Rotavirus epidemiology of children in Bursa, Turkey: a multi-centered hospital-based descriptive study

Mustafa Hacımustafaoğlu[1], Solmaz Çelebi[1], Mehmet Ağın[1], Güven Özkaya[2]

Departments of [1]Pediatric Infectious Diseases and [2]Biostatistics, Uludağ University Faculty of Medicine, Bursa, Turkey

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In this multi-centered study, we aimed to evaluate the distributional incidence of rotavirus acute gastroenteritis (RVAGE) according to age groups and epidemiological features of hospitalized and outpatient cases in the city center of Bursa, Turkey.

This study was carried out in a multi-centered setting that included the four largest hospitals dealing with more than 90% of the pediatric population in Bursa. Children under 15 years old with acute gastroenteritis (AGE) were included in the study. During a period of one year, all of the hospitalized AGE cases and initially one out of 15 systematically determined outpatient cases with AGE were included in the study. RV diagnosis was made by using monoclonal RV antigen kits (BioMérieux, France) in fresh stool.

Of 542,199 annual general hospital visits in those four hospitals, 5,988 were diagnosed with AGE (1.1%). The annual general AGE incidence in children under 15 years of age was found to be 1.7% per year. The annual incidence of RVAGE was 2.8%, 2.5%, 1.5%, and 0.14% in the cases aged <1 year, <2 years, <5 years, and 5-14 years, respectively. The hospitalization rate of RVAGE was estimated to be 22.5%, 27%, 20%, and 12.5% in the cases aged <1 year, <2 years, <5 years, and 5-14 years, respectively. RVAGE comprised 21% of the outpatient AGE cases and 0.35% of the total general pediatric outpatient cases.

Acute gastroenteritis (AGE)-related hospitalizations comprised 5.7% and RVAGE-related hospitalizations 1.6% of all hospitalizations. RVAGE comprised 28.5% of all AGE hospitalizations. It was found that the annual RVAGE-related hospitalization incidence was 629/100,000 in those aged <1 year, 553/100,000 in those aged <2 years, 293/100,000 in those aged <5 years, and 17/100,000 in those aged 5-14 years.

Rotavirus acute gastroenteritis (RVAGE) in both hospitalized and outpatient cases was found to be higher (60%) in boys than girls. It was found that the RV positivity in hospitalized AGE cases was higher than in outpatient AGE cases (28.5% vs. 21%, p=0.002). Eighty-six percent of hospitalized and 76% of outpatient RVAGE cases were <5 years (p=0.018).

When the monthly distribution of RVAGE was examined in hospitalized and outpatient cases, it was found that RVAGE increased rapidly after October and decreased after March in cases aged <5 years. The highest RV positivity rate was detected as 49.5% in January in hospitalized AGE cases and 31.5% in February for outpatient cases. In those <5 years, the lowest RV positivity rate was detected in the June-September period both in hospitalized (between 11-25%) and in outpatient (between 0-18%) cases. Nearly half (47%) of the hospitalized RVAGE in those <5 years were hospitalized in the January-March period. More than half of the outpatient RVAGE cases (55%) aged <5 years were detected in the January-March period. No meaningful differences were found in the monthly distribution and in the monthly RV positivity rates between hospitalized and outpatient cases.

In conclusion, RV was found to be a significant etiologic agent in hospitalized (28.5%) and outpatient (21%) AGE cases in Bursa. Nearly 80% of the

RVAGE cases were aged <5 years. Approximately half of the cases were seen in the January-March period. In January, half of the hospitalized cases and one-third of the outpatient AGE cases were RVAGE. Our findings have revealed a comparable pattern in RVAGE epidemiology in Bursa to that of the European countries and the United States.

Key words: rotavirus, epidemiology, acute gastroenteritis.

Although rotavirus acute gastroenteritis (RVAGE) is seen in adults, it is actually a disease of children less than five (<5) years of age. The presence of high viral load of infective virus in the stool and the probable characteristics of infection spread through respiratory secretions cause the rotavirus (RV) to be the most significant agent of acute gastroenteritis (AGE) in developed countries. RV has been detected as an etiologic agent in 4-20% of outpatient AGE visits and in 20-50% of hospitalized AGE cases <5 years of age in Europe[1-3]. In developed countries, the annual hospitalization rate due to RVAGE in the <5 years population has been found between 250-870/100,000[4].

