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(RESEARCH ARTICLE)

The prevalence of typhoid fever in Bingham University

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Abstract

Typhoid fever remains a major cause of enteric disease and a significant public health problem. The disease is said to be very prevalent in the developing countries, of which Nigeria is one. The aim of this study is to determine the prevalence of typhoid fever among Bingham University students. A total of 125 blood and stool samples were collected randomly from both male and female students of Bingham University. The blood samples were tested for salmonella antigen using Widal test while stool samples were cultured on Salmonella/Shigella agar for the isolation of the causative agent. From the Widal test 80 (69.6%) samples were positive for *Salmonella typhi* infection, while the stool culture yielded 94 (75.2%) samples that showed the presence of *Salmonella typhi*. The gender distribution showed that the prevalence was higher in female students (87.30%) than the male students (62.90%). The infection was highest in the age group of 21-25 years which had 86.36% prevalence. The lowest prevalence was observed in the age group 26-30 years with 46.15%. The prevalence of typhoid fever is generally high in the University. Therefore, proper sanitary measures should be observed by the students in the university. The results also proved the superiority and reliability of stool culture technique over the Widal test in the diagnosis of *Salmonella typhi* infection. This study will provide the school administration adequate knowledge on the infection and serve as a guide in proffering solution to halt further spread of the disease in the institution.

Keywords: Prevalence; *Salmonella typhi*; Widal test; Stool culture

1. Introduction

Typhoid fever is a systemic disease caused by *Salmonella typhi*. The bacterium is a Gram- negative bacillus which only infects humans. In the year 2000, typhoid fever affected 17 million people worldwide with approximately 600,000 deaths [1]. In 2010, an estimated burden of typhoid fever was 26.9 million episodes globally. However, in Africa, a basic prevalence of 362 cases per 100,000 persons is reported every year. [2].

Typhoid fever is a bacterial disease transmitted by the ingestion of food or water contaminated with feces of an infected person which contain the bacterium *Salmonella typhi*. The organism enters through the gastrointestinal tract and spreads through the circulatory system (bacteremia), inflaming the lining of the small and large intestine (intestinal mucosa). Severe cases can lead to delirium or coma, and may be life threatening [3].

Infected individuals usually shed the bacteria in the feces and urine. Food and water supplies can be contaminated due to insufficient hand washing after defecation or urination. Infrequently, domestic animals may serve as a reservoir for paratyphoid. In areas with poor sanitation practices, flies may spread the disease from feces to food, causing outbreak of typhoid fever. Although some infected individuals are in the carrier stage, they are still capable of spreading the diseases to others [4]. Human infection usually occurs after the consumption of contaminated foods and water. Foods such as meat, poultry, milk and egg products present a higher risk of infection. Hospital workers who do not follow the

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hospital's sterile procedures can be infected through the soiled linens of infected individuals. Similarly, the bacteria have been spread by personnel in pediatric wards, either on their hands or the soiled linens of infected individuals. Flies can infect or contaminate food [5].

The colonization of the reticuloendothelial system is a characteristic feature of *Salmonella typhi* infection. Some infected individuals who become life-long carriers serve as the reservoir for *Salmonella typhi*.

The virulence factors of *S. typhi* include the possession of the Vi antigen and the production of an endotoxin (which is typical of Gram negative organisms). The production of the protein called "invasin" permits non-phagocytic cells to take up the bacterium and allows it to live intracellularly. Due to its resistance to the innate immune response system, *Salmonella typhi* is a foremost pathogen for human being [6].

Four different clinical symptoms are expressed by *Salmonella enteric* and these include enteric fever, gastroenteritis, bacteremia and an asymptomatic carrier state. A high incidence is reported amongst children under the age of five, adults between 20-30 year old, and patients who are 70 years or older [7].

Salmonella typhi usually invades the surface of the intestine in humans, but studies have shown their growth and survival in the deeper tissues of the spleen, liver, and the bone marrow. Signs and symptoms of typhoid often include a sudden onset of a high fever, a headache and nausea. Depending on where the organism is positioned, common symptoms such as loss of appetite, diarrhea and enlargement of the spleen are also observed [1]. Fever up to 39^{o}C, sudden nausea, headache, chills, abdominal cramps, vomiting and diarrhea are signs of gastroenteritis or food poisoning.

