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The Pharma Innovation

ISSN: 2277- 7695
TPI 2016; 5(12): 37-44

www.thepharmajournal.com
Received: 10-10-2016
Accepted: 11-11-2016

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Seasonal trending of rotavirus infection in infantile patients from Baghdad with acute gastroenteritis

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Abstract
Worldwide, viral agents are the most common causes of infant and young children gastroenteritis where Rotavirus illness is recognized as significant cause of morbidity and is a common cause of hospitalization followed by other viruses. Rotavirus infections were reported to have a seasonal trend in some geographical regions.
Objectives: This research work was performed to assess the prevalence and seasonal variation as well as the clinical profile laboratory criteria of Rotavirus- associated diarrhea among pediatric patients from Baghdad.
Study Design: An outpatient-hospital based prospective study was carried out at AL-Elweya Pediatric Hospital and Children Welfare Teaching Hospital, Baghdad from February1st, 2013 till January 31th, 2014. Stool specimens from 807 children less than 5 years of age suffering from acute gastroenteritis were tested for the presence of rotaviruses by an immunochromatographic assay (ICA) (CER TEST: SPAIN) for Rotavirus. Males constituted 57.9% (467 out of 807) while the females were 42.1% (340 out of 807). A male: female ratio was1.4:1. Their age ranged from 0.5-60 months.
Results: Rotavirus-positive stool specimens was detected in 325 (40.3%) among acute diarrheal children aged less than five years. Rotavirus infections showed two peaks; the highest one was during September (61 cases) and the second was during January (52 cases). These infections were also shown during the hottest months in Iraq, July and August, where the number of cases dropped to three and nine cases, respectively.
Conclusions: Our statistical analyses indicated that Rota-viral gastroenteritis had peaked in an equal highest number of occurrences in autumn as well as winter seasons and were more frequently observed among younger children.

Keywords: Infants, children, gastroenteritis, rotavirus, rate of infection, seasonality

1. Introduction
Acute gastroenteritis is one of the most common diseases among humankind worldwide. The greatest morbidity and mortality are among those at their extremes of age [1]. Yearly, more than 700 million acute diarrheas occurred in children less than five years of age with a mortality rate estimated to be 3-5 million cases, the majority of these occur in developing countries [2]. In developing countries, gastroenteritis is a common cause of death in children < 5 years. Deaths from diarrhea are less common in developed countries, yet this illness leads to many hospitalizations or doctor visits [3].
The improvements in sanitation have significantly decreased the gastroenteritis cases caused by bacteria and parasites, yet, it has little effect on viral gastroenteritis. Viral gastroenteritis, here in, is gradually increasing, particularly in the developed countries [4]. Rotavirus remains the most common cause of severe childhood diarrhea worldwide and of diarrheal mortality in developing countries [5]. Children in the poorest countries account for 82% of rotavirus deaths [6]. Fever, abdominal pain, lethargy, diarrhea and vomiting are the main symptoms of Rotavirus gastroenteritis that may lead to hypovolemic shock, dehydration and death [7-9].
Rotavirus is transmitted by the fecal-oral route [7] where the highest rates were reported in children under five years of age and the majority of affected children were between the age of three and five years [10].

The proportion of acute Rotavirus gastroenteritis (RVGE) ranged from 16% to 61% per year in Middle Eastern and North African countries. It was found in a study that covered by EMRO for the WHO Eastern Mediterranean region as a whole, including the countries of Egypt, Iran, Iraq, Jordan, Libya, Morocco, Oman, Syria, Tunisia, and Yemen as well as Afghanistan and Sudan that the overall annual prevalence of RVGE among the gastroenteritis in children under five years of age was 42% [11]. The proportion of RVGE cases have increased over time in Egypt (from 8% to 42% between 2000 and 2007) [11, 12] and in Iran (from 15% in 2003-2004 to 59% in 2006-2007) [13, 14] while the proportion of RVGE in Saudi Arabia has fallen from 35% in 1995-1996 to around 12% since 2002-2003 [15, 16]. However, the proportion of RVGE in the other countries has remained relatively stable [17].

In addition, there is seasonality to rotavirus infection where the majority of cases in temperate climates occurring in the winter months between November and February [7, 18]. However, seasonality in tropical and developing countries is less marked [7, 10, 18]. In Middle Eastern and North African countries, a number of countries reported seasonality data including Egypt [12, 19], Iran [13, 20], Libya [21], Morocco [22], Oman (23), Saudi Arabia (24), Tunisia [25-27], and Turkey [28-31]. After all the precedent data, we think that it is reasonable to reveal the possible seasonality of rotavirus infection in children under five years in our country to enrich data dealing with such field of viral infection.

2. Materials and Methods

2.1 Study population

During a period of one year, from February 2013 to January 2014, a prospective study was conducted at two pediatric hospitals in Baghdad (AL Elweya Pediatric Hospital and Children Welfare Teaching Hospital (CWTH)) on a freshly-collected stool samples from a total number of 807 cases of acute diarrhea among children aged less than five years.

A questionnaire was completed for each patient containing the following information: name, age, gender, clinical data (fever, nausea, vomiting, abdominal pain, and diarrhea), macroscopic and microscopic laboratory examinations of stool samples. The inclusion criteria was to include in this study a watery stool samples (at macroscopic examination) & a parasite–free stool samples at microscopic examination(using saline &iodine preparations) from the diarrheal cases that were not lasting more than seven days after the onset of illness. The exclusion criteria was neither to include a reported hemorrhagic fresh stool samples nor containing parasitic agents (Giardia lamblia or *Entamoeba histolytica*) in their stools.

