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Rotavirus Incidence in Different Regions of the Russian Federation in the Pre-Vaccination Period

ABSTRACT

The article presents the results of a retrospective epidemiological analysis of the rotavirus incidence in the Russian Federation, Saint Petersburg, Novgorod Oblast and the Sakha Republic (Yakutia) in 2000-2013. It identifies regional variations in the epidemic process intensity in the pre-vaccination period, age groups of risk, and the role of the water factor in the infection transmission. The age group most susceptible to the disease is children under two years of age.

Keywords: rotavirus infection, incidence, virological testing, vaccination.

INTRODUCTION

According to the World Health Organization (WHO), every year they register about one billion cases of diarrhea worldwide, causing up to 4 million deaths, with 60-70% of the patients being children under the age of 14 years [13]. In the Russian Federation (RF), acute enteric infections (AEI) consistently rank third or fourth among the infectious diseases of childhood [1,2]. In recent years, we witness an increased role of viral gastroenteritis, which is alarming due to its widespread and high incidence in child population [9, 11]. Every year, from 50 to 80% cases of diarrhea in the world are caused by viruses, and mostly, by rotaviruses accounting for 25 to 60% of AEI [7]. Rotavirus infection (RVI) is a common highly contagious infection, and a global pressing problem. Annually, they register about 138 million RVI cases, with 454 to 705 thousand people dying of the infection [8,10,12]. The highest RVI incidence rates are found in children aged 6 to 24 months; by the age of five years, almost every child has had several episodes of rotavirus gastroenteritis [10,14]. In Russia, the mortality of RVI has increased over 22-fold (from 3.2 per 100,000 the population in 1993 to 71.6 in 2013), mainly due to the improved etiological deciphering of AEI [4]. For the Russian Federation as a whole, children hospitalized with RVI under 12 months make 28.0% of children under six years of age [5].

At present, there are three licensed live RVI vaccines in the world: monovalent one for genotype G1P rotavirus [8], monovalent one for genotype G9P rotavirus [11] and pentavalent one for rotaviruses of genotypes G1P [8], G2P [4], G3P [8] G4P [8] and G9P [8]; they have proven efficient and safe in practice. RVI vaccination is introduced in over 100 countries around the world; in 42 countries it is a part of the national immunization schedule. The rotavirus vaccines not only help to reduce the incidence, but also reduce the number of deaths, decrease the

number of hospitalizations and associated socio-economic losses. In October 2012, the Russian Federation registered the pentavalent vaccine; in 2013, a number of subjects began immunization of children under regional vaccination programs and on the paid basis, as well (Moscow, Saint Petersburg, Lipetsk, Yekaterinburg, Omsk, Novosibirsk, Krasnoyarsk, Yakutsk and others). In May 2014, the Ministry of Health included RVI immunization in the calendar of preventive vaccinations by epidemic indications [6].

Aim of the research: to determine the patterns and regional features of the rotavirus infection epidemic process in subjects of the Russian Federation before initiation of the rotavirus vaccination program.

MATERIALS AND METHODS

We have done a retrospective epidemiological analysis of RVI incidence in Saint Petersburg, Novgorod Oblast and the Sakha Republic (Yakutia) for the period 2000-2013. The materials are obtained from the forms of the federal statistical observation: No. 2 "Information on infectious and parasitic diseases", No. 2-13 "Information on the activities of sanitary-hygienic, microbiological and parasitological laboratories, the Center for Hygiene and Epidemiology in the Sakha Republic (Yakutia)", No. 23 "Information on outbreaks of infectious diseases." We used the data from the State reports on the sanitary-epidemiological welfare of the population in these regions for 2013; bulletins of statistics and analytical materials "Infectious diseases in the Russian Federation for 2012-2013." The Rotavirus-Antigen-IFA-Best test systems manufactured by JSC Vector-Best were used to detect the rotavirus antigen in water samples. We analyzed the results of testing samples of drinking water and wastewater in the Sakha Republic (Yakutia). We used conventional methods of statistics. The statistical analysis of the data and graphics are made using standard Microsoft Office software package (Excel, Word, 2010).

