ORIGINAL ARTICLES

THE IMPACT OF ROTAVIRUS VACCINE ON DIARRHEAL DISEASES AMONG CHILDREN UNDER FIVE YEARS: A RETROSPECTIVE ANALYSIS OF DATA FROM 2012 TO 2015 IN THE YILO KROBO MUNICIPALITY OF GHANA

Owusu-Sarpong A[1], Agbeshie K[2], Teg-Nefaah PT[3]
[1]Lower Manya Krobo Health Directorate Odumase; [2]Yilo Krobo Municipal Health Directorate Somanya; [3]School of Public health University of Ghana

Abstract

Introduction: Diarrhea is an important childhood disease with high morbidity and mortality among children under 5 years of age in developing countries such as Ghana. Rotavirus vaccine was introduced in Ghana in 2012 to reduce the incidence of diarrhea among children in Ghana. The objective of the study is to assess the impact of rotavirus vaccines on the burden of diarrheal diseases among children under five years reported in the Yilo Krobo Municipality from 2012 to 2015.

Methods: A retrospective analysis of routinely collected and reported data on the monthly outpatient department (OPD) morbidity returns and vaccination reports from health facilities in the Yilo Krobo Municipality was done.

Results: The burden of diarrheal diseases in children under five years declined from 2012 to 2014 with a slight increase in 2015. Diarrhea formed 9.71% of OPD cases in children under five years in 2012 with a reduction to 7.73% between 2013 and 2015.

Conclusion: The rotavirus vaccine has had some impact on the incidence of diarrheal diseases reported at the outpatient departments.

Key Words: Rotavirus vaccines, Diarrhoea, Impact, Yilo Krobo, Ghana

Introduction

The Expanded Program on Immunization (EPI) was launched in 1978 with six vaccines: oral Polio, Measles, Diphtheria-pertussis-tetanus (DPT) and Bacillus Calmette-Guerin (BCG) for children under one year and Tetanus toxoid (TT) for pregnant women. These vaccines were introduced to reduce the morbidity and mortality of vaccine preventable diseases. Outreach, static and campaign strategies were used to reach the population[1]. Ghana introduced the Pneumococcal and Rotavirus vaccines in April 2012 as part of its (EPI) to prevent and reduce pneumonia and diarrheal diseases respectively.

Immunization is one of the ways of preventing diseases especially among children and has contributed to the reduction of childhood diseases. Developing countries contribute about 95% of the deaths in children under five years globally. Seventy percent (70%) of these deaths can be prevented by immunisation[2]. When many individuals are vaccinated, there can be protection for all through herd immunity[3].

Corresponding Author: **Dr. Akosua Owusu-Sarpong**
P. O. Box 64, Odumase
Tel: 00233 208131976
Email Address: akos_owususarpong@yahoo.com
Conflict of Interest: None Declared

The success of the initial vaccines in reducing morbidity and mortality provided enough evidence to further introduce new vaccines to cater for other diseases. Ghana began the process to introduce the pneumococcal and rotavirus vaccines as well as a second dose of measles in 2009[1].

Rotavirus is the most common pathogen causing diarrhoea[4] in children under one year leading to dehydration and death. For childhood diarrhea hospitalizations, rotavirus accounted for 22% in 1986 compared with 39% in 2004[5]. To prevent diarrhea, two doses of the rotavirus vaccine are required for children at 6 and 10 weeks of age.

With the introduction of rotavirus vaccine as part of the routine immunization program, the burden of diarrheal diseases is expected to decline. However, this has not been established since no study has been done to determine the impact of the vaccine. This study therefore, sought to look at the effect of the vaccine on the clinical burden of the disease after its introduction in the Yilo Krobo Municipality.

Objective

To assess the effect of rotavirus vaccines on the burden of diarrheal diseases among children under five years of age in the Yilo Krobo Municipality from 2012 to 2015.

Methods

Study Area

The Yilo-Krobo Municipality is one of the twenty-six Municipals in the Eastern Region of Ghana, strategically located in the south eastern part of the country. It shares boundaries with the Lower and Upper Manya-Krobo Municipalities in the North and East, Dangbe West and Akwapim North Municipalities in the South, New Juabeng, East Akim and Fanteakwa Municipalities in the West. The Municipality covers a land area of 805 square kilometers with Somanya as the Municipal capital.

The 2010 Housing and population Census indicates an estimated 2015 population size of 97,466 giving the number of children under five years as 13,255.

Study Design

A retrospective analysis of routinely collected and reported data from health facilities in the Yilo Krobo Municipality to the district health information system 2 (dhim 2) platform of the Ghana Health Service was done.

