

## Full Length Research

# SALMONELLA INFECTION AMONG UNDERGRADUATE STUDENTS OF IMO STATE UNIVERSITY OWERRI, NIGERIA

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Studies on *Salmonella* infection among undergraduate students of Imo State University Owerri, Nigeria was carried out to determine proportion and relationships between infections of *Salmonella* infection with demographic characteristic and toilet hygiene practice. This was done using a non-invasive standard bacteriological technique involving stool culture and biochemical identification of isolates. Chi square analysis and Spearmans correlation were used to test for independence and degree of relationship. Percentage was used to determine proportion. The result showed *Salmonella* infection had a proportion of 36.89%. The predominant *Salmonella* species isolated was *Salmonella typhimurium*. The disease showed a dependence ( $P > 0.05$ ) on toilet hygiene and demographic characteristics of the students ( $p < 0.05$ ). Females had more proportion of the disease than males. Infection of *Salmonella* increased with higher class level of the students. There was a higher proportion of *Salmonella* infection among the 18-21 years age range. Improved pit was found to be associated with low proportion of disease. Water cistern with manual lever was associated with *Salmonella* infection whereas hand washing in addition to use of hand sanitizers showed association with low proportion of *Salmonella* infection. It is therefore necessary to provide awareness on the harmful effects of enteric pathogens as well as encourage early diagnosis. Non-invasive method of diagnosis can be used for mass screening for salmonellosis especially in Nigeria where invasive methods are not widely accepted. The provision of basic amenities, cafeterias that offer affordable services and meet adequate hygiene, in school premises should not be neglected.

**Keywords:** *Salmonella*, Intestinal Helminth Infection, Undergraduate Students, Imo State University Owerri, Nigeria.

## INTRODUCTION

Food borne diseases are a global public health problem. *Salmonella* is a Gram-negative, facultative, intracellular anaerobe that causes severe

inflammation of the intestinal mucosal epithelium resulting in gastroenteritis and enteric fever (Patel and Mc Cormick, 2014). Enteric fever caused by *Salmonella* affects only humans (who are the reservoir) and is spread through consumption of contaminated food and drink handled by people who

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shed the organism from stool or, less commonly, urine (Cheesbrough, 2006/2004). It may also be acquired from ingesting water contaminated with sewage. Food needs to be heavily contaminated for infection to occur - approximately  $10^5$  to  $10^9$  cells may be required to cause illness (Bhutta, 2006; Tam et al., 2008; Crump and Mintz, 2010; Reddy et al., 2011). The three main serovars (serotypes) of *Salmonella enterica* are *Typhimurium*, *Enteritidis*, and *Typhi*. This means that they all belong to the genus *Salmonella*, a division that groups similar, though not identical bacteria together (Frobisher et al., 1974; McKane and Kandel, 1995; Talaro and Talaro, 1996).

Inexperienced and poor personal hygienic food handlers play a role in the transmission of food borne infections (Abera et al., 2010). Diarrheal disease continues to be an important cause of morbidity and mortality in developing countries and globally, intestinal parasites, and *Salmonella* species remain major contributors to acute enteric infections (Ishaleku et al., 2015).

