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Epidemiology of rotavirus caused diarrhoea in infants in Oman

Ebtihag, E. M[1]., Ali, Y.H.[2]

[1] Sudan Academy of Sciences
[2] Central Veterinary Research laboratory, P.O. Box 8067, Al amarat, Khartoum, Sudan
**Corresponding author: Dr. Yahia Hassan Ali*
Central Veterinary Research Laboratory, Virology Department, P.O.Box:8067
Email: y_beik@hotmail.com

ABSTRACT: Objectives: To investigate the epidemiology of rotavirus associated diarrhoea in children under 5 years of age in Sultanate of Oman. **Methods:** Data about the incidence of gastroenteritis, reported clinic visits, hospitalization during 2006-2008 was collected and statistically analyzed. Two regions were selected for the study (North and South Batinah). ELISA for detection of group A rotavirus antigen was applied on 200 fecal samples collected from diarrhoeic infants in the study area.

Results: During 2006-2008 North Batinah had reported the highest prevalence rate (51.5%) of 2672 rotavirus tested feacal samples. Most of rotavirus positive cases were at 7-12 months of age. The incidence of diarrhea was slightly more in males (54-55%). Out of 200 ELISA tested faecal samples in 2008, rotavirus antigen was detected in 125 (62.5%), of which 69.6% were in North Batinah while only 30.4 were in South Batinah. Highest prevalence of rotavirus was observed in 7-12 months of age (59%). Males comprised 53.6% of total positives.
Conclusions: Rotavirus infection is found to be widely distributed in Oman. Highest prevalence of rotavirus was observed in 7-12 months of age (59%). Rotavirus associated diarrhea is more prevalent in North Batinah area in Oman.

KEY WORDS: Epidemiology, Rotavirus, Diarrhoea, infants, Oman

INTRODUCTION

Gastroenteritis represents a very important health problem facing human being since long time and up to now. In the past, many countries had no healthy and clean water resources because of which a lot of gastro-enteritis epidemics had occurred world wide. Among these comes rotavirus gastroenteritis as one of the most serious problems accounting for 20-70% of all hospitalization and 20 % of deaths due to gastroenteritis in young children (Anon, 2003). Rotavirus infection has a worldwide distribution, and it is the most common cause of severe diarrhea in young children. Almost all children are infected by the age of 3-5 years (Patric et al., 1999).

The Control of Diarrheal Disease (CDD) programme was launched in Oman in 1985. There has been a dramatic decline in diarrhea related mortality. The incidence rate of diarrhea episodes reduced from 745/1,000 among under-five children in 1991 to 298/1,000 in 2003.

Work on rotavirus associated diarrhea in Oman is scares. Since the study on rotavirus in Oman reported by Aithala et al (1996), no study to explore rotavirus diarrhea had been conducted.

This study was intended to investigate the epidemiology of rotavirus and its role in causation of gastroenteritis in children in Oman. The study would be a base for controlling rotavirus in Oman.

MATERIALS and METHODS

Study Area: Two areas in Sultanate of Oman have been selected for this study (North Batina and South Batinah).

Targeted groups: Children under 5 years of age admitted to hospital and complained from fever and diarrhea.

Data Collection: Data about the incidence of gastroenteritis in children under 5 years of age with regards to the reported clinical visits, hospitalizations (Morbidity and deaths) in Sultanate of Oman from 2006 to 2008 was collected from the monthly and annual records of Ministry of Health; Sultanate of Oman (Surveillance of Rotavirus in Oman). Data was statistically analyzed.

Sample collection and storage: Faecal specimens from targeted groups were immediately collected following the onset of symptoms (diarrhea and fever) and kept at – 20ºC till used.

A total of 200 faecal specimens were collected from different children under 5 years of age who were presented with diarrhea and hospitalized in two separate selected areas in Sultanate of Oman during the period of January to April 2008. 128 stool specimens out of 200 samples were collected from North Batina comprising 64.0% from total sample size. 72 stool samples were collected from South Batina comprising 36 % from the whole collected samples. The targeted population was divided into different age categories according to their age in months. The targeted group included 112 males and 88 females.

Detection of group A rotavirus antigen by Enzyme linked Immuno Sorbent Assay (ELISA): The collected 200 faecal samples were examined for rotavirus antigens using IDEIA^{TM} Rotavirus ELISA kits, UK. The test was performed according to the instructions of the manufacturer.

RESULTS

Prevalence of rotavirus infection in children in Oman (2006-2008): During 2006-2008 the numbers of children admitted to hospitals with diarrhea in the different regions in Oman were 272, 1726, 674, respectively. Rotavirus antigen was detected in fecal samples of these children, it's prevalence was 100 %, 52.7%, 69.7%, respectively. The reported cases of diarrhea were low in 2006 then increased in 2007 and seems to be increasing in 2008 as the reported cases in the first 4 months were almost three times those reported in 2006. The details are shown in Table 1.

