Prevalence and Antibiotics Susceptibility Pattern of Bacteria Associated with Gastroenteritis in Minna, Niger State, Nigeria

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ABSTRACT: Gastroenteritis is the inflammation of the lining of the gastrointestinal tract, which brings about sudden onset of diarrhoea and vomiting. The study is aimed at determining the prevalence and antibiotic susceptibility pattern of bacteria associated with gastroenteritis in Minna, Niger state. A total of 328 stool specimens were collected from children and adults, of which 215 were positive for gastroenteritis. The age group 0-9 years had the highest frequency of occurrence 69(32.09%). *E. coli* was found to be the most frequently isolated bacteria in all age groups 117(35.67%), other bacteria isolated were *Salmonella* species 82(25.00%), *Shigella* species 5(1.52%), *V. cholera* 51(15.55%), *V. parahaemolyticus* 33(10.06%), *Citrobacter* species 14(4.27%), *Klebsiella* species 12(3.66%), *Ps. aeruginosa* 7(2.13%), *Proteus* species 5(1.52%), and *Enterobacter* species 2(0.61%). The antibiotic profile for isolated enteropathogenic bacteria showed that most of the organisms were highly susceptible to ciprofloxacin, chloramphenicol and sulphamethoxazole/trimethoprim, but highly resistant to ampicillin and cefuroxime sodium. There was a significant difference between the antibiotics ($p<0.05$). These results show the need to promote rational use of antibiotics in the population. The result also suggests that, the incidence of diarrhoeal diseases is quite common in the population especially among children therefore diarrhoeal should be taken more seriously.

KEYWORDS: ANTIBIOTICS SUSCEPTIBILITY, ENTEROPATHOGENIC BACTYERIA, GASTROENTERITIS, PREVALENCE

INTRODUCTION

Gastroenteritis is said to be the inflammation of the lining of the gastrointestinal tract, which involves both the stomach ("gastro") and the intestines ("entero") and this brings about sudden onset of diarrhoea and vomiting. Infection due to gastroenteritis has been known to be caused by microorganisms such as *Salmonella* species, *Shigella* species, *Campylobacter* species, *E. coli* O157:H7, *Listeria monocytogenes*, *Vibrio cholerae*, *Yersinia enterocolitica*, *Rotavirus*, *Cryptosporidium* species, *Entamoeba histolytica*, and *Giardia lamblia* [8]. Other causes are by ingestion of some food items, chemical toxins or drugs. Although, gastroenteritis in healthy adults is usually not serious, causing only discomfort and inconvenience. It can cause life-threatening dehydration and electrolyte imbalance in the very ill or weak, the very young, and the very old. Others that could be susceptible to gastroenteritis may include children and workers in daycare centers and nurseries, students living in dormitories, military employees, and travelers [7].

According to Ochei and Kolhatkar [20], gastroenteritis and diarrhoea is said to be a major cause of morbidity and mortality in areas where there are no adequate portable water and sanitation.

Gastroenteritis can be transmitted from one person to another, when hands are not thoroughly washed after using the toilet, or when people touch their mouth after coming in contact with object(s) (like diaper or toy) contaminated by infected stool.

Gastroenteritis can also be transmitted faecal-orally, when food or water contaminated by infected stool are ingested. Contaminated water is sometimes ingested unintentionally when swimming in pond contaminated by stool from animal(s) or in swimming pool contaminated by stool from infected person(s). In some cases, gastroenteritis is acquired through contact with animals that carry the infectious microorganism [7].

Bacterial gastroenteritis ranges from mild to severe, manifesting with symptoms such as diarrhoea, nausea, vomiting, abdominal discomfort and fever. It is usually self-limiting, with a duration of less than 24 hours, but improper management of an acute infection can lead to a protracted course for several days [6].

MATERIALS AND METHODS

Study Area: The study was conducted in Minna, Niger State. A city with estimated population of 304,113 in 2007, located in the west central Nigeria and it is the capital of Niger State. The major ecological problem in the state is flooding, particularly when the Niger River overflows its banks [24].

Ethical Consideration: Approval for the study was obtained from the Research, Ethics and Publication Committee of Niger State Hospital Management Board, General Hospital, Minna. Consent of all participants were also sought and obtained.

Study Population: The study population comprised of children and adults of both gender with signs and symptoms suggestive of gastroenteritis visiting the hospitals/clinics.

