ROTAVIRUS DIARRHOEA AMONG CHILDREN AGED LESS THAN FIVE YEARS IN HOSPITAL SETTING IN DAR ES SALAAM, TANZANIA.

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By

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A Dissertation Submitted in (Partial) Fulfilment of the Requirements for the Degree of Master of Medicine (Paediatrics and Child Health) of Muhimbili University of Health and Allied Sciences

October, 2019

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled**: "Rotavirus diarrhoea among children aged less than five years in hospital setting in Dar es salaam, Tanzania"** in (partial) fulfilment of the requirements for the degree of Master of Medicine (Paediatrics and Child Health) of the Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam, Tanzania.

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DECLARATION AND COPYRIGHT

I, **Dr**. **Neema Nalitolela**, hereby declare that this **dissertation** is my own original work and that it has not been presented and shall not be presented to any other university for a similar or any other degree award.

Signature…… **Date**……

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DEDICATION

This work is dedicated to my family especially to my husband and children, my parents and my siblings.

ABSTRACT

Background: Among the global efforts that have been made to reduce childhood mortality due to diarrhoea is the development of a rotavirus vaccine; however, diarrhoea remains among the highest causes of death in children under five years of age in developing countries. Before the introduction of rotavirus vaccine in Tanzania rotavirus infection was the leading cause of severe diarrhoea in children below the age of five years but there is a paucity of studies reporting the magnitude of this infection after the introduction of rotavirus vaccine. This hospital-based study reports the proportion of children with rotavirus associated diarrhoea in Dar es Salaam, its severity and associated factors.

Objectives: To determine the proportion as well as clinical severity and identify associated factors for Rotavirus-associated diarrhoea among children less than five years of age in hospital settings in Dar es Salaam.

Methods: A hospital based cross-sectional study was conducted at the inpatient and outpatient paediatric departments of the selected health facilities from September 2018 to February 2019. A total of 314 children meeting inclusion criteria were enrolled into the study. A structured questionnaire was administered to collect demographic and medical history, anthropometric measurements were taken and a stool sample was collected from each patient for Rotavirus antigen detection using CTK Biotech Onsite rotavirus antigen rapid test

Data Analysis: Data entry, cleaning and analysis were done using SPSS software version 20. Overall proportion of children with Rotavirus infection was calculated and Contingency tables were constructed for bivariate analysis to explore factors associated with Rotavirus infection. Chi-square and Fisher's exact tests were used to determine significance difference between responses. Multivariate logistic regression was used to assess the risk factors; the model permitted determination of having rotavirus infection in relation to associated factors. Factors with p-value less than 0.05 were considered significantly associated with rotavirus diarrhoea.

Results: A total of 314 children were included in the study with age range between 2-59 months. The median age was 12 months with an interquartile range of 8-19 months. Proportion of Rotavirus diarrhoea among studied participants was found to be 10.5%. The most significant symptoms of Rotavirus diarrhoea were vomiting (p value=0.018) and severe dehydration (p value=0.000).

Independent associated factors of Rotavirus diarrhoea included; Age of mother between 35-49years (AoR 4.1, 95%CI 1.0-17.1, p value=0.05), Geographical distribution (Ilala District,

AoR 4.0, 95%CI 1.1-10.4, p value=0.039), Mother not washing hands before feeding the child or preparing child's meal (AoR 8.5, 95% CI 2.6-28.1, p value=0.000) and drinking bottled/treated water(AoR 5.4, 95%CI 1.3-22.7, p value=0.02).

Conclusion and recommendation:

Rotavirus infection was noted to be prevalent and severe among children with diarrhoea. The difference in prevalence among the districts is also of concern and hence larger community based cohort studies are needed to assess the association of Rotavirus diarrhoea with the geographical variation across districts and regions. Improving sanitation and hygiene through health education amongst households is crucial for disease prevention.

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LIST OF ABBREVIATIONS

CI	Confidence Interval
ELISA	Enzyme-linked immunosorbent assay
EPI	Expanded Programme for Immunization
IVDP	Immunization and Vaccines development programme
IMCI	Integrated Management of Childhood Illness
KCH	Kiambu county hospital
LOC	Loss of consciousness
MDH	Mbita district hospital
MNH	Muhimbili National Hospital
MUAC	Mid-upper arm circumference
NSP4	Non-structural protein 4
OFC	Occipitofrontal circumference
RNA	Ribonucleic acid
SPSS	Statistical Package for the Social Scientists
TM	Trademark
WHO	World Health Organisation

DEFINITION OF TERMS

Diarrhoea: the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual)

Severe dehydrating diarrhoea: Diarrhoea that presents with features of dehydration which includes:

Severe dehydration (at least two of the following signs): lethargy/unconsciousness, sunken eyes, unable to drink or drink poorly, skin pinch goes back very slowly (≥2 seconds) and signs of shock.

Some dehydration (two or more of the following signs): restlessness, irritability, sunken eyes, drinks eagerly, thirsty.

Other features are; vomiting, seizures, altered mental status and loss of consciousness as a result of electrolyte imbalance or hypoglycaemia.

