

A Correlational study between Nutritional Status and Severity of Rotavirus Diarrhea in children under five years in Bandung, Indonesia

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ABSTRACT

AIM: Diarrhea disease is a major cause of poor nutritional status in children. Malnutrition can make a person more susceptible to infection that also contributes to malnutrition, causing a vicious cycle. Surveillance of children hospitalized for diarrhea in 3 Indonesian hospitals found 60% were rotavirus positive and 41% were positive in outpatient clinics. The aim of this study was to measure the correlation of nutritional status with severity of rotavirus diarrhea.

MATERIALS AND METHODS: This study uses cross sectional design and included all children under 5 years old, both inpatients and outpatients, who presented with acute diarrhea at Dr. Hasan Sadikin General Hospital from January 2009 through December 2012. The Vesikari Clinical Severity Scoring System was considered the measurement for severe rotavirus diarrhea. Assessment of nutritional status used anthropometric weight for height from World Health Organization (WHO) child growth standards. Categorical data were analyzed by Pearson Chi square test.

RESULTS: Among 427 children aged 1-59 months, with rotavirus seropositive stool specimens, there were 258 (60%) boys and 169 (40%) girls. Nutritional status included "well nourished" (74%), "moderately malnourished" (23%) and "severely malnourished" (3%), while the distribution of severity for rotavirus diarrhea was "mild" (10%), "moderate" (21%) and "severe" (69%). This study showed that nutritional status had no significant correlation with severity of rotavirus diarrhea, $p = 0.524$.

CONCLUSIONS: Nutritional status had no significant correlation with severity of rotavirus diarrhea.

Key words: Children; Nutritional status; Severity rotavirus diarrhea

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INTRODUCTION

Diarrheal disease is a major cause of poor nutritional status in children^[1]. Diarrhea is the second leading cause of death among children under the age of 5, resulting in one in 9 child deaths worldwide^[2]. The mortality rate for children under five suffering from acute diarrhea has fallen from 4.5 million deaths annually in 1979 to 1.6 million deaths in 2002. In developing countries acute diarrhea continues to take a high toll on children; major causes of death among children under five include diarrhea (15%) and deaths associated with malnutrition (54%)^[3]. Malnutrition is frequently part of a vicious cycle that includes disease and poverty. Malnutrition in children is the consequence of a range of factors that include insufficient food intake, often related to poor food quality, and severe and repeated infectious diseases, or frequently some combinations of the three^[4]. Malnutrition can make a person more susceptible to infection that contributes to malnutrition, causing a vicious cycle^[5]. A surveillance study in three Indonesian hospitals found that 60% of children hospitalized for diarrhea and 41% of children in outpatient clinics were rotavirus positive^[6]. Rotavirus was detected in 47.8% of surveillance samples in Bandung (Indonesia)^[7]. In tropical countries rotavirus is found year-round^[8].

The rotavirus infection in association with malnutrition may cause a significant rise in gut permeability to environmental macromolecules, a combination that results in more severe mucosal damage, including disruption of the microvillus border^[9]. Infection adversely affects nutritional status through increased catabolism, reductions in dietary intake, and intestinal absorption and sequestration of nutrients that are required for tissue synthesis and growth^[10]. Poor appetite, vomiting, deliberate with holding of food resulting in poor intake; malabsorption of macro and micronutrients; hastening of intestinal transit time; disturbance of metabolic and endocrine functions; and direct loss of protein and other nutrients in gastrointestinal tract are some of the known mechanisms which have an impact on nutrition during an episode of diarrhea^[1].

Rotavirus is a leading cause of severe acute diarrhea requiring hospitalization among infants and young children worldwide^[11]. Severe acute malnutrition in Kenyan children, complicated by diarrhea, had a higher risk of death than those who did not have diarrhea during their hospital stay^[12]. In particular, promotion of breastfeeding to prevent diarrhea and reduce its nutritional complications, as well as continued feeding during illness and supplementation with selected micronutrients, both to prevent enteric infections and to reduce their severity, are all important to control diarrheal diseases and their associated nutritional complications^[10]. In rotavirus diarrhea, however, there was no significant association between exclusive breastfeeding and severe dehydration^[13].