There have been some studies done about RVAGE epidemiology in Turkey. Considering these studies, RV positivity in children with AGE is usually between 16.6-36.8%[5-13]. However, there has not been any study in Turkey about the incidence of RVAGE in both hospitalized and outpatient cases as well as the different age groups. In this study, we aimed to evaluate the age-group distributional incidence of RVAGE and the epidemiologic features with regards to hospitalized or outpatient status in the city center of Bursa in the Marmara region of Turkey.

Material and Methods

Bursa is a city located in the Marmara region in northwest Turkey. It is a highly industrialized city, and the average per capita income is one of the highest in Turkey. The city also possesses good health indexes that are comparable to the European countries (the infant mortality rate in 2007 was 16.7 per 1,000 live births in Turkey versus 6.7 in Bursa). The population of the city center of Bursa is 1,539,655, which accounts for 2.2% of the overall population of Turkey. This study was carried out on a multi-centered basis with the participation of the four largest pediatric hospitals in the city center of Bursa, which deal with nearly 90% of the population in the city. Since only the children between the ages of 0 to 14 years could legally be admitted to these hospitals during this study, all the data were assessed as the age group of 0 to 14 years.

According to the 2008 Turkish Institute of Statistics (TUIK) data, the population of the 0-14 age group in the city center of Bursa is 355,255 (23% of the city population). The population distribution figures according to these age groups are: 110,585 in the 0-4 age group (<5 years), 48,600 in the 0-1 age group (<2 years) and 24,300 in first year group (<1 year). The annual total number of pediatric outpatient cases of the 0-14 age group in those four hospitals is 542,199 (average 1.5 child physician visits per year). The annual number of hospitalized children is 22,655, which accounts for 6.4% of the population and 4.2% of the total hospital visits.

The study lasted for one year, and was approved by the Research Ethics Committee of the Medical Faculty, Uludağ University (28 November 2006, 2006-23/27). An informed consent was taken from the legal guardians of the children. The children vaccinated against RV previously were excluded from the study. RV antigen was detected by the method of monoclonal antibody in fresh stool (BioMérieux VIKIA Rota-Adeno, France). In the leaflet of this test, it is reported that these traditional kits have a sensitivity of 96.1% and specificity of 97.2%, comparable with the other monoclonal antibodies-related immuno-chromatographic tests. Clinical and other laboratory findings were studied, but not included in this study.

The AGE diagnosis was defined as $\geq$3 watery stools per day (not related to antibiotic use or food intolerance)[14]. The cases with other chronic diseases causing gastroenteritis were not included in the study. Routine stool culture

was taken, but only salmonella and shigella could be analyzed in our laboratories. Four cases yielding bacterial cultures (*Salmonella enteritidis* in 3 cases, *Shigella flexneri* in 1 case) were excluded from the study. The indications for hospitalization included but were not restricted to fever >41°C, findings of severe dehydration (acute loss of ≥10% of body weight), vomiting and/or diarrhea for four days or longer, malnourishment, and toxic appearance[15]. RV was tested in fresh stool samples. All of the hospitalized AGE patients were included in the study and tested for RV. However, for economic reasons, not all the outpatient AGE cases were included in the study. The outpatient AGE cases were included in the study not randomly but with a systematic determination; initially, the average of 1/15 patients and their stool samples were analyzed for RV. In order to prevent the loss of epidemiologic data, when there were <15 outpatient cases of AGE within a week in one hospital, at least one case with AGE was included in the study. Therefore, out of the total of 5,988 outpatient AGE cases, 497 (8.3%, average 1/12) were included in the study. If RV antigen test was positive, the AGE case was defined as RVAGE. The results were evaluated on the Statistical Package for the Social Sciences (SPSS) program (version 13.0, Chicago, IL, USA). Real p values were used, and a p value of less than 0.05 was considered statistically significant.

