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Prevalence of Salmonellosis among Undergraduate Students in Owerri Metropolis, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Due to the rigorous nature of tertiary education, some students struggle to maintain good hygiene and healthy eating habits, predisposing them to infectious diseases. This study assessed the presence and prevalence of *Salmonella* infection among undergraduate students in Owerri Metropolis. Stool samples were collected from 97 students (24 males and 73 females) and cultured on *Salmonella* and *Shigella* agar. Out of the 97 students tested, 18(18.55%) tested positive, with the highest 10(55.56%) intensive prevalence coming from *Salmonella typhimurium*, followed by *Salmonella paratyphi* 7(38.89%) and *Salmonella typhi* 1(5.55%). The final-year students showed the highest number of *Salmonella* infections. The result also revealed the highest infection rate of 9(50.00%) among students aged 18-20 years in their first year of study, while the older students recorded a low infection rate of 1(5.56%). It is, therefore, very important that awareness of good hygiene and preventive measures for salmonellosis and other similar infections are intensified.

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Keywords: Enteric fever; university students; enterobacteriaceae; food-borne diseases; food poisoning.

1. INTRODUCTION

Salmonellosis is an infection caused by *Salmonella* bacteria. It is one of the most frequent bacterial foodborne infections affecting humans and animals. Salmonellosis-causing agents are found in both human and animal intestines and are typically transmitted to humans via contaminated food or water [1]. According to World Health Organisation research from 2010, approximately 16 million individuals worldwide are afflicted with typhoid fever each year, with 500,000 to 600,000 fatalities. Even in developed countries, outbreaks of water and food-borne infections, like salmonellosis, continue to threaten public health and local and national economies [2].

One specific population identified as potentially susceptible to salmonellosis is undergraduate students enrolled in tertiary institutions. This is because students pursuing that level of education are frequently exposed to shared living quarters, dining areas, possibly infected food served during social gatherings, and unhygienic surroundings [3]. Additionally, it was suggested that students are at risk for diseases caused by enteric organisms due to the living conditions of dorms and apartments and the unsanitary food and water outlets around colleges [4].

Furthermore, these young adults struggle to balance their health, social, and financial requirements with a demanding academic life [5], which further puts them at risk of consuming unhealthy foods that might have one or more *Salmonella* pathogens. In most cases, infections of *Salmonella* within the undergraduate student population increase absenteeism and reduce academic performance. Hence, there is a need to intensify research on this. According to Udeze et al. [6] and Okonko et al. [3], the outcome of studies of this nature would not only contribute to the body of knowledge but will also give insight into the current pattern of disease infection on which future control strategies can be built.

Furthermore, studies like this will benefit the school administration, nongovernmental organisations, and the general public by providing up-to-date baseline data for planning, epidemiology research, control programmes, and enlightenment [7]. In light of these, this research was aimed at assessing the presence and prevalence of *Salmonella* infection among undergraduate students in Owerri, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area and Subjects

The study was conducted in Owerri Metropolis, the capital of Imo State of Nigeria. Owerri lies between coordinates 5.4650°N and 7.035°E and is in the heart of Igbo land, the Southeast region of Nigeria. Due to its location and beauty, Owerri is host to numerous public, private, and government establishments, including several tertiary institutions.

2.2 Sample Collection

Undergraduate students of the tertiary institutions in the Owerri metropolis were recruited as the subjects of this study. At first, approval was obtained from the management of the selected schools and hostels, then the informed consent of the participants was obtained. Ninety-seven (97) students between 18 and 30 were randomly recruited. Their demographic information, including name, sex, age, year of study, source of water, source of food, and standard of living, was obtained using questionnaires. Furthermore, stool (faecal) samples were obtained from each participant in sterile universal containers and transported immediately to the laboratory for processing.

2.3 Isolation and Identification of *Salmonella*

The stool samples were cultured aerobically overnight on *Salmonella Shigella* agar and at 37°C. The isolated *Salmonella* species were identified using the relevant biochemical tests described by Cheesebrough [8].

3. RESULTS

3.1 Overall Prevalence of Salmonellosis among the Students

Out of the 97 stool samples, *Salmonella* species were isolated from 18 (18.55%) samples: 6(6.18%) from males and 12(12.37%) from females (Table 1).

3.2 Prevalence of *Salmonella* Species among the Students in Relation to Sex

Table 2 shows the prevalence of the different species of *Salmonella* in relation to gender. Only 10 (55.56%) samples yielded positive results for *S. typhimurium*, and these were from only female participants. On the other hand, 1 (5.55%) case of *S. typhi* infection was seen in male participants with none in females. Lastly, seven (7) samples yielded positive results for *S. paratyphi,* with 5(27.78%) from males and 2(11.11%) from females. In summary, out of the 18 positive samples for *Salmonella*, *Salmonella typhimurium* had the highest 10(55.56%) prevalence, followed by *S. paratyphi* 7(38.89%) and then *S. typhi* 1(5.55%).

3.3 Prevalence of *Salmonella* Species among the Students in Relation to Age

Table 3 shows the prevalence of the different species of *Salmonella* in relation to age. It was recorded that a total of 10 samples yielded positive results for *S. typhimurium* with 9(30.00%) from people within the age range of 18-20 years, 1(5.56%) from those between 21-25 years, and none from those in the 26-30 years age range. Moreover, *S. typhi* was isolated from a sample of 1(5.56%) of those within the 26-30 years age range only. Lastly, 6(33.38%) samples from students between 21-25 years of age were positive for *S. paratyphi*, 1(5.56%) from those of 26-30 years was also positive, while none from 18-20 years of age was positive for *S. paratyphi.* In summary, infection prevalence by age showed that the age group with the highest infection was 18-20 years, with a total infection of 50.00%. This is followed by the age group 21-25 years with a total infection of 38.89%, while the age group with the lowest infection was 26-30 years.