The aim of this study was to measure the correlation of nutritional status with severity of rotavirus diarrhea among young children.

METHODS

This study used cross sectional design and included all children under 5 years old (U5) inpatients and outpatients who presented with acute diarrhea at Dr. Hasan Sadikin General Hospital, Bandung, West Java, Indonesia, from January 2009 through December 2012. A fresh fecal specimen was obtained from enrolled children within 24 hours after admission and was stored at 4°C-8°C before being tested at the Laboratory of Microbiology using Pro Spec TTM Rotavirus microplate assay as the Rota antigen agent of detection.

For this study diarrhea was defined as three or more abnormally

loose or watery stools during the previous 24 hours. This analysis used the Vesikari Clinical Severity Scoring System to assess the severity for diarrhea caused by Rotavirus. System parameters take into account each of the important symptoms identified in the clinical presentation profile: diarrhea, vomiting, fever, dehydration, and the duration of diarrhea and vomiting. An additional parameter considered is treatment status. There are seven scoring parameters (Table 1) included in the Vesikari Clinical Severity Scoring System (Table 2)^[14]. The Vesikari assessment is currently considered the best measurement for severe rotavirus diarrhea.

Nutritional status was assessed with WHO child growth standards, specifically weight-for-height. Length of infant and children under 24 months of age was measured lying down (supine). Height of children over 24 months of age was measured while standing. For simplicity, however, infants and children under 87 cm was measured lying down (or supine) and those above 87 cm standing. Malnutrition was defined as “well nourished” (no wasting) “moderately malnourished” (weight-for-heights score [WHZ] < -2.00SD), and “severely malnourished” < -3.00 SD^[4,15]. These anthropometric WHO child growth standards are a measure of SDs above or below the median for the international reference population. The deviation of an individual’s value from the median value of a reference population, divided by the standard deviation of the reference population^[4,15].

Independent variables used in this analysis included sex, age, nutritional status, clinical manifestation of diarrhea, fever, dehydration status, and hospitalization. The severity of dehydration was assessed according to the WHO Integrated Management of diarrhea and categorized into “severe”, “some”, or “no dehydration”^[16]. Patients without any signs of dehydration were considered assess with mild disease (no dehydration). Moderate or some dehydration was defined as one or more of the following signs: restlessness, irritability, sunken eyes, drinking eagerly, thirsty, and skin pinch goes back lowly. Severe dehydration was defined as two or more of the following signs: lethargy or un consciousness, sunken eyes, drinks poorly or not able to drink, and skin pinch goes back very slowly (>2 seconds)^[16]. This study was approved by the Ethical Committee.

Statistical analysis

Data were expressed as sums and percentages. The correlation of severity of rotavirus diarrhea and nutritional status was analyzed by Pearson Chi square test and values of < 0.05 were considered statistically significant. Data was analyzed using Epi Info v.3.5.4.

Table 1 Vesikari Clinical Severity Scoring System Parameters and Scores.

Parameter	Score		
	1	2	3
Diarrhea			
Maximum Number Stools per Day	1 - 3	4 - 5	≥ 6
Diarrhea Duration (Day)	1 - 4	5	≥ 6
Vomiting			
Maximum Number Vomiting per Day	1	2 - 4	≥ 5
Vomiting Duration (Day)	1	2	≥ 3
Temperature	37.1 - 38.4	38.5 - 38.9	≥ 39.0
Dehydration	N/A	1 - 5%	≥ 6%
Treatment	Rehydration	Hospitalization	N/A

Table 2 Vesikari Severity Category.

