Identification of Acute Rotavirus Diarrhea and Analysis of its Risk Factors in Children Under-5 Years in Surabaya, Indonesia

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Abstract

Background: Diarrhea is the most common disease among children and still a major cause of morbidity and mortality. Among the various causes of acute diarrhea in children, rotavirus is the most frequent one, especially in developing countries where universal rotavirus vaccination has not been introduced, including Indonesia.

Objectives: This study aimed to determine the percentage of acute rotavirus diarrhea in children and analyze its risk factors in Tanah Kali Kedinding Primary Health Care, Surabaya, Indonesia.

Method: Stool specimens were collected from a total 116 children under-5 years visiting Tanah Kali Kedinding Primary Health Care in Surabaya, Indonesia due to acute diarrhea during September 2018 – January 2019. Rapid stool antigen immunochromatograhic test was used to identify group A rotavirus antigen. Some potential risk factors were analyzed.

Results*:* Among 116 samples from children with acute diarrhea, 67 (57.8%) were identified group A rotavirus positive. Samples with rotavirus positive were obtained mostly form male (p=0.008). Malnutrition was associated with an increased risk of rotavirus infection (p=0.025). Male and malnutrition were about 3 times more likely to have rotavirus infection. Other risk factors including children' age, history of exclusive breastfeeding, mothers' education and the amount of income were not statistically associated with rotavirus diarrhea.

Conclusion: The occurence of children with acute rotavirus diarrhea in this study was 57.8%. Some risk factors for rotavirus infection were gender and malnutrition. Control measures such as anticipating its risk factors need to be adapted, according to the further epidemiology investigation.

Keywords *: rotavirus, acute diarrhea, risk factors, children under-5 years*

Introduction

Diarrhea is the most common disease among children with approximately nearly 1.7 billion cases and kills around 525,000 children every year worldwide.[1] In Indonesia, the incidence of diarrhea was very high, with 270 new cases per 1,000 persons and its prevalence in children under-5 years was 12.3% in 2018.[2]

Acute diarrhea is an inflammatory disease on intestine caused by various agents like viruses, bacteria and parasites. Among the causative agents, rotavirus is the most frequent one in children. Rotavirus is primarily spread via the fecal-oral route, either by person-to-person contact or through ingestion of food or water that has been contaminated with the stool of infected

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persons.[1] Rotavirus is a viral infection that depends on seasonal changes, with the highest its prevalence occurs in cooler months.[3] Symptomatic presentations of rotavirus infection which are more visible at the age of 6- 24 months include fever, vomiting, and acute watery diarrhea.[4,5] There is no specific treatment for rotavirus other than fluid and electrolyte replacement to prevent several complication such as dehydration, sepsis, gastrointestinal (GI) bleeding, respiratory infections, myocarditis, hepatic abscess, hepatitis, seizures and meningoencephalitis.[6,7]

Studies of rotavirus infection in children under-5 years previously have been conducted in some cities in Indonesia. In Jakarta, rotavirus infection was detected in 42%, twice more than norwalk like viruses (prototype of norovirus) infection in 1997-1999.[8] In Bali, rotavirus infection was reported 49.8% in 2009-2011.[9] Nirwati et al reported the prevalence of rotavirus in Yogyakarta was 57% in 2009 and in Mataram was 65.47% in 2015.[10,11] The prevalence of rotavirus infection among hospitalized pediatric patients in Surabaya during 2015-2018 was 31.7%.[12] Proportion of rotavirus infection in the community (primary health care) in Bandar Lampung was 74.3%, and no potential risk factor was found to be associated with the disease.[13] Many studies showed the high prevalence of rotavirus infection in Indonesia, however rotavirus vaccination has not been included in a national immunization program (still included in an optional immunization).[14]

In East Java province, the prevalence of diarrhea in children under-5 years increased from 6.6% in 2013 to 10.7% in 2018.[15] Surabaya is a capital of East Java province, and Tanah Kali Kedinding Primary Health Care was ranked fourth for the highest case number of diarrhea (1,460 cases) in Surabaya in 2018.[16]

Only a few studies have reported acute rotavirus diarrhea in cities in Indonesia including its risk factors. This study aimed to determine the proportion of acute rotavirus diarrhea in children and analyze its risk factors in Tanah Kali Kedinding Primary Health Care, Surabaya.