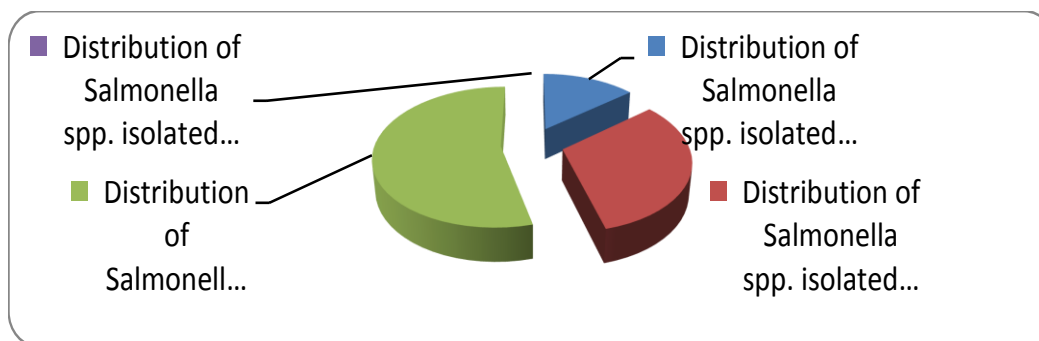
Enteric infections like *Salmonella* and intestinal helminths are widespread diseases affecting the population in Nigeria (Ishaleku et al., 2015). Poor personal and environmental hygiene, waste disposal as well as consumption of food sold by commercial vendors are major factors that encourage stable transmission (Smith et al., 2008; Crump and Mintz, 2010). Although school children are particularly at high risk of enteric infections due to their undeveloped hygienic habits, it is necessary to understand the pattern of infections of these diseases among young adults who have just gained independence from their care-givers. The present study is targeted at undergraduate students who are faced with the responsibility of balancing their health, social and financial needs with exacting academic life. Since poor health leads to absenteeism and low academic performance, it is therefore necessary to explore the occurrence of *Salmonella* and intestinal helminthes infections among this population. The result of which would add to the body of knowledge, provide insight to current infection pattern of the diseases on which future control strategies can be based. In addition, this study would be beneficial to the school management, Non-Governmental Organizations, students of Imo State University and the general public by providing a current baseline data for planning, epidemiological studies, control programs and enlightenment.

The living conditions of hostel quarters coupled with the low hygienic standards of food and water sold around University campuses expose students to infections with these enteric organisms. Undergraduate students are young adults whom the society assumes are capable of handling multiple tasks of catering for their health, academics and social needs which may be overwhelming exposing them to the risk of infection. It is therefore imperative to explore the extent to which these students are free of enteric infections which would automatically translate to the effect of their behavior and environment on their health. It is also important to monitor the dynamics of these enteric pathogens to avoid the possible negative effects which may arise by their interactions.