Rotavirus diarrhoea: diarrhoea that occurs as a result of an infection by Rotavirus, an RNA virus of a reoviridae family that is spread by faecal-oral route and causes the destruction of epithelial cells of the intestinal villi.

Rotavirus vaccine: a live attenuated vaccine that is given in children less than five years of age to protect them against Rotavirus infection.

1.0 INTRODUCTION

1.1Background.

1.1.1 Overview of diarrhoea

Diarrhoea is the passage of loose or watery stool at least three times (or more frequent passage than is normal for the individual) in a twenty-four-hour period. It is the second leading cause of childhood mortality among children aged less than five years, it causes up to 1.5 to 2 million childhood deaths annually (1).

Diarrhoea occurs as a result of the reversal of the normal net absorptive status of water and electrolytes. The excess water content in the stool is due to an imbalance in the physiology of the small and large intestinal processes involved in the absorption of ions, organic substrates and water (2).

Acute diarrhoea is defined as the abrupt onset of three or more loose stools per day and lasts no longer than fourteen days while chronic or persistent diarrhoea is defined as an episode that lasts longer than fourteen days (3). The distinction has implications not only for classification and epidemiologic studies but also for clinical practices, because persistent diarrhoea often has different aetiologies, poses different management approaches and has a different prognosis (4).

The most common cause of diarrhoea in young children is Rotavirus, an RNA virus belonging to Reoviridae family. It has groups ranging from A to G with Group A having multiple strains and causing majority of childhood infections (5).

The virus is transmitted by the faecal-oral route. It infects and damages the cells that line the small intestine and causes diarrhoea (6). Other typical symptoms and signs in children with rotavirus infection include vomiting and fever.

Rotavirus is a major cause of severe dehydrating diarrhoea in both developed and developing countries. The WHO rotavirus surveillance network estimates that more than a third of diarrhoea hospitalizations among children under five years of age are attributed to rotavirus infection. In 2008, rotavirus caused an estimated 453,000 deaths in children younger than five years, more than half of which occurred in developing countries (7).

Other factors that have been associated with diarrhoea include poverty, poor sanitation and hygiene and development indices (8).

1.1.2 Pathogenesis of Rotavirus associated diarrhoea.

Three factors are thought to play a role in the pathogenesis of diarrhoea caused by Rotavirus. Reduced levels of intestinal brush border enzymes such as maltase, sucrase, and lactase that lead to malabsorption of D-xylose and lactose in the setting of acute infection is one of the mechanisms of pathogenesis. Osmotic diarrhoea likely occurs as a result of villous epithelial cell destruction with resulting brush border enzyme deficiency and complex sugar malabsorption (9).

The rotavirus enterotoxin protein NSP4 has been shown to have direct toxic effects on the gastrointestinal mucosa. It also regulates calcium homeostasis and virus replication, in addition to acting as an enterotoxin (10). Another mechanism is through activation of the enteric nervous system, resulting in net intestinal fluid and electrolyte secretion (11).

1.1.3 Treatment and prevention of Rotavirus associated diarrhoea

The broad principles of management of diarrhoea in children include oral rehydration therapy, enteral feeding and diet selection, zinc supplementation and additional therapies such as probiotics. Due to the limited effect of sanitation-based strategies for preventing the spread of the virus, several rotavirus vaccines have been developed, out of which two oral vaccines (RotaTeq and Rotarix) have been licensed (12). Tanzania is one among the developing countries in which the burden of diarrhoeal disease has been highlighted and rotavirus associated diarrhoea has been reported to be among the commonest causes (13). In view of this, rotavirus vaccine was introduced into the national childhood immunization programme as one of the preventive strategies.

