

Original Research Article

PREVALENCE OF *Salmonella typhi* INFECTION IN KARU LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA.

ABSTRACT

Aim:The aim of this study is to determine the prevalence of *Salmonella typhi* infection in Karu Local Government Area of Nasarawa State, Nigeria.

Place of Study: Karu Local Government Area, Nasarawa State; Department of Biological Sciences, Bingham University, Karu.

Materials and Methods: Two hundred and fifty two blood and stool samples were collected from volunteers including children and adults, using stratified random sampling method. Widal test served as a screening test while the stool culture served as the confirmatory test. A sample was considered positive with the titer value of 1:80 and above. Biochemical tests were carried out on each isolate to further confirm the presence and identification of *S. typhi*.

Results: Out of the 252 samples screened, 158 were found to be positive for *S. typhi* with a prevalence of 62.70%. The gender distribution of the disease revealed a higher prevalence of 71.43% in females than 53.97% in males. Also the age distribution of the disease revealed the highest prevalence of 80.95% in the age group of 1-15 years and the least prevalence of 40.30 % within the age group of 46-60 years. The distribution of the infection was statistically significant ($p > 0.05$) to age. The infection was highest in Mararaba with a prevalence of (77.38%) and the least prevalence of 48.81% was recorded in Karu.

Conclusion: The prevalence of *Salmonella typhi* infection in Karu local government of Nasarawa State of Nigeria is high. This situation calls for urgent control measures on the part of individuals and the government by provision of basic life utilities such as portable water.

Key words: *Salmonella typhi*, Stool culture, Widal test, Antibiotics.

1.0 INTRODUCTION

Salmonella enteric serovar typhi is the bacterial agent that is responsible for causing Typhoid fever (enteric fever) which is an endemic disease in the tropics. The disease is systemic and is often contracted by the ingestion of food or water that is contaminated with the pathogen usually from a fecal-oral source. *Salmonella typhi* is not known to infect animals [1]. Typhoid fever, also known as typhoid, is a symptomatic bacterial infection due to *Salmonella typhi* and affecting only humans [2].

Risk factors for the disease include eating food prepared outside the home, such as ice creams or flavoured ice drinks from street vendors, drinking contaminated water and eating vegetables and salads that have been grown with human waste as fertilizer [3]. A close contact or relative with recent typhoid fever, poor housing with inadequate food and personal hygiene and recent consumption of antimicrobials are further risk factors [4,5,6].

Symptoms may vary from mild to severe and usually begin six to thirty days after exposure to the organism with gradual onset of high fever over several days. Weakness, abdominal pain, constipation, headaches, diarrhea and vomiting are uncommon. While some people develop a skin rash with rose-colored spots severe cases result to confusion. In untreated cases symptoms may last weeks or months. Other people may carry the bacteria without being affected; however, and are still able to spread the disease to others.

The encounter of humans to *S. typhi* is made via fecal-oral route from infected individuals to healthy ones, often from asymptomatic individuals who become chronic carriers and they exhibit no signs and symptoms of the disease, but actively shed viable organisms capable of infecting others. The disease often occurs in children and young adults between 5 and 19 years old. Poor hygiene of patients shedding the organism can lead to secondary infection, as well as consumption of shellfish from polluted bodies of water. The most common source of infection, however, is drinking water tainted by urine and faeces of infected individuals. The estimated inoculum size necessary for infection is 100,000 bacteria. Typhoid fever has been reported as the most common laboratory infection [7].

The mode of entrance of the bacterial species into the human body is most commonly achieved by ingestion, with the importance of aerosol transmission unknown. Once ingested, the organisms multiply in the small intestine over the period of 1-3 weeks, breach the intestinal wall, and spread to other organ systems and tissues. The innate host defenses do little to prevent infection due to the inhibition of oxidative lysis and the ability to grow intracellularly after uptake. The damage caused by typhoid fever is reversible and limited if treatment is started early in the infection. This leads to a mortality rate of less than 1% among treated individuals who have an antibiotic-susceptible strain of *S. typhi*, making the outcome and prognosis for patients a positive one [8]. *Salmonella typhi* infection is still a global health problem and human are the only natural reservoir host. *S. typhi* is the common cause of diarrhea and other gastrointestinal tract infections in humans.