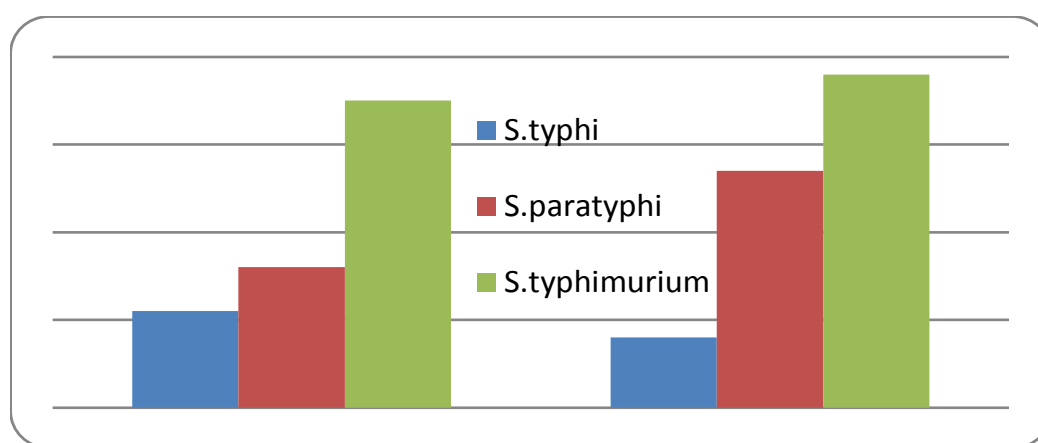
## MATERIALS AND METHODS

The study was observational involving a cross sectional survey of apparently healthy individuals currently enrolled in undergraduate programs of Imo State University Owerri. The study was carried out in Imo State University Owerri. Imo State is located in the South Eastern Region of Nigeria. The population of this study was undergraduate male and female students at different levels and fields of study, living away from home. Only students aged between 18-25 years were included in the study. Sample collection involved a non-invasive method which relied on the isolation of *Salmonella* from stool samples collected from participants. Other relevant information was obtained using combined open and closed ended structured questionnaire. Three hundred and sixty seven stool samples were collected and analyzed in the laboratory. A portion (1g) of the stool was cultured on a selective media and differential media (*Salmonella* - *Shigella* Agar and Maconkey agar). The 48hrs growth was subjected to biochemical and sensitivity tests for confirmation of the organism according to Cheesbrough (2004/2006). A little portion of the stool sample was collected with a sterile wireloop and streaked on the prepared SSA. The inoculum was incubated at 37°C for 24-48hours. Any pale colored colony was sub cultured on nutrient agar, Maconkey agar, peptone water, Christensen's urea slope, and Kliglar Iron slope. A portion of the 24hr growth was examined microscopically to determine Gram reaction.

The data obtained were subjected to statistical



**Figure 1.** Distribution of *Salmonella* spp. Isolated among participants.



**Figure 2.** Sex distribution of *Salmonella* infection of students.

analysis to test for independence using Chi-Square test at 5% level of significance and 95% Confidence Interval (CI). Descriptive statistics was used to summarize the data characteristics using percentage to show proportion. Spearman's Correlation was used to test the degree of relationships.

## RESULTS

### Distribution of *Salmonella* species Isolated among Participants

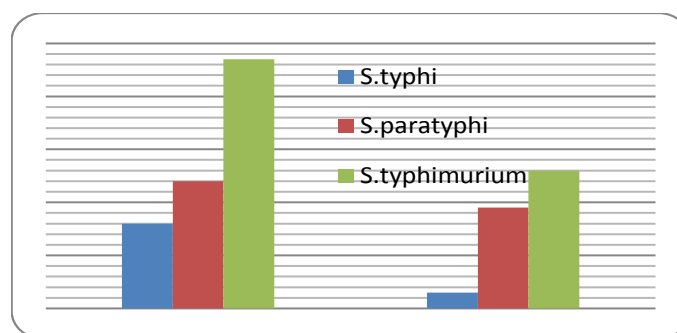
Out of the 135 positive samples for *Salmonella*, *Salmonella typhimurium* had the highest (54.07%) prevalence followed by *Salmonella typhi* (31.85%). *Salmonella typhi*? or *Enteritidis* had the least with a prevalence of (14.07%) (Figure 1).

### Sex distribution of *Salmonella* infection among students

Of the 135 positive *Salmonella* samples, males accounted for 45.93% whereas females accounted for the remaining 54.07%. Males showed a higher prevalence of *S. typhi* (8.15%) than females (5.93%). Females showed a significantly higher prevalence of *S. paratyphi* (20.00%) than males (11.85%) (Figure 2).

### Age distribution of *Salmonella* infection among students

Out of the 135 *Salmonella* positive students, the age range 18-21years showed a higher prevalence (23.71%) than the age range 22-25% (13.08%). *Salmonella typhi* was higher among the students within the age range 18-20years (Figure 3).



**Figure 3.** Age distribution of *Salmonella* infection of students.

### Distribution of *Salmonella* In Relation To Toilet Hygiene Practices

Out of the total (367) participants, 324 (88.28%) used water cistern while only 43 (12.81%) used improved pit. None of the participants used the open toilet system. Out of the 324 participants that used the water cistern, 123(91.11%) tested positive for *Salmonella*. Of the 43 that used improved pit toilet, 12(8.89%) tested positive for *Salmonella*. All (100%) the participants used water to clean their toilets. However, 217 (59.13%) used manual lever to flush whereas 150 (40.87%) used bucket to flush. Multiple answers were recorded. None (0.00%) of the participants used automatic flushing system or do nothing after toilet use. The participants that used manual lever recorded the highest (86.75%) prevalence for *Salmonella*. All the participants (100.00%) recorded the use of tissue paper for anal cleaning. None (0.00%) of the participants wash with water or do nothing after toilet use. Response on hand washing after toilet use grouped the participants into two, those that used water alone 204(55.59%) and those that used water and soap 163 (44.41%). The participants that washed hands with water only had a higher 84 (55.63%) prevalence of infection than those that washed with water and soap 67 (44.37%), see Table 1.