Severity Category			
Mild	Moderate	Severe	Maximum score
< 7	7 - 10	≥ 11	20

RESULTS

In the 4-year period from January 2009 through December 2012, there were 945 children with hospital admissions aged 1-59 months for acute diarrhea at Dr. Hasan Sadikin General Hospital, 427 (45%) of these patients were rotavirus positive and included in this study. There were 258 (60%) boys and 169 (40%) girls. We found that most children were well-nourished (74%), followed by moderately malnourished (23%), and a small group suffered severe acute malnutrition (3%). Children admitted for diarrhea showed year-round distribution for hospital admission with an annual peak in January. The severity scores of rotavirus diarrhea were most commonly severe (69%), followed by moderate (21%), and mild (10%). We observed that more patients with rotavirus diarrhea were admitted to the hospital (62%), and among these, more had “severe” diarrhea (80.4%). Severe diarrhea was more common among male infants between 1 and 24 months of age. Among patients with severe diarrhea, most were well-nourished (normal) and presented with vomiting but no fever. These patients also showed signs of dehydration and were more often admitted to the hospital. Severity of rotavirus diarrhea had no significant correlation with sex, age, nutritional status, and fever (Table 3). Conversely, vomiting, dehydration and hospitalization had significant correlation with severity of rotavirus diarrhea (Table 3).

After examining hospitalization status, outpatients showed no significant correlation between severity of rotavirus diarrhea and either dehydration nor nutrition status (Table 4). Inpatients, however, showed a significant correlation with dehydration status. Vomiting was significantly associated with severe diarrhea in both outpatients and inpatients.

DISCUSSION

Our study showed a rotavirus prevalence of 45% in children with diarrhea attending the Dr. Hasan Sadikin General Hospital. Similar results for rotavirus prevalence were obtained from a related study from Ahmed *et al*^[17].

We found rotavirus diarrhea predominantly in male children

(60%), which is also quite similar to other studies^[17,18]. However, as in our study, no significant correlation of gender with severity of rotavirus diarrhea was evident in previous studies^[19,20].

Our study found the number of children less than 2 years of age

Table 3 Correlation of Nutritional Status with Severity of Rotavirus Diarrhea.

Variables	n (%)	Severity of Diarrhea Rotavirus			p
		Mild (< 7)	Moderate (7-10)	Severe (≥ 11)	
		n = 43 (10)	n = 91 (21)	n = 293 (69)	
Sex					
Boys	258 (60)	25 (9.7)	51 (19.8)	182 (70.5)	0.556
Girls	169 (40)	18 (10.6)	40(23.7)	111 (65.7)	
Age (months)					
1 ≤ 24 month	386 (90)	38 (9.8)	81 (21.0)	267 (69.2)	0.747
> 24 - 59 month	41 (10)	5 (12.2)	10 (24.4)	26(63.4)	
Nutritional status					
Well-nourished (normal)	317 (74)	30 (9.5)	73 (23.0)	214 (67.5)	0.524
Moderately malnourished	98 (23)	12 (12.2)	17 (17.4)	69 (70.4)	
Severely malnourished	12 (3)	1 (8.3)	1(8.3)	10 (83.4)	
Clinical Manifestation					
Vomiting	327 (77)	4 (1.2)	39(11.9)	284 (86.9)	<0.001
Without vomiting	100 (33)	39 (39.0)	52 (52.0)	9 (9.0)	
Fever					
< 37.5 °C	249 (58)	29 (11.6)	53 (21.3)	167 (67.1)	0.324
37.5 - 38.5 °C	126 (30)	13 (10.3)	27 (21.4)	86 (68.3)	
> 38.5 °C	52 (12)	1 (1.9)	11 (21.2)	40 (76.9)	
Dehydration					
No Dehydration	171 (40)	35 (20.4)	48 (28.1)	88 (51.5)	<0.001
Some Dehydration	230 (54)	7 (3.0)	41 (17.8)	182 (79.1)	
Severe Dehydration	26 (6)	1 (3.8)	2 (7.7)	23 (88.5)	
Hospitalization					
Outpatient	162(38)	31 (19.1)	51 (31.5)	80 (49.4)	<0.001
Inpatient	265(62)	12 (4.5)	40 (15.1)	213 (80.4)	

Table 4 Correlation of Hospitalization Status with Nutritional Status and Severity of Rotavirus Diarrhea.