Collection of Samples: Fresh faecal specimens were collected in sterile universal containers. For children whose faecal specimens could not be collected, rectal swabs were collected using sterile swab sticks.

Laboratory Examination

Macroscopic examination: Gross examination of the faecal specimen was performed to note characteristics such as: Color, consistency and the presence of blood/mucus [20].

Culturing of specimens: All faecal specimens collected were inoculated onto the following media: Nutrient agar, MacConkey agar, *Salmonella-Shigella* (SS) agar, and Thiosulphate citrate bile salt sucrose (TCBS) agar**.**

Specimen were inoculated into the following enrichment media; selenite F broth used for the isolation of *Salmonella* species and incubated for 18 hours at 37^{o}C, and alkaline peptone water was used to isolate *Vibro* species and incubated for 6 hours at 37^{o}C. Direct inoculation was done on MacConkey agar and incubated for 24 hours at 37^{o}C. Samples isolated in selenite F broth were subcultured on SS agar and incubated for 24 hours at 37^{o}C, while samples isolated in alkaline peptone water were subcultured on TCBS and incubated for 24 hours at 37^{o}C [23].

Biochemical characteristics of recovered isolates were compared with those of known taxa. The antibiotics susceptibility pattern of isolates was determined using the disc diffusion method and read according to the Clinical and Laboratory Standards Institute [11].

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RESULTS

The prevalence of bacterial gastroenteritis in relation to age and gender, showed that children between the age group of 0-9 years had the highest prevalence in both male 38(33.33%) and female 31(30.69%) while age group ≥ 70 had the least prevalence of 7(3.26%) (Figure1). The profile of bacteria isolated in relation to gender showed that both male and female had high level of occurrence in *E. coli* isolates at 59(36.88%) and 58(34.52%) respectively. Also, in some cases the same frequency of occurrence in male or female occurred in more than one organism (Table 1).

In the distribution of bacteria isolates according to age groups, *E. coli, Salmonella* species, *V. cholerae*, and *V. parahaemolyticus*, were the bacteria with high frequency in all age groups, while *Citrobacter* species, *Klebsiella* species, *Shigella* species, *Ps. aeruginosa*, *Proteus* species, *Enterobacter* species were the least frequent in all age groups. Enteropathogenic bacteria were isolated with higher frequency from patients in age group 0-9 years 127(38.72%) compared with that isolated from ≥70 years 11(3.35%) (Table 2)

In table 3 the clinical features present among cases of gastroenteritis showed that the percentage of patients who were positive with fever had the highest frequency 173(80.47%), this was followed by diarrhoea 139(64.65%) and then nausea 127(59.07%).

Table 4 is the susceptibility of enteropathogenic bacteria to various antibiotics by disc diffusion test. All the isolates were susceptible to ciprofloxacin with *Shigella* species, *Citrobacter* species, *Proteus* species, and *Enterobacter* species, showing 100% susceptibility. There was 0% susceptibility to Ampicillin and Cefuroxime except for *E. coli* isolates which had 2(1.71%) and *Salmonella* species which had 2(2.44%) for ampicillin. *Pseudomonas aeruginosa* showed resistant to all the antibiotics.

From the macroscopic examination of stool specimen observed in this study, patients with watery (diarrhoeagic) stool had the highest frequency of occurrence 139(64.65%), while a total of 102(47.44%) samples had mucous in stool and 33(15.35%) had blood in stool (Table 5).