The typhimurium serotype is the most common cause of gastroenteritis. An estimated 1.3 billion cases and 3 million deaths occur annually due to non-typhoidal salmonella [8]. *Salmonella paratyphi* A remains uncommon in Africa [9]. *Salmonella typhi* can be identified in the laboratory by several biochemical and serological tests [10]. In the event that treatment is begun right on time in the contamination, the harm caused by typhoid fever is reversible and restricted.

If treatment is started early in the infection, the injury produced by typhoid fever is reversible and restricted. This results in a lower mortality rate of less than 1% among treated persons who possess an antibiotic-susceptible strain of *S. typhi*, making the outcome and prognosis for patients a positive one [11]. Typhoid fever remains a major cause of enteric disease and a significant public health problem [12] and is now very prevalent in developing world of which Nigeria belongs [13]. It is therefore very imperative to study the disease in order to put it under check and thus curtailing its devastating effects. This study will find out the prevalence rate of typhoid fever in Bingham University. The outcome of the work would increase awareness about typhoid fever, treatment and preventive measures to limit the occurrence of the disease in Bingham community and the general public. This work is aimed at determining the occurrence and prevalence of typhoid fever among Bingham University students. The following objectives were pursued: isolating and identifying *Salmonella typhi* or paratyphi from the subjects' stool, carrying out serological analysis of the subjects' blood samples using Widal test kits, generating base line data for future research in the University and to determine the distribution of the disease in relation to age and gender of the subjects. Useful recommendations were also made as to the measures against the spread of the infection.

This study is limited to the study of the prevalence of typhoid fever using both Widal and Stool culture test among students of Bingham University, Karu, Nasarawa State.

2. Material and methods

2.1. Study Area

This study was carried out in Bingham University Karu, Nasarawa State, Nigeria. Karu Local Government Area of Nasarawa state is located between latitude 8°5'N and10°42' N and longitude 7° 34'E and 7° 43'E of Greenwich Meridian. Bingham University is located on kilometer 26 Abuja-Keffi express road.

2.2. Study Population

Two hundred and fifty blood and stool samples were collected from students (one hundred and twenty five female samples and one hundred and twenty five male samples was collected).

2.3. Ethical Consideration

Ethical approval for the study was sought from the University Registrar, who granted the permission.The research and ethical committee of the university also gave its approval to conduct this research. Likewise, consent of the subjects was sought before collecting samples from them. Only the volunteers were screened for *Salmonela typhi* infection.

2.4. Materials

Rapid slide agglutination test kits, (Spinreact, Spain), Salmonella/Shigella agar (ZSA Chemical, Germany), Incubator (Cole Medical, England).

2.5. Sample Collection

Blood samples were collected from students using venipuncture method. Sterile stool bottles were labeled accordingly and given to the students for the collection of stool sample. The samples were collected and taken to the laboratory immediately for laboratory examinations.

2.6. Laboratory Procedure

Four procedures were used for the identification of *Salmonella typhi*. These are Widal test, stool culture, Gram staining and biochemical tests. Widal test was used as a quick presumptive serological test, while stool culture using Salmonella/Shigella Agar, Gram staining and biochemical tests were used to confirm isolation of *Salmonella typhi* 14]. The results obtained in this work were analyzed using Chi square.

3. Results

All the isolates of *Salmonella typhi* were found to be Gram-negative rods with polar flagellation and negative to indole and urease tests but positive to coagulase and catalase tests. A total of 125 students were tested for typhoid fever, of these 94 students tested positive to *Salmonella typhi* constituting 75.2% prevalence, using stool culture (Table 1) and 80 tested positive using Widal test, giving a prevalence of 69.6% of the study population. A low prevalence was obtained from the use of Widal test kits when compared to the stool culture technique (75.2% and 69.6%, respectively) and this could suggest that the typhoid infection in the studied subjects was recent and antibodies had not been generated enough to be detected using Widal test in some of the samples. Therefore, in this study stool culture method where the growth of *Salmonella typhi* was evidence of infection, was relied upon.

Table 1 The overall prevalence of typhoid fever among Students in Bingham University

Infection screened for	Number of people examined	Number of people infected	Number of uninfected people	Prevalence (%)
Typhoid fever	125	94	31	75.2

Table 2 shows the prevalence of *S. typhi* infection using stool culture and Widal test.Stool culture technique resulted in a prevalence 69.6% while a prevalence of 75.2% was reported using Widal test. The difference between the prevalence of the infection with regards to the method used was statistically significant with $P > 0.05$ therefore; the detection of the infection could be related to the method used.