Stool samples were collected in a labeled screw- cap clean container. Stool samples were tested by immunochromatographic assay (purchased from CerTest, Spain) for antigenic detection of Rotavirus and were done according to instructions of the manufacturers. Allowing the card–device, test reagents and stool samples to reach to room temperature prior to testing. A separate stool collection tube and device were used for each sample and the assay was done right after collection. To detect Rotaviruses, approximately 100 mg or 100 micro-liter of stool sample was put and shaken in collection tube containing the diluents. Four drops or 100ul was dispensed in the circular window of card. The results (appearance of the colored bands) were read after 10 minutes.

This CerTest-Rotavirus KIT is a qualitative immunochromatographic assay for determination of rotavirus in fecal samples. The membrane on the test band region is pre-coated with mouse monoclonal antibodies against Rotavirus antigens.

During testing, the sample is allowed to react with the colored conjugates (anti-Rotavirus mouse monoclonal antibodies-red microspheres) which were pre-dried on the test. The mixture then moves upward on the membrane by capillary action. As the sample flows through the test membrane, the colored particles migrate. In the case of positive result the specific antibodies present on the membrane will capture the colored particles and a red colored line becomes visible. The mixture continues to move across the membrane to the immobilized antibody placed in the control band region, a green-colored band always appear. The presence of this green band serves as: 1-verification that sufficient volume is added, 2-that proper flow is obtained and 3-as an internal control for the reagents. Insufficient specimen volume, incorrect procedural or deterioration of the reagents are the most likely reasons for control line failure.

Negative results were indicated by only one green band (control line). For positive result, in addition to the green control band, a red band also appeared in the site of result line. A total absence of the control colored band (green) regardless the appearance or not of the result line (red) was evaluated as an invalid result.

3. Results

In a period of one year, 807 children with acute diarrhea, aged less than five years, were studied. Among them, 467 (57.9%) were males and 340 (42.1%) were females. Male to female ratio was 1.4:1 (Figure 1).

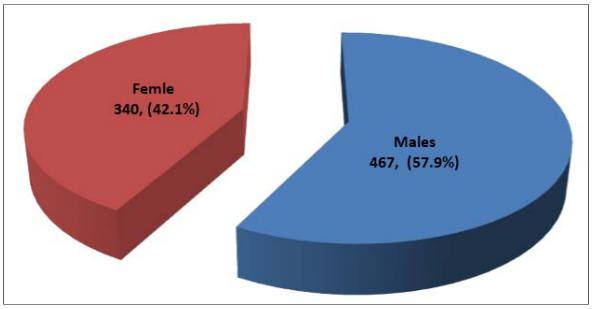

Fig 1: Distribution of the studied diarrhoeal children according to their gender

Rotavirus antigen was revealed in of 325 (40.3%) of the fecal samples (Figure 2). Among those studied children who have Rotavirus antigen- positive diarrhea, 56.6% were males and 43.4% were females with a male to female ratio of 1.3:1(Table 1).

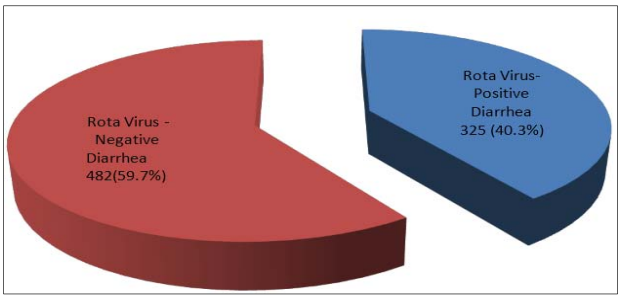

Fig 2: The studied children with Rotavirus gastroenteritis

Table 1: Diarrheal Children according to their gender and Rotavirus infection

Rotavirus Antigen	Males		Females		Total	
	No.	%	No.	%	No.	%
Rotavirus-Positive Diarrhea	184	56.6	141	43.4	325	40.3
Rotavirus-Negative Diarrhea	283	58.7	199	41.3	482	59.7
Total	467	57.9	340	42.1	807	100.0

Although children with acute diarrhea due to Rotavirus were younger (mean age 10.5 ± 8.4months) than those without Rotavirus infection (mean age 12.7±11.5 months) yet the difference in mean age was statistically not significant (Students' T Test, df= 803, P=0.19) (Table 2).

Table 2: Diarrheal Children with Rotavirus infection according to their age

Age (in months)	Rotavirus Diarrhea	Non-Rotavirus Diarrhea	Total	P Value
Range Mean ± SD	0.5 – 60 10.5 ± 8.4	0.5 – 60 12.7± 11.5	0.5 – 60 11.6 ± 9.95	0.19**
Number	325	482	807	

*Difference in mean age is statistically not significant (Students' T Test, df = 803, P=0.19)

Children with acute diarrhea whom fecal specimens were positive to Rotavirus antigen significantly developed fever more than those without Rotavirus (85.2% versus 71.4%) ($\chi 2$ = 14.7, df = 1, P=0.0001) (Figure3). On the other hand, nearly all children with Rotavirus diarrhea significantly developed vomiting compared to 78.8% of those without Rotavirus diarrhea ($\chi 2$ = 11.1, df = 1, P=0.0009) (Figure 3).

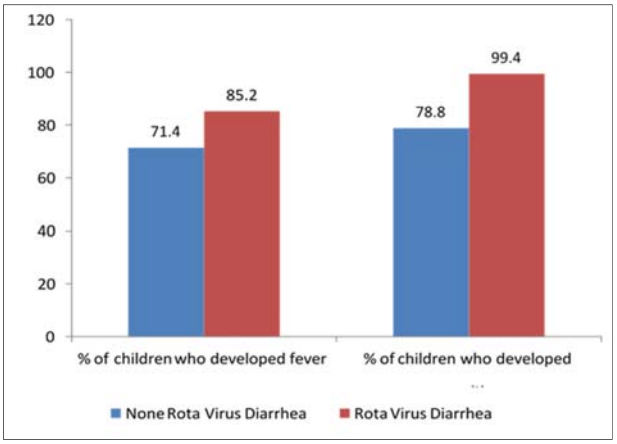

Fig 3: Presentation of children with acute Rotavirus diarrhea as fever and vomiting

Stool specimens examination revealed that (3+/4+) fatty drops was found in 93.9% of children with Rotavirus diarrhea compared to 35.5% of children with negative–Rotavirus diarrhea and 39.8% of those children negative–Rotavirus diarrhea had no fatty drops in their stool specimens compared to only 1.2% with Rotavirus diarrhea. Statistically significant associations were revealed regarding this fecal parameter (χ^2 = 317.8, df = 3, P=0.0000) (Table 3).