Data Source and Study Variables

Routine service data including morbidity and immunization service data entered into the district health information systems (dhim 2) platform, which is the main reporting portal of the Ghana Health Service was extracted. Data extracted was between January 2012 to December 2015 for diarrheal diseases as well as immunization data. The data was extracted from the monthly morbidity report and monthly EPI report in the dhim 2.

Diarrheal diseases were the main conditions studied. The diagnosis of this condition in the health facilities within the Municipal was based on Integrated Management of Childhood Illness protocol (IMCI)[6]. Demographic characteristics like age, sex and geographic location were among the study variables.

Data Analysis

The data on outpatient cases of diarrhea in children under 5 was extracted into Microsoft Excel, 2013 version. It was also used to group and summarize the OPD morbidity form and monthly vaccinations. The proportion of diarrheal diseases on total Outpatient conditions was calculated to know the burden/prevalence of the condition from 2012 to 2015. This was compared over the period to determine increase or decrease in burden of diarrhea. A simple correlation analysis of diarrhea cases seen was run to determine the relationship between the years and cases recorded. This was done using Statistical Package for Social Sciences (SPSS v25)

The trend and vaccine coverage rates for rotavaccine was also extracted and calculated from the monthly EPI (vaccination) report on the dhim 2 platform. Vaccine coverage rates were determined with number of doses administered per number of targeted children under one year for the period. As stated, the number of doses administered was taken from the vaccination report whereas the targeted children were from the demographic data of the Yilo Krobo Municipality.

Ethical Considerations

Data used in the study is available on the Ghana Health Service dhim 2 system of reporting data. Discussions were also held with the health authorities in the Municipality before using the data for the study.

Results

As shown in table 1 diarrheal diseases contributed 2598 (9.71%) out of 26707 new cases in children under five in 2012 compared with 3045 (8.21%) out of 37064 in 2013. This declined further to 2517(7.21%) out of 34884 new cases in 2014. In 2015, diarrheal diseases were 2867 (7.74%) out 37006 (Refer to table 1).

Table 1. Total Diarrheal cases from 2010 to 2015

Year	Diarrhea (<5)	Total <5 Conditions	% Diarrhea (<5)
2012	2598	26707	9.71
2013	3045	37064	8.21
2014	2517	34884	7.21
2015	2865	37006	7.71

The district recorded high immunization coverages as shown in table 2 below.

Table 2. Four year trend of immunization coverage for rotavaccine

Year	1st doses adm.	% cov.	2nd doses adm.	% cov.
2012	2174	59.35	1885	51.46
2013	3892	104.06	3960	105.88
2014	3982	104.30	4074	106.71
2015	4550	116.70	4606	118.13

Trend of Diarrhea and distribution

The study showed a general trend in reduction of diarrhea cases as shown in figure 1.

The review showed diarrhea in children under 1 year in 2012 to be 13.79%. This reduced to 10.19% in 2013. Amongst children 1 – 4 years, diarrhea was 8.86% in 2012. This reduced to 7.82%, 6.62% and 6.85% in 2013, 2014 and 2015 respectively (figure 2). Diarrheal diseases among males in 2012 was 10.37% and 9.04% among females. In 2013, diarrhea among males was 8.65% and 7.75% in females reducing to 7.35% in males and 7.07% in females in 2014. There was an increase in 2015 of 7.91% in males and 7.56% in females.

Rural-Urban Differences

There was consistent reduction of diarrhea cases in the rural areas starting with 10.5% in 2012 to 9.9%, 8.5% and 7.9% in 2013, 2014 and 2015 respectively whereas there was a slight increase in 2015 in the urban areas. Refer to fig 3