Results

A total of 5,988 children with AGE visited the hospital on an outpatient basis. This comprised 1.1% of all outpatient visits. Annual AGE incidence in the 0-14 age group was found as 1.7%. The hospitalization rate of AGE cases <5 years was found as 100/10,000. AGE-related hospitalizations comprised 5.7% of all hospitalizations.

Rotavirus acute gastroenteritis (RVAGE) comprised 21% of the outpatient AGE cases and 0.35% of the general total outpatient visits. The rate of RV positivity in the outpatient AGE cases was found as 27.7%, 25%, 22.9%, and 15.8% in those aged <1 year, <2 years,<5 years, and 5-14 years, respectively. The annual RVAGE incidence was estimated as 2.8% in those aged <1 year, 2.5% in those <2 years, 1.5% in those <5 years, and 0.14% in those 5-14 years.

The hospitalization rates of RVAGE cases were estimated as 22.5% in the <1 year group, 27% in the <2 years group, 20.5% in the <5 years group, and 12.5% in the 5-14 years group. The hospitalized RVAGE cases comprised 1.6% of all hospitalizations. The general RV positivity rate of hospitalized AGE cases was 28.5%. Considering the age groups in hospitalized AGE cases, the RV positivity rate was found as 29.7%, 30.7%, 29.4%, and 23% in those aged <1 year, <2 years, <5 years, and 5-14 years, respectively. The annual incidence of RVAGE-related hospitalization was found as 629/100,000 in those <1 year, 553/100,000 in those <2 years, 293/100,000 in those <5 years, and 17/100,000 in those 5-14 years. Forty-one percent of the hospitalized RVAGE cases were <1 year, 73% <2 years and 88% <5 years. The RV positivity in hospitalized AGE cases was found to be significantly higher than in the outpatient cases (28.5% versus 21%, p=0.002). Eighty-six percent of the hospitalized RVAGE and 76% of the outpatient cases were <5 years (p=0.018) (Table I).

The monthly distributions of RVAGE in hospitalized and outpatient cases are illustrated in Figures 1a and 1b and in Table IIa and IIb. According to these figures, RVAGE increases quickly after October in both hospitalized and outpatient cases and decreases after March. In those <5 years, it was found that the highest RV positivity was 49.5% in January in hospitalized AGE cases and 31.5% in February in outpatient cases. In those <5 years, the lowest rate of RV positivity was detected between the months of June-September (11-25% in hospitalized and 0-18% in outpatient cases). In those <5 years, nearly half of the hospitalized RVAGE cases (47%) and more than half of the outpatient cases (55%) were seen between January and March. No significant difference was found in the monthly distribution of hospitalized and outpatient cases and the rate of RV positivity.

It was estimated that there were 400 RVAGE-related hospitalizations and nearly 1,900 outpatient physician visits annually in cases aged 0-14 years in the city center of Bursa. Those figures were thought to be 350 and 1,700, respectively, in those <5 years. As was

Table I. The Distribution of Hospitalized and Outpatient RVAGE Cases According to Gender and Age

	Hospitalized cases Total, N: 1293 RV+, N: 368 (%)	Outpatient cases N: 497 RV+, N: 105 (%)	
Female	149/368 (40%)	42 (40%)	NS*
Male	219/368 (60%)	63 (60%)	
RV positivity (%)	368/1293 (28.5%)	105/497 (21%)	P=0.002
Number <5 years (%)	316/368 (86%)	80(76%)	P=0.018
Age Distribution (RV+)			NS
<6 months	42/368 (11%)	8/105 (7%)	
7-12 months	109/368 (30%)	26 (25%)	
13-24 months	115/368 (31%)	26 (25%)	
25-60 months	56/368 (15%)	24 (23%)	
5-14 years	46/368 (13%)	21 (20%)	
Total (RV+)	368/368 (100%)	105 (100%)	

NS: Not significant.

explained in the Material and Methods section, given the fact that the four large hospitals where this study was carried out deal with almost 90% of the city center of Bursa, it can be concluded that these figures can predictably be 10% higher. When we project our results on the whole country, it can be estimated that among the 0-14 years group, at least 20,000 hospitalizations per year and nearly 100,000 outpatient visits per year, and among those <5 years, at least 17,500 hospitalizations and 85,000 outpatient visits per year are to be expected.