3.4 Prevalence of Salmonellosis in Relation to Year of Study

It was observed in this study that students in their first year of study (year 1) had the highest 9(50.00%) prevalence of infection, followed by those in year 2, 7(38.19%), while the year 3 and 4 students had a low 1(5.56%) prevalence (Table 4).

Table 1. Prevalence of salmonellosis

Variables	No. tested	Positive	Negative
Male	24(24.74%)	6(6.18%)	18(18.55%)
Female	73(73.26%)	12(12.37%)	61(62.8%)
Total	97 (100%)	18 (18.55%)	79 (81.35%)

Table 2. Prevalence of *Salmonella* Species in relation to sex

Sex	No. tested	No. positive for *S. typhimurium*	No. positive *S. typhi*	No. positive for *S. paratyphi*
Male	24(24.74%)	0 (0.00%)	1 (5.55%)	5(27.78%)
Female	73(75.27%)	10 (55.56%)	0 (0.00%)	2(11.11%)
Total	97 (100%)	10 (55.56%)	1 (5.55%)	7 (38.89%)

Table 3. Prevalence of *Salmonella* Species in relation to Age

Age	No. tested	No. positive for S. *typhimurium*	No. positive for *S. typhi*	No. positive for *S. paratyphi*
18-20	80(82.47%)	9(30.00%)	0(0.00%)	0(0.00%)
21-25	10(10.31%)	1(5.56%)	0(0.00%)	6(33.38%)
26-30	7(7.22%)	0(0.00%)	1(5.56%)	1(5.56%)

Table 4. Prevalence of *Salmonella* Species infection in relation

Year of study	No. tested	No. positive for S. *typhimurium*	No. positive for *S. typhi*	No. positive for *S. paratyphi*
Year 1	40(41.24%)	9(50.00%)	0(0.00%)	0(0.00%)
Year 2	35(36.08%)	1(5.56%)	0(0.00%)	6(33.33%)
Year 3	15(15.46%)	1(5.56%)	0(0.00%)	0(0.00%)
Year 4 and above	7(7.22%)	0(0.00%)	0(0.00%)	1(5.56%)

4. DISCUSSION

This study assessed the prevalence of *Salmonella* infection among undergraduate students in Owerri, Nigeria. It was observed that the overall prevalence of salmonellosis among undergraduate students of tertiary institutions in Owerri was 18.55%. This is lower than the 36.78% reported among undergraduate students at Imo State University, Owerri, by Udujih et al. [4]. This lower prevalence recorded in this study suggests a decline in the spread of *Salmonella* infections among the students. Because the previous research by Udujih et al. [4] was done years ago, more awareness/sensitization programs have been launched, and the living and feeding conditions of undergraduate students in Owerri have improved. This might be true as a recent report by Dike-Ndudim et al. [9] had a lower prevalence rate of 14.84%. However, further research should include an increase in the sample size, molecular identification of the organisms, and antimicrobial susceptibility pattern of the isolated organisms. The prevalence recorded in this study was also lower than 39.4% recorded in Nassarawa State in middle belt of Nigeria [10], and the 63.8% reported in General Hospital, Etinan area in Akwa Ibom State of Nigeria [11].

Furthermore, three Species of *Salmonella* were identified in this study. They include *S. typhimurium, S. paratyphi,* and *S. typhi*. These species were also isolated in the study by Udujih et al. [4] and Dike-Ndudim et al. [9]. It was observed among these isolated species that the prevalence of *S. typhimurium* was the highest, followed by that of *S. paratyphi.* At the same time, *S. typhi* had the lowest infection prevalence rate. This finding disagrees with the report from Dike-Ndudim et al. [9], in which *S. paratyphi* and *S. typhi* had the same prevalence rate. In contrast, *S. typhimurium* had the lowest prevalence rate. According to the U.S. Department of Health and Human Services [12], most infections with *S. typhi* cause severe diarrhea, leading to hospital admissions of infected patients. The asymptomatic status of the study population might explain the low prevalence of *S. typhi* infection recorded in this study.

The distribution of *Salmonella* infection in relation to age showed a significantly higher prevalence of infection among the age group of 18-20 years than the age group of 21-25 years. This is in line with the findings from the study by Luka et al. [13], in which it was reported that younger students tend to adhere poorly to good hygienic practices compared to older students. Moreover, it has been documented that typhoid fever is generally known to be a disease predominantly in school-age children and young adults [14]. Therefore, it could be assumed that poor hygienic practices among younger students predispose them to various infectious diseases, including Salmonellosis.

The sex distribution of *Salmonella* infection showed a significant difference among the sexes. Females had a higher percentage of infection than males. This corroborates the report of Uttah et al. [11], who, according to a longitudinal study, reported that the prevalence of enteric fever was slightly higher in females than in males. However, research on this should be intensified to know if there are biological or cultural factors that make women more susceptible to Salmonellosis than men.

5. CONCLUSION

In conclusion, the prevalence of Salmonellosis among undergraduate students of tertiary institutions in the Owerri metropolis of Nigeria is slightly high. However, it is lower than some previous reports from other sources. This shows a significant improvement in the effectiveness of various public health intervention and prevention programmes. However, more work needs to be done. Proper awareness of the

health and socioeconomic impacts of enteric salmonellosis, preventive measures, and the need for early diagnosis must be intensified. Furthermore, providing basic amenities, such as clean water, proper sewage/drainage system, and safe handling of wastes, would aid in reducing the occurrence of enteric infections and eradicate the diseases they cause.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT

As per international standards or university standards, Participants' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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