methods

Different types of culture media were used in this present study i.e. brain heart infusion, blood agar, MacConkey agar, Muller Hinton agar, KIA, etc. Among the antibiotics used were- Nalidixic acid, Azithromycin, Cotrimoxazole, Chloramphenicol, Ampicillin, Gentamycin, Ciprofloxacin, Ceftriaxone and Cefixime. All samples were collected from out-patient department (OPD) and in-patient department (IPD) patients of hospital having clinical symptoms of microbial infection (enteric fever). Samples were collected from both sexes and different age groups. A total of 427 clinical isolates were tested from OPD and IPD patients. The specimen types that included in this study were blood. After collection of samples, they were inoculated on specific media and incubated at 37 o C for 24-48 h. Different biochemical tests were done for identification i.e. Catalase, Oxidase, Motility Indole Urea (MIU), Citrate utilization test and Triple Sugar Iron (TSI) test. The conventional method of antibiotic susceptibility testing by disc diffusion method is by far the commonest method of choice for the average laboratory for selection of appropriate antimicrobial drug.

Results and Discussion

Out of total positive samples, 81% were *S. typhi* and 19% *S. paratyphi* (Fig.1) and regarding gender prevalence, in case of male patients- *S. typhi* (78%) and *S. paratyphi* (56%) and in case of female patients- *S. typhi* (67%) and *S. paratyphi* (28%) (Fig.2). The prevalence of *S. typhi* and *S. paratyphi* in indoor and outdoor patients were also studied where it was observed that in case of indoor patients, *S. typhi* and *S. paratyphi* were 39% and 29%, respectively; and in case of out-door patients, *S. typhi* and *S. paratyphi* were 84% and 27%, respectively (Fig. 3). In age group study of *S. typhi* and *S. paratyphi* status, it was observed that 0-10 years age group was the most prevalent group for *S. typhi* whereas, for *S. paratyphi*, 20-30 years age group was the most prevalent group (Fig. 4). The most common risk factors are contaminated drinking water or food with feces from either acutely infected persons, persistent execrators, or chronic asymptomatic carriers, poor sanitation, inadequate hygiene practices, and low socio-economic status (Mogasale et al 2014). Prompt and effective antimicrobial therapy is the mainstay in the management of enteric fever to preclude the cases of morbidity and mortality. But the indiscriminate use and predominantly misuse of the antimicrobials have resulted in the emergence of multidrug-resistant strains. Chloramphenicol was referred to as the gold standard of therapy since its introduction in 1948 (Bhatia et al 2007). Resistance to chloramphenicol may be attributed to the acquisition of drug resistance genes on plasmids, which encodes an enzyme that inactivates or modifies the drugs. In present study, antibiotic sensitivity pattern of both *S. typhi* and *S. paratyphi* were studied where it was observed that *S. typhi* and *S. paratyphi* both were sensitive (100%) against Gentamycin, Ciprofloxacin, Cefrtriaxone and Cefrixime; whereas again both *S. typhi* and *S. paratyphi* were resistant against Nalidixic acid and Azithromycin (Fig. 5). Though Cefixime and ceftriaxone showed susceptibility, the possibility of antibiotic resistance with the irrational use of these antibiotics cannot be deterred. In present context of changing dynamics of resistance to antibiotics, it is imperative to have constant surveillance and antibiotic susceptibility data available to clinicians for appropriate management of the disease. According to Patil and Mule (2019), All 100% Salmonella isolates were sensitive to cefixime, ceftriaxone and azithromycin and 94.4% of the isolates were significantly sensitive to chloramphenicol and significant reduced susceptibility to ofloxacin 3.6% was observed. Moreover, they stated that all *S. typhi* and *S. paratyphi* isolates were susceptible to azithromycin, cefixime, and ceftriaxone; 89.47% to 95.24% of *S. typhi* isolates and 100% of *S. paratyphi* A were susceptible to chloramphenicol. None of *S. paratyphi* isolates were sensitive to floxacin. Various studies had reported a higher prevalence of *S. typhi* over *S. paratyphi* isolates in blood samples collected from patients with enteric fever. In 2013, Choudhary et al reported 57.9% isolates of Salmonella to have serovar typhi and 41.6% to have serovar paratyphi A in blood isolates of Salmonella species obtained from a tertiary care hospital in south India (Choudhary et al 2013). In another study, 64.1% were found *S. typhi* and 35.9% were *S. paratyphi* (Adhikari et al 2012) whereas, the ratio of *S. typhi* to *S. paratyphi* isolates (4:1) was found to be higher than that reported by Dutta et al (2009-2013). In 2016, Ramesh et al also reported a higher proportion of *S. typhi* isolates than *S. paratyphi* (81% vs 19%) among 200 Salmonella isolates obtained from patient blood samples. Other studies had also reported a higher prevalence of *S. typhi* against *S. paratyphi* with a ratio varying from 1.6:1 to 3.7:1 (Mohanty et al 2006, Bhattacharya et al 2011, World Health Organization 2012). However, few studies had also reported a higher prevalence of *S. paratyphi* over *S. typhi* isolates (Shirakawa et al 2006, Wu et al 2010). Though there is no specific reason for serovar variation, S. typhi infection is mainly due to waterborne transmission, and *S. paratyphi* is due to food-borne transmission; with the former requiring smaller inoculum, and the latter requiring a larger inoculums. Our study confirms the re-emergence of susceptibility of Salmonella strains to chloramphenicol. This study thus emphasizes the need for continuous evaluation and judicious use of antimicrobials, considering the ever-changing landscape. Further prospective studies are warranted to correlate the clinical outcome of treatment based on in vitro antimicrobial susceptibility patterns of Salmonella isolates in typhoid cases.