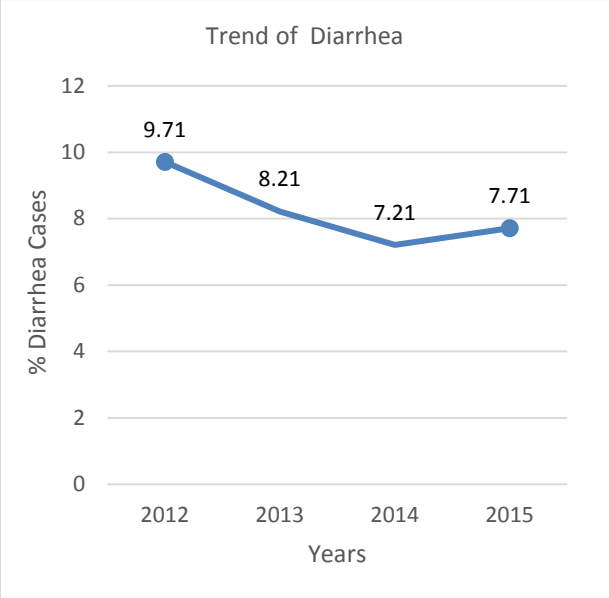

FIG. 1 TREND OF DIARRHOEA DISEASES, 2012 - 2015

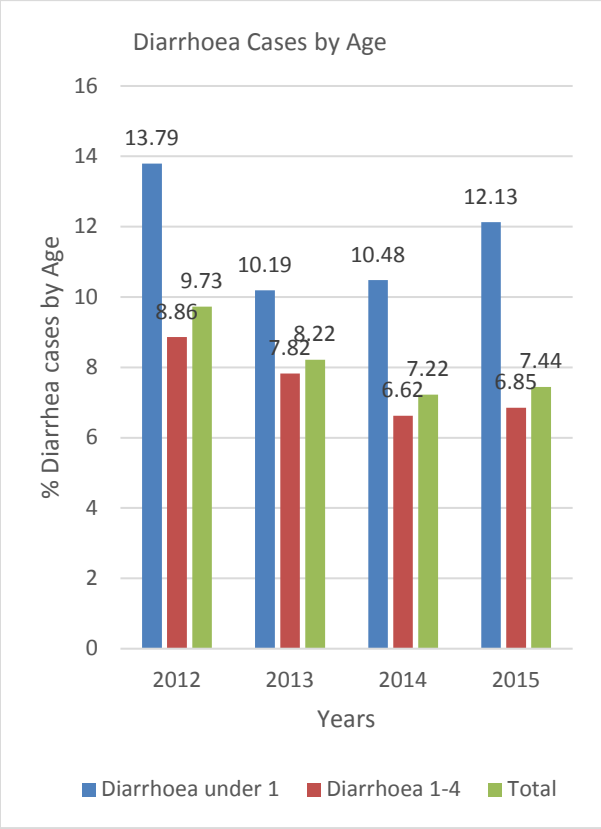

FIG 2. DIARRHEA CASES BY AGE, 2012 - 2015

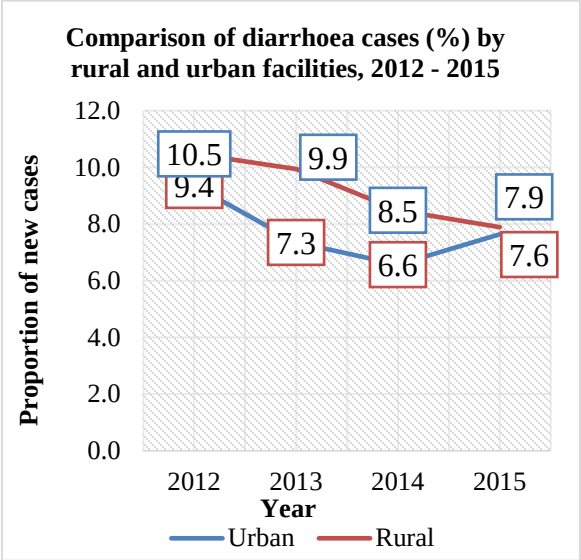

Fig. 3 Diarrhoea in urban and rural areas, 2012-2015

Discussion

The introduction of rotavirus vaccine reduces the mortality and morbidity of diarrhoea[7,8], and it's expected that, a decline in diarrhea diseases seen at OPD should happen especially among children under five. From the analysis of the data for the Yilo Krobo municipality, diarrheal diseases were 9.73% of total cases seen in children under five in 2012 and declined to 7.22% in 2014. There was however, an increase to 7.74% in 2015. Amongst the diarrhea diagnoses, males were mostly affected. Between 2012 and 2015, diarrheal diseases at OPD amongst male children under five was 4.3% and 3.6% in females. Also, children under one year were more likely to be diagnosed of diarrhea compared with those 1–4 years. From the data analyzed, 11.06% of children under 1 were treated for diarrhea compared with 7.27% among those 1–4 years.

As indicated earlier, the burden of diarrhea in children under five years kept declining from 2012 to 2014 with slight increase in 2015. However, there were consistent reductions in diarrhea cases in rural areas over the four year period and the slight increase in 2015 was as a result of increase in urban areas. The impact of rotavirus vaccine on diarrhea mortality and morbidity depends on vaccine effectiveness as well as vaccine administration in accordance with the recommended schedule[8]. Quality immunization services with valid doses in both rural and urban areas will result in reduction of diarrhea diseases in both areas, however differences in immunization services in these areas will result in reduction in the disease burden in one area with increases in the other areas. The incidence among children under one and 1-4 years were 13.79% and 8.86% in 2012 which reduced to 10.96% and 7.11% in 2013 – 2015. The reduction in the burden of diarrhea cases is consistent with other studies conducted elsewhere. A study conducted in Brazil showed a huge

decline in hospitalizations and about a 50% decrease in deaths in children under one year and 32.9% decrease in older children[9] after the introduction of Rotavirus vaccine. Also, in a similar study conducted on the effect of rotavirus vaccine on diarrhea morbidity, there were reductions in hospitalizations due to rotavirus infections and diarrhea episodes. The effectiveness of the vaccine against rotavirus infection is demonstrated by significant reduction in child morbidity and mortality in low-income countries if implemented appropriately[10].

