The Burden of Gastroenteritis in the Post-Rotavirus Vaccine Era in Ghana: A Hospital Diagnoses-Based Study

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ABSTRACT

*Globally, gastroenteritis is the second cause of post-neonatal morbidity and mortality. **Aims:** This study evaluates the burden of acute gastroenteritis (AGE) in the central part of the Volta Region of Ghana to assess the impact of rotavirus vaccination in the region. **Methods:** Hospital diagnoses records of in-patients from seven major health centres within and around the city of Ho were collected and analysed. The inclusion criteria considered children who were five years and below, and hospitalized in the selected health centres. The number of AGE cases included in the study was 1908, out of 17,017 hospitalized cases. **Results:** Children between the ages of 12 and 24 months had the highest incidence of AGE, but the incidence however declined significantly after 24 months of age, which may be due to acquired natural immunity which develops with age. The data revealed that more boys were hospitalized compared to girls, and the months of July and August recorded the most cases. Out of the 1908 hospitalized cases of AGE, 99.2% were treated and discharged and 0.6% deaths were recorded. Yearly analysis of the diagnoses records over the period under consideration showed that there was no significant difference in the number of AGE cases reported to the hospitals. **Conclusion:** This study suggests that the problem of diarrhoea mortality in children still exist after the introduction of the rotavirus vaccine, and therefore the search for a complete solution continues until the last child is saved from diarrhoea death.*

Keywords: Gastroenteritis, Rotavirus vaccine, Diarrhoea

INTRODUCTION

Acute gastroenteritis (AGE) is characterized by infection leading to the inflammation of the gastrointestinal tract. The condition is associated with combination of diarrhoea, vomiting, abdominal pains and fever. Untreated AGE often results in dehydration, loss of energy and eventually death in some cases [1]. Globally, AGE is responsible for an estimated 19% deaths in children under five years [2]. United States of America reports about 179 million cases of AGE annually [3] and the AGE accounts for about 10% hospitalization of children under 5 years [4]. In Australia, about 10,000 hospital admissions of the above mentioned age group is due to AGE and about 20.5% in the United Kingdom. In Africa, AGE is responsible for approximately 1.87 million deaths in children, and known to be one of the most common diseases associated with high morbidity and mortality in developing countries [5]. The prevalence of AGE in Ghana was recorded as 5847 out of about 30000 children that were hospitalized at two referral hospitals in the Accra Metropolis Namely Children's hospital and Korle Bu Teaching hospital [6]. The 2010 population and housing census of Ghana confirmed that, AGE was one of the top ten morbidity indicators from the Volta Region of Ghana with 55,286 AGE cases (3.67%) [7]. AGE may be caused by agents such as viruses, bacteria or protozoans [4] which infect the gut and are responsible for the diarrhoea and vomiting [5]. Among these pathogens, viral agents are the major cause of gastroenteritis in developing countries. Viral AGE in children is caused by a number of viruses including noroviruses (NV), human rotaviruses (HRV), human adenoviruses (HAdV), human astroviruses (HAstV), and sapoviruses (SaV) [8]. Globally, 20% of all fatal diarrhoea are caused by severe rotavirus infection [9], and the infection accounted for an average of 215,000 deaths in 2013 [10]. Rotavirus infection was implicated as the major cause of diarrhoea in children in West Africa [9]. In 2012, 528 out of 1077 (49%) diarrheal cases from Ghana tested positive for rotavirus [11], and another hospital-based study in 2014 recorded 3160 rotavirus cases out of 3963 (80%)

diarrheal cases [6]. To reduce the morbidity and mortality due to rotavirus infection, the World Health Organization (WHO) has recommended the use of rotavirus vaccines worldwide [12]. Introduction of the rotavirus vaccines is responsible for the reduction of diarrhoea cases in the Americas and a number of European countries [13]. In Ghana, introduction of the rotavirus vaccine, Rotarix®, into the Expanded Programme on Immunization (EPI) in May 2012 has reduced rotavirus-induced gastroenteritis, and has allowed the detection and estimation of other viruses that are associated with severe diarrhoea [14]. Since rotavirus is a major cause of AGE in children in Ghana, the introduction of the vaccine is expected to lead to a reduction in diarrhoea cases. This study was designed to understand the disease burden of AGE in children, 5 years and below, in the central part of the Volta Region of Ghana.