Discussion

Bursa is one of the highly industrialized cities and one of the socioeconomically leading cities in Turkey[16]. The infant mortality rate in Bursa (6.7 per 1,000 live births) is lower than the average of Turkey (16 per 1,000 live births) and is comparable to developed European countries (average 5 per 1,000 live births in countries such as Sweden, France, Germany, and Greece).

According to the national disease load survey, diarrhea-related diseases are one of the significant groups of diseases in the 0-14 age group in Turkey. They are among the top four leading to mortality, comprising 8.4%[8]. In this study, in the 0-14 age group, it was estimated that there were about 400 RVAGE hospitalizations and 1,900 RVAGE outpatient

Table IIa. Monthly Distribution of Hospitalized RVAGE and Total AGE Cases with Regard to Age Groups

	<2 years RVAGE/Total AGE n/N (%)	<5 years RVAGE/Total AGE n/N (%)	≤14 years RVAGE/Total AGE n/N (%)
January	50/107 (47)	60 /121 (50)	64/131 (49)
February	51/117 (44)	61/144 (42)	66/162 (41)
March	26/112 (23)	34/141 (24)	41/163 (25)
April	20/94 (21)	22/119 (18)	25/140 (18)
May	21/108 (19)	29/147 (20)	33/169 (20)
June	10/60 (17)	14/77 (18)	16/94 (17)
July	12/56 (21)	13/67 (19)	15/84 (18)
August	7/54 (13)	9/77 (12)	11/90 (12)
September	13/42 (31)	14/55 (25)	17/73 (23)
October	22/38 (58)	28/57 (49)	35/69 (51)
November	26/53 (49)	28/63 (44)	30/74 (41)
December	11/34 (32)	13/40 (33)	15 /44 (34)
Total	269/875 (31)	325/1108 (29)	368/1293 (28)

Table IIb. Monthly Distribution of Outpatient RVAGE and Total AGE Cases with Regard to Age Groups*

	<2 years RVAGE/Total AGE n/N (%)	<5 years RVAGE/Total AGE n/N (%)	≤14 years RVAGE/Total AGE n/N (%)
January	12/35 (34)	15/54 (28)	15/72 (21)
February	14/36 (39)	18/57 (32)	22/81 (27)
March	11/40 (28)	14/60 (23)	17/76 (22)
April	7/35 (20)	10/49 (20)	14/68 (21)
May	5/28 (18)	11/49 (22)	15/71 (21)
June	1/12 (8)	1/13 (8)	1/16 (6)
July	0/6 (0)	0/10 (0)	1/13 (8)
August	1/6 (17)	2/11 (18)	3/15 (20)
September	0/3 (0)	0/7 (0)	1/11 (9)
October	1/10 (10)	3/14 (21)	3/17 (18)
November	5/19 (26)	5/27 (19)	5/32 (16)
December	5/17 (29)	6/20 (30)	8/25 (32
Total	62/247 (25)	85/371 (23)	105/497 (21)

*: Because of the average 1/12 outpatient AGE cases included in the study, to estimate total outpatient cases, the figures shown in the table should be multiplied by the average 12.

physician visits in Bursa. Considering the population <5 years of age, the figures were estimated as 350 and 1,700, respectively. When we project them to Turkey, we can obtain the following figures: considering the 0-14 years and <5 years groups, nearly 100,000 and 85,000 outpatient cases per year, and 20,000 and 17,500 hospitalizations per year, respectively. However, there are some limitations to this projection. Firstly, Turkey is not a uniformly socioeconomically homogeneous country, and with regard to different regions, there can be some epidemiological fluctuations throughout Turkey. Since Bursa is one of the most developed cities in Turkey, this figure may not be truly reflected throughout the country. Secondly, we found no mortality due to RVAGE in Bursa. However, it is rational to think that there can be some mortality due to RVAGE in Turkey at large. We could not include all the pediatric AGE visits in the city center of Bursa because of practical difficulties. This can also be regarded as one of the study's limitations. Then, given the fact that the four hospitals dealt with 90% of the city, it can be concluded that the disease burden can predictably be 10% higher. This study was conducted for a period of one year only. It is known that in some viral infections, there can be some epidemiological fluctuations from year to year or in certain periods (e.g. every 2 or 3 years). This may be another limitation of our study. It is estimated that for every hospitalized child with RVAGE, 8 children are consulted to a physician and receive medical treatment. Again, for every child receiving medical treatment, 4 children are treated at home without visiting a physician[2]. In Bursa, according to this estimation, for every 350 hospitalized children aged <5 years, 2,800 outpatient physician visits will be expected because of RVAGE, and this figure is higher

