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Prevalence and Antibiogram of *Salmonella enterica* Among Patients Attending Selected Hospital in Sokoto Metropolis

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ABSTRACT

Salmonella enterica is a rod-shaped, flagellated, facultative anaerobic Gram-negative bacterium and a member of the genus *Salmonella*. a number of its serovars are serious human pathogens. This study was designed to determine the prevalence of *Salmonella* enterica among patients suspected of gastrointestinal tract infections in some selected hospitals within Sokoto metropolis and to determine the antibiogram profile of the organisms isolated. A total of 187 stool samples of male and female patients aged 1-52 years were cultured for the presence of *Salmonella* species. The prevalence of *Salmonella enterica*among the patients was 14.4%. A prevalence of 22.0% was found among patients in the age group of 11-15 years, followed by patients in the age group 6-10 with a prevalence of 17.6%. The lowest prevalence 5.9% was observed among patientsin the age group 1-5, Patients in the age group16-20 had a prevalence of 16.7% while patients aged ≥ 21 had a prevalence of 13.3%. Antibiotic susceptibility test showed that the isolates were sensitive to Gentamicin 37%, Nitrofurantoin 59%, ciprofloxacin 78%, ceftriaxone 41%, ceftazidime 33% and cefuroxime 67%but resistance to Cloxacillin 96%, erythromycin 100%, Ampicillin 100%and Augmentin 100%was observed. Further research to detect presence of salmonellae in clinical samples and itsantibiotic susceptibility profile is hereby recommended.

Keywords: Prevalence, *Salmonella enterica*, Patient, Sokoto

INTRODUCTION

Despite global improvements in public health facilities, bacterial infections still remain an important public health problem worldwide (Mirmomeni *et al.,* 2009). Infectious microbial diseases constitute a major cause of death in many parts of the world, particularly in developing countries (El Hussein *et al*., 2010).As much as 80% of ill health in developing countries is attributed to bad water and poor sanitation (Garba *et al*., 2007). *Salmonella enterica* causing human diseases are divided into human-restricted typhoidal serovars (Typhi and Paratyphi) associated with typhoid fever, and non-typhoidal *Salmonella* (NTS) serovars which have a broader host-range and are frequently zoonotic. It is one of the major food-borne pathogens and has importance as a leading cause of food-borne bacterial diseases in humans throughout the world (Erol *et al.,* 2013). Non-typhoidal *Salmonella* (NTS) have emerged as an important cause of invasive bloodstream infection in sub-Saharan Africa, among young children with malaria and

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malnutrition, and among adults with HIV (Gordon, 2012).

Salmonella enterica is one of the most common causes of human gastroenteritis worldwide and improper handling and ingestion of inadequately cooked food primarily cause the infections (Hasman *et al.,* 2005). *Salmonella*-associated infections do not present with distinct clinical features: other bacterial, viral and even protozoans may mimic its presentations (De Jong *et al.,* 2012, Akinyemi *et al.,* 2007). Transmission of salmonellae is essentially by the faecal-oral route: via ingestion of faecally contaminated food and water, unclean hands, flies and meat from infected animals (Okonko *et al.,* 2011).School-age children, especially those from resource-poor settings with inadequate water and sanitation systems, are disproportionately affected (Kariuki, 2008).The increasing rates of resistance to traditional agents (i.e., ampicillin, chloramphenicol, and trimethoprim–sulfamethoxazole) have turned the treatment of invasive salmonellosis into a clinical dilemma (Chen *et al.,* 2013).

MATERIALS AND METHODS

Sample Collection and Analysis

The specimens were collected in sterile, clean wide-necked containers, labelled with patient's details and given appropriate laboratory numbers and transported to the laboratory for analysis. Portions of the stool samples were inoculated into Selenite F broth.and incubated at 370C for 24hours. A loop full from the overnight broth was cultured on Deoxycholate Citrate Agar. The plates were incubated aerobically at 37 ^{0}C for 24 hours as described by Cheesbrough, (2006).

Biochemical Identification.

Suspected *Salmonella* colonies were sub-cultured on Nutrient agar. This was to obtain a pure culture of theisolates for biochemical tests that included Indole test, Triple sugar iron agar test, Citrate utilization test, Urea test and motility test.

