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Original Article

# Epidemiology of Rotavirus diarrhea in children under five: A hospital-based surveillance in Jakarta

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## Abstract

***Background*** Rotavirus is still a major cause of acute diarrhea in children around the world, both in developed and developing countries. WHO Surveillance from 2001 to 2008 showed that in children under five years of age treated for acute diarrhea, on average 40% of cases were caused by rotavirus. A previous study in Indonesia showed that the incidence of rotavirus diarrhea in children ranged from 20%-60% of diarrhea cases. However, there have been few studies identifying the genotypes of rotavirus strains in Indonesia. This information is indispensable for manufacturing vaccines.

***Objective*** To examine the epidemiology of rotavirus diarrhea, including genotypes and clinical characteristics, in children under five years who were hospitalized in Jakarta.

***Methods*** This study was a prospective surveillance conducted at Cipto Mangunkusumo Hospital, Jakarta from January to December 2007 investigating hospitalized children under five years of age who suffered from acute diarrhea.

***Results*** Ninety-nine patients joined the study. The incidence of rotavirus infection in this study was 67%. The youngest was 2 months of age and the oldest 54 months of age, with an average age of 13.6 months. As much as 92% of rotavirus diarrhea was found in subjects aged 3-23 months, with a peak age of 12-23 months. Nutritional status, degree of dehydration, bloating, fever, blood in stool, and mucus in the feces were not significantly different between rotavirus and non-rotavirus diarrhea. Vomiting tended to be more frequently experienced by children with rotavirus diarrhea than those with non-rotavirus (88% vs. 67%). There was no clear, seasonal pattern for rotavirus diarrhea. Most G genotypes in this study were G1 (35%), G9 (12.5%), G2 (7.5%) and the majority of P genotypes were P6 (52.5%), P8 (17.5%) and P4 (10%).

***Conclusions*** The incidence of rotavirus diarrhea in hospitalized children under five years of age in Jakarta was 67%, with a predominance of G1, G9 and G2 genotypes. **[Paediatr Indones. 2011;51:138-43]**.

***Keywords:*** *epidemiology, incidence, acute diarrhea, rotavirus, children, Jakarta*

Rotavirus is the leading cause of acute diarrhea in children across the world with around 527,000 deaths per year due to diarrhea in children less than five years old. Children in Asian and African countries account for 85% of these deaths.[1-3] WHO surveillance from 2001-2008 revealed that 40% of treated, acute diarrhea cases worldwide in children less than five years old were caused by rotavirus. The highest number of rotavirus strains reported were G1, G2, G3, G4 and G9 genotypes.[3] Several epidemiological studies of rotavirus diarrhea in Asia (Malaysia, Vietnam, Thailand, Hong Kong, Taiwan, Korea, India, Middle East), Africa, Latin America (Brazil), and Europe showed that rotavirus diarrhea remains a health problem with negatively impacting health costs, time wasted and quality of life, due to the high morbidity and mortality rates.[4-17]

Improved hygiene and sanitation can drastically lower the incidence of diarrhea caused by non-rotavirus agents, whereas rotavirus diarrhea is only slightly influenced by hygiene and sanitation

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improvements. Rotavirus is often referred as a democratic virus, because it can affect children in developing and developed countries with similar incidence. Through vaccination it is hoped that morbidity and mortality rates of diarrhea caused by rotavirus infection can be reduced in children. In countries that have carried out a rotavirus vaccination program, decreases in the incidence of severe rotavirus infection have been observed, although mild infection remains ongoing.[2-4]

Previous studies in Indonesia, since rotavirus was found by Bishop in 1973, have described the incidence of rotavirus infection as a cause of acute diarrhea in children to range from 20%-60%.[18-21] Yet only a small number of studies in Indonesia identified the rotavirus strains responsible for infection. This study is part of a multi-center study involving six research facilities: Muhammad Husein Hospital, Palembang; Cipto Mangunkusumo Hospital, Jakarta; Hasan Sadikin Hospital, Bandung; Sardjito Hospital, Yogyakarta; Sanglah Hospital, Denpasar; and Mataram Hospital, Nusa Tenggara Barat. The purpose of this study was to investigate the epidemiology, strains and clinical characteristics of rotavirus infection in children under five with acute diarrhea.

