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RESEARCH ARTICLE

STUDIES ON *SALMONELLA* PREVALENCE CO-INFECTIONS WITH SCHISTOSOMIASIS AMONG SUBJECTS IN SELECTED RURAL COMMUNITIES AND GENERAL HOSPITAL IN ZONE A SENATORIAL DISTRICT OF BENUE STATE, NIGERIA

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ABSTRACT

The overall aim of this study was to determine the prevalence of co-infection of typhoidal salmonellosis and schistosomiasis amongst selected subject groups in zone A geopolitical zone of Benue State Nigeria. Five locations were randomly selected and they were: Iange, Sati, Korgyen, Ikov Sati and Adikpo. A total of 180 subjects were studied. Two clinical samples (urine and stool) were collected from each subject following standard medical laboratory practices and guidelines. A total of 360 clinical samples were investigated using microscopic, cultural and biochemical methods. *Salmonella*cul ture, isolation and biochemical tests were carried out from faecal samples. Schistosomiasis was diagnosed through the detection of parasite eggs in stool for *S. mansoni* or urine specimens for *S. haematobium*. Computation was done for: total *Salmonella* infection and *Salmonella*-schistosomiasisco-infection. There were 25 cases of *Salmonella* infection out of 180 samples thus resulting in prevalence of 13.89% in zone A axis of Benue State. Prevalence per sampling distribution across the communities from highest to lowest are: Ikov Sati (21.67%), Adikpo (15%), Sati (11.1%) and Iange (4.76%). No Salmonella cases were recorded at Korgyen community among 21 samples. Sex status revealed 36% male and 64% female. Occupational status showed 60% farmers as the most infected group, 12% each for student and marketers and 8% each for civil servants and okada riders. Age group 21-30 years were the most vulnerable as they constituted 32% of the infected subjects. Age group 1-10 years was 1% while 61-70 years had no salmonella cases. There were 8 cases of *Salmonella*-schistosomiasis co-infections out of 180 samples with a total prevalence of 4.44% in the study area. Across the communities, Iange and Korgyen had no co-infection cases while Adikpo had the highest number of 5 with a prevalence of 8.33%. followed by Sati (5.55%). Male and female had equal proportion of co-infection cases while farming was the highest (50%) among the occupational type and Age group 21-30 was the highest (38%) among the age groups. The information given in this report is vital in the control of Salmonella and its co-infections with schistosomiasis in the study area.

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INTRODUCTION

The human schistosomiasis is categorized by the WHO as a neglected tropical disease caused by *Schistosoma* species. It is the second most devastating tropical parasitic disease worldwide after malaria (Chistulo *et al*.,2004; WHO, 2018). Salmonellosis is a symptomatic bacterial infection caused by *Salmonella* species. Salmonellosis is one of the most common causes of diarrhea globally with high morbidy rate (Ohad *et al*., 2014). Schistosomiasis and typhoidal salmonellosis have similar geographical distribution. They are restricted to areas with poor sanitation and warm temperature in the tropical and sub-tropical regions (Lar *et al*., 2006). The causative organisms share similar habitat/microhabitats. They are water borne and enteric. Both diseases affect rural dwellers especially children and farmers having frequent contact with water bodies (Imarenezor *et al*., 2013). Moreover, both infections are highly prevalent in areas with poor sanitation and contaminated water bodies and they both end as enteric infections (Lar *et al*., 2006). In most studies, *Schistosoma-Salmonella* co-infection cases are much higher in children and young adults than older ages. Both infections can affect the liver and kidney function and combined action can cause devastating physiological effect. However, the studies on the prevalence of mixed infections of schistosome-*Salmonella* cases are grossly insufficient across African communities (Lar *et al*., 2006).