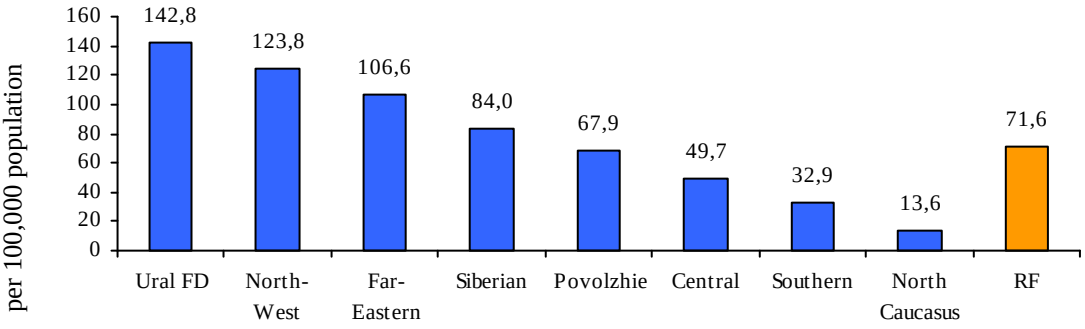

Figure 1. Rotavirus incidence in federal districts of the Russian Federation in 2013

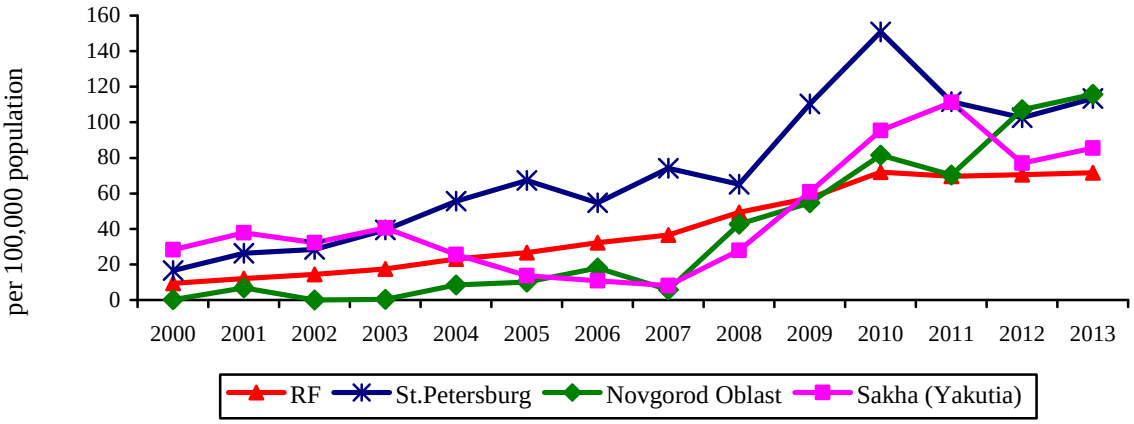

Figure 2. Rotavirus incidence trends in the Russian Federation, Saint Petersburg, Novgorod Oblast and Sakha Republic (Yakutia) in 2000 – 2013

RESULTS AND DISCUSSION

Rotavirus is registered in almost all subjects of the RF. When analyzing the data on the incidence in different federal district, we found out that in 2013, the figures varied from 13.6 in the North-Caucasian Federal District (NCFD) to 142.8 in the Ural Federal District (UFD) per 100,000 population, which depends on the level of laboratory diagnosis (Fig. 1). Four federal districts showed the incidence rate exceeding the average one by 1.2 to 2 times.

In the North-Western (NWFD) and Far-Eastern (FEFD) federal districts, in 2013, the RVI incidence was 123.8 and 106.6 per 100,000 population, respectively. Novgorod Oblast and Saint Petersburg rank 6th and 7th among 11 regions of the North-Western Federal District; the Sakha Republic (Yakutia) ranks 6th out of 9 regions of the FEFD. Saint Petersburg accounts for 30.4% of the diagnosed RVI, Novgorod Oblast - 4.2%, Sakha Republic (Yakutia) - 12.2% of the total

incidence of this infection in the North-Western and the Far-Eastern Federal Districts.