Table 3: Children with acute Rotavirus diarrhea according to fecal fatty drops in their stool specimens

Amount of fecal fatty drops	Rotavirus Diarrhea		Non- Rotavirus Diarrhea		Total		P Value
	No.	%	No.	%	No.	%	
None	4	1.2	192	39.8	196	24.3	0.0000*
1+ /2+	10	3.1	132	27.4	142	17.6	
3+/4+	305	93.9	152	31.5	457	56.6	
Full field	6	1.8	6	1.3	12	1.5	
Total	325	40.3	482	59.7	807	100.0	

*Statistically significant association ($\chi 2$ = 317.8, df = 3, P=0.0000)

Figure (4) shows the distribution of cases with acute diarrhea due to Rotavirus according to monthly occurrence, it showed two peaks the highest one was during September (61 cases) and the second was during January (52 cases). It also showed that during the hottest months in Iraq, July and August, the number of cases dropped to three and nine cases, respectively. In the present research the pattern of annual cyclical variation for Rotavirus was studied by applying the Edwards' test to detect the seasonal variation with both twelve and six months' periods. The total number of Rotavirus cases was (325), the monthly distributions of these cases is illustrated in figure [4] and the relationship between months of occurrence (k) and frequency of cases (fi) for both twelve and six months' periods are shown in figures 5 and 6 respectively.

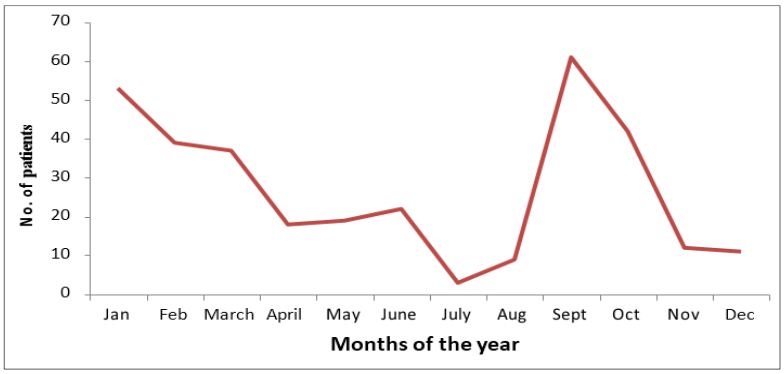

Fig 4: Distribution of cases with acute diarrhea due to Rotavirus by months of occurrence

The curve in figure five, showing the relationship between (k) and (fi), has one peak and one trough during the year, indicating an obvious seasonal variation. This was emphasized by applying an extension of the Edwards' method which showed the occurrence of two peaks and troughs in the year (figure 6); indicating that the frequencies followed a sinusoidal curve of the period of six months and that the two peaks were six months apart and of the same height.

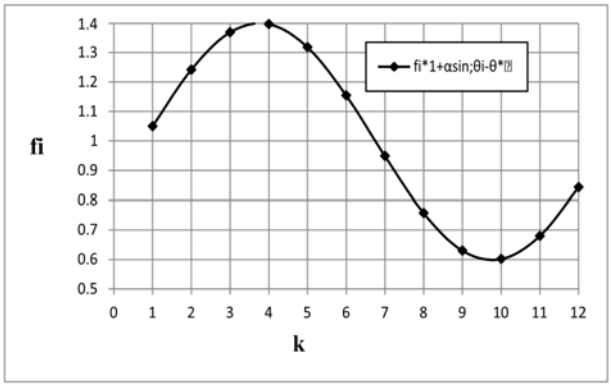

Fig 5: Edwards test; yearly distribution of acute Rotavirus diarrhea

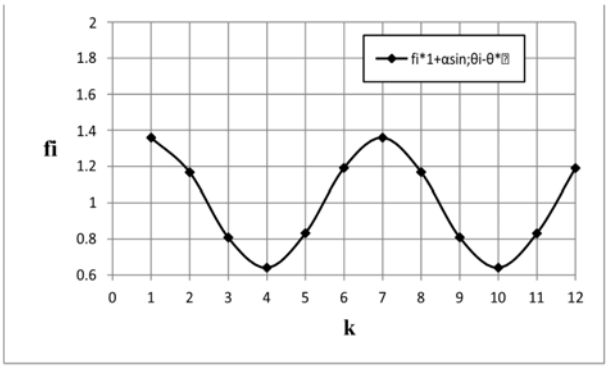

Fig 6: Edwards test; six monthly distributions of acute Rotavirus diarrhea

4. Discussion

The importance of Rotavirus infection could be recognized on reviewing the death estimates in the WHO report on mortality rates due to RVGE in the Middle East and North Africa [32], where the fatalities ranged from a low of <10 per year (Bahrain, Kuwait, and Qatar) to a high of 4,723 per year (Iraq) (and this equal to zero to 112 per 100,000 infants under five years of age, with an average estimate based on demographic indicators from UNICEF for the mortality rate from these 20 countries was at 39 per 100,000 per year [33]. It is impossible to diagnose rotavirus infection depending on clinical presentation, since the clinical features of rotavirus gastroenteritis do not differ from those of gastroenteritis caused by other pathogens. In addition, confirmation of rotavirus infection by laboratory testing is necessary for either reliable rotavirus surveillance or in clinical settings to avoid inappropriate use of antimicrobial therapy. Moreover, Rotavirus is shed in high concentration in the stool of children with gastroenteritis and a fecal specimen is the preferred specimen for diagnosis [34].