Antibiotic Susceptibility Testing of Isolates

The Kirby-Bauer disk diffusion test was performed following the guidelines of the Clinical Laboratory Standards institute (CLSI 2014) These antibiotics: ampicillin (10µg) ,nitrofurantoin (200µg), cefuroxime (30µg), augmentin (30µg), Erythromycin (5µg) , gentamicin (10µg), ciprofloxacin (5µg), ceftriaxone (30µg),ceftazidime (30ug) and cloxacillin (5µg) were tested

A standardized suspension of the *Salmonella* isolates was prepared in 0.85% sodium chloride until the turbidity of the resulting solution was 0.5 McFarland. A sterile swab stick was used to inoculate the surface of Mueller-Hinton agar with the standardized innoculum. A multidisc (AbtekBiologicals Ltd., Britain) was then aseptically placed on the inoculated agar surface and incubated at 37^{0}C for 18 hours. The antibiotics diffuse into the agar, establishing a concentration gradient. Inhibition of microbial growth was indicated by a clear area (zone of inhibition) around the antibiotic disks. The diameter of zones of inhibition was recorded following CLSI 2014 guidelines.

RESULTS

The total prevalence of 12.1%*Salmonella* isolates in Specialist hospital Sokoto was observed in contrast to a prevalence of 19%*Salmonella* in Maryam Abacha hospital Sokoto. A prevalence of 11% among male patients was observed at the specialist hospital Sokoto while 18% prevalence was recorded in

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male patients at the Maryam Abacha hospital Sokoto. In female patients, the prevalence of *Salmonella* was 13% in specialist hospital while, 20% was observed in females in Maryam Abacha hospital as shown in Table 1.

Table 2 showed the age group prevalence of *Salmonella* in the selected hospitals the highest prevalence (22.0%) was observed among patients age group 11-15 followed by patients age group 6-10 with a prevalence of (17.2%). The lowest prevalence (5.9%) was observed among patients age group 1-5, patients age group16-20 had a prevalence of (16.7%) while patients aged ≥ 21 had a prevalence of (13.3%).

The antibiotic susceptibility profile of the isolates showed that they were most sensitive to, ciprofloxacin (78%), cefuroxime (67%) nitrofurantoin (59%) ceftriazone (41%) Gentamycin (37%) and ceftazidime (33%) and Resistance against these antibiotics was observed in this order Cloxacillin (96%), Augmentin (100%), Ampicillin (100%) and Erythromycin (100%).

Table 1: Prevalence of *Salmonella* base on gender in the selected hospitals

Gender	Specialist Hospital			Maryam Abacha Hospital		
	No. of patients screened	**No. of *Salmonella* isolated**	**% prevalence**	**No. of patients screened**	**No. of *Salmonella* isolated**	**% prevalence**
Male	56	6	11%	28	5	18%
Female	68	9	13%	35	7	20%
Total	**124**	**15**	**12.1**	**63**	**12**	**19%**

Table 2: Prevalence of *Salmonella* species in the study area based on Age

Ages	No. of samples analysed	No. positive	% prevalence
1-5	51	3	5.9%
6-10	29	5	17.2%
11-15	41	9	22.0%
16-20	36	6	16.7%
21-above	30	4	13.3%
Total	**187**	**27**	**14.4%**

Table 3: Antibiotic susceptibility profile of *Salmonella* species isolated

Antibiotics	Disc content (µg)	No. and % sensitive	No. and % resistant
Gentamicin	10µg	10(37%)	17(63%)
Erythromycin	5µg	0	27(100%)
Ceftazidime	30µg	9(33%)	18(67%)
Cefuroxime	30µg	18(67%)	9(33%)
Ceftriazone	30µg	11(41%)	16(59%)
Cloxacillin	5µg	1(4%)	26(96%)
Augmentin	30µg	0	27(100%)
Ampicillin	10µg	0	27(100%)
Nitrofurantoin	200µg	16(59%)	11(41%)
Ciprofloxacin	5µg	21(78%)	6(22%)

DISCUSSION

A prevalence rate of 14.4% was observed in this study which is lower than 28.8% that was reported in a study by Bagudo *et al*. (2014), Adabara *et al.* (2012) reported 45.0% prevalence from Minna-Niger State, Nigeria, Of the 187 isolates obtained,14.6% (15/27)

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were isolated among females patients while 14.3% (12/27) were isolated among males patients. Children between 1-5 years of age had a prevalence 5.9%. This finding is consistent with the findings by Ogunyele *et al*., (2005) who observed that (5 –11 years) had a prevalence of 5.8%.It is also in agreement with the findings by Chiu *et al.,* (1994), Diez-Dorado *et al*, (2004) and Yagupsky *et al*., (2002).

Malla *et al.,* (2005) reported that there is seasonality in the occurrence and frequency of *Salmonella* infections in Nigeria, with *Salmonella typhi* infections following the rainfall pattern with a peak in July. The highest prevalence of *Salmonella enterica* from patients in this study was found in the age group 6-15years. The high isolation of *Salmonella* in this age group is consistent with the findings by Fashea *et al*. (2010) and Abdullahi *et al.*(2012) who reported that children of school going age and young adults were more likely infected with *Salmonella enterica.* Most probably because the undeveloped immune system of this age group makes them vulnerable to enteric pathogens (Ja'afar *et al.,* 2013).