Variable	Clinical Manifestation	Severity of Diarrhea Rotavirus			*p value	
		n = 427	n = 43 (10)	n = 91 (21)		n = 293 (69)
Outpatient	Without vomiting	45	28 (62.2)	16 (35.6)	1 (2.2)	< 0.001
	Vomiting	117	3 (2.6)	35 (29.9)	79 (67.5)	
	No Dehydration	90	24 (26.7)	28 (31.1)	38 (42.2)	0.065
	Some Dehydration	71	7 (9.9)	23 (32.4)	41 (57.7)	
	Severe Dehydration	1	0 (0)	0 (0)	1 (100)	
	Well-nourished (normal)	122	24 (19.7)	43 (35.2)	55 (45.1)	0.227
	Moderately malnourished	38	6 (15.8)	8 (21.1)	24 (63.1)	
	Severely malnourished	2	1 (50)	0 (0)	1 (50)	
Inpatient	Without vomiting	55	11 (20)	36 (65.5)	8 (14.5)	< 0.001
	Vomiting	210	1 (0.5)	4 (1.9)	205 (97.6)	
	No Dehydration	81	11 (13.6)	20 (24.7)	50 (61.7)	< 0.001
	Some Dehydration	159	0 (0)	18 (11.3)	141 (88.7)	
	Severe Dehydration	25	1 (4.0)	2 (8.0)	22 (88.0)	
	Well-nourished(normal)	195	6 (3.1)	30 (15.4)	159 (81.5)	0.209
	Moderately malnourished	60	6 (10)	9 (15)	45 (75)	
	Severely malnourished	10	0 (0)	1 (10)	9 (90)	

*Pearson chi square test.

infected with rotavirus was nine times greater than among children aged 2 to 5 years; however, age showed no significant correlation with severity of rotavirus diarrhea. This result is similar to the findings of studies from Ahmed *et al* and Nitiema *et al*^[17,21].

One quarter of the children in our study presenting with rotavirus diarrhea also suffered from malnutrition. A previous study by Talbert *et al* shows that diarrhea is a common complication (49%) in children hospitalized with severe acute malnutrition^[12]. It is known that malnutrition affects severity of diarrhea much more than it affects incidence of diarrhea. Another study showed the risk of diarrhea was 19.80% in normal participants and 27.45% in undernourished children^[22]. The clinical severity score for diarrhea was greater with malnutrition for all malnutrition indicators, status nutrition in this study no significant correlation with severity of rotavirus diarrhea.

The distribution of severity of rotavirus diarrhea in our study where more than two-thirds of patients had “severe” scores is similar to other studies. Ibrahim *et al* also reported among rotavirus positive cases, 56% had severe scores, 32% had moderate scores moderate scores and 12 % had mild scores^[20].

In this study, clinical manifestations such as frequent vomiting were common (77%), and this might contribute to the higher proportion of diarrhea associated with moderate or severe dehydration (60%). Vomiting and dehydration are significantly correlated with severity of rotavirus diarrhea in our study, and previous studies also reported similar findings^[23]. Among children with rotavirus diarrhea, the number presenting with and without a fever was similar to that found by Saker *et al*^[24]. Fever showed no significant correlation with severity of rotavirus diarrhea. This result was comparable to that of Ibrahim *et al*^[20].

The significant correlation between patient hospitalization status and the severity of rotavirus diarrhea in our study, perhaps related to the longer duration of the illness, was also found in a study from García Roig *et al*^[23]. This is consistent with a study by Mathew *et al* that found rotavirus positive patients accounted for 35.9% of diarrhea-related hospitalizations among children less than 5 years of age^[25]. Khagayi *et al.* reported the cumulative risk of rotavirus hospitalizations by 5 years of age as 1 in 40^[18].

In conclusion, our study found that nutritional status had no significant correlation with the severity of rotavirus diarrhea in young children.

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