Materials and Method

Stool specimens were collected from children under-5 years visiting Tanah Kali Kedinding Primary Health Care in Surabaya due to acute diarrhea during September 2018 – January 2019. Acute diarrhea is defined as passage of ≥3 of abnormally loose or watery stools in the preceding 24 hours or as a new onset of diarrhea in a patient without a history of diarrhea in the previous 14 days. Rapid stool antigen immunochromatograhic testing by using SD rotavirus BIO LINE (SD Bioline Rotavirus Rapid; Standard Diagnostics, Inc, Yongin, Korea) was performed to identify VP6 antigen of group A rotavirus according to the manufacturer's instructions. The sensitivity and the specificity of this test were 100% and 92.4%, respectively. Data of socio-economic and history of breastfeeding was collected using a standard questionnaire by interview. Nutritional status was collected from raw data (medical record) which then analyzed using cut off Z-Score WHO 2006 and recommendation of Indonesian Pediatric Society.[17] All data were analyzed using SPSS 20 with chi-square or fisher's exact test for categorical variables.

Ethical clearance for this study was obtained from the Ethics Committee of Faculty of Medicine, Universitas Airlangga, Surabaya. Informed consent for participation in this study was obtained from parents of each individual.

Results

Among a total of 116 enrolled children, most of them (57.8%) were rotavirus-positive and the rest (42.2%) were rotavirus-negative. More boys (59.7%) were infected with rotavirus infection than girls. Most of both children with and without rotavirus infection were 1-2 years old, had mothers with tertiary education and parents who earned income under city minimum wage (Table 1). All children have not been vaccinated with rotavirus vaccination.

Some potential risk factors of rotavirus infections were analyzed in this study, including age, gender, history of exclusive breastfeeding, nutritional status, maternal education, parents' income. Among those factors, only gender and nutritional status were statistically significant. Male and malnutrition were about 3 times more likely to have rotavirus infection (OR=2.789, CI=1.298-5.989, p=0.008 and OR=3.05, CI=1.120-8.304, p=0.025, respectively).

Table 1. Socio-economic distribution

Variable	Total sample (N=116)	
	Rotavirus (+) N=67	**Rotavirus (-) N=49**
Gender		
Male	40 (59.7%)	17 (34.7%)
Female	27 (40.3%)	32 (65.3%)
Age		
1 - 2 years	37 (55.3%)	27 (55.1%)
>2 - 3 years	14 (20.9%)	9 (18.4%)
>3 - 4 years	6 (8.9%)	7 (14.3%)
>4 - 5 years	10 (14.9%)	6 (12.2%)
Maternal Educational Level		
No formal education	0	0
Primary level	12 (17.9%)	6 (12.3%)
Secondary level	20 (29.9%)	18 (36.7%)
Tertiary level	35 (52.2%)	25 (51%)
Wage		
Under city minimum of wage	47 (70.1%)	33 (67.3%)
Above city minimum of wage	20 (29.9%)	16 (32.7%)

Table 2. Risk factors for rotavirus infection

Variable	Total sample (N=116)		p value	OR (95% CI)
	Rotavirus (+) N=67	**Rotavirus (-) N=49**		
Gender				
Male	40 (59.7%)	17 (34.7%)	0.008	2.789
Female	27 (40.3%)	32 (65.3%)		(1.298-5.989)
Age				
1-2 years	37 (55.3%)	27 (55.1%)	0.990	1.005
>2-5 years	30 (44.7%)	22 (44.9%)		(0.479-2.108)
Exclusive Breastfeeding				
Yes	52 (77.6%)	41 (83.7%)	0.419	0.676
No	15 (22.4%)	8 (16.3%)		(0.261-1.750)
Nutritional Status				
Malnourish	20 (29.9%)	6 (12.2%)	0.025	3.050
Well-nourish	47 (70.1%)	43 (87.8%)		(1.120-8.304)

***Cont.*.** **Table 2. Risk factors for rotavirus infection**

Maternal Educational Level Primary Level Above Primary Level	 12 (17.9%) 55 (82.1%)	 6 (12.3%) 43 (87.7%)	0.405	1.564 (0.543-4.505)
Wage Under city minimum of wage Above city minimum of wage	 47 (70.1%) 20 (29.9%)	 33 (67.3%) 16 (32.7%)	0.747	1.139 (0.515-2.520)