Table 2 Prevalence of typhoid fever using Stool culture and Widal test

Method	Number of samples collected (%)	Number of samples positive (%)	Number of samples negative (%)
Stool culture	125 (50.0)	94 (75.2)	31 (24.8)
Widal test	125 (50.0)	80 (69.6)	45 (30.4)
Total	250	174 (69.60)	76 (30.40)

Table 3 shows the prevalence of typhoid fever in relation to gender. The infection rate was higher among the female students with 55 out of 63 (87.30%) samples that tested positive and the male students with 39 out of 62 students

(62.90) tested positive. The difference between the prevalence of the infection among the sexes was statistically significant with P > 0.05, therefore the infection was gender related.

Table 3 Prevalence of typhoid fever in relation to gender

Sex	Number of samples collected (%)	Number of samples positive (%)	Number of samples negative (%)
Male	62 (49.60)	39 (62.90)	23 (37.10)
Female	63 (50.40)	55 (87.30)	8 (12.70)
Total	125	94 (75.20)	31 (24.80)

Table 4 shows the prevalence in relation to age. The highest prevalence was among the age group of 21-25 years which had 60 out of 69 students (86.96%) that tested positive. Similarly, a high prevalence of 73.33% was recorded among the age group of 16-20 years where 22 out of 30 students were positive. The least prevalence of 46.15% (12 out of 26 students) was recorded among the age group 26-30 years. The difference between the prevalence of the infection among the age groups was statistically significant with P > 0.05, therefore the infection was age related.

Table 4 Prevalence of typhoid fever in relation to age

Age	Number of samples collected (%)	Number of samples positive (%)	Number of samples negative (%)
16-20	30 (24.0)	22 (73.33)	08 (26.67)
21-25	69 (55.20)	60 (86.96)	09 (13.04)
26-30	26 (20.80)	12(46.15)	14(53.85)
Total	125	94 (75.20)	31 (24.80)

4. Discussion

This study showed an overall infection rate of 75.20%, suggesting a high prevalence of typhoid fever among Bingham University students. A prevalence of 75.2% is considered to be high for an enlightened community such as a university. When compared with similar works carried out across the country, this prevalence is higher than the prevalence of 26.6% and 42.4% reported among students of University of Ilorin [15], 50.0% prevalence reported by [16] in Ekiti State, South Western Nigeria, 63.8% prevalence obtained in the general hospital, Etinan in Akwa Ibom state [17] and 68.2% prevalence obtained in Abia state [18].

The prevalence obtained in this work is however lower when compared to other studies conducted in different parts of the country. For instance, Okonko *et al* [19] reported 92.50% prevalence in Abeokuta, South-Western Nigeria. Eze *et al* [20] also conducted a study on malaria and typhoid co-infection in University of Nigeria, Enugu state and reported a prevalence of 92.0% and 87.1%, respectively [18].

The variations in prevalence of this infection from one geographical part of the country to another could not be unconnected with the varied sanitary conditions of the studied communities, socioeconomic conditions, diagnostic method used among other factors [4].

Although the high prevalence recorded in this work is reflected in both genders, the prevalence is comparatively higher in females than in males (87.30% in females 62.90% in males). This may be due to the fact that most females who perform most of the house chores are the ones who fetch water from polluted water bodies like wells and streams thus making them highly vulnerable to the infection. The assertion that the disease is more prevalent among females than males falls in line with the works of [15] and [17] who reported prevalence rates of 42.4% for females, 33.0% for males and 68.2% for females, 58.0% for males, respectively.

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 [21].

Considering the age factor, the infection was quite high across all ages, ranging between 46% to 73% prevalence, as the age intervals are quite close among the studied subjects. However, the high prevalence of 73.33% and 86.96% was obtained in the age groups 16-20 years and 21-25 years respectively.This prevalence rate is similar to the reports of [22] and [23] who reported that the peak age group for typhoid infection is 21 – 30 years. Similarly, [24] reported a high prevalence among males of age group 10-25 years. This prevalence could be attributed to the life pattern of the age groups, which involves their active nature, engaging frequently in physical activities, consuming more foods and drinks that are hawked and probably contaminated by younger people. The lowest prevalence of 46.15% in the age group 26-30 years could indicate that the group is relatively resistant due to frequent boosting of immunity [13, 25-26]. The results also agrees with the assertion of [7] who reported that typhoid fever is more common in children under the age of five, adults within 20-30 years old, and individuals that are 70 years or older.