A simple correlation analysis between the year and diarrhea burden was -0.830 which denotes that diarrheal diseases generally reduced with time and this agrees with several studies that indicates the reduction of diarrheal diseases following introduction of rotavirus vaccine. Studies have showed reduction in diarrhea diseases, hospital admissions and mortalities from diarrhea diseases after introducing rotavirus vaccine .[8,9]

The rotavirus vaccine also recorded high coverage and drop-ins in the Municipality over the three years period (table 2).

It is known that when immunization rates for the introduction of these vaccines, for example Rotavirus vaccine and Pneumococcal Conjugate Vaccine are high, the carriage of Rotavirus and *Streptococcus pneumoniae* decreases significantly[11] and therefore the disease condition reduces. It therefore, becomes crucial for immunization practices to be done properly to ensure that targeted children receive potent vaccines at the right intervals or timing through the right route of administration to ensure reduction in vaccine preventable diseases in children and improve child survival.

Limitations of Study

The review was based on outpatient data reported by health facilities. Other important factors like regular change and modification of data collection and reporting forms during the period posed a limitation, however data officers were trained on the use of the new data collection forms to reduce the limitation.

Conclusion

Vaccination is an important means of preventing diseases especially in children. The rotavirus vaccines were introduced to prevent and reduce the burden of diarrheal diseases. Immunization rate for the municipality was high for rotavirus and the data demonstrated reduction in diarrheal diseases seen at the OPD in Yilo Krobo Municipality following the introduction of the rotavirus vaccine

Acknowledgement

I acknowledge the staff of Yilo Krobo Municipal Health Management team for their support in this work as well as the staff of Faculty of Public Health, Ghana College of Physicians and Surgeons for their support.

References

1. WHO/UNICEF/GHS. MINISTRY OF HEALTH - GHANA Immunization Programme Comprehensive Multi - year Plan In line with Global Immunization Vision and Strategies. Geneva: 2014.
2. Mashal T, Nakamura K, Kizuki M, Seino K, Takano T. Impact of conflict on infant immunisation coverage in Afghanistan: a countrywide study 2000-2003. *Int J Health Geogr* 2007; 6:23.
3. Finn A, Savulescu J. Is immunisation child protection? *Lancet* 2011; 378:465–468.
4. Parashar UD, Bresee JS, Gentsch JR, Glass RI. Rotavirus. *Emerg Infect Dis* 1998; 4:561–570.
5. Parashar UD, Gibson CJ, Bresee JS, Glass RI. Rotavirus and severe childhood diarrhea. *Emerg Infect Dis* 2006; 12:304–306.
6. WHO. IMCI Chart Booklet. Geneva: 2014.
7. Chang MR, Velapatiño G, Campos M, Chea-Woo E, Baiocchi N, Cleary TG, Ochoa TJ. Rotavirus seasonal distribution and prevalence before and after the introduction of rotavirus vaccine in a peri-urban community of Lima, Peru. *Am J Trop Med Hyg* 2015; 92: 986–988.
8. Widdowson MA, Meltzer MI, Zhang X, Bressee JS, Parasher UD. Cost-effectiveness and potential impact of rotavirus vaccination in the United States, *Pediatrics*, 2007,119: 684-697
9. Gurgel RQ, Ilozue C, Correia JB, Centenari C, Oliveira SMT, Cuevas LE. Impact of rotavirus vaccination on diarrhoea mortality and hospital admissions in Brazil. *Trop Med Int Heal* 2011; 16:1180–1184.
10. Munos MK, Fischer Walker CL, Black RE. The effect of rotavirus vaccine on diarrhoea mortality. *Int J Epidemiol* 2010; 39(SUPPL. 1):56–62.
11. Akeda H, Chang B, Nakamura Y, Hamabata H, Ameku K, Toma T, et al. Impact of Seven Valent Pneumococcal Conjugate Vaccine on Nasopharyngeal Carriage in Young Children in Okinawa, Japan. *World J Vaccines* 2015; 5:88–95.