## Methods

This study was a prospective surveillance in Cipto Mangunkusumo Hopital Jakarta conducted from January to December 2007. We included all patients with acute diarrhea aged less than five years old who were hospitalized at the one-day care (ODC) facility or pediatric ward of Cipto Mangunkusumo Hospital. Acute diarrhea was defined as loose or watery stools with a frequency of more than 3 times in 24 hours and lasting for less than 14 days. After informed consent was obtained, history taking and physical examination in the inpatient unit were conducted to complete the data in the research form which included age, sex, nutritional status, degree of dehydration, clinical symptoms (fever, vomiting, bloating, stool characteristics) and final diagnosis. Nutritional status of patients was determined by measuring weight to height ratios (weight/height) and were classified by *z*-score: <-2 for under nutrition, between -2 to 2 for normal nutrition and >2 for overweight.

Fecal specimens were stored at 4-8 °C then sent to the Biofarma Laboratory, Bandung to test for rotavirus. Detection of rotavirus antigen was performed using the enzyme immunoassay (EIA) (Premiere Rotaclone and Dakopatts, Dako International) method. A total of 40 stool specimens testing positive for rotavirus were sent to the microbiology laboratory at Gadjah Mada University to determine the genotype of the rotavirus strains.

This study was approved by the Ethical Committee of Research in Medical Health at Faculty of Medicine, University of Indonesia.

## Results

Between January to December 2007 there were a total of 106 children less than five years old hospitalized for acute diarrhea in the Department of Child Health, Cipto Mangunkusumo Hospital. Stool specimens could not be collected for seven patients for various reasons, so that left 99 patients in our study. The youngest was aged 2 months and the oldest 54 months, with average age of 13.6 months. A total of 66/99 (67%) patients tested positive for rotavirus as the cause of diarrhea. The majority of diarrhea cases were found in children aged 3-23 months. (**Figure 1**) Rotavirus infections were similarly clustered in children aged 3-23 months (92%), with a peak age of 12-23 months.

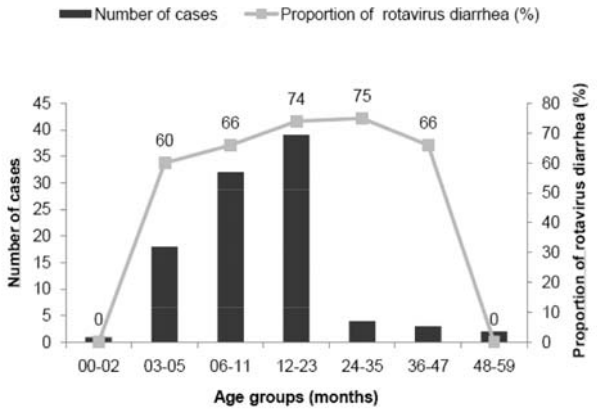


**Figure 1.** Age groups of patients < 5 years old with acute diarrhea in Jakarta.

**Table 1** shows the clinical characteristics associated with rotavirus infection including sex, age, nutritional status, degree of dehydration, vomiting, bloating, fever, and stool characteristics.

**Table 1.** Clinical characteristics associated with rotavirus infection in children < 5 years old with acute diarrhea

| Clinical Characteristic | Rotavirus Positive N = 66 (%) | Rotavirus Negative N = 33 (%) | P* |
|---|---|---|---|
| Male sex | 33 (50) | 19 (57) | 0.477 |
| Age group | | | 0.247 |
| 0 – 5 months | 11 (17) | 8 (24) | |
| 6 – 35 months | 53 (80) | 22 (67) | |
| 36 – 59 months | 2 (3) | 3 (9) | |
| Nutritional status weight/height (z-score) | | | 0.861 |
| Under(< -2) | 15 (22.5) | 8 (24) | |
| Normal (-2 to 2) | 50 (76) | 24 (73) | |
| Over (> 2) | 1 (1.5) | 1 (3) | |
| Degree of dehydration | | | 0.600 |
| No dehydration | 1 (1.5) | 0 (0) | |
| Mild-moderate | 64 (97) | 33 (100) | |
| Severe | 1 (1.5) | 0 | |
| Vomiting | | | 0.012 |
| Yes | 58 (88) | 22 (67) | |
| No | 8 (12) | 11 (33) | |
| Bloating | | | 0.095 |
| Yes | 41 | 26 | |
| No | 25 | 7 | |
| Fever | | | 0.674 |
| Yes | 8 (12) | 5 (15) | |
| No | 58 (88) | 28 (85) | |
| Blood in stool | | | 0.074 |
| Yes | 2 (3) | 4 (12) | |
| No | 64 (97) | 29 (88) | |
| Mucus in stool | | | 1.00 |
| Yes | 22 (33) | 11 (33) | |
| No | 44 (67) | 22 (67) | |