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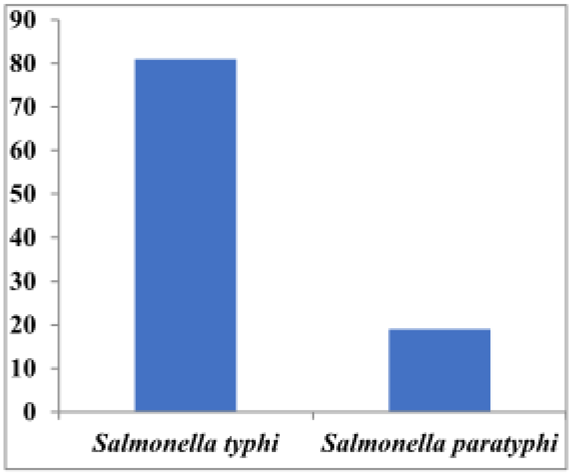

Fig. 1: Status of S. typhi and S. paratyphi

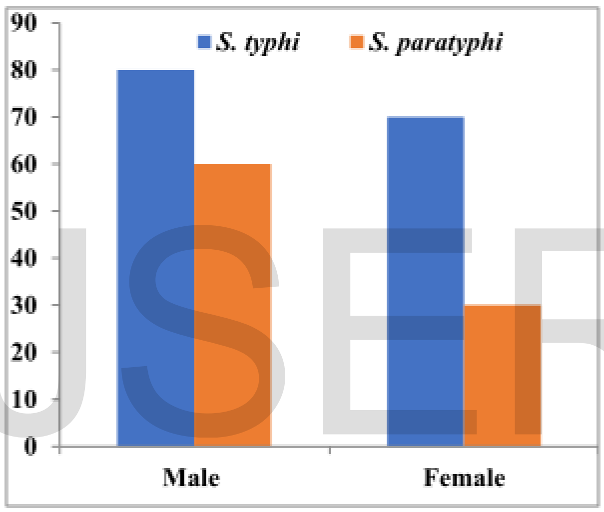

Fig. 2: Gender status of S. typhi and S. paratyphi

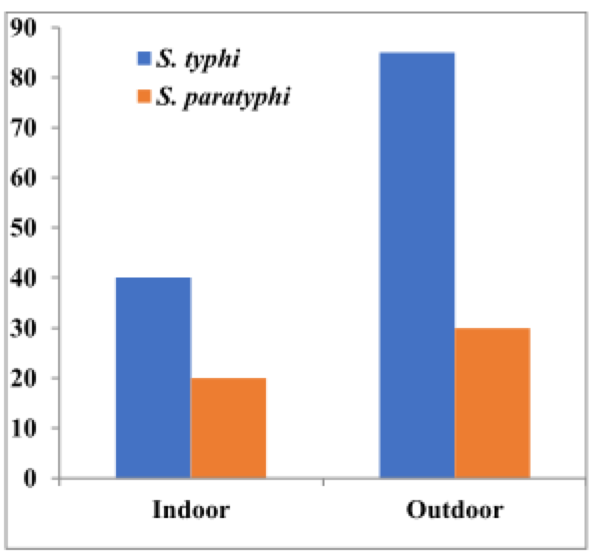

Fig. 3: Prevalence of S. typhi and S. paratyphi in indoor and outdoor patients