Comparing the Widal test result with the culture technique, the Widal test showed less positive samples than the stool culture. A total of 125 students were tested for typhoid fever, of these 94 students tested positive to *Salmonella typhi* constituting 75.2% prevalence, using stool culture and 80 tested positive using Widal test, giving a prevalence of 69.6% of the study population. The stool culture method was adopted for this study as it is a confirmatory and more reliable method for the diagnosis of typhoid fever. In most African countries of which Nigeria is inclusive, the Widal agglutination test (regardless of its limitations) is the main regular diagnostic technique utilized in the identification of *Salmonella typhi*. This is due to the fact that it involves minimal training and equipment, it is easy to execute and it is moderately cheap in terms of cost [27]. However, the major drawback of the Widal test is its cross-reactivity with some other bacteria of same genus [28] and its mimicking symptoms with malaria which often produces false positive results.

5. Conclusion

Typhoid fever is a major public health problem and also a problem in this institution. From the investigation carried out the prevalence of typhoid fever is 75.2% within this institution which is really high. An urgent control measure should be put in place in order to avert epidemic of the disease. Proper awareness about Typhoid fever should be conducted to reduce the incidence of this disease among students in the institution. Proper sanitary measures should be taken in the preparation of food and drinking water should be made safe by boiling before drinking. The environment should also be kept clean at all times especially from human waste products. Routine screening of students and food handlers in the University community is advocated and infected persons should be treated adequately after performing antibiograms of the causative agent.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that there is no competing interest.

Statement of ethical approval

A written approval from the research and Ethics committee of the university was collected and preserved by the authors.

Statement of informed consent

In line with the university standard, patient's written consent was collected and preserved by the authors.

References

[1] Chin J. (2000). Control of communicable disease manual. American Public Health Association, 17.

[2] Buckle GC, Fischer Walker CL and Black RE. (2012). Typhoid fever and Paratyphoid fever: systematic review to estimate global morbidity and mortality for 2010. Journal of global Health, 2(1), 2.

[3] Humphrey T. (2004).Salmonella, stress responses and food safety. Nature Reviews Microbiology, 2, 504-509.

[4] Crump J, Youssef FG, Luby SP, Wasfy MO, Rangel JM, Taalat M, Oun SA and Mahoney FJ. (2004). Estimating the incidence of typhoid fever and other febrile illnesses in developing countries. Emerging infectious diseases, 9(5), 539.

[5] Den W, Shian-Ren L, Plunkett G, Mayhew GF, Rose DJ, Burland V, Kodoyianni V, Schwartz DC and Blattner, FR. (2003). Comparative Genomics of *Salmonella enteric* serovar Typhi Strains Ty2 and CT18. Journal of Bacteriology, 185, 2330-2337.

[6] Hatta M, Gorris MG, Heerkens E, Gooskens J and Smits, HL. (2002). Simple dipstick assay for the detection of *Salmonella typhi*- specific IgM antibodies and the evolution of the immune response in patients with typhoid fever. American Journal of Tropical Medicine and Hygiene, 66, 416-421.

[7] Melzer M, Altman G, Rakowszcyk M, Yosipovitch ZH and Barsilai B. (2004). *Salmonella* infections of the kidney.The Journal of urology 94, 23–27.

[8] Lynch MF, Blanton EM, Bulens S, Polyak C, Vojdani J and Stevenson J. (2009). Typhoid fever in the United States, 1999–2006. The Journal of the American Medical Association, 302(8), 59–65.

[9] Marks F, Von Kalckreuth V and Aaby P. (2017). Incidence of invasive Salmonella disease in sub-Saharan Africa: a multicentre population-based surveillance study. The Lancet Global Health, 5(3), e310-e323.

[10] Philippa MA, Shanahan J, Mary V, Thomson CJ and Sebastian GB. (2003). Molecular analysis of and identification of antibiotic resistance genes in clinical isolates of *Salmonella typhi* from India. American Society for Microbiology, 36, 1595.