METHODS

Administrative and institutional clearance were obtained from the Volta Regional Health Directorate to collect in-patient primary hospital data on AGE. The hospital data were collected from seven health centres (Volta Regional Hospital, Ho Municipal Hospital, Ho Polyclinic, Margret Marquart Catholic Hospital, Hohoe Municipal Hospital, Anfoega Catholic Hospital, and Peki Hospital) in the central part of the Volta Region of Ghana. The health centres provide primary, secondary and/or tertiary health care service for over 12000 children annually. All the centres provide general medicine, surgery and other specialized services such as oncology and cardiac health care, and are located in four adjoining municipalities of the Volta Region: South Dayi, Kpando, Ho, and Hohoe Municipal Assemblies. Children 5 years and below with AGE who were admitted in one of the seven hospitals within the period of January 2012 to December 2014 were considered for the study. AGE was defined as diarrhoea (loose stool with or without vomiting), cholera and dysentery, and was diagnosed as either principal diagnosis (major cause of illness and hospitalization) or additional/secondary diagnosis (additional cause of illness and hospitalization), as indicated in the hospital records. In the case of the additional diagnosis, the patients presented a major cause of illness to the hospital and were further diagnosed of AGE as the secondary/minor cause of illness.

Microsoft Excel™ was used for data entry and preparation, and IBM SPSS version 20 was used for data analysis. Frequency distribution and percentages were used to compare the cases recorded in the various health centres. Independent T-test (95% CI) was used to compare AGE cases recorded in the various years. The gender distributions of AGE were normalized against total number of cases recorded for each gender (male and female) to avoid biases.

RESULTS

Demographic characterization of the study population

Over a period of 36 months, hospital data of children hospitalized in 7 selected hospitals were collected and analysed. To determine the distribution of AGE with respect to the individual health centres, the percentage of AGE of in-patient cases reported was calculated as a fraction of the total number of cases received by the respective health centres. The Hohoe Municipal Hospital recorded the highest percentage AGE cases (15.2%) followed by Ho Municipal Hospital (13.0%) (Table 1).

Table 1 In-patient cases of children 5 years and below from selected health centres

Name of health centres	Number of AGE cases/Number of in-patient cases	Percentage of AGE cases in each health centre
Volta Regional Hospital	209/2489	8.4
Ho Municipal Hospital	280/2152	13.0
Ho Polyclinic	3/51	5.9
Hohoe Municipal Hospital	699/4608	15.2
Margret Marquart Catholic Hospital	258/2764	9.3
Anfoega Catholic Hospital	330/3685	9.0
Peki Hospital	129/1268	10.2
Total	**1908/17017**	**11.2**

Acute gastroenteritis (AGE) was defined as diarrhoea (loose stool with or without vomiting), cholera and dysentery.

Annual distribution of AGE cases

Over the period of three conservative years (January 2012 - December 2014) considered for the study, a total of