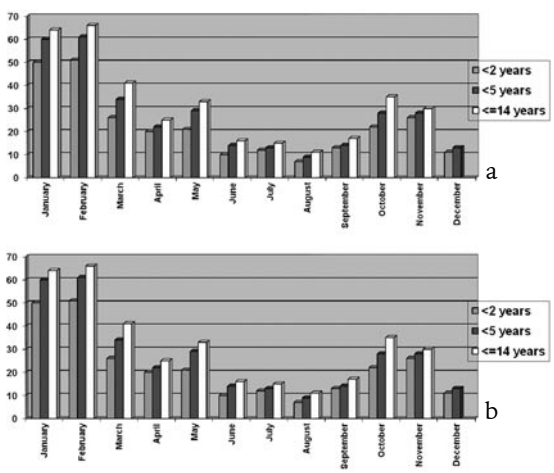

Figure 1a. The monthly distribution of hospitalized RVAGE cases. **Figure 1b.** The monthly distribution of outpatient RVAGE cases*.

*: Because of the average 1/12 outpatient AGE cases included in the study, to estimate total outpatient cases, the figures shown in the table should be multiplied by the average 12.

than our estimation of 1,700. This can be explained by the fact that consultation to a physician for AGE is lower in Turkey than in the developed countries. However, the figures we have found can be comparable to those of Europe and United States, given the population of Turkey (67 million). It has been calculated that there were on average 700,000 cases of RV-related outpatient AGE cases and 87,000 hospitalized cases in Europe, and there are nearly 500,000 RV-related outpatient cases annually in the United States[2]. It is possible that there may be some differences in these figures with respect to the level of development of the countries.

Nearly 170,000 children <5 years in the United States have been hospitalized due to diarrhea in the last two years, and this figure has been constant for the last 20 years. RVAGE constitutes nearly one-third of the diarrhea-related hospitalizations, and 55,000 annual hospitalizations are estimated due to RVAGE[17,18]. In a study done in the United States, 4.9% of the hospitalized children <5 years are hospitalized with AGE. Further, all the RVAGE-related hospitalizations may comprise 2.5% of the pediatric hospitalizations[17,19]. The AGE hospitalizations in our study comprised 5.7% and RVAGE 1.6% of all hospitalizations. Although these figures seemed to differ from the numbers reported, they were found to be comparable as well. The rate of general AGE hospitalizations in those <5 years in our study was found as 100/10,000, and this result is comparable to the rate of 49.4-136/10,000 of AGE in children <5 years in two studies done in the United States[17,18,20].

In our study, RV positivity in AGE was 21%. The RV detection rate in AGE may vary in different countries and different age groups in the world. In developing countries, the RV positivity rate in AGE cases <5 years was 46.7% in Vietnam, 23% in the dry season and 4% in rainy season in Tanzania, 20% in Bangladesh, and 25% in Iran[21-25]. In various European countries, the RV positivity in AGE cases <5 years was 1.2-7.4% in the Czech Republic, 18.4-30.6% in Hungary, 5.5-39.4% in Poland, 2.7-3.2% in Romania, 0.29-1.1% in Slovakia, 7.1-15.6% in Russia, and 20-29.5% in Slovenia[26]. The RV positivity rate in AGE was 17% in all age groups in France and 14% in those <5 years of age in Denmark[27,28].

Taking these figures into account, there is a wide spectrum of RV positivity in AGE in different countries, even within the same country. In general, there are also no consistent rates of RV positivity in developed and developing countries. It will be rational to compare and evaluate the studies about RV positivity with respect to the age of the children, the season in which the study was done, as well as the country.