In the present research, Rotavirus gastroenteritis (RVGE) was recognized in 40.3% of the fecal samples among the studied children who have acute diarrhea (Figure 2). The results of another previous studies conducted in other parts of Iraq have shown a proportion of RVGE among Iraqi children in Basrah as 24% [35], In the present research, Rotavirus gastroenteritis (RVGE) was recognized in 40.3% of the fecal samples among the studied children who have acute diarrhea (Figure 2). The results of another previous studies conducted in other parts of Iraq have shown a proportion of RVGE among Iraqi children in Basrah as 24% [35], in Erbil [36], and in Kirkuk city was 16.9% (37). Overall, the annual proportion of RVGE among reported episodes of pediatric gastroenteritis in the Middle East and North Africa region was 42% [11]. This figure is further emphasizing the ubiquitous nature of the disease which is similar to a published estimate of the proportion of RVGE (43%) from a prospective multicountry study in Western Europe [38].

However, when Middle Eastern and North African countries were compared to each other, large variations in proportion of RVGE estimates were observed, with a low of 16%-23% reported in Saudi Arabia, Tunisia, and Egypt, and a high of 44%-61% in Syria, Oman, and Kuwait. These variations are limiting comparability across these countries but might also reflect either actual differences in RVGE proportion or could be related to variations in study design [17].

Other study by Zamani and associates (2004) [14] has reported Rotavirus antigen detection in (15.3%) of patients. Similar studies have been conducted in the neighboring countries with geographical locations around as well as not so far from Iraq. The reported data from Iran pointed for a rate of infection from 35% to 62% [39], while in Jordan (33%) [40], and in Turkey (37%) (30). One study by (EMRO) that covered the WHO Eastern Mediterranean region as a whole, including many countries (Egypt, Iran, Iraq, Jordan, Libya, Morocco, Oman, Syria, Tunisia, and Yemen) as well as Afghanistan and Sudan [11] has found an overall annual prevalence of RVGE among reported episodes of gastroenteritis in children under five years of age was 42%. In addition to these estimates of regional morbidity based on global models, limited information is available on the disease burden of rotavirus for individual countries of the region [41].

When comparing the most recent reviewed studies that reported data on the proportion of RVGE in children less than five years of age in Middle Eastern and North African countries, the rate of detection of Rotavirus antigen in the present study is among that reported proportion of RVGE which was ranged from 16% to 61% per year. However, the countries with the lowest proportion of RVGE (16% to 23%) were Saudi Arabia [42, 24, 15, 43, 16], Tunisia [11, 25, 26, 27, 44, 45], and Egypt [46, 11, 12, 47]. Those with the highest proportion of RVGE included Syria (61%) [11], Oman (50%) [11, 23, 48], and Kuwait (44%) [49]. A community study in 6 largest European countries revealed that RV was found to be the major etiologic agent of pediatric nosocomial diarrhea (31–87%) [17]. In Iraq, out Of 260 children from 1 month to 5 years of age who were admitted with acute diarrhea in Erbil, Iraqi Kurdistan, 37% were infected with rotavirus [36]. The other Iraqi study was that been conducted in Kirkuk city where out of 177 stool specimens from children, less than 5 years of age, referred for fever, abdominal pain, vomiting and/or acute diarrhea, Rotavirus was identified in 30(16.9%) of the total cases studied [37].

Nosocomial RV (NRV) infections are mainly associated with infants 0–5 months of age, whereas community-acquired RV disease is more prevalent in children 6–23 months of age [18].

Regarding the Rotavirus infections in relation to the age of infected children of that study conducted in Kirkuk city, and

out of 177 stool specimens, Rotavirus antigen was detected in 36.6% of infants aged between 7 and 12 months [37]. In a study of Iraqi Kurdistan [41], more than 75% of cases of rotavirus diarrhea in that study occurred in children <1 year of age, with an overall mean age of slightly more than 9 months. Noteworthy, a data collected from 44 studies in the Middle East and North Africa (as reported in WHO report) showed that rotavirus imposes a heavy burden among children less than five years of age (11).

Most European community-acquired rotavirus gastroenteritis occurs in children aged <2 years, and a high proportion occurs in infants aged <6 months. Cases were also observed among very young infants <2 months of age [50]. In the study of Zamani *et al*. (2004) [14], infants between 6 and 12 months of age were most frequently affected. In this study, Rotavirus can be regarded as a major etiologic agent of acute diarrhea in infants and children up to 5-years-old in Iran. A study by Alicem Tekin (2010) in Turkey, detection of rotavirus was established in (16.7%), the viral antigen positive cases were most frequently seen during autumn and winter months in children between 5-24 months of age [51]. However; 30% of the infants with rotavirus in Iran were <1 year of age [52], 50% in Kuwait were <1 year of age (53), and 63% in Turkey were <2 years of age (30). A community study in 6 largest European countries revealed that RV disease is more prevalent in children 6–23 months of age [17]. The progressive implementation of rotavirus vaccines in the field will hopefully change this picture. Also the data came from a study conducted by European health care systems also highlight the need for a vaccine that can provide protection for at least the first 2 years of life and from as early as possible before 6 months of age [50].

Males have outstanding female regarding their infectivity by Rotavirus; Out of these 30 Iraqi patients infected with rotavirus, 19 (63.3%) were males and 11 (36.3%) were females [37]. A similar precedency of males was noticed in another Iraqi study [36].

Another study conducted in Iran indicated that 58% of were males and 42% were females [54].

Children with acute diarrhea whom fecal specimens were positive to Rotavirus antigen developed highly significant fever than those without Rotavirus infection (85.2% versus 71.4%) ($\chi 2 = 14.7$, df = 1, P=0.0001) (Figure3). In comparism to a study conducted in Iran, our results were higher regarding fever than that reported there (47.5% of cases) [54].