In developing countries where both *Salmonella* and schistosoma are endemic, co-infections may be common and a synergistic interaction may complicate the course of infection and make diagnosis and therapy difficult (Lar *et al*., 2006). High prevalence of mixed infections of the two organisms has been reported in some parts of Nigeria (Lar *et al*., 2006; Njunda and Oyerinde, 1996). In most cases, two species of *Schistosoma* (*S. haematobium* or *S. mansoni*) are known to interact with any typhoidal *Sal. enterica* strains (Typhi or Paratyphi). The interaction is symbiotic. The bacteria is fastened to the surfaces of digestive opening of the worn using the pili. This specialized relationship causes the bacteria to evade diagnosis and treatment. The nature of disease interaction is also poorly understood. This may hinder appropriate control programme by relevant stakeholders. The present study intends to fill these gaps. The overall aim of this study was to determine the prevalence of co-infection of typhoidal salmonellosis and schistosomiasis amongst selected subject groups in zone A geopolitical zone of Benue State Nigeria,

METHODOLOGY

Study Area: The study area was Zone A geopolitical zone of Benue State, Nigeria. Five locations were randomly selected and they were: Iange, Sati, Korgyen, Ikov Sati and Adikpo.

Study Design: A total of 180 subjects were studied. Three groups of subjects were targeted and they were: (a) primary school children, (b) farmers including rural fishermen, rice farmers and sugarcane farmers at river banks and (c) General hospital subjects which include farmers, marketers, okada riders and civil servants attending the hospital. Two clinical samples (urine and stool) were collected from each subject following standard medical laboratory practices and guidelines. A total of 360 clinical samples were investigated using microscopic, cultural and biochemical methods.

Salmonella culture, isolation and biochemical tests This involved the isolation of *Salmonella* culture from faecal sample for biochemical characterisation and detection. Stool samples were inoculated on sterile XLD (Xylose Lysine Deoxycholate) Agar using the steak plate method (Cheesbough, 2009) and incubated at 37^{o}C using a laboratory incubator for 18-24hours. Colony which shows the characteristic red to pink colour on XLD with or without black centre (Hydrogen sulphide production) were sub-cultured to obtain pure culture. The pure cultures were sub-cultured on sterile nutrient agar plates for 18-24hours from where biochemical test were carried out following standard biochemical tests (Cheesbough, 2009) including citrate, urease, indole, hydrogen sulfide (H_2S), oxidase and catalase tests.

Detection of Schistosoma species: Schistosomiasis was diagnosed through the detection of parasite eggs in stool for *S. mansoni* or urine specimens for *S. haematobium*(Gberikon *et al*., 2015) following WHO standard guideline. Stool samples were examined for eggs of *S. mansoni* identified through their oval shape with lateral spine. Urine samples were examined for *S. haematobium* eggs identified through their oval shape bearing terminal spine. Ten millilitre (10ml) of urine sample was taken in a syringe and filtered using polycarbonate membrane filter of 12.0µm pore size and 13ml in diameter (Sterlitegh Inc. USA) and Swinex filter holder. After filtration, the membrane filter was removed using a force and placed on a clear slide. It was stained with a single drop of lugols iodine for 15min. The eggs of intestinal schistosomiasis were detected in faecal specimens through a technique using methylene blue-stained cellophane soaked in glycerine or glass slides, known as the Kato-Katz technique (Kosala *et al*., 2015). All slides were viewed on the light microscope (Binocular Olympus CH) using appropriate low power objective lenses.

Statistical Data Analysis: Statistical analysis was done using SPSS (20.0) software. Data were described and presented in tables and charts. Number of positive subjects in each category of infection was counted. Proportions of infected subjects were expressed as percentages. Prevalence (in percentage) of each co-infection cases were computed based on zone, locations, sex, occupation and age. Computation was done for: Total *Salmonella* infection and *Salmonella*-schistosomiasisco-infection.

RESULTS

There were 25 cases of Salmonella infection out of 180 samples thus resulting in prevalence of 13.89% in zone A axis of Benue State (Table 1). Prevalence per sampling distribution across the communities from highest to lowest are: Ikov Sati (21.67%), Adikpo (15%), Sati (11.1) and Iange (4.76%). No Salmonella cases were recorded at Korgyen community among 21 samples. Table 2 presents demographic data of Salmonella infected subjects. Sex status revealed 36% male and 64% female. Occupational status showed 60% farmers as the most infected group, 12% each for student and marketers and 8% each for civil servants and okada riders. Age group 21-30 years were the most vulnerable as they constituted 32% of the infected subjects. Age group 1-10 years was 1% while 61-70 years had no salmonella cases.