### DISCUSSION

The overall prevalence of *Salmonella* infection was high (36.78 %) similar to the findings of Adogo et al, (2015) in his study among students in Niger State. Three species of *Salmonella* were identified. *Salmonella typhimurium* had the highest prevalence

followed by *Salmonella paratyphi* whereas *Salmonella typhi* had the least prevalence. According to U.S Department of Health and Human Services (2016) most infections with *Salmonella typhi* causes severe diarrhea that the patient must be hospitalized. The asymptomatic status of the study population might explain the low prevalence of *Salmonella typhi*.

The distribution of *Salmonella* infection in relation to age showed that there was a significantly ( $P < 0.05$ ) 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 study by Luka, et al., (2000), who reported that students within the younger age group exhibit low hygienic practices while the students within the higher age group might be more aware and enlightened on the need for good hygienic practice. Earlier study found that enteric fevers are more prevalent in males than in females (Akinyemi et al., 2000/2005).

The sex distribution of *Salmonella* infection showed a significant difference ( $p < 0.05$ ) among the sexes. Females had higher proportion of infection than males although overcrowding and low level of sanitation (Ajero and Ukaga, 2006), close contact with infected individuals, poor living conditions, usage of faecally contaminated soil and water and poor environmental sanitation (Ukaga et al., 2002) are risk factors of infection.

Improved pit in this study is shown to be associated with a lower prevalence of infection. This study also showed that infection with *Salmonella* is positively correlated with the use of Water Cistern (manual lever). Those that use Hand Sanitizers in addition to hand washing have been highlighted by this study to be associated with low prevalence of *Salmonella* infection.

**Table 1.** Distribution of salmonella in relation to toilet hygiene practices.

Toilet Hygiene	Variables	No of participants (%) N=367	Salmonella positive (%) N=135	r (p value)
Toilet type	Improved pit	43(12.81)	12(8.89)	0.452* (0.000)
	Open toilet	0(0.00)	0(0.00)	
	Water cistern	324(88.28)	123(91.11)	
Toilet cleaning	wash with water	367(100.00)	135(100)	0.047 (0.367)
	Cover with ash	0(0.00)	0(0.00)	
	Do nothing	0(0.00)	0(0.00)	
Flushing	Automatic	0(0.00)	0(0.00)	0.185* (0.000)
	Manual Lever	217(59.13)	109(80.74)	0.185* (0.000)
	Bucket	150(40.87)	26(19.26)	
	Do nothing	0(0.00)	0(0.00)	
Anal Cleaning	Tissue paper	367(100.00)	135(100)	0.890** (0.000)
	Wash with water	0(0.00)	0(0.00)	
	Do nothing	0(0.00)	0(0.00)	
Hand washing after use	Water only	204(55.59)	74(54.81)	0.890** (0.000)
	Wash with soap	163(44.41)	61(45.19)	

Spearman correlation(r\*) at p-value <0.000; r (+ <0.4 is weak, + 0.5 is moderate, < + 1.00 is strong).

## CONCLUSION

In conclusion, out of 367 samples that were examined *Salmonella typhimurium* was the predominant *Salmonella* infection. The results showed that prevalence of *Salmonella* infection is dependent on sex, and Age, and is related to toilet hygienic practices of the undergraduate students. Based on the results from this study, it is therefore recommended that proper awareness on the harmful effects of enteric infections and early diagnosis should not be neglected. In addition, as Obiukwu et al., (2008) and Stephenson et al., (2000) recommended, the provision of basic amenities such as adequate water supply would aid in reducing the occurrence of enteric infections and eradicating the diseases they cause and sanitary improvements such as safe, efficient and hygienic management of water (particularly for drinking), disposal of feces, food preparation and education should be encouraged to enable individuals adopt behavioral changes. Surveillance of enteric diseases such as Salmonellosis should become a matter of necessity for the safe guard of public health.

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