This virus remains the most common cause of severe childhood diarrhea worldwide and in developing countries for diarrheal mortality [5]. Children in the poorest countries account for 82% of rotavirus deaths [6].

The main symptoms of RVGE are fever, abdominal pain, lethargy, diarrhea and vomiting that ultimately might lead to hypovolemic shock and dehydration and in severe cases to death [7-9]. Infection in newborn children, although common, is often associated with mild or asymptomatic disease (8). Rotavirus an infections can occur throughout life: the first usually produces symptoms, but subsequent infections are typically mild or asymptomatic (9).

In the study of Zamani *et al*. (2004), watery diarrhea was present in 68.5% of children [14]. A significant proportion (20 – 40%) of infections are asymptomatic, which contributes to the spread of the virus and might reduce the efficiency of prevention measures given as they are implemented too late. RV infections usually become apparent between the 2nd and the 6th day of hospitalization. Typical symptoms are fever (60–100% of cases), together with acute vomiting and diarrhea [18].

Most of children with Rotavirus diarrhea developed vomiting while 78.8% of those without Rotavirus diarrhea presented with vomiting (Figure 3). In comparism to an Iranian study, our results were higher than that reported there (42.5%) [54].

It was noticed that 93.9% of fecal specimens from children with Rotavirus diarrhea revealed (3+/4+) fatty drops or more while stool examination has identify 32.8% of children having negative–Rotavirus diarrhea (Table 3).

NRV infections are seasonal in most countries, occurring in winter; this coincides with the winter seasonal peak of other childhood virus infections (eg, respiratory syncytial virus and influenza viruses), thus placing a heavy burden on health infrastructures [18].

Up to our best knowledge, this research is a recent supplementation on the seasonal prevalence of rotavirus infection in Iraq.

It is also logical to review the results from other studies that had been conducted in countries within the range of geographical latitudes as our country Iraq (Baghdad) which is located at (33° 20ǫ 0∃ North, and 44° 26ǫ 0∃ East) [55].

The monthly distribution of acute Rotavirus diarrhea in this study showed two highest peaks; one was during September and the second was during January while during the hottest months in Iraq (July and August) the number of cases was dramatically dropped (Figure 4).

The first peak in our study was consistent with that peak of rotavirus infection reported in Iran (February–March), Kuwait (March–May), and Turkey (December) [52, 53, 30].

To our knowledge, this is a recent description of the seasonal activity of Rotavirus infectivity in infantile patients from Baghdad with acute gastroenteritis.

Rotavirus infections in Turkish children have been mainly detected in winter season (namely December (50%), January (46.8%), February (41.2%) and March (31.6%)) but reduced during the summer, and then started to rise in November (38.9%) [56].

In the study of Zamani *et al.* (2004), the detection rate was highest in the spring and lowest in summer [14].

Active surveillance program of rotavirus throughout North America has revealed that Rotavirus infection is the major cause of severe diarrhea and hospitalizations in children and suggesting an annual rotavirus epidemic behavior that followed a regional sequence from west to east. The peak of the annual rotavirus epidemic had occurred first in Mexico and the Southwest of the United States in late fall, went systematically across the continent in the winter, and ended in the Northeast United States and the Maritime Provinces of Canada in the spring. In addition, when detections were grouped by region, onset of the epidemic had followed the same regional sequence as the peak [57].

In East Africa, an increase of RV was noted in the autumn-winter season. The average age of children infected with these agents was less than one year [58]. In a surveillance of gastroenteritis, Rotavirus symptomatic infections have peaked in winter months in Turkey, too [59].

In the present study, rotavirus was prevalent throughout the year with higher frequency in September and October similar to what was reported from Turkey [60], whereas in northern Iran, rotavirus infection incidence was higher in winter (68%) and autumn (62%) [39]. The rates of viral AGE in Iran according to the seasons were as follows; in winter 44%; in spring 34%, in autumn 18% and in summer 4% [54]. Close

geographical conditions of Iran and Turkey as well as regions in Iraq may be a factor for these close similarities in the rotavirus outbreak times.

Previous reports also showed rotavirus outbreaks in different geographical locations of US and Europe. In the United States, a seasonal pattern for rotavirus has begun from the southwest in November and reaches to the northeast in April or May [61]. In Europe, rotavirus has prevailed during January–March. A community study [18] in 6 largest European countries (France, Germany, Italy, Poland, Spain and the United Kingdom) revealed that RV infections are seasonal in most of these countries, occurring in winter.

An unexplained shift of the peak of RV epidemic activity from winter to early spring has been reported in Japan during the last 2 decades [62]. Also the present study is consistent with those results of a study conducted in Japan during the last 3 decades for rotavirus seasonality where the rotavirus peak shifted gradually from January to April (winter to early spring) during 17 seasons.

In Europe, RV infection has been described as highly seasonal, outbreaks occurring during late autumn, winter and early spring [63-70]. In the United States, the RV epidemic follows a unique progressive wave from South West States towards North East States from winter to spring, with no clear explanation [18]. For most of these countries, the peak season for Rotavirus gastroenteritis is in the winter from November to April.

The exception to this is Egypt where Rotavirus infection peaks in July to November [12, 19]. In Turkish children with acute gastroenteritis due to Rotavirus was mainly detected in winter season, namely December (50%), January (46.8%), February (41.2%) and March (31.6%), reduced during the summer, and started to rise in November (38.9%) [56]. However, in tropical countries such as Malaysia, a seasonal pattern for rotavirus was not reported [4].

Regarding the overall respects, further studies are recommended to determine whether climatic differences, recognized viral features, or other factors have effects in this apparently unique seasonal pattern.

The findings of this research work indicate that rotavirus is a major etiologic cause of diarrhea among Iraqi children from Baghdad and supports the potential benefits of the licensed rotavirus vaccine latterly implemented in our country.