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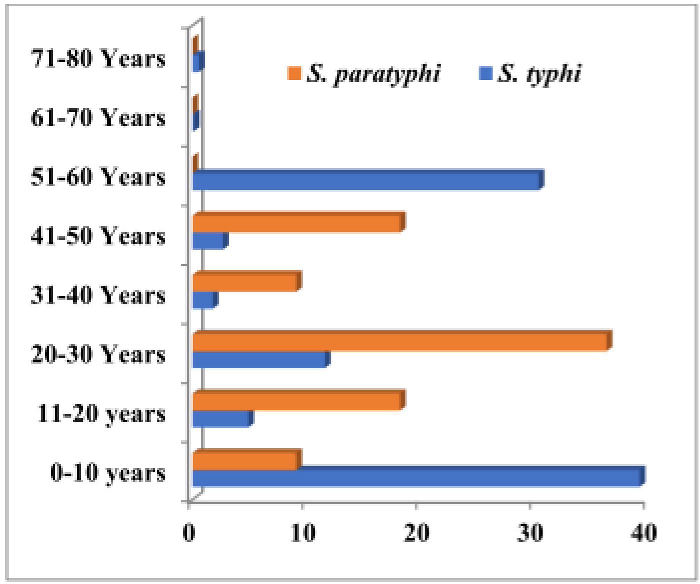
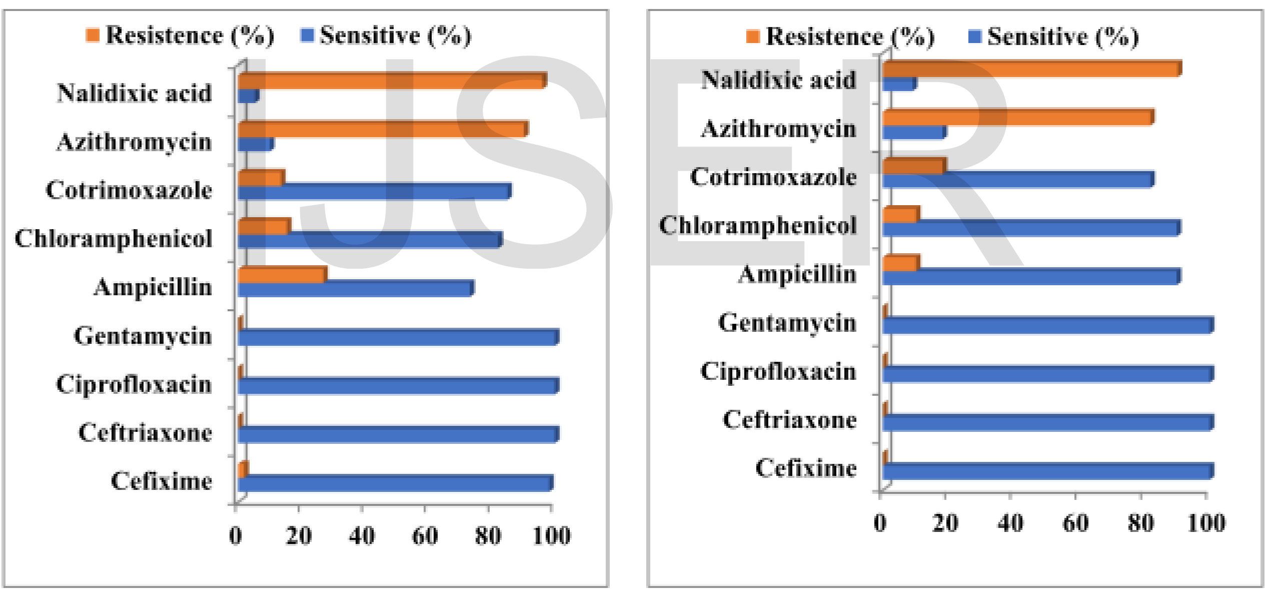


Fig. 4: Status of S. typhi and S. paratyphi in different age group patients.



(A) **(B)**

Fig. 5: Antibiotic sensitivity pattern (A) S. typhi (B) S. paratyphi.