17017 children were hospitalized in the selected health centres out of which 1908 (11.2%) were diagnosed of AGE as the principal or secondary cause of the hospitalization (Table 1). Even though there were small differences in the annual AGE cases recorded for all the health centres which were 27.5%, 37.5% and 35.0% for 2012, 2013 and 2014, respectively, these differences were not statistically significant (Figure 1). The seasonal distribution of AGE cases suggests a high incidence in the dry seasons compared to the wet seasons (Figure 1) with January recording the highest number of cases (13.5%), even though there was no record for January 2014.
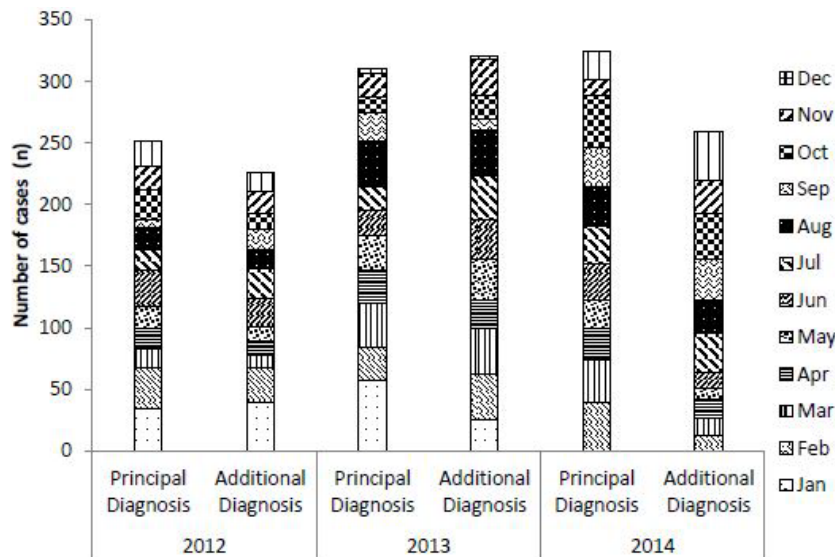

Figure 1 Annual distribution of AGE cases

Age and sex distribution of AGE cases

The incidence of AGE was highest in age group 12-24 months, but the cases were lower in ages below and above the age group 12-24 months (Figure 2). The yearly incidence of children hospitalized with AGE cases increased from 2012 to 2014 in all the age groups except those who are less than 12 months of age in which 2014 recorded the least number of cases (Figure 2). The number of boys with AGE admitted were more than girls but this difference was not statistically significant when boys with AGE (1,062 cases out of 9,267 male admissions) was compared to girls with AGE (845 cases out of 7,742 female admissions). The sex of 8 patients was not found in the records of the health centres.
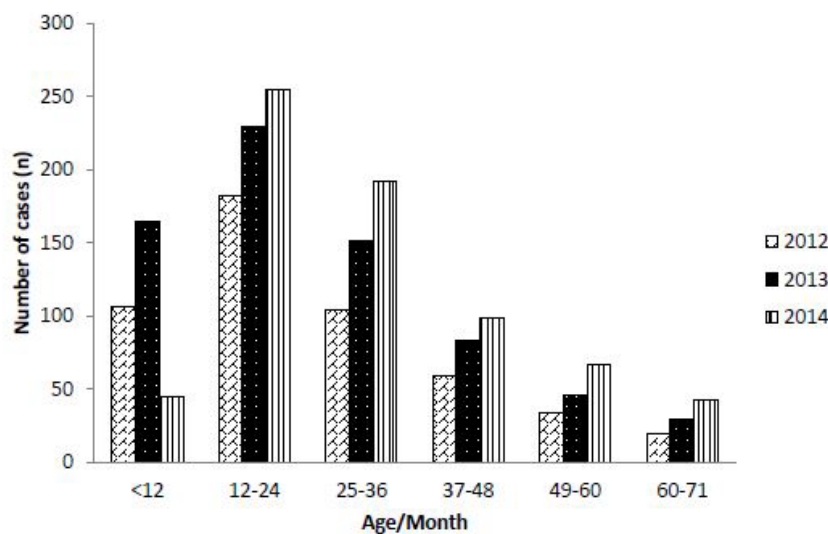

Figure 2 Age and sex distribution of AGE cases

Effectiveness of AGE treatment

A large number of AGE cases (99.0%) were treated and discharged which suggests that the facilities have adequate treatment for AGE. However, a small percentage of the patients were transferred (0.3%), absconded (0.2%) or died (0.6%) (Table 2). Even though all the hospitals lack diagnostic tools for viral and protozoan AGE, some bacterial AGE cases were diagnosed by microscopy and/or stool culture.