As given in table 3, there were 8 cases of salmonella-schistosomiasis co-infections out of 180 samples with a total prevalence of 4.44% in the study area. Across the communities, Iange and Korgyen had no co-infection cases while Adikpo had the highest number of 5 with a prevalence of 8.33%. followed by Sati (5.55%). Male and female had equal proportion of co-infection cases (Figure 1) while farming was the highest (50%) among the occupational type (Figure 2) and Age group 21-30 was the highest (38%) among the age groups (Figure 3).

Table 1. ***Distribution of Salmonella infection in Benue State based on locations***

Location	Number of Infected Subjects and their proportions	Sampling Distribution	Prevalence Per Sampling Distribution (%)
Iange	1	21	4.76
Sati	2	18	11.11
Korgyen	0	21	0.00
Ikov Sati	13	60	21.67
Adikpo	9	60	15.00
Total	25	180	13.89

DISCUSSION

In the present work, *Salmonella* prevalence of 13.9% was higher than the 5% tolerable limit of the WHO.

Table 2: ***Distribution of Salmonella infection based on demographic information***

Sex	No of Infection cases/Proportion	Occupation	No of Infection cases/Proportion	Age	No of Infection cases/Proportion
Male	9 (36%)	Farmer	15 (60%)	1-10	1 (4%)
Female	16 (64%)	Student	3 (12%)	11-20	5 (20%)
		Marketer	3 (12%)	21-30	8 (32%)
		Civil servant	2 (8%)	31-40	5 (20%)
		Okada rider	2 (8%)	41-50	2 (8%)
				51-60	4 (16%)
				61-70	0 (0%)
Total number of infected subjects	25		25		25

Table 3. ***Distribution of schistosomiasis and Salmonella mixed infection based on location***

Location	Number of Infected Subjects and their proportions	Sampling Distribution	Prevalence Per Sampling Distribution (%)
Iange	0	21	0.00
Sati	1	18	5.55
Korgyen	0	21	0.00
Ikov Sati	2	60	3.33
Adikpo	5	60	8.33
Total	8	180	4.44

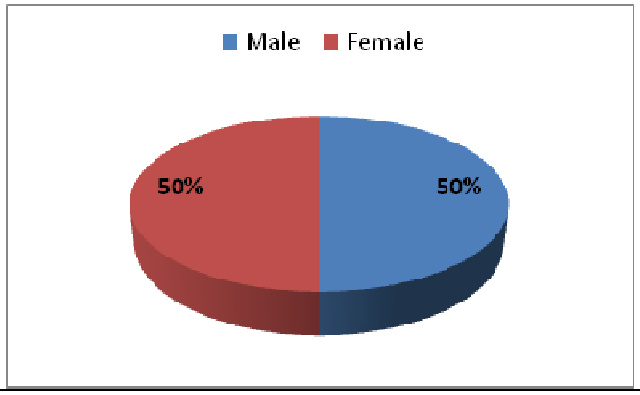

Fig. 1*: Sex distribution of subjects with co-infections of Salmonella-schistosomiasis*

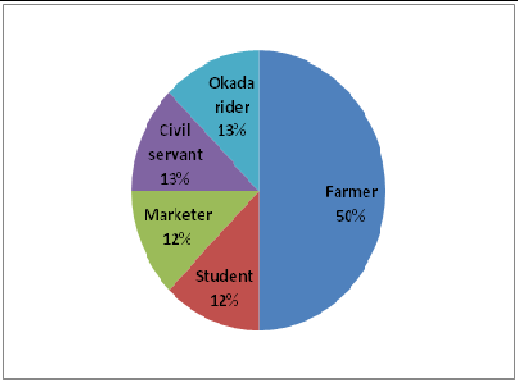

Fig. 2: ***Occupation distribution of subjects with co-infections of Salmonella-schistosomiasis***

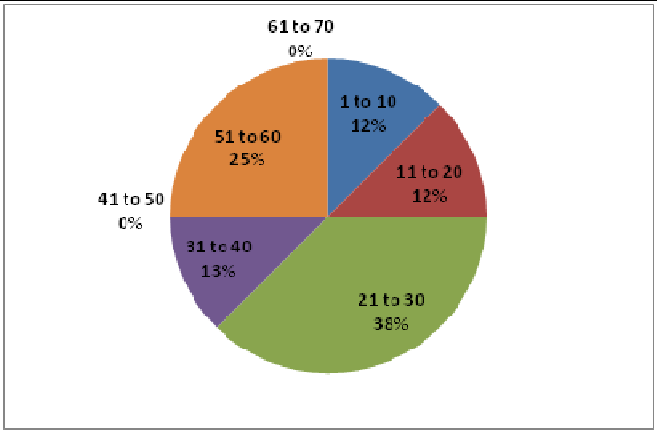

Fig. 3. ***Age distribution of subjects with co-infections of Salmonella-schistosomiasis***