In female patients in the Specialist hospital Sokoto a prevalence of 13% was observed while in Maryam Abacha hospital the prevalence rate was 20%. In males patients in specialist hospital Sokoto the prevalence of Salmonella enterica was 11% while 18% prevalence was observed in Maryam Abacha hospital .A high prevalence in females than males was observed in a study by Umeh and Agbulu, (2010) who found a 58.0% prevalence of *Salmonella* Typhi in females. They also observed a higher prevalence of *S. paratyphi* in females than in males between the ages of 11-20 years. Females are more likely to be infected with *Salmonella* probably, because they tend to do more domestic chores involving water that may be contaminated and tend to drink such contaminated water.The high prevalence of the organisms in the males patients is likely because of their eating habits; males eat at different restaurants where probably the level of sanitation could be low.

The foundation of modern medicine is built on the availability of effective antibiotics, especially in economically deprived areas of the world where the disease burden due to bacterial infections remains high (Goossens*et al.,* 2005). High susceptibility of *Salmonella* species to nitrofurantoin was also observed in this study. Most *Salmonella* Enterica strains were susceptible to ciprofloxacin among Nigerian patients (Ibrahim *et al*., 2005). In Lagos, Nigeria, Akinyemi *et al*.,(2007) reported 18% reduced susceptibility of *Salmonella* to ciprofloxacin. High susceptibility to ciprofloxacin was reported in a study by Marks *et al*. (2010) and Uwe Groß *et al.*(2011)**.** High proportions of *salmonellae* was observedto be resistant to ciprofloxacin in Accra, Ghana (Namboodiri *et al.,* 2011). High susceptibility of *Salmonella* to ciprofloxacin and nitrofurantoin in this study is consistent with the findings by Malla *et al*., (2005). This may be attributed to the relatively high cost of ciprofloxacin and nitrofurantoin. Therefore, quinolones are not used indiscriminately because not many can afford them. A study among patients of a hospital in Bangladesh by Islam *et al*.,(2008) reported cephalosporins more effective than fluoroquinolones for the treatment of infection caused by *Salmonella* Typhi. Current reports of multidrug resistance strains of *Salmonella* Typhi (Adabara *et al*., 2012), reported the observation. *Salmonella* isolates were most susceptible to cephalosporins; cefoxitin, cefotaxime, cefepime and ceftazidime. Resistanceto ceftriaxone 16% was observed in this studywhich is in contrast to the findings by

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Mills-Robertson *et al.*(2002) and Schwarz *et al*.,(2010) who had all isolates in their study susceptible to ceftriaxone.Quinolones are not approved for use in children due to concerns about cartilage damage (Lynch *et al*., 2009). In children, cephalosporins such as ceftriaxone are an important line of therapy (Weill *et al*., 2004). An increase in resistance among *Salmonella* to extended-spectrum cephalosporins is a significant public health concern because ceftriaxone is a drug of choice for the treatment of severe Salmonellosis in children (Rabsch *et al.,* 2001). A high proportion of *Salmonella* isolates were resistant to erythromycin, cloxacillin, augmentin and ampicillin in our study. Similar results reported in other parts of Ghana by Uwe Groß *et al*.,(2011) and in some parts of Kenya by Kariuki *et al*., (2005) observed the resistance of Non Typhoidal Salmonellaeto commonly used drugs including ampicillin which rose from 31% in 1994 to 42% in 2003. High resistance to augmentin-erythromycin (71%) and ampicillin/cloxacillin (70%) has also been reported (Marks *et al*., 2010).

Multidrug resistance was found among the isolates in this study. Similar results were found in Nepal where several *Salmonella* isolates were found to be resistant to at least four antibiotics (Bhatta *et al*., 2005). A study in Ghana reported 50% and 63% of the isolates resistant to ampicillin, erythromycin, and augmentin (Marks *et al*., 2010). Another study in Accra reported 87% of *Salmonella* sero *group* Bisolates that were multidrug resistant (Mills-Robertson *et al*., 2003). Recent studies havereported *invitro*resistance to these antibiotics in *Salmonella* infections in Funtua, Nigeria (Abdullahi *et al*., 2012). This may probably be as a result of indiscriminate use of these antibiotics as well as the overuse of these drugs in human medicine over a long period. Self-medications is another factor that may account for this high level of resistance to these antibiotics.

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