Developed countries have uncommon occurrence of typhoid fever where most cases are either acquired abroad or imported by emigrants with an estimated annual incidence of 540 per 100,000 or about 17 million cases worldwide. A study conducted by Crump and his colleagues estimated approximately 22 million cases of typhoid each year with at least 200 000 deaths [9]. Outbreaks of typhoid fever are frequently reported from sub-Saharan Africa and countries in South-east Asia [10,11, 12]. Individuals who are infected can develop a chronic infection in the gall bladder. In the pre-antibiotic era, the case fatality

rate of typhoid fever was 10–20%. Today, with prompt treatment, it is less than 1% [13]. Since *S. typhi* is human-restricted, these chronic carriers become the crucial reservoir, which can persist for decades for further spread of the disease, further complicating the identification and treatment of the disease [14]. Lately, the study of *Salmonella typhi* associated with a large outbreak and a carrier at the genome level provides new insights into the pathogenesis of the pathogen [15].

There is an uncertain distribution pattern of *S. typhi* infection in Nigeria due to geographical variation. Some investigations found that enteric fever is more prevalent in male than in females [16], but [17] found no influence of age, sex and social class on the distribution pattern of the infection in Nigeria.

It is very relevant to screen for *Salmonella typhi* in view of the high morbidity and mortality rates that characterize the disease, especially in the developing countries like Nigeria. The current magnitude of the disease in the country is not known as there has been no surveillance study carried out nationally or at State or Local Government level. In particular, there has been no report on the prevalence study of *S. typhi* in Karu Local Government. This study will, therefore, generate a base line data for the Primary Health programme in the Local and State Governments. It will also create awareness concerning the disease, and measures to control the silent killer disease would be sought. .

2.0 MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Karu Local Government Area of Nasarawa state. It has an area of 2,640 km². Karu local government has its headquarters in New Karu town. From west to east, the urban area includes towns like Kurunduma, Nyanya, Mararaba, New Karu, Ado, Masaka and GidanZakara. Three sites were selected; Mararaba, Masaka, and New Karu.

2.2 Study Population

Stratified random sampling technique was used to collect two hundred and fifty two (252) stool and urine samples from adults and children who reported in the Health centers for medical care.

2.3 Ethical Consideration

Ethical approval to carry out this study was obtained from the Local Government Headquarters, after which a written consent was obtained from each participant before sample collection.

2.4 Blood collection and Widal test

The upper part of the arm was tied, a little above the elbow with a tourniquet to make the vein more prominent. The vein was then traced and the overlaying skin was disinfected with methylated spirit. A sterile needle was inserted into the vein horizontally to collect blood, after which the tourniquet was untied and the needle withdrawn gently. A dry, sterile cotton wool was placed over the area to avoid continuous flow of blood. The blood was dispensed gently into an Ethylenediaminetetraacetate(EDTA) container and was transferred within two hours of collection to the laboratory in a sterile transparent polythene bag for processing.

Sera obtained from the blood samples and the test reagents (previously stored in the refrigerator at 2-8°C) were brought out of the refrigerator and left on the work bench for an hour to attain room temperature; after which the Widal test was carried out by Rapid Screening slide agglutination test, using Spinreact (Spain). The titre was read before one minute duration as directed by the manufacturer of the Widal kit.

2.5 Stool sample collection and culture

Stool samples were collected by giving patients sterile plastic container and were instructed on how to collect the early morning stool, which is more concentrated. The stool samples were equally transferred to the laboratory in a sterile transparent polythene bags within two hours of collection for culturing.

A pinch from each stool sample was aseptically cultured on Salmonella/Shigella agar plate, using streak method, and incubated at 37°C in a preset incubator for 24 hours. After incubation period the plates were observed for bacterial growth. Any plate with positive/significant growth was subcultured to obtain pure culture. The isolates were identified using their cultural characteristics, Gram reaction, cell morphology, motility test and biochemical tests (Chessbrough, 2005).

3.0 RESULTS

Using stool culture technique all positive plates yielded pinkish mucoid colonies with black centers on Salmonella/Shigella Agar. The colonies were large with smooth/entire margin and convex in elevation. The biochemical tests revealed the isolates to be catalase positive, oxidase negative, urease negative, and motility positive. The Gram reaction and microscopy showed the isolates to be Gram negative rods with polar flagellation.