Age distribution of rotavirus associated diarrhea in children in Oman detected by ELISA during 2006-2008: Out of 2672 children admitted to hospitals with diarrhea and tested for rotavirus antigen in Oman during 2006-2008, most of positives were found in 7-12 months of age (57.2% in 2006, 61.9 % in 2007 and 62.4% in 2008). The second severely affected age group is 13-24 months; the reported prevalence of diarrhea at this age during 2006, 2007, 2008 were 18.9%, 16.1% and 16.3%, respectively. Data are presented in Table 2.

Sex variation of rotavirus infected children detected by ELISA in Oman during 2006-2008: Rotavirus antigen positive results were detected in 919 of 1498 males (61.3%) and in 730 of 1149 females (63.5%). The incidence of diarrhea was slightly more in males; the prevalence of rotavirus

infection was also slightly more in males (54.4% in 2006, 55.9% in 2007 and 56.2% in 2008). The detected positives in females were 45.6%, 44.1% and 43.8% for the 3 years of study. The results are presented in Table 3.

Detection of rotavirus antigen using ELISA in North and South Batinah: The rotavirus antigen detection ELISA results had showed a total prevalence rate of 62.5 % for both regions i.e. 125 positives out of 200 cases. The prevalence of rotavirus infection in North Batinah is far higher than in South Batinah. There were 87 positive cases detected in North Batina comprising a prevalence rate of 69.6%. Those 38 positive cases which were detected in South Batina were comprised a prevalence rate of 30.4%. Table 4 and Figure 1 shows the prevalence rate of rotavirus in the two studied areas.

The prevalence of rotavirus infection among age groups in North and South Batinah: The distribution of the rotavirus diarrheal disease was studied among different age groups. The targeted groups were divided into 6 categories according to their age as following 1-6 months, 7-12, 13-24, 25-36, 37-48, and 49-60 months. The incidence rate was highest in the 7-12 months (59% of total positives) then in 1-6 months group (19.7%) and lowest in the 25-36 months group (4.9%). Table 5 and Figure 2 summarize these findings.

Sex distribution of rotavirus infection in children in North and South Batinah: The results of rotavirus antigen ELISA showed that there were 67 positive males out of the 125 positive cases comprising a proportion of 53.6% of total positive cases. The positive females' were 58 with a prevalence rate of 46.4% of total positives. Table 6 and Figure 3 showed these results.

Data analysis: The diagnosis of diarrhea diseases due to rotavirus in targeted groups was analyzed and rotavirus was found to be significantly the major cause of the disease. The statistical analysis showed a significance value for rotavirus infection (P value = 0.047).
The occurrence of rotavirus infection in the two sexes was insignificantly associated with the gender when the both sexes were equally exposed to risk factor. The statistical analysis showed insignificant relation between infection and sex, (P value = 0.462).

DISCUSSION

Diarrhea is one of the most health problems facing children under 5 years of age with variable incidence in different countries. Estimated diarrhea episodes worldwide are 1.4 billion per year in children under 5 years of age (Parashar et al., 2003). Out of this number estimated cases that need only homecare, clinic visit and hospitalization are 1.29 billion, 124 million, and 9.0 million, respectively. With estimated 2.1 million diarrhea deaths annually (Parashar et al., 2003).

In Chile, 88.2 % of diarrhea episode required only care at home, 10.3 % required a clinic visit and 1.5 % required hospitalization (Ferreccio et al., 1991). Rotavirus was found to be the major cause of diarrhea in children in industrialized and developing countries, mostly occurs between 3 months and 2 years of age (Bresee et al., 2004). Nguyen et al (2001) reported the detection of rotavirus antigen in 56% of stool specimens from children with diarrhea in Vietnam, 41% in China, 56% in Myanmar and 29% in Hong Kong.

Rota virus gastroenteritis is one of main serious illnesses require hospitalization, it is most frequently occur in infants and young children from 6 months to two years of age (Bern and Glass, 1994, Bishop, 1996).

Although Rota virus occur with high frequency in the developed countries, mortality is low In the united states, Rota viruses causes about 5% to 10% of all diarrheal episodes in infants and children under 5 years old; however these viruses account for 3% to 5% of sever diarrheal episodes (Anon, 1999).

Rota virus diarrheal episodes in under 5 years of age in developing countries is estimated to be 130 million cases; over 18 million of which were considered moderately sever. It was estimated that 873000 infants and children under 5 years of age die from Rota virus diarrheal illness annually in developing countries (Pipittajan, et al., 1991, Crawley et al., 1993).