Generally, it is accepted that RV positivity in AGE does not demonstrate great differences in accordance with the level of development of the countries, with the RV positivity rates being similar in developing and developed countries. Our average rates also showed similar distributions to those of Europe and other developed countries. However, the RV positivity in AGE may vary according to the age group. The RV detection rates in AGE are higher in those <5 years, especially in those <2 years. In those <2 years, RV positivity in AGE was found as 44-62%[7,10,29]. The RV positivity rates in our study with respect to the age groups were 27%, 25%, 22.9%, and 15.8% in those <1 year, <2 years, <5 years, and 5-14 years, respectively. These figures support the view that the highest risk for RVAGE is in the <5 years group, and especially in those <2 years. Since the effect of the vaccine especially in the first two years is higher, the rate of prevention of RVAGE in vaccinated children can also cover the highest-risk age groups.

The RV positivity in healthy children in the <2 years age group was 0-6% in Turkey[5,12]. These results imply that there may be asymptomatic RVAGE up to the level of 6% in addition to the clinically apparent RVAGE. The incidence of asymptomatic RVAGE was detected as 3.6% in those <5 years in Vietnam, 4% in all age groups in France and <1% in those <5 years in Denmark[21,27,28]. The RV positivity in healthy children in Turkey is similar to the level in other countries. We did not investigate the RV positivity in healthy children. However, taking into account RV stool positivity in asymptomatic children, it can be concluded that the actual RV infection pool is higher than the level we detected in our patients. Even if these children are not ill, they may play a role in the spread of the disease. The risk may be even higher in such places as daycare/nursery centers where children stay together.

In epidemiologic studies, it is important to use reliable diagnostic methods. The RV detection in studies conducted in Turkey was usually carried out through antigen detection methods such as latex agglutination or enzyme-linked immunosorbent assay (ELISA). In a study in Turkey, children in the 0-3 age group with acute diarrhea were analyzed by various methods such as latex agglutination, ELISA and polyacrylamide gel electrophoresis (PAGE), showing RV positivity of 15.5%, 12.5% and 11.8%, respectively[30]. In another study in Turkey with 148 cases, latex antigen and ELISA methods yielded positivity of 12% and 17.5%, respectively[31]. No difference was found in either study between the RV detection rate and the method used. Buesa et al.[32] studied RV through polymerase chain reaction (PCR), ELISA, PAGE, and electron microscopic methods, and obtained RV positivity rates of 30%, 29%, 26.8%, and 25%, respectively. In some other studies, the tests carried out by ELISA, latex agglutination, PAGE, and electron microscopic methods were found to be comparable[33-35]. The detection of RV by enzyme immunoassay (EIA) was obtained with as high as 99% sensitivity and specificity[17,20]. In this study, we used VIKIA Rota-Adeno traditional kits (BioMérieux, France), with the sensitivity of 96.1% and specificity of 97.2%, comparable with the other immuno-chromatographic tests using monoclonal antibodies. Regarding these studies, the different diagnostic methods mentioned above were usually found comparable. Therefore, the EIA RV antigen detection method using the monoclonal antibodies that we used in our study can be considered as a reliable diagnostic test in the detection of RV.

In this study, the RVAGE incidence in those <1 year, <2 years, <5 years, and 5-14 years was determined as 2.8%, 2.5%, 1.5%, and 0.14%, respectively. The RVAGE incidence was found as 11% in those <6 years (3% for <6 months, 27% for <1 year) in Japan [36]. In Europe, RVAGE-related physician visits in those <2 years was nearly 4% in Germany, 0.8% in Austria, 1.4% in Switzerland, 0.5% in Holland, and 2.8% in Finland[2]. Despite some differences among the countries, the percentage figures obtained in Turkey are usually comparable to those in developed countries. In fact, since it is not a common practice for Turks to visit the physician for mild illnesses such as AGE, the real incidence of RVAGE in our country can be expected to be a bit higher.