The analysis of the long-term trends of RVI incidence in Russia shows a constant improvement of laboratory diagnosis of the infection, as well as regional differences in the intensity of the epidemic process. In the past four years, before the initiation of the vaccination program, the RVI incidence in Russia had stabilized at 69.6 ± 0.2 – 72.1 ± 0.2 per 100,000 population. However, with this nationwide stabilization, the three regions in question are characterized by a constant upward trend (Fig. 2). In 2000-2013, Novgorod Oblast showed the greatest increase in the incidence, going up by 810 times. In Saint Petersburg, the incidence has increased by 7 times. In the Sakha Republic (Yakutia), the epidemic process is characterized by less RVI growth – by 3 times.

During the observation period, Saint Petersburg showed the incidence rate significantly higher than the average for the Russian Federation, and it varied between 16.6 ± 0.6 – 150.9 ± 18 per 100,000, with the 2013 figure at 113.4 ± 1.5. Novgorod Oblast initiated extensive laboratory diagnostics of RVI in 2008, which affected the incidence: over 14 years, the minimal RVI incidence was recorded in 2000 at 0.1 ± 0.1 per 100,000; the maximum one – in 2013 at 115.8 ± 4.3 per 100,000. As of 2013, the Sakha Republic (Yakutia) had the same figure at a significantly lower level – 85.4 ± 3.0 per 100,000 ($p < 0.05$).

The RVI epidemic process on the territory of these Russian subjects is predominantly sporadic. In 2013, the patients affected during outbreaks in Saint Petersburg made 0.3% (2 focal points with 18 affected people), in Novgorod Oblast - 3% (3 focal points with 22 affected people). The same year, there were no RVI outbreaks registered in the Sakha Republic (Yakutia).

The study of the RVI incidence in different population groups showed that the epidemic process in the compared regions of Russia involves mainly children under 2 years of age (Table 1).

In 2013, Novgorod Oblast and the Sakha Republic (Yakutia) had the incidence of children under the age of 1 year at 2055.5 ± 168.9 and 2278.3 ± 118.5 per 100,000 population, respectively ($p > 0.05$), with a significantly lower figure for the Russian Federation as a whole at 1215.2 ± 8.0 ($p < 0.001$). In the age group of 1-2 years, the highest incidence rate was registered in Novgorod Oblast – 2263.6 ± 127.1 ($p < 0.001$). The lowest rate of the epidemic process was observed in the Sakha Republic (Yakutia) – 1157.8 ± 61.5 ($p < 0.001$).

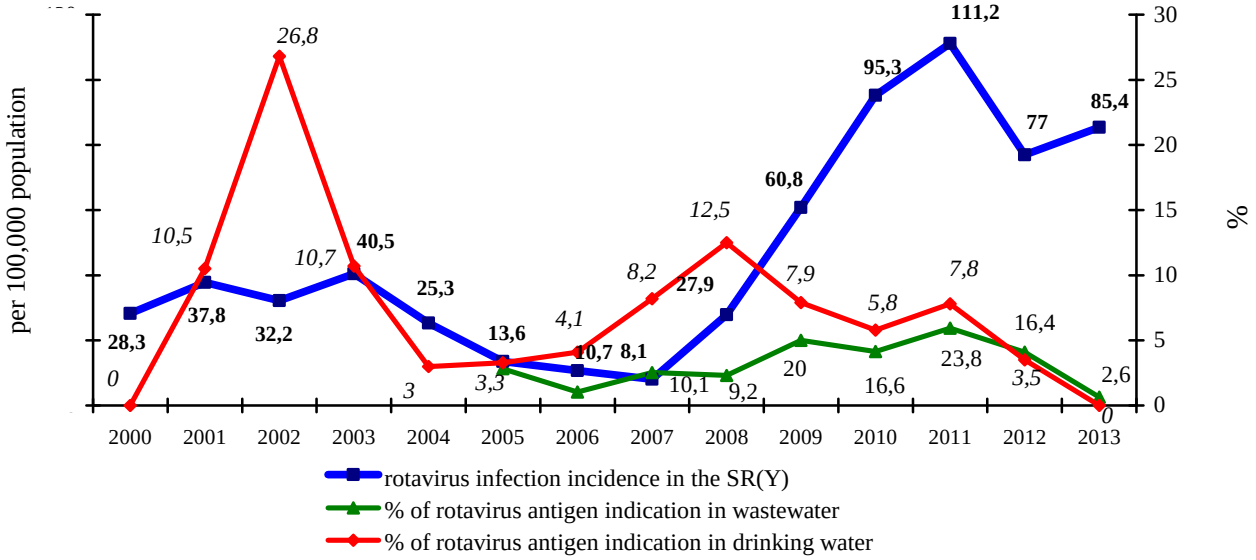

Figure 3. Rotavirus infection incidence in the Sakha Republic (Yakutia)

and the share of the rotavirus antigen detection in samples of drinking water and wastewater,

2000–2013

Table 1.