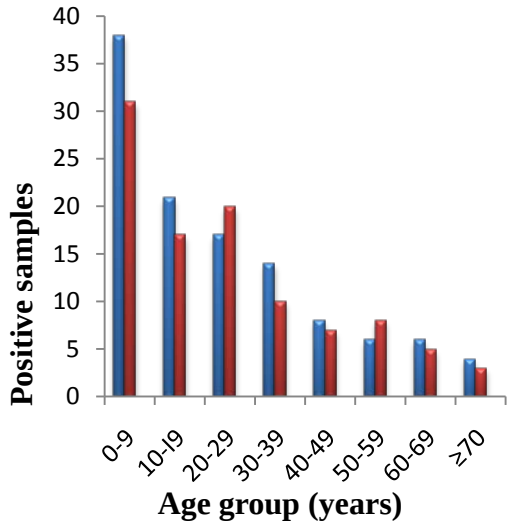

Figure 1: Prevalence of Bacteria Gastroenteritis in relation to Age and Gender

Table 1: Profile of Bacteria Isolated in relation to Gender

Bacteria	Number of Occurrence		Total (%)
	Male (%)	Female (%)	
E. coli	59(36.88)	58 (34.52)	117 (35.67)
Salmonella species	42 (26.25)	40 (23.81)	82(25.00)
Shigella species	2 (1.25)	3 (1.79)	5 (1.52)
V. cholera	26 (16.25)	25 (14.88)	51(15.55)
V. parahaemolyticus	15 (9.38)	18 (10.17)	33(10.06)
Citrobacter species	6 (3.75)	8 (4.76)	14(4.27)
Klebsiella species	4 (2.50)	8 (4.76)	12(3.66)
Ps. aeruginosa	1 (0.6)	6 (3.57)	7 (2.13)
Proteus species	4 (2.50)	1 (0.60)	5 (1.52)
Enterobacter species	1 (0.63)	1 (0.60)	2 (0.61)
Total	**160(48.78)**	**168(51.22)**	**328**

Table 2: Occurrence of Bacteria Pathogens Isolated from Gastroenteritis Among Different Age Groups

Age groups	Bacteria species										**Total (%)**
(years)	A	B	C	D	E	F	G	H	I	J	
0−9	41(32.28)	35(27.56)	4(3.15)	21(16.54)	15(11.81)	6(4.72)	3(2.36)	1(0.79)	1(0.79)	0 (0.00)	**127(38.72)**
10−19	19(45.24)	11(26.19)	0 (0.00)	5 (11.90)	3 (7.14)	0 (0.00)	3(7.14)	1(2.38)	0 (0.00)	0 (0.00)	**42(12.80)**
20−29	18(39.13)	8 (17.39)	0 (0.00)	8 (17.39)	3 (6.52)	4(8.70)	1(2.17)	2(4.35)	2(4.35)	0 (0.00)	**46(14.02)**
30−39	12(30.00)	9 (22.50)	0 (0.00)	7 (17.50)	4 (10.00)	3(7.50)	3(7.50)	1(2.50)	1(2.50)	0 (0.00)	**40(12.20)**
40−49	9(34.62)	7 (26.92)	0 (0.00)	3 (11.54)	2 (7.69)	1 (3.85)	2(7.69)	0 (0.00)	0 (0.00)	2(7.69)	**26(7.93)**
50−59	9(39.13)	5 (21.74)	1(4.35)	3 (13.04)	3 (13.04)	0 (0.00)	0 (0.00)	2(8.70)	0 (0.00)	0 (0.00)	**23(7.01)**
60−69	5(38.46)	4 (30.77)	0 (0.00)	2 (15.38)	1 (7.69)	0 (0.00)	0 (0.00)	0 (0.00)	1(7.69)	0 (0.00)	**13(3.96)**
≥70	4(36.36)	3 (27.27)	0 (0.00)	2 (18.18)	2 (18.18)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	**11(3.35)**

Key: A=*E. coli*, **B**=*Salmonella* spp, **C**=*Shigella* spp, **D**=*V. cholera*, **E**=*V. pareahaemolyticus*, **F**=*Citrobacter* spp, **G**=*Klebsiella* spp, **H**=*Ps. aeruginosa*, **I**=*Proteus* spp, **J**=*Enterobacter* spp

Table 3: Occurrence of Gastroenteritis in relation to the Clinical Features

Clinical Features	Positive (%)	Negative (%)
Fever	173 (80.47)	42 (19.53)
Diarrhoea	139 (64.65)	76 (35.35)
Abdominal pain	96 (44.65)	119 (55.35)
Nausea	127 (59.07)	88 (40.93)
Vomiting	73 (33.95)	142 (66.05)
Loss of weight	16 (7.44)	199 (92.56)

Table 5: Occurrence of Gastroenteritis in relation to the Nature of Stool Specimen

Nature of Stool	Positive (%)	Negative (%)
Formed Stool	27 (12.56)	188 (87.44)
Semiformed Stool	49 (22.79)	166 (77.21)
Watery Stool	139 (64.65)	76(35.35)
Watery/Blood in Stool	33 (15.35)	182 (84.65)
Watery/Mucus in Stool	102 (47.44)	113 (52.56)