This could be considered as a huge burden to the study area and the affected communities especially Sati (11.1%), Ikov Sati (21.67%) and Adikpo (15%) communities. This deviates from reports of *Salmonella* in other small populations elsewhere including the 42.4% incidence among University of Ilorin Students (Udeze *et al*., 2010) and 40% prevalence reported in Biu Bornu State (Isa *et al*., 2013). However, the present investigation is within *Salmonella* infections reported among College of Education students in FCE Zaria with 9.3% prevalence and among ABU students in Zaria with 16.5% cases (Adeshina *et al*., 2009). According to WHO (2017), typhoid risk is higher in populations that lack access to safe water and adequate sanitation. Factors such as low level of education and hygienic are predominant in the affected rural areas. The above position may be true because the Kyogen community without any case of *Salmonella* is a small rural

community with cool and serine atmosphere. Farmers are largely affected with typhoid cases. Poor food handling among farmers had earlier been associated with increase typhoid fever in many parts of Africa (Amber *et al*., 2016). Since farming is the mainstay of people in the study area, harvested and consumed food might have been contaminated. Moreover, the WHO standard guideline lays emphasis on proper cooking of food before consumption. It is clear that the affected groups consume unhiegenic food and unsafe water. After harvesting, fruits and vegetables are washed in the same river where people are simultaneously engaging in other activities such as swimmimg and washing of clothes. These habitats may contaminate the farm produce before they are sold in the markets. All age groups have equal chances of being infested with *Salmonella* depending the prevailing sanitary conditions. Females are more vulnerable than males. This may indicate low level of hygiene among rural women in their domestic activities such as cooking. Also fruits and vegetables are sold in markets majorly by women. This brings to question the level of hygienic practices in the fruits and vegetables sold in the markets. Aguoru *et al*. (2015) earlier reported high level of bacterial contaminants on surfaces of some edible fruits sold across major markets in Makurdi, Benue State. Heavy presence of infectious microbes was reported in the analysed fruit samples. They include *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* spp, *Pseudomonas aeruginosa*, *Streptococcus* spp, *Salmonella* spp, *Lactobacillus* spp and *Proteus* spp.

Schistosomiasis and *Salmonella* mixed-infection has a prevalence of 4.4% in the study area and it is still within acceptable level. However, Adikpo and Sati communities recorded higher prevalence of co-infection than the WHO 5% limit. Farmers recorded the highest *Salmonella* infection as wellm as *Salmonella*-schistosomiasis co-infection cases. Similar findings have been reported in some communities in Nigeria (Ifeanyi *et al*., 2009; Igwe, 2014). The present findings fully agree with positions of many authors that there are overwhelming cases of concurrent infections in Africa caused by a synergy of bacteria, helminths, protozoans and viruses (Obi *et al*., 1996; Igwe and Agbo, 2014). It is believed that schistosomiasis and typhoidal salmonellosis have similar geographical distribution. They are restricted to areas with poor sanitation and warm temperature in the tropical and sub-tropical regions (Lar *et al*., 2006). The causative organisms share similar habitat/microhabitats, being water borne and enteric. Both diseases affect rural dwellers especially children and farmers having frequent contact with water bodies (Imarenezor *et al*., 2013). In most studies, Schistosoma-*Salmonella* co-infection cases are much higher in children and young adults than older ages. This position is upheld in the present work.

CONCLUSION

Prevalence of *Salmonella* infection in the study area was 13.89% while co-infection with schistosomiasis gave 4.4% prevalence. While the single *Salmonella* infection was higher than the WHO 5% limit with females being more infected than males, co-infection was below the limit of exposure with equal sex distribution. Adikpo and Sati communities recorded higher prevalence of co-infection than the WHO 5% limit while other communities had low co-infection cases. The information given in this report is vital in the control of Salmonella and its co-infections with schistosomiasis in the study area.

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