[11] Agwu E, Ihongbe JC, Okogun GR and Inyang NJ. (2009). High incidence of co-infection with malaria and typhoid in febrile HIV infected and AIDS patients in Ekpoma, Edo state, Nigeria. Brazilian Journal of Microbiology, 40, 329- 332.

[12] Crump JA and Mintz ED. (2010). Global Trends in Typhoid and Paratyphoid Fever. Clinical Infectious Diseases, 50(2), 241-246.

[13] Parry CM (2005) Epidemiological and clinical aspects of human typhoid fever: In, Salmonella infections: clinical, immunological and molecular aspects, Mastroeni, P andMaskell, D. (ed), University Press, Cambridge, 1-10.

[14] Cheesbrough M. (2005). District laboratory practice in tropical countries part 2 (2nd Edition), Cambridge University Press, UK, 240 - 243.

[15] Udeze AO, Abdulrahman F, Okonko IO and Anibijuwon II. (2010). Seroprevalence of *Salmonella typhi* and *Salmonella paratyphi* among the first year students of University of Ilorin, Ilorin, Nigeria. Middle-East Journal of Scientific Research, 6 (3), 257-262.

[16] Ajibade VA. (2013). Prevalence of resistance among *Salmonella typhi* isolates in Ekiti State, Southwestern Nigeria 2009-2011. Global Journal of Medical Research Microbiology and Pathology, 13(3), 4-8.

[17] Uttah EC, Osim SE, Etta H, Ogban E and Okon NEE (2000). Four-year longitudinal assessment of the prevalence of typhoid fever among those attending the General Hospital Etinan, Nigeria. International Journal of Scientific and Research Publications, 3 (7), 150.

[18] Emmanuel IU (2017). Sero-prevalence of *Salmonella typhi* antibodies among adult residents of some selected rural communities of Abia and Enugu States, Southeast Nigeria: a cross-sectional study. International Journal of Research in Medical Sciences. 5(8), 3400-340.

[19] Okonko IO, Soleye FA, Eyarefe OD, Amuson TA, Abubakar MJ, Adeyi AO, OjezeleMO and Fadeyi A. (2010). Prevalence of *Salmonella typhi* among patients in Abeokuta South-Western Nigeria. British Journal of Pharmacology and Toxicology, 1(1), 6-14.

[20] Eze EA, Ukwah BN, Okafor PC and Ugwu KO. (2011). Prevalence of Malaria and typhoid co-infections in University of Nigeria, Nsukka District of Enugu State, Nigeria. African Journal of Biotechnology, 10(11), 2135-2143.

[21] Zailani SB, Aboderin AD and Onipede AD. (2004) Effect of socioeconomic status, age and sex on antibody titer profile to *Salmonella typhi*/*paratyphi* in Ile-Ife, Nigeria. Nigerian journal of medicine: journal of the National Association of Resident Doctors of Nigeria, 13(4), 383-387.

[22] Onabowale O and Ogunbiyi TA. (1996). Typhoid enteritis in Lagos, Nigeria. Nigerian Medical Journal, 6(4), 45-47.

[23] Kabiru OA, Yetunde OO, Oladeji GO and Akitoye OC. (2012). A retrospective study of community acquired *Salmonella* infections in patients attending public hospitals in Lagos, Nigeria. Journal of Infection in Developing Countries, 5(6), 387-395.

[24] AjayiOE, Olukunle OF and Boboye BE. (2015). Prevalence of Typhoid Fever among Different Socio- demographic Groups in Ondo State, Nigeria. Journal of Applied Life Sciences International, 3(2), 89-95.

[25] Mastroeni P and Maskell D. (2005). Epidemiological and Clinical aspects of human typhoid fever. Salmonella infections: Clinical, Immunological and Molecular Aspects, University Press, Cambridge, 1-10.

[26] Parry CM. (2006). Epidemiological and clinical aspects of human typhoid fever. In: Matroeni, P. and Maskell, D. (Eds.) Salmonella infections: clinical, immunological and molecular aspects, University Press, Cambridge, 1-18.

[27] Nsutebu EF and Ndumbe PM (2001). The Widal test for typhoid fever: is it useful? Africa Health, 23(3), 5-8.

[28] Aziz Tand Haque SS. (2012). Role of Widal test in the diagnosis of typhoid fever in context to other test. American Journal of Biochemistry, 2(1), 16-18.

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