5. References

1. Wilhelmi de Cal I, Mohedanodel Pozo RB, and Sánchez-Fauquier A: Rotavirus and other viruses causing acute childhood gastroenteritis. Enferm Infecc Microbiol Clin. 2008; 26(13):61-5. [Article in Spanish] (English Abstract).
2. Mamdoh MM, Ibrahim RT. Prevalence of group a rotavirus, enteric adenovirus, norovirus and *Astrovirus* infections among children with acute gastroenteritis in Al-Qassim, Saudi Arabia; Pak J Med Sci. 2007; 23(4):551- 555.
3. Glass RI, Bresee J, Jiang B, Gentsch J, Ando T, Fankhauser R *et al.* Gastroenteritis viruses: an overview. Novartis Found Symp. [Jour]. 2001; 238:5-19; discussion 19-25.
4. Akan H, İzbırak G, Gürol Y, Sarıkaya S, Gündüz TS, Yılmaz G *et al.* Rotavirus and adenovirus frequency among patients with acute gastroenteritis and their relationship to clinical parameters: a retrospective study in Turkey. Asia Pac Fam Med. 2009; 8(1):8.
5. Widdowson MA, Steele D, Vojdani J, Wecker J, Parashar UD. Global rotavirus surveillance: preparing for the introduction of rotavirus vaccines. J Infect Dis. 2009; 200(1):S1-S8.
6. Parashar UD, Hummelman EG, Bresee JS, Miller MA, Glass RI. Global illness and deaths caused by rotavirus disease in children. Emerg Infect Dis. 2003; 9(5):565-572.
7. Diggle L. Rotavirus diarrhoea and future prospects for prevention. Br J Nurs. 2007; 16(16):970-974.
8. Grimwood K, Lambert SB. Rotavirus vaccines: opportunities and challenges. Hum Vaccin. 2009; 5(2):57-69.
9. Parashar UD, Gibson CJ, Bresse JS, Glass RI. Rotavirus and severe childhood diarrhea. Emerg Infect Dis. 2006; 12(2):304-306.
10. Parashar UD, Bresee JS, Gentsch JR, Glass RI. Rotavirus. Emerg Infect Dis. 1998; 4(4):561-570.
11. Teleb N. Rotavirus Surveillance Network in the Eastern Mediterranean regional. In Presented at the 8th International Rotavirus Symposium; Istanbul. 2008.
12. Wierzba TF, Abdel-Messih IA, Abu-Elyazeed R, Putnam SD, Kamal KA, Rozmajzl P *et al.* Clinic-based surveillance for bacterial- and rotavirus-associated diarrhea in Egyptian children Am J Trop Med Hyg. 2006; 74(1):148-153.
13. Eesteghamati A, Gouya M, Keshtkar A, Najafi L, Zali MR, Sanaei M *et al*. Sentinel hospital-based surveillance of rotavirus diarrhea in Iran J Infect Dis. 2009; 200(1):S244- S247.
14. Zarnani AH1, Modarres Sh, Jadali F, Sabahi F, Moazzeni SM, Vazirian F. Role of rotaviruses in children with acute diarrhea in Tehran, Iran; Journal of Clinical Virology. 2004; 29(3):189-193.
15. Tayeb HT, Dela Cruz DM, Al Qahtani A, Al Ahdal MN, Carter MJ. Enteric viruses in pediatric diarrhea in Saudi Arabia. J Med Virol. 2008; 80(11):1919-1929.
16. El Sheikh SM, El Assouli SM. Prevalence of viral, bacterial and parasitic enteropathogens among young children with acute diarrhoea in Jeddah, Saudi Arabia. J Health Popul Nutr. 2001; 19(1):25-30.
17. Khoury H, Ogilvie I, El Khoury AC, Duan Y, Goetghebeur MM. Burden of rotavirus gastroenteritis in the Middle Eastern and North African pediatric population. BMC Infectious Diseases. 2011; 11:9.
18. Gleizes O, Desselberger U, Tatochenko V, Rodrigo C, Salman N, Mezner Z *et al.* Nosocomial rotavirus infection in European countries: A review of the epidemiology, severity and economic burden of hospital-acquired rotavirus disease. Pediatr Infect Dis J. 2006; 25(1):S12-S21.
19. Naficy AB, Abu-Elyazeed R, Holmes JL, Rao MR, Savarino SJ, Kim Y *et al.* Epidemiology of rotavirus diarrhea in Egyptian children and implications for disease control. Am J Epidemiol. 1999; 150(7):770-777.
20. Modarres S, Rahbarimanesh AA, Karimi M, Modarres S, Motamedi-Rad M, Sohrabi A *et al.* Electrophoretic RNA genomic profiles of rotavirus strains prevailing among hospitalized children with acute gastroenteritis in Tehran, Iran. Arch Iran Med. 2008; 11(5):526-531.
21. Ali MB, Ghenghesh KS, Aissa RB, Abuhelfaia A, Dufani M. Etiology of childhood diarrhea in Zliten, Libya. Saudi Med J. 2005; 26(11):1759-1765.
22. Benhafid M, Youbi M, Klena JD, Gentsch JR, Teleb N,