Two hundred and fifty two (252) samples of the people of Karu local government were tested during this study. Of these a total of 158 samples were found to be positive for *S.typhi* with a general prevalence of 62.70% (Table 1).

Table 2 shows a comparison between the two methods used to determine the prevalence of *S.typhi* infection in the studied Local Government, while Table 3 indicates the prevalence of the infection in the three sites sampled in the Local Government. Mararaba had the highest prevalence of 77.38%, followed by 61.90% in Masaka, and Karu with 48.81% had the least prevalence of the disease. The distribution of the infection was statistically significant ($p > 0.05$) to the sample Sites.

Table 4 indicates the prevalence of *S. typhi* infection with respect to gender in the study sites, the result shows that the prevalence of *S. typhi* infection was higher in females in which 90 out of 126 were positive giving a prevalence of 71.43%, than in males where 68 out of 126 were positive with a prevalence of 53.97%. This result shows that the distribution of the infection is Gender related ($p > 0.05$).

Table 5 shows the prevalence of *S. typhi* infection with respect to age in the study sites in general; the results shows that *S. typhi* infection was highest in the age group of 1-15 years where 51 out of 63 were

positive with a prevalence of 80.95% and the least was found in the age bracket 46-60 years where 29 out of 63 were positive with a prevalence of 40.03%. The distribution of the infection was statistically significant ($p > 0.05$) to age.

The Socioeconomic Status distribution of the infection revealed the highest prevalence of 39.68% among the Low Class of the studied population. This was followed by 20.63% prevalence in the Middle Class, while the lowest prevalence of 2.38% was recorded in the High Class group (Table 6).

TABLE 1: The overall prevalence of Typhoid fever in Karu LGA.

Infection Screened for	Number of people examined	Number of people infected	Number of uninfected people	Prevalence (%)
Typhoid fever	252	158	94	62.70

Table 2: WidalTest Compared with Culture Technique

Method used	Number (%)	Positive (%)	Number Negative (%)	Number Screened (%)
Widal Test	175(69.44)	77 (30.56)		252 (50.0)
Stool Culture	158 (62.70)	94 (37.30)		252 (50.0)
TOTAL	333	171		504

Table 3: Prevalence of *S. typhi* infection with respect to sites of study

Sites	Number positive (%)	Number negative (%)	Number examined (%)
Mararaba	65(77.38)	19 (22.62)	84 (33.33)
Masaka	52 (61.90)	32 (38.10)	84 (33.33)
Karu	41 (48.81)	43 (51.19)	84 (33.33)
Total (62.70%)	158	94	252

Table 4:Prevalence of *S.typhi*infectionwith respect to gender of the participants

Gender	Number positive (%)	Number negative (%)	Number examined (%)
Male (26.98%)	68 (53.97)	58 (46.03)	126 (50.0)
Female (35.72%)	90 (71.43)	36 (28.57)	126 (50.0)

Total (62.70%) 158 94 252

Table 5: Prevalence of *S. typhi* infection with respect to age of the participants

Age group	Number positive (%)	Number negative (%)	Number examined (%)
1-15 (20.24%)	51 (80.95)	12 (19.05)	63 (25.0)
16-30 (17.46%)	44 (69.84)	19 (30.16)	63 (25.0)
31-45 (13.49%)	34 (53.97)	29 (46.03)	63 (25.0)
46-60 (11.51%)	29 (46.03)	34 (53.97)	63 (25.0)
Total (62.70%)	158	94	252

Table 6: Prevalence of *S. typhi* infection in relation to Social Status

Social Status	Number Positive (%)	Number Negative (%)	Total Number Screened (%)
High Class	6 (9.68)	56 (90.32)	62 (24.60)
Middle Class	52 (74.29)	18 (25.71)	70 (27.78)
Low Class	100 (83.33)	20 (16.67)	120 (47.62)
Total	158	94	252

4.0 DISCUSSION

The result of this study revealed that out of the 252 samples collected, 175 were positive for Widal test with a prevalence rate of 69.44% and 158 were positive for stool culture with a prevalence rate of 62.70%. The higher positive rate of Widal test may be because of prior antibiotic therapy by some participants that could have hindered growth on culture medium. On the other hand *S. typhi* shares O and H antigen with other *S. serotypes* and has cross-reacting epitopes with other Enterobacteriaceae, and this can lead to some false positive results. In areas of endemicity there is often a low background level of antibodies in the normal population. Determining an appropriate titre level for positive result can be difficult since it varies between areas and between times in given areas (Clegget *al.*,1994). Although the two values for the prevalence using Widal test and culture technique were very close (69.44% and 62.70%, respectively), Culture technique was preferably adapted in this work as the isolation, characterization and identification of the isolates could be more confirmatory than using serologic Widal test.