In our study, the RV positivity rate in hospitalized AGE was found significantly higher (28.5%) than in the outpatient AGE cases (21%; $p<0.01$). The RVAGE cases constituted nearly one-third of all hospitalized AGE cases. It was found generally that RV was responsible for 30%-50% of all the hospitalized AGE cases[1]. The rate of RV positivity in AGE may vary according to the age of the patient and the season in which the study was conducted, as well as the severity of the AGE (hospitalized versus outpatient status). In our study, the RV positivity rate for ages of 0-14 years for the whole year was 21%. In the United States, an average of 10.4% RV positivity was reported in hospitalized AGE cases <5 years of age between 1987 and 1997[17]. Another study reported the incidence as 13% between 2000-2001[17,20]. However, it is considered that the RV positivity rate in the United States in general is higher and that one-third of the diarrhea-related hospitalizations (average 170,000 per year) are caused by RV (55,000 hospitalizations per year)[17,18]. Nearly one-third of our AGE-related hospitalizations (29.5%) are caused by RV, and our rate is comparable to those of other countries and the United States.

Rotavirus acute gastroenteritis (RVAGE) can cause considerable hospitalization burden in children, especially in those <2 years. In a study of children <5 years with RVAGE in Finland, 11% of them were hospitalized[37]. In another multi-centered study conducted in Germany among children <48 months with RGVAGE, 6.2% of them were hospitalized[38]. In a study done in Turkey, 30.9% of children with RVAGE <5 years old needed hospitalization [7]. In our study, the hospitalization rates in children with RVAGE were found between 12 to 27% with respect to various age groups. Our hospitalization figures were found comparable with the studies mentioned above (relatively higher than those of Finland and Germany and lower than the Turkish study).

The annual incidences of RVAGE hospitalization in Bursa were found as 629/100,000 in those <1 year, 553/100,000 in those <2 years, 293/100,000 in those <5 years, and 17/100,000 in those 5-14 years. Of the hospitalized RVAGE

cases, 41% were <1 year, 73% <2 years and 86% <5 years. The percentage of the <5 years old in hospitalized RVAGE (86%) was significantly higher than outpatient RVAGE (76%). Therefore, it can be concluded that, not surprisingly, the severity of RVAGE is higher in children <5 years. In developed countries (Europe, Australia and the United States), the average annual incidence of RVAGE-related hospitalization in those <5 years was found as 445/100,000[2]. In Japan, the RVAGE-related hospitalization in those <1 year is higher, and was found as 9.7-16/1,000 children/year[39]. In the studies done in Europe, the RVAGE-related hospitalization in those <5 years was estimated to be 370 (290-565)/100,000 on average. In our study, the annual incidence of RVAGE-related hospitalization was comparable to that of developed countries[26-28]. Since this is the only study regarding the incidence in Turkey, a comparison could not be done with other data in our country.

Rotavirus (RV) is encountered in the northern hemisphere mostly in the winter season. It may cause infections throughout the whole year in tropical regions. In our study, RVAGE in both hospitalized and outpatient cases illustrated a sharp rise after October and a fall after March. Considering the other studies done in Turkey, the seasonal distribution of RVAGE in our country usually shows a similar distribution pattern. RVAGE cases in Turkey show a sharp increase in winter and early spring months[6,7,10,40]. Our findings also show similarity to those of European countries and the United States[41]. In our study, in children <5 years, the highest RV positivity within AGE for hospitalized cases was encountered in January, with 49.5%, and for outpatient cases in February, with 31.5%. The lowest RV positivity rates in children <5 years both in hospitalized (between 11-25%) and outpatient (between 0-18%) cases were encountered in June-September. Almost half of the RVAGE cases among those <5 years were seen in January-March. In the other studies done in Turkey, the highest RV positivity rate in AGE was found in the winter season (between 22-65%) and the lowest rates between June-September (between 2.9-22%)[6,7,10,40]. In regard to other studies done in Turkey, our RV rates in the winter season were comparable, but were lower in the summer months. We found no significant differences in the monthly distribution and in the RV positivity rates of outpatient and hospitalized cases. It was concluded that RVAGE in Bursa reached peak levels in late winter and early spring seasons.

In conclusion, RV was been found to be a significant etiologic agent both in hospitalized and outpatient AGE cases in Bursa. Our findings have revealed a comparable pattern in RVAGE epidemiology in Bursa to that of the European countries and the United States. Considering the high disease burden, administrating the RV vaccines as a part of the routine vaccination schedule can be recommended.

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