Widdowson MA *et al.* Epidemiology of rotavirus gastroenteritis among children <5 years of age in Morocco during 1 year of sentinel hospital surveillance, June 2006-May 2007. J Infect Dis. 2009; 200(1):S70-S75.
23. Al Awaidy SA, Bawikar S, Al Busaidy S, Baqiani S, Al Abedani I, Varghesem R. Considerations for introduction of a rotavirus vaccine in Oman: Rotavirus disease and economic burden. J Infect Dis. 2009; 200(1):S248-S253.
24. Kheyami AM, Nakagomi T, Nakagomi O, Dove W, Hart CA, Cunliffe NA. Molecular epidemiology of rotavirus diarrhea among children in Saudi Arabia: first detection of G9 and G12 strains. J Clin Microbiol. 2008; 46(4):1185-1191.
25. Sdiri-Loulizi K, Gharbi-Khelifi H, de Rougemont A, Chouchane S, Sakly N, Ambert-Balay K *et al*. Acute infantile gastroenteritis associated with human enteric viruses in Tunisia. J Clin Microbiol. 2008; 46(4):1349-1355.
26. Fodha I, Chouikha A, Peenze I, De Beer M, Dewar J, Geyer A *et al.* Identification of viral agents causing diarrhea among children in the Eastern Center of Tunisia. J Med Virol. 2006; 78(9):1198-1203.
27. Trabelsi A, Peenze I, Pager C, Jeddi M, Steele D. Distribution of rotavirus VP7 serotypes and VP4 genotypes circulating in Sousse, Tunisia, from 1995 to 1999: emergence of natural human reassortants. J Clin Microbiol. 2000; 38(9):3415- 3419.
28. Bozdayi G, Dogan B, Dalgic B, Bostanci I, Sari S, Battaloglu NO *et al*. Diversity of human rotavirus G9 among children in Turkey. J Med Virol. 2008; 80(4):733-740.
29. Ceyhan M, Alhan E, Salman N, Kurugol Z, Yildirim I, Celik U *et al.* Multicenter prospective study on the burden of rotavirus gastroenteritis in Turkey, 2005-2006: a hospital-based study. J Infect Dis 2009; 200(1):S234-S238.
30. Karadag A, Acikgoz ZC, Avci Z, Catal F, Gocer S, Gamberzade S *et al.* Childhood diarrhoea in Ankara, Turkey: epidemiological and clinical features of rotavirus-positive versus rotavirus-negative cases. Scand J Infect Dis. 2005; 37(4):269-275.
31. Kurugol Z, Geylani S, Karaca Y, Umay F, Erensoy S, Vardar F *et al.* Rotavirus gastroenteritis among children under five years of age in Izmir, Turkey. Turk J Pediatr. 2003; 45(4):290-294.
32. World Health Organization: Child rotavirus deaths. [http://www.who.int/immunization_monitoring/burden/rotavirus_estimates/en/index.html] website. World Health Organization; 2009].
33. UNICEF. Information by country and programme - Demographic indicators. [http://www.unicef.org/infobycountry/index.html] website. UNICEF; 2009.
34. Nakawesi *et al.* Prevalence and factors associated with rotavirus infection among children admitted with acute diarrhea in Uganda BMC Pediatrics. 2010; 10:69.
35. Mahmood DA, Feachem RG. Clinical and epidemiological characteristics of rotavirus- and EPEC-associated hospitalized infantile diarrhea in Basrah, Iraq. J Trop Pediatr. 1987; 33:319-256.
36. Ahmed HM, Coulter JB, Nakagomi O, Hart CA, Zaki JM, Al-Rabaty AA *et al.* Molecular characterization of rotavirus gastroenteritis strains, Iraqi Kurdistan., Emerg Infect Dis. 2006; 12(5):824-6.
37. Zaman NAK, AAl-Tae AR, Saadoon IH. Prevalence of Rotavirus, Adenovirus, and Rotavirus- Adenovirus Co-infection among children less than 5 years in Kirkuk city. Second Scientific Conference – Science College – Tikrit University, Second Scientific Conference – Science College – Tikrit University, 2012.
38. Forster J, Guarino A, Parez N, Moraga F, Roman E, Mory O *et al.* Hospital-based surveillance to estimate the burden of rotavirus gastroenteritis among European children younger than 5 years of age. Pediatrics. 2009; 123(3):e393-e400.
39. Hamkar R, Yahyapour Y, Noroozi M, Nourijelyani K, Jalilvand S, L Adibi L. Prevalence of Rotavirus, Adenovirus, and *Astrovirus* Infections among Patients with Acute Gastroenteritis in, Northern Iran. Iranian J Publ Health. 2010; 39(2):45-51.
40. Youssef M, Shurman A, Bougnoux M-E, Rawashdeh M, Bretagne S, Strockbine N Bacterial. Viral and parasitic enteric pathogens associated with acut e diarrhea in hospitalized children from northern Jordan. FEMS Immunol Med Microbiol. 2000; 28:257-63.
41. Malek MA, Teleb N, Abu-Elyazeed R, Riddle MS, El Sherif M, Steele AD *et al.* The Epidemiology of Rotavirus Diarrhea in Countries in the Eastern Mediterranean Region. J Infect Dis. 2010; 202(1):S12-S22.
42. Kheyami AM, Areeshi MY, Dove W, Nakagomi O, Cunliffe NA, Anthony HC. Characterization of rotavirus strains detected among children and adults with acute gastroenteritis in Gizan, Saudi Arabia. Saudi Med J. 2008; 29(1):90-93.
43. Ghazi HO, Khan MA, Telmesani AM, Idress B, Mahomed MF. Rotavirus infection in infants and young children in Makkah, Saudi Arabia. J Pak Med Assoc. 2005; 55(6):231-234.
44. Chouikha A, Fodha I, Bouslama L, Fredj MBH, Jaoua S, Boujaafar N. Emergence and characterization of human rotavirus G9 strains in Tunisia J Infect Dis. 2009; 200(1):S239-S243.
45. Al Gallas N, Bahri O, Bouratbeen A, Ben Haasen A, Ben Aissa R. Etiology of acute diarrhea in children and adults in Tunis, Tunisia, with emphasis on diarrheagenic Escherichia coli: prevalence, phenotyping, and molecular epidemiology. Am J Trop Med Hyg. 2007; 77(3):571-582.
46. Kamel AH, Ali MA, El Nady HG, de Rougemont A, Pothier P, Belliot G. Predominance and circulation of enteric viruses in the region of Greater Cairo, Egypt. J Clin Microbiol. 2009; 47(4):1037-1045.
47. El Mohamady H, Abdel-Messih IA, Youssef FG, Said M, Farag H, Shaheen HI *et al.* Enteric pathogens associated with diarrhea in children in Fayoum, Egypt. Diagn Microbiol Infect Dis. 2006, 56(1):1-5.
48. Al Lawati Z, Al Toubi M. Community health & disease surveillance newsletter Oman. [http://www.moh.gov.om/reports/publications/Newsletter17-8.pdf] website Ministry of Health, Oman; 2009.
49. Marmash RW, Dalwai AK, Szucs G, Molla AM, Pacsa AS, Al Nakib W *et al.* Genotypic characterization of rotaviruses and prevalence of serotype-specific serum antibodies in children in Kuwait. Epidemiol Infect. 2007; 135(8):1331-1337.
50. Graham S-G, Berner R, Ninan T, Barberousse C, Meyer