Rotavirus infection incidence in different population groups of the Russian Federation, Novgorod Oblast and the Sakha Republic (Yakutia) in 2013

No.	Subject	RVI morbidity, total	by the age groups (years):				
			under 1 year	1 - 2	3 - 6	7 - 14	15 - 17
		o/oooo±m	o/oooo±m	o/oooo±m	o/oooo±m	o/oooo±m	o/oooo±m
1	Russian Federation	71.6±0.2	1215.2±8.0	1321.4±6.2	329.4±2.3	49.8±0.7	16.2±0.6
2	Novgorod Oblast	115.8±4.3	2055.5±168.9	2263.6±127.1	425.5±40.6	99.9±15.0	30.7±13.4
3	Sakha Republic (Yakutia)	85.4±3.0	2278.3±118.5	1157.8±61.5	129.1±15.3	27.8±5.1	0

In Yakutia, the main risk group for RVI development are children of the first year of life, the incidence rate in which amounted to 2278.3 ± 118.5 ($p<0.001$) in 2013. In Novgorod Oblast, the incidence in the age groups under 1 year and 1-2 years was not statistically different – 2055.5 ± 168.9 and 2263.6 ± 127.1, respectively ($p>0.05$). In Russia as a whole, the greatest intensity of the epidemic process is observed in children of 1-2 years of age – 1321.4 ± 6.2 ($p<0.001$). Novgorod Oblast had high rates of rotavirus gastroenteritis in children of 3-6, 7-14 and teenagers of 15-17 years.

Monitoring of the pathogen circulation in the environment is an important part of the epidemiological surveillance of RVI, which is necessary for identifying risk factors for the disease. This purpose requires virological testing of drinking water from centralized water supply, as well as wastewater and open water. The study found out that, in contrast to Saint Petersburg and Novgorod Oblast, in the Sakha Republic (Yakutia) the rotavirus antigen was detected in samples of drinking water and wastewater almost every year. The analysis of how often the rotavirus antigen was found in drinking water showed that the first and most intense rise of the rotavirus antigen detection took place 2001-2002 (10.5 ± 3.3 and 26.8 ± 69%, respectively), due to the powerful effects of spring flooding on the Lena River in 2001 (Fig. 3). However, the RVI incidence remained at a relatively low level.

The second rise of the rotavirus antigen detection was recorded in 2008 (12.5 ± 2.9%), which preceded an increased morbidity. In 2011, with the maximum level of RVI incidence, there were relatively high detection rates of rotavirus antigen in drinking water (7.8 ± 3.4%). In 2012, along with the reducing incidence, there was registered a decrease in the frequency of antigen detection in drinking water to 3.5 ± 1.5%. [3]. However, in 2013, with an increase in RVI incidence, the virus antigen in samples of drinking water was not observed. The calculation revealed a direct weak correlation between the incidence and frequency of the rotavirus antigen detection in drinking water (Spearman's rank correlation coefficient $p=0.12$). Over the entire follow-up period, the average percentage of the rotavirus antigen detection in wastewater was 14.5 ± 1.0%, with the minimum rate in 2006 (4.1 ± 2.0%), and the highest in 2011 (23.8 ± 3.5%). These results indicate that the waterway RVI transmission has a certain impact, but it is not a risk factor, particularly in infants.

CONCLUSION

1. The results of the study showed that in the pre-vaccination period there were regional features of the RVI incidence, manifesting themselves in different intensity of the epidemiological process.

2. The age group of risk are children under 1 year and of 1-2 years of age, which corresponds to the data from statistics and literature on other regions and countries.

3. Water factor has a certain impact on RVI transmission in the Sakha Republic (Yakutia); however, its role has been decreasing lately.

4. The results of the study have proven the necessity of vaccination against RVI of children under 1 year of age.

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