Table 2 Effectiveness of treatment of diarrheal diseases

Outcome of treatment	Principal Diagnosis				Additional Diagnosis				Total (%)
	AGE	Dysentery	Cholera	Diarrhoea/Nausea	AGE	Dysentery	Cholera	Diarrhoea/Nausea	
Treated and Discharged	929	8	10	45	834	19	5	39	1889 (99.0%)
Died	7	0	0	1	1	0	0	2	11 (0.6%)
Transferred	4	0	0	1	0	0	0	0	5 (0.3%)
Absconded	0	0	0	0	3	0	0	0	3 (0.2%)
Total (%)	940 (49.3%)	8 (0.4%)	10 (0.5%)	47 (2.6%)	838 (44%)	19 (1.0%)	5 (0.3%)	41 (2.1%)	1908 (100%)

DISCUSSION

Our study evaluated the burden of acute gastroenteritis (AGE) in the central part of the Volta Region of Ghana. Acute gastroenteritis is known to be among the top three causes of child morbidity and mortality [5], and of critical importance for public health. The results of this study indicated that AGE was more prevalent in the municipal hospitals (Hohoe and Ho Municipal Hospital) than the regional hospital. The Municipal Hospitals usually have majority of the patients from the rural communities near the facilities, while the regional hospital received referral and emergency cases from all the other health centers [15]. The high percentage of AGE cases recorded by Hohoe and Ho Municipal hospitals may be due to poor living conditions (poor dietary and hygienic conditions) of the rural inhabitants of the municipality [16-19]. The high number of AGE cases in developing countries are also due to poor planning and evaluation of interventions to control diarrhoea deaths [2]. One of the major problems encountered by developing countries in reducing child mortality is the lack of systems that regularly generate data on causes of morbidity and mortality.

This study provides baseline data on the morbidity and mortality of AGE cases in the Volta Region of Ghana. The data from the central part of the Volta Region of Ghana showed that there were no significant differences in the yearly hospital diagnosed AGE cases from 2012 to 2014. A prevalence study has reported a decline in the burden of rotavirus induced AGE in Ghana since the vaccine was introduced into the immunization system in May 2012 [6]. The reduction of diarrhoea cases due to the rotavirus vaccine suggests that other diarrhoea causing agents may be contributing to the high numbers and consistent incidence of AGE cases recorded after the introduction of the vaccine in the central part of the Volta Region. Our study was based on hospital diagnoses which included all AGE cases, but the etiological agents responsible for the diseases were not known. It is therefore recommended that the cause of diarrhoea at the study site should be investigated to determine the role of the vaccine in reducing AGE and also provide data on other possible causes of AGE. As a follow up to this study, the authors are putting a proposal together to investigate the cause of diarrhoea at the study site.

Children between the ages of 12-24 months had the highest number of AGE case. The children less than 12 months of age were, presumably, protected by passive immunity which is provided by maternal antibodies, but the immunity wanes off by the age of 12 months. The period between the development of innate immunity and the wearing off of the passive immunity makes the children below the age of 12 months susceptible to most infections [20]. AGE is the major type of infection observed before age 12 months [19], and most children older than 24 months of age develop immunity against diarrhoea pathogens, hence the reduced number of AGE cases recorded with increase in age. The observation that there were more AGE cases in boys than girls may be due to boys being more adventurous and mobile than girls, and thus making the male sex to come into contact with gastro-enteric agents which cause AGE than the female sex. Similar results that boys are more exposed to gastro-viral agents have also been shown in other studies across the world [6,16,18,19,21].

CONCLUSION

Diarrhoea mortality in children is still a problem in the central part of the Volta Region even after the introduction of the rotavirus vaccine. This study therefore suggests that there is the need to search for a complete solution for diarrheal morbidity and mortality until the last child is saved from diarrheal death.

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