Table 4: Antibiotics Susceptibility Pattern of Bacteria Isolated from cases of Gastroenteritis

Bacteria	Antibiotics (µg)						
	CIP (%)	SXT (%)	C (%)	TE (%)	NA (%)	AMP (%)	CXM (%)
E. coli n=117	93(79.49)	72(61.54)	73(62.39)	31(26.50)	73(62.39)	2(1.71)	7(5.98)
Salmonella spp n=82	44(53.66)	57(69.51)	54(65.85)	22(26.83)	27(32.93)	2(2.44)	3(3.66)
Shigella spp n=5	5(100.00)	4(80.00)	5(100.00)	3(60.00)	4(80.00)	0(0.00)	0(0.00)
V. cholera n=51	48(94.12)	24(47.06)	25(49.02)	16(31.37)	29(56.86)	0(0.00)	0(0.00)
V. parahaemolyticus n=33	24(72.73)	17(51.52)	20(60.61)	8(24.24)	12(36.36)	0(0.00)	1(3.03)
Citrobacter spp n=14	14(100.00)	10(71.43)	11(78.57)	10(71.43)	9(64.29)	0(0.00)	2(14.29)
Klebsiella spp n=12	11(91.67)	6(50.00)	10(83.33)	4(33.33)	0(0.00)	0(0.00)	0(0.00)
P. aeruginosa n=7	1(14.29)	1(14.29)	1(14.29)	1(14.29)	1(14.29)	0(0.00)	0(0.00)
Proteus spp n=5	5(100.00)	4(80.00)	5(100.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Enterobacter spp n=2	2(100.00)	1(50.00)	2(100.00)	0(0.00)	1(50.00)	0(0.00)	0(0.00)
Total	**247(75.30)**	**196(59.76)**	**206(62.80)**	**95(28.96)**	**156(47.56)**	**4(1.22)**	**13(3.96)**

Key: CIP=Ciprofloxacin (5µg), **SXT**=Sulphamethoxazole/Trimethoprim (25µg), **C**=Chloramphenicol (30µg), **TE**=Tetracycline (30µg), **NA**=Nalidixic acid (30µg), **AMP**=Ampicillin (10µg), **CXM**=Cefuroxime sodium (30µg)

DISCUSSION

Acute diarrhoea due to bacterial infection is an important cause of morbidity and mortality in infants and young children in most developing countries including Nigeria [2].

Figure 1 which is the prevalence of bacterial gastroenteritis in relation to age and gender, showed that children within the age bracket 0-9 years of age were more susceptible to gastroenteritis 69(32.09%). This is similar to studies carried out by Nahed [18] in Gaza strip, Palestine and by Das, Saha, and Singhal [12] in India, were they was an increase in diarrhoea cases in children below the age of 5 years. This was due to greater percentage of patients with gastroenteritis belong to this age and also because enteropathogenic bacteria were isolated with a higher frequency from patients belonging to this age group. The age group with the lowest frequency of occurrence was ≥70 years, which had a percentage of 7(3.26%). The reduction in the frequency of occurrence in this age bracket was due to the number of cases that visited the hospital and also because most people in this age bracket visit the hospital only in very severe cases. In this study, age had a statistically significant association with gastroenteritis ($p<0.05$) which is similar to a study done by Asamole-Osuocha [4], in which age had a statistically significant association with diarrhoeal disease in Abuja. There was no significant difference between male and female ($p>0.05$) in this study which is similar to a study done in Jos by Christopher and Okolo [10] where although, there were more male children with diarrhoea, the odds of having diarrhoea was not significantly related to sex. The reason for the finding being that bacteria gastroenteritis does not depend on gender for infection to occur.

The rate of isolation of bacteria species according to gender is shown in Table (1). In this study, *E. coli* had the highest incidence of 117(35.67%) while *Enterobacter* species had the lowest rate of 2(0.61%) with respect to gastroenteritis. According to Nweze [19], *E. coli* showed the highest incidence rate of 44.74% in a research titled, the virulence properties of diarrheagenic *E. coli* and etiology of diarrhoea in infants, young children and other age groups in South East, Nigeria. The finding in this study also indicated that *Salmonella* infection was slightly higher in male 42(26.25%) than female 40(23.81%). This is in agreement with an earlier study by Ifeanyi, Bassey, Ikeneche, Isu and Akpa [16] that showed *Salmonella* infections being relatively higher in male children than their female counterparts in the same age group. The occurrences of bacteria gastroenteritis has nothing to do with gender ($p>0.05$).