* Chi square test, P <0.05 is considered significant

**Figure 2** shows the seasonal pattern of rotavirus infection. The distribution suggested that rotavirus infection was present at all times in a year. Nevertheless, the highest number of cases mainly occurred between January and June and decreased from July to December.

Forty stools specimens testing positive for rotavirus were randomly taken for genotype examination. We found the G genotype distribution was G1 (14, 35%), G2 (3, 7.5%), G9 (5, 12.5%), and untypeable (18, 45%), while G3 and G4 were not found. The majority of P genotypes were P6, P8 and P4, which accounted for 52.5%, 17.5%, 10%, respectively.

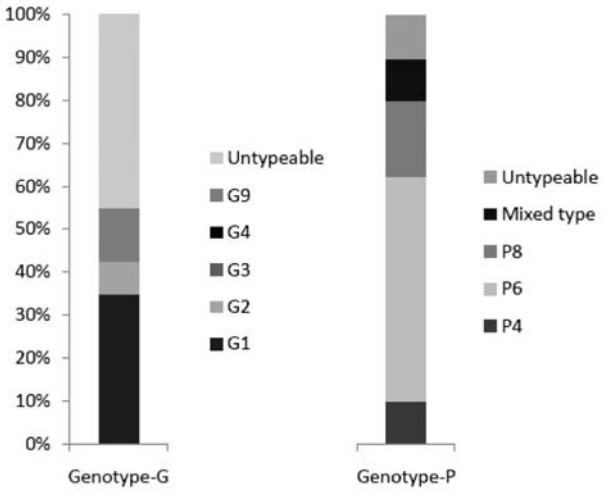


**Figure 3.** Rotavirus genotype distribution in children < 5 years old in Jakarta.

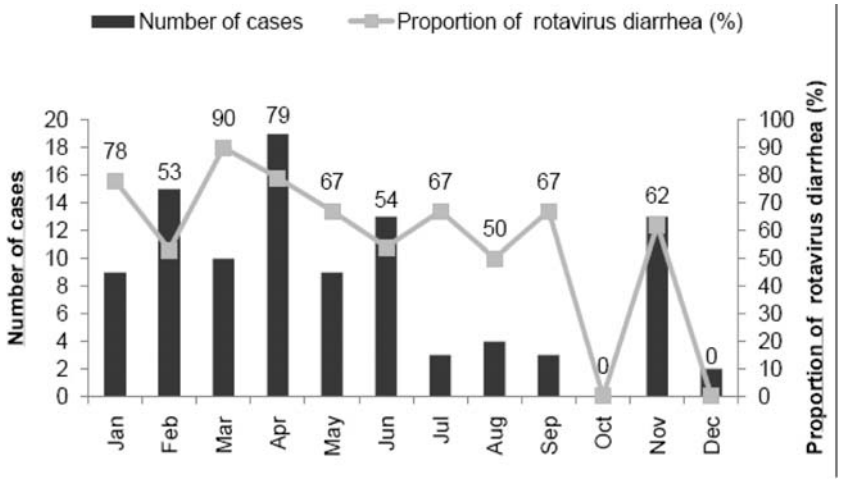


**Figure 2.** Seasonal pattern of Rotavirus diarrhea in children < 5 years old in Jakarta.

## Discussion

The incidence of rotavirus diarrhea (67%) in this study was higher than that of other studies around the world, an average incidence of 40%.[4-17] Rotavirus remains a major cause of acute diarrhea in children and previous studies in Indonesia showed that the incidence of rotavirus infection as a cause of acute diarrhea in children ranged from 20% -60%.[18-21] In comparison with other research centers in Palembang, Bandung, Yogyakarta, Denpasar and Mataram, with incidences of rotavirus infection of 64%, 51%, 39%, 61% and 65%,respectively, Jakarta (67%) had the highest incidence.[22] This result was slightly higher than a previous study (61%) of outpatients in the Pediatric Gastroenterology outpatient clinic, Cipto Mangunkusumo Hospital.[18] Patients with acute diarrhea caused by rotavirus infection tended to have more severe clinical symptoms, so they were more likely to be hospitalized than those with non-rotavirus diarrhea.

The predominant patient age group testing positive for rotavirus was 6-23 months, similar to many other studies throughout the world.[4-17] This can be explained by the fact that at the age of < 6 months, maternal antibodies have a protective effect, while at > 23 months children may have developed natural immunity due to recurrent rotavirus infections. The peak age of 12-23 months in this study differs somewhat to many other studies in Asia which showed a peak of infection in the first year of life.[4] The age distribution of children with rotavirus infection in our study is consistent with a European study showing the peak of infection in the second year of life.[15]

**Table 1** shows that gender did not differ between patients with acute diarrhea testing rotavirus positive (50%) and rotavirus negative (57%). Nutritional status of patients was determined by measuring the weight to height ratio (weight / height) and was classified by z-scores: < -2 for under nutrition, between -2 to 2 for normal nutritional status and > 2 for overweight. Nutritional status was not significantly different between patients testing rotavirus positive and those testing rotavirus negative. Previous research has shown that malnutrition causes more severe disease symptoms, however, the risk of rotavirus infection did not appear to be influenced by nutritional status.