The estimated deaths due to rotavirus infection in Africa are approximately 15000 annually (Molbak et al., 2000). Rotavirus was detected in faeces of 57 (30.8%) of children with diarrhea in Iran (Akbar et al., 2006). Low prevalence of rotavirus was detected in children with diarrhea in Makkah at Saudi Arabia (Hani et al., 2005). In Sudan, the epidemiology of gastroenteritis was studied; rotavirus was detected in 26% of samples (Ali et al, unpublished data).

In Oman during the time in which this study was conducted the percentage of diarrhea to other diseases that required hospitalization was increased (especially in North Batinah). This indicated that diarrhea was one of the major children health constraints in Sultanate of Oman with increased incidence rate in 7-12 month of age group (around 57% in the 3 years of study).

Most of infected children in the present study were under 2 years of age, with highest prevalence at 7-12 months of age. This is comparable to previous reports (Pipittajan, et al., 1991, Crawley et al., 1993). Infants under 6 months of age experience the next highest frequency of Rota virus diarrhea (Pipittajan, et al., 1991, Crawley et al., 1993).

In a study in USA, the age distribution of patient admitted to the hospital with gastroenteritis of any etiology was different for black and non black patients, 51% of all black patient admitted for gastroenteritis were younger than 6 months of age (Brandit et al., 1981).

It was noted that the majority of reported cases were in North Batinah region, this is mainly due to high population in this region and the low public awareness. Cases recorded in other regions may reflect under estimation as rotavirus infection is expected to be of high prevalence due to poor hygiene and sanitation.

In 1986, the institute of medicine (IOM) , on the basis of published studies and fixed experience , reported that annually rotavirus causes approximately 110 million episodes of severe diarrhea in children less than 5 years of age worldwide (Bern and Glass, 1994).

The results of this study showed that the incidence of rotavirus gastroenteritis is similar to the (IOM) estimate and is consistent with a recent analysis demonstrating that overall diarrhea illness in children world – wide has not declined appreciably in the past two decades. However, the analysis of the data of this study showed that the total hospitalization from Rota virus disease is substantially lower than the IOM estimate.

More than 125 million cases of diarrhea each year were attributed to rotavirus. It was estimated that rotavirus causes 12.5% of all deaths due to diarrheal disease, and 0.6% of all deaths in children less than 5 years of age (Bishop, 1996).

In Sultanate of Oman in the year 2007, North Batinah region reported 321 positive fecal samples out of 621 (51.7%) while South Batinah region reported 165 positive samples out of 308 (53.6%).

It was noticed in this study that the prevalence of rotavirus associated diarrhea in Oman is increasing specially in North Batinah region as the reported cases in the first 4 months of 2008 were almost three times those reported in 2006 This may be due to high population and low public awareness. Some increase in cases reported at Muscat was noticed, but this could be attributed to the fact that Muscat is the capital and most of cases of remote areas are referred to Muscat for treatment.

With regard to the sex variation of children affected by rotavirus induced diarrhea, slight increase in prevalence rate was noticed in males, however there was no significant difference between the two sexes statistically.

This study has explored the epidemiology of rotavirus infection among children in Oman, however detailed study to investigate and characterize the causative agent on molecular biology level is highly recommended.

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Table 1: Rotavirus antigen detection using ELISA in faecal samples of diarrheic children in Oman (2006-2008).

Year	Region	Total tested	POSITIVE	%POSITIVE
2006	Dakhilyah	45	45	100.0%
	Dhofar	44	44	100.0%
	Muscat	103	103	100.0%
	North Batinah	50	50	100.0%
	South Batinah	30	30	100.0%
	Total	272	272	100.0%
2007	Dakhilyah	176	82	46.6%
	Dhofar	242	112	46.3%
	Muscat	372	227	61.0%
	North Batinah	621	321	51.7%
	South Batinah	308	165	53.6%
	Total	1726	907	52.7%
2008	Dakhilyah	111	78	70.3%
	Dhofar	35	30	85.7%
	Muscat	116	67	57.8%
	North Batinah	258	189	73.3%
	South Batinah	154	106	68.8%
	Total	674	470	69.7%
	Total of 3 years	2672	1652	61.8

Table 2: Age distribution of diarrheic children tested for rotavirus antigen using ELISA in Oman during 2006-2008