N, Román M *et al*. Hospital-Based Surveillance to Estimate the Burden of Rotavirus Gastroenteritis Among European Children Younger Than 5 Years of Age: Pediatrics. 2009; 123(3):e393-e400.
51. Alicem T. The frequency of rotavirus and enteric adenovirus in children with acute gastroenteritis in Mardin; Journal of clinical and experimental investigations. 2010; 1 (1):41-45.
52. Khalili B, Cuevas LE, Reisi N, Dove W, Cunliffe NA. Hart CA Epidemiology of Rotavirus diarrhoea in Iranian Children. J Med Virol. 2004; 73:309-12.
53. Sethi SK, Al-Nakib W, Khuffash FA, Majeed HA. Acute diarrhea and rotavirus infections in young children in Kuwait. Ann Trop Paediatr. 1984; 4:117-21.
54. Shokrollahi MR, Noorbakhsh S, Monavari HR, Darestani SG, Motlagh AV, Nia SJ. Acute Nonbacterial Gastroenteritis in Hospitalized Children: A Cross Sectional Study. Journal of Microbiology. 2014; 7(12):e11840.
55. Iraq - Wikipedia, The Free Encyclopedia - Scribd: by Anand Sahu https://es.scribd.com/doc/242142145/Iraq-Wikipedia-The-Free-Encyclopedia Iraq - Wikipedia, The Free Encyclopedia - Download as PDF File (.pdf), Text File (.txt) or read online.
56. Ozdemir S, Delialioğlu N, Emekdaş G. [Investigation of rotavirus, adenovirus and *Astrovirus* frequencies in children with acute gastroenteritis and evaluation of epidemiological features]. Mikrobiyol Bul. 2010; 44(4):571-8. [Article in Turkish] (English Abstract).
57. LeBaron CW, Lew J, Glass RI, Weber JM, Ruiz-Palacios GM. Annual rotavirus epidemic patterns in North America. Results of a 5-year retrospective survey of 88 centers in Canada, Mexico, and the United States. Rotavirus Study Group. JAMA. 1990; 264(8):983-8.
58. Basu G, Rossouw J, Sebunya TK, Gashe BA, de Beer M, Dewar JB *et al*. Prevalence of rotavirus, adenovirus and *Astrovirus* infection in young children with gastroenteritis in Gaborone, Botswana. East Afr Med J. 2003; 80(12):652-5.
59. Rodriguez-Baez N1, O'Brien R, Qiu SQ, Bass DM. *Astrovirus*, adenovirus, and rotavirus in hospitalized children: prevalence and association with gastroenteritis. J Pediatr Gastroenterol Nutr. 2002; 35(1):64-8.
60. Bulut Y, İşeri L, Ağel E, Durmaz B. Akut Gastroenterit Ön Tanılı Çocuklarda Rotavirüs Pozitifliği. İnönü Üniversitesi Tıp Fakültesi Dergisi. 2003; 10(3):143-5. [Article in Turkish] (English Abstract).
61. Bernstein DI. Rotavirus overview. Pediatr Infect Dis J. 2009; 28(3):S50-3.
62. Dey SK, Ushijima H, Phathammavong O, Chanit W, Okitsu S, Mizuguchi M *et al.* Seasonal trend and serotype distribution of rotavirus infection in Japan, 1981-2008. Pediatric Infectious Disease Journal: February 2010; 29(2):166-167.
63. Languepin J, Doit C, Cezard JP, Bingen E, Navarro J. Pediatric nosocomial diarrhea. Pathol Biol (Paris). 2000; 48:764-769.
64. Mrukowicz JZ, Krobicka B, Duplaga M *et al.* Epidemiology and impact of rotavirus diarrhoea in Poland. Acta Paediatr Suppl. 1999; 88:53-60.
65. Moulin F, Marc E, Lorrot M *et al.* Hospitalization for acute community- acquired rotavirus gastroenteritis: a 4-year survey. Arch Pediatr. 2002; 9:255-26.
66. Maille L, Beby-Defaux A, Bourgoin A *et al.* Nosocomial infections due to rotavirus and respiratory syncytial virus in pediatric wards: a 2-year study. Ann Biol Clin (Paris). 2000; 58:601-606.
67. Sermet-Gaudelus I, de La Rocque F, Salomon JL *et al.* Rotavirus nosocomial infection in pediatric units: a multicentric observation study. Pathol Biol (Paris). 2004; 52:4-10.
68. Clark HF, Offit PA, Glass RI, Ward RL. Rotavirus vaccines. In: Plotkin SA, Orenstein WA, eds. Vaccines. 4th ed. Philadelphia, PA: WB. Saunders. 2004, 1327-1345.
69. Gendrel D, Basse N, Palmer P *et al.* Coincidental outbreaks of rotavirus and respiratory syncytial virus in Paris: a survey from 1993 to 1998. Arch Pediatr. 1999; 6:735-739.
70. Sanchez-Fauquier A, Wilhelmi I *et al.* Diversity of group a human rotavirus types circulating over a 4-year period in Madrid, Spain. J Clin Microbiol. 2004, 1609-1613.