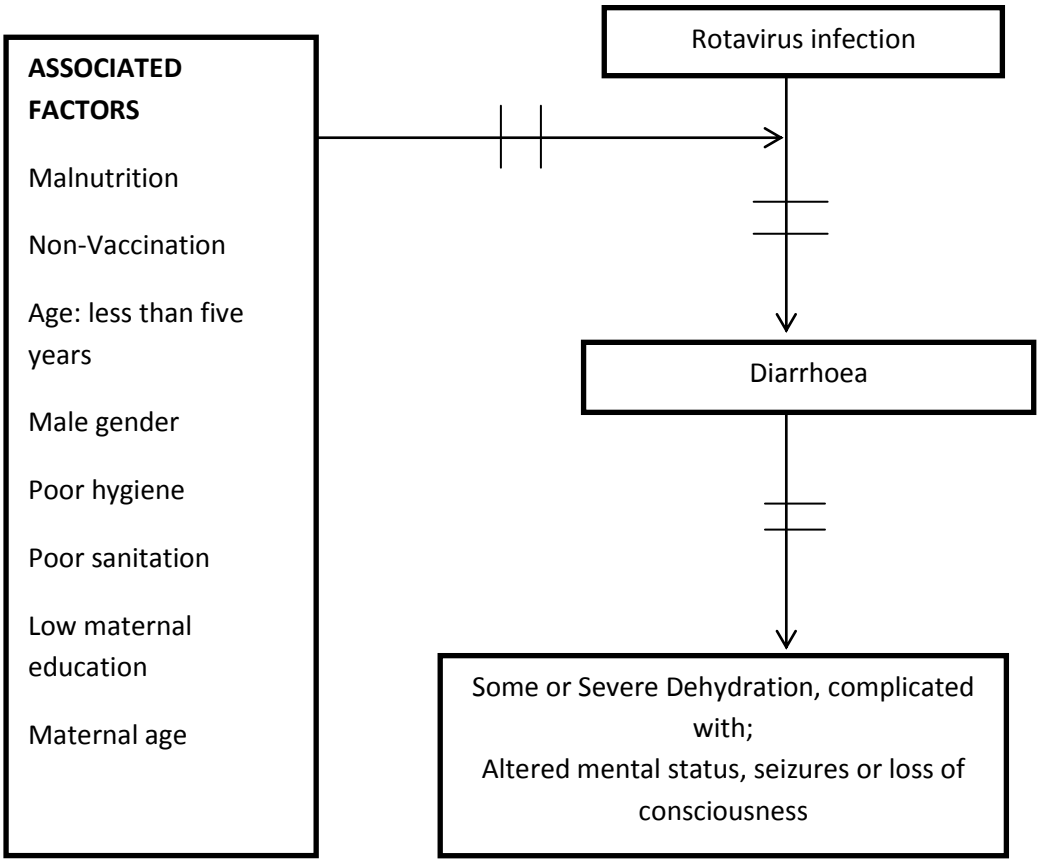
1.2 Problem statement.

Global efforts have been made to reduce children's mortality; however diarrhoea remains among the highest causes of death in children under five years of age in developing countries. In 2015 a total of 1.31 million deaths globally were attributed to diarrhoea, 499,000 of these occurring among children. Rotavirus was still found to be the main causative agent, causing 146,000 deaths despite a reduction in mortality rate by 44% since 2005 (14).

Cases of diarrhoea in children are still seen in our hospital settings despite reduction in prevalence of rotavirus associated diarrhoea, however there is paucity of studies that report the severity of these cases and whether or not the rotavirus still causes the severe forms of diarrhoea as it was the case before introduction of vaccine. Furthermore, studies have

reported a significant association between diarrhoea in children below five years of age and several important factors including inadequate potable water supplies, limited sanitation, poor hygiene practices (15) and nutritional status among others (16). However, whether or not rotavirus infection specifically has a direct association with these factors is still a controversy.

1.3 conceptual framework



Summary of Conceptual framework.

The main cause of diarrhoea in children is Rotavirus infection which can be prevented by rotavirus vaccine. Other associated factors for diarrhoea in children include poor nutritional status, age less than five years, male gender, poor hygiene, Poor sanitation, low maternal education and maternal age. The complications of diarrhoea in children include dehydration, altered level of consciousness and seizures due to electrolyte imbalance and hypoglycaemia. These can be prevented by thorough treatment of the cause and proper fluid replacement.

1.4 Rationale

Factors associated with rotavirus diarrhoea in developed and developing countries are different. In sub-Saharan Africa these factors include: Nutritional status, episodes occurring in the dry season and age under 2 years (17). Some of the studies have found conflicting results on the effect of nutritional status on the risk of rotavirus diarrhoea where an association has been observed between better nutritional status and risk of developing symptomatic rotavirus infection in the first three years of life (18). Other studies have found contact with diarrhoea outside the household, poor food hygiene, accommodation with less than five rooms, bottle-feeding, low birth weight, male gender, maternal education level, maternal smoking and maternal age < 20 years to increase the risk of rotavirus diarrhoea(17).

This study therefore gives an estimate of the proportion of rotavirus infection in children aged less than five years in hospital setting and also highlights the severity of rotavirus diarrhoea in such a population six years post rotavirus vaccine introduction.

It further reports the associated factors for rotavirus diarrhoea in children aged less than five years. Therefore information obtained from it will be beneficial to clinicians in our hospital settings for both management and prevention of diarrhoeal cases.

1.5 Research questions

1. What proportion of children aged below five years who present with diarrhoea in Dar es Salaam's hospital setting have rotavirus infection?
2. Is rotavirus still the main cause of severe diarrhoea in children aged below five years?
3. What factors are associated with rotavirus infection among children aged below five years with diarrhoea in hospital setting in Dar es Salaam?

1.6 Objectives

1.6.1 Broad Objective

To determine the proportion as well as clinical severity and identify associated factors for rotavirus infection among children aged below five years presenting with Diarrhoea in the hospital setting in Dar es Salaam, Tanzania.

1.6.2 Specific Objectives

1. To determine proportion of children with Rotavirus infection among children aged below five years presenting with diarrhoea in hospital setting in Dar es Salaam.
2. To assess the clinical severity of rotavirus infection in children aged below five years presenting with rotavirus diarrhoea in hospital setting in Dar es Salaam.
3. To identify factors associated