The overall prevalence of 62.70% obtained in this work was considered to be high and calls for an urgent control measure in Nasarawa State of Nigeria in particular. The prevalence obtained agrees with the work of Uttah et al., (2013) who reported 63.8% prevalence in Etinan General hospital in Akwalbom State of Nigeria. Our prevalence is however higher than the 50.0% prevalence reported by Ajibade (2013) in Ekiti State, South Western Nigeria. It is higher than the prevalence of 26.6% and 42.4% reported among University of Ilorin students (Udeze et al., 2010). Likewise, it is higher than the 42.0% prevalence obtained in Biu, Bornu State (Isa et al., 2013). On the other hand, the prevalence recorded in this work is lower when compared with other results from different parts of the country. These include Eze et al., (2011), who worked on malaria and typhoid co-infection in University of Nigeria, Nsukka in Enugu State and reported a prevalence of 92.0%. Okonko et al., (2010) also reported 92.50% prevalence in Abeokuta, South-Western Nigeria.

The variations in prevalence of this infection from one geographical part of the country and even globally could be due to the fact that several factors determine the occurrence and prevalence of *Salmonella typhi* infection. Such factors could not be unconnected with the varied sanitary conditions of the studied communities, and their socioeconomic conditions, among other factors [9] (Crump et al., 2004).

Mararaba had the highest prevalence of *Salmonella typhi*, with a prevalence of 77.38% and the least observed prevalence was in Karu, having a prevalence of 48.81%. The high prevalence generally observed here could be due to lack of clean drinking water, proper sanitation and hygiene and also food prepared by infected individuals as suggested by [2] Wain et al., 2015. Mararaba is densely populated and congested when compared to the other two sites studied, a situation that suggests poor hygiene and sanitation, thus the highest prevalence of 77.38%. Masaka, with 61.90% prevalence also had poor sanitation, poor drainage and waste disposal systems, a condition that could lead to contamination of water sources of inhabitants.

The results also revealed a high prevalence of *S. typhi* infection among females than in males contrary to the studies carried out by [14] (Nkoumou et al., 2000); their studies found that the enteric fever is more prevalent in males than in females. Also [23] Okonko et al., (2010) reported 70.0% prevalence for females and 92.4% prevalence for males. Likewise [21] Isa et al., (2013) reported 39.5% prevalence for females and 43.3% prevalence for males. Males seem to be at greater risk of exposure to *Salmonella typhi* than females, presumably due to fewer adherences by males to hygiene measures, including hand washing before handling food and eating, hygienic practices [9] (Sogard et al., 2007 and Crump et al., 2004). Again the disparity of the infection prevalence among the genders in different geographical areas across the globe is expected as several factors, ranging from cultural to physiologic and immunologic, can affect the disease status of each gender (Zailani et al., 2004).

Children between the ages of 1-15 years were found to have the highest prevalence of the infection (80.95%). This rate calls for concern as it indicates a clear danger for rapid transmission of the infection

because children interplay or relate easily with one another and they are less hygienic than the adults. This result is in agreement with the report of Virginia *et al.*, (1995) in Cibu City. It also agrees with the assertion of WHO (2007), which states that the disease often occurs in children and young adults between 5 and 19 years old.

CONCLUSION

The prevalence of *Salmonella typhi* infection in Karu local government of Nasarawa State of Nigeria is high, with the overall prevalence of 62.70%. This situation calls for urgent control measures on the part of individuals and the public. Urgent Government intervention is equally of utmost importance to raise public awareness about the disease, as well as intensify public health talks. The government should also improve the living conditions of the people, especially in the areas of environmental sanitation as well as provision of basic life utilities, like the provision of portable water and public toilet. These measures would stem the spread or transmission of the silent killer disease and by so reduce the morbidity and mortality rates associated with the disease.

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