[3,4,23] Other clinical characteristics including the degree of dehydration, abdominal bloating, fever, the presence of blood and mucous in the stool were not significantly different between rotavirus positive patients and rotavirus negative patients. This shows that the fecal characteristics cannot be used to differentiate rotavirus and non-rotavirus infections. Somewhat surprisingly, symptoms of bloating in this study did not differ significantly between rotavirus and non-rotavirus diarrhea, since generally the intestinal villi damage in children with acute diarrhea caused by rotavirus is thought to commonly causes symptoms of secondary lactose intolerance due to reduced lactase enzyme. Patients with acute diarrhea caused by rotavirus infection were more likely to experience vomiting compared to those with non-rotavirus infection (88% vs. 67%, P=0.012). Hence, patients with acute rotavirus diarrhea were more likely to be hospitalized compared to those with non-rotavirus diarrhea because of oral rehydration failure due to vomiting.

The seasonal pattern of rotavirus infection was similar to that of other studies in several countries in Asia with similar climates to Indonesia.[10,11] This finding differs from research in Turkey and some sub-tropical countries, which showed rotavirus diarrhea to be more common in the winter season from November to February, and rarer in the summer.[15-17]

The genotype of rotavirus strains found in the WHO surveillance in 2001-2008 were G1, G2, G3, G4 and G9, differing from the results of our research.[3] Compared to other research centers, Jakarta had the highest proportion of untypeable genotypes (45%), followed by Yogyakarta (27.5%). Of the six research centers in this multi-centered study, only Yogyakarta had genotypes G3 and G4, while other research centers had various distributions of G1, G2, G9 and untypeable genotypes.[22] We found the majority of P genotype infections were strains commonly circulating worldwide, namely P6, P8 and P4. Mixed infections and untypeable strains both accounted for 10%. Further development in genotype determination is needed, particularly for untypeable genotypes. These strains may prove to conform to a known genotype if investigated further.

In conclusion, the incidence of rotavirus diarrhea in hospitalized children under age five years in Jakarta was 67%. The predominant G genotypes were G1, G2 and G9, and P genotypes were P6, P8 and P4.

Nutritional status, degree of dehydration, abdominal bloating and fever were not significantly different between rotavirus and non-rotavirus diarrhea cases. Vomiting tended to be more frequently experienced by children with rotavirus diarrhea, hence these patients required hospitalization more often than patients with non-rotavirus diarrhea. Stool characteristics were not a good determinant for distinguishing rotavirus and non-rotavirus diarrhea.

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