Year	Age group	Total	POSITIVE	%POSITIVE	% Age group
2006	1 – 6	32	32	100.0%	12.1%
	7 – 12	151	151	100.0%	57.2%
	13 – 24	50	50	100.0%	18.9%
	25 – 36	17	17	100.0%	6.4%
	37 – 48	12	12	100.0%	4.5%
	49 – 60	2	2	100.0%	0.6%
	Total	264	264	100.0%	
2007	1 – 6	225	103	45.8%	11.9%
	7 – 12	946	535	56.6%	61.9%
	13 – 24	274	148	54.0%	17.1%
	25 – 36	123	51	41.5%	5.9%
	37 – 48	45	14	31.1%	1.6%
	49 – 60	31	13	41.9%	1.5%
	Total	1644	864	52.6%	
2008	1 – 6	94	59	62.8%	12.8%
	7 – 12	373	287	76.9%	62.4%
	13 – 24	112	75	67.0%	16.3%
	25 – 36	49	26	53.1%	5.6%
	37 – 48	27	11	40.7%	2.4%
	49 – 60	4	2	50.0%	0.4%
	Total	659	460	69.8%	

Table 3: Sex variation of rotavirus infection among children detected by ELISA in Oman (2006-2008)

Year	Sex	Total	POSITIVE	%POSITIVE	% Sex
2006	Female	124	124	100.0%	45.6%
	Male	148	148	100.0%	54.4%
	Total	272	272	100.0%	
2007	Female	738	400	54.2%	44.1%
	Male	967	507	52.4%	55.9%
	Total	1726	907	52.5%	
2008	Female	287	206	71.7%	43.8%
	Male	383	264	68.9%	56.2%
	Toal	674	470	69.7%	
Total 3 years	Female	1149	730	63.5%	
	Male	1498	919	61.3%	

Table 4: Prevalence of rotavirus infection in diarrheic children in the two studied regions in Oman detected by ELISA (2008).

Regions	No. of tested samples	Positive	Negative	Prevalence rate	P value
North Batina	128	87	41	69.6%	0.047
South Batina	72	38	34	30.4%	
Total	200	125	75	62.5%	

Table 5: The Results of rotavirus ELISA tested faecal samples among different age groups in North and South Batinah in Oman (2008).

Age Group Per month	Number tested	Number positive	Number Negative	% of positive	% +/ total positives
1-6	32	24	8	75	19.7
7-12	108	72	36	66.7	59
13-24	26	13	13	50	10.7
25-36	17	6	11	35.3	4.9
37-48	14	7	7	50	5.7
Total	197	122	114	61.9	100

Table 6: The Results of rotavirus antigen ELISA for testing faecal samples collected from diarrheic children of both sex in the two regions in Oman (2008).

Sex	Total number tested	Positive	Negative	% + / total positives
Male	112	67	45	53.6 %
Female	88	58	30	46.4 %
Total	200	125	75	62.5.%

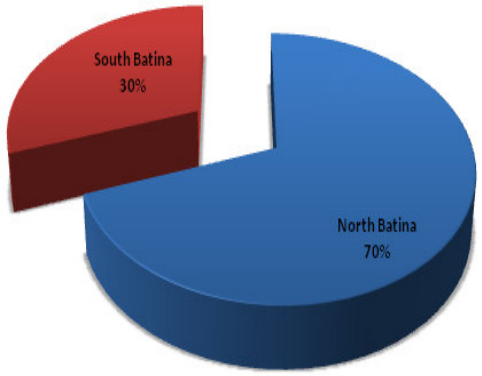

Figure 1: Group A rotavirus prevalence in children with diarrhea in two regions in Oman during 2008.

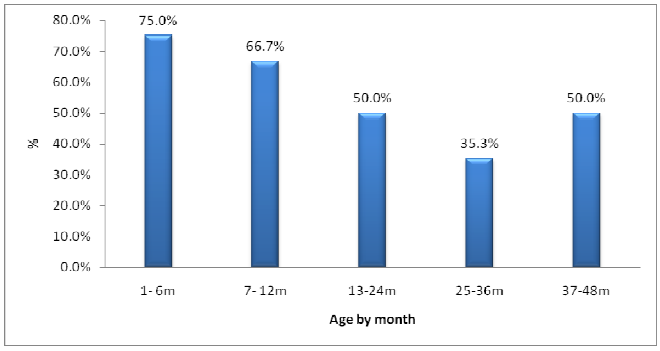

Figure 2: Prevalence of rotavirus infection among different age groups detected by ELISA in two regions in Oman (2008)

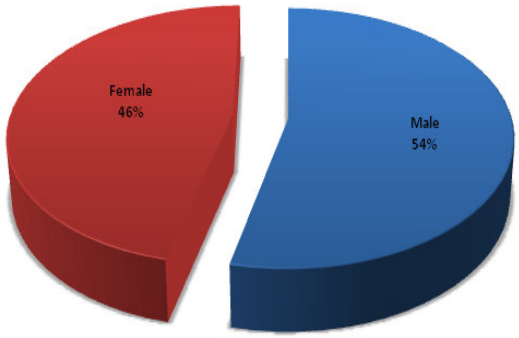

Figure 3: Prevalence of rotavirus infection in diarrheic children of both sexes detected by ELISA in Oman during 2008.