The occurrence of bacteria pathogens isolated from patient with gastroenteritis in Minna based on different age group were showed in Table (2). Enteropathogenic bacteria were isolated with a higher frequency from patients belonging to the age group 0-9 years 127(38.72%) and a decrease in bacteria species was observed with increase in age, a statement that is in line with a study done in Gaza strip, Palestine by Nahed [18]. The study showed that *E. coli* isolates were higher in children less than 9 years of age 41(35.04%), and also higher than other bacteria isolated, this was equally similar to a statistical analysis done by Ifeanyi, Isu, Akpa, and Ikeneche [17] in which *E. coli* was significantly associated with diarrhoea in children younger than 3 years ($P<0.05$) and it was the most frequently isolated bacteria in all age groups. *Citrobacter* species, *Klebsiella*

species, *Ps. aeruginosa*, *Proteus* species, *Enterobacter* species were the least frequent in all age group. These bacteria are usually normal flora of human intestinal tract but could become opportunistic pathogens responsible for a wide range of infections [15]. *Klebsiella* may produce *E. coli*-like enterotoxins and cause acute gastroenteritis in infants and young children. Enteric illnesses due to *Klebsiella* are more predominant where populations are more crowded and conditions less hygienic [13].

Table (3) shows certain clinical features which may be present in gastroenteritis. Present in high percentage is fever 173(80.47%), which is in line with most studies that revealed that high number of patients with gastroenteritis had high fever during diarrhoea [22]. Other clinical features are diarrhea 139(64.65%), nausea 127(59.07%), abdominal cramps 96(44.65%), vomiting 73(33.95%) and weight loss 16(7.44%).

Table (5) shows how susceptible the different bacteria isolated from gastroenteritis are to each of the antibiotics used. *Shigella* species, *Citrobacter* species, *Proteus* species, and *Enterobacter* species, were 100% susceptible to Ciprofloxacin, while the remaining bacteria isolates had susceptibility of above 70% except *Ps. aeruginosa* which was resistant. This is in contrast with Cheesbrough [9], which says that ciprofloxacin (fluroquinolone) is active against *Pseudomonas* and is used to treat serious systemic infection. The resistance could be due to the misuse or overuse of drugs. The least susceptible antibiotics is ampicillin 4(1.22). This is related to a study done by Abdullahi, Olonitola and Inabo [1] in Kano State, whereby bacteria isolates associated with diarrhoea among children attending some hospitals in Kano metropolis showed that ampicillin was the least susceptible to the bacteria isolated. Bauer and Kirby [5] and Perilla [21] reported that, antimicrobial susceptibility of diarrhoeal pathogen is usually affected because acquired antimicrobial resistance is a worldwide problem due to the increasing use of antimicrobials in humans, animals, and agriculture. In developing countries the situation is particularly serious because antimicrobials can be obtained outside recognized treatment centers, and taken without medical authorization or supervision and also, the high cost of an antibiotic result in an incomplete course being purchased [21]. The effectiveness of drugs such as ciprofloxacin may be because it is not widely used due to the high cost and it is not readily available in most rural communities.

As shown in Table (5), the nature of stool is one of the determinants of gastroenteritis, which is said to be the macroscopic examination of stool specimen. It was shown that the presence of watery (diarrhoeagic) stool was highest 139(64.65%), while watery/mucous in stool was 102(47.44%), and bloody diarrhoea was 33(15.35%) These occurrences are similar to different literatures that have listed the symptoms of gastroenteritis as diarrhoea (being the most common symptom) which may be accompanied by visible blood and mucus [7] [14].

CONCLUSION

The result from this study showed that children between the ages of 0-9 years were more susceptible to infectious diarrhoea because a higher percentage 69(32.09%) of positive samples were from patients of this age group.

It was observed that ampicillin and cefuroxime had high rate of resistance. In the case of ciprofloxacin, susceptibility was high in all the organisms isolated except for

Pseudomonas aeruginosa which showed resistant to all the drugs tested. It is important to note that, the rise in the availability and usage of antimicrobial agents for symptomatic treatment has been the backbone for the emergence of antimicrobial resistance. It is therefore important to monitor the susceptibility patterns of microorganisms as it contributes significantly to the burden of diarrhoea.

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