Discussion

One hundred and sixteen children with acute diarrhea in a community (a primary health care) in Surabaya were enrolled in this study. Sixty seven (57.8%) children were infected with rotavirus. This result was in agreement with previous studies in hospitalized children in other cities in Indonesia, ranged 31.7%-65.5% of rotavirus infections, however it was less from the prevalence reported in a primary health care in Bandar Lampung (74.3%).[8-13] All of those studies presented high number of rotavirus infection, however a rotavirus vaccination has not been included in a national immunization program yet. [14] Compared with the result of the previous study in a referral hospital (31.7%) in the same city (Surabaya), our study in the community found the higher number of rotavirus infection. Hospitalized patients at tertiary health care tend to have more severe disease. It looks like that the number of milder rotavirus infection in community was more than that in hospital. Salim et al (2014) reported among 327 cases with rotavirus infection, 91.4% (299) presented mild dehydration and 11 (3.4%) presented severe dehydration.[9]

In our study, children with male gender were about 3 times more likely to have rotavirus infection ($p<0.05$). It confirmed the previous report that ratio of male and female with rotavirus infection was 1.6 : 1.[9] However, Fidhow et al (2017) reported that gender was not a significant factor associated with rotavirus infection.[18]

Although age was not a significant factor, most children under-2 years (55.3%) were infected with rotavirus. This result was supported by previous studies in other cities in Indonesia and also in India.[8,12,19,20] The incidence of rotavirus infection rarely occurs in children less than 6 months and more than 2 years. It might due to passively mother's anti-rotavirus antibodies through exclusive breastfeeding, while after 2 years of age the children have already developed antibodies against repeated infection.[21]

A previous study showed that clinical infants who were breastfed presented milder symptoms of shorter duration than infants who were bottle-fed.[22] Breastfeeding reduces gastrointestinal infections as breast milk contains lactadherin that is protective against symptomatic rotavirus infection. Human milk also contains anti-rotavirus antibodies that seem to play a smaller role against pathogens.[23] In our study, children with history of exclusive breastfeeding were less likely to have rotavirus infection (OR 0.67), although the history of exclusive breastfeeding was not statistically significant as its risk factor ($p>0.05$). This result was in line with the Shen et al' finding.[24]

Malnutrition was associated rotavirus infection ($p<0.05$). Children with malnutrion had a 3 times increased risk of rotavirus diarrhea. Epidemiological studies suggested a strong association between childhood malnutrition and increased risk of infectious diarrhea. The increased incidence and severity of infections in malnourished children is largely due to the deterioration of immune function; limited production and/or diminished functional capacity of all cellular components of the immune system have been reported in malnutrition.[25] However, certain infectious diseases, including rotavirus infection also cause malnutrition, which can result in a vicious cycle. Among all causes of childhood diarrhea, rotavirus is one of the most significant attributable one[26] and cellular attachment with healthy cells in the brush border of the intestine is fundamental in the pathophysiology of the rotavirus infection.[27-29] Malnutrition with the possibility of shortening of villi in malnourished infants may inhibit rotavirus entry and replication.[30]

Children with rotavirus diarrhea whose mothers had tertiary education were predominant (52.2%). It was suggested that mothers with higher education were more likely to be aware of health condition of their children. Unfortunately, in this study, most of them had a low household income. Parashar et al (2003) showed from the median 2.1 million deaths due to diarrhea, 85% occurred in children from low-income countries. The proportion of deaths in infants with diarrhea shows a declining trend with increasing income levels.[31]

The finding of high number of acute rotavirus diarrhea needs a great attention and anticipation. The earlier detection of the infection could prevent the greater severity in those children. Improving nutritional status and implementation of rotavirus vaccination as a national immunization program might be considered to lower the incidence of acute rotavirus diarrhea.

Conclusion

The occurence of children with acute rotavirus diarrhea in Tanah Kali Kedinding Primary Health Care, Surabaya was 57.8%. Interestingly, it was higher than that in hospital reported previously in Surabaya. Some risk factors associated with rotavirus infections were gender and malnutrition. Control measures such as anticipating its risk factors need to be adapted, according to the further epidemiology investigation.

Conflict of Interest: There was no conflict of interest in this study.

Ethical Clearance: The ethical clearance was obtained from KEPK, Faculty of Medicine, Universitas Airlangga No. 84/EC/KEPK/FKUA/2019.

Source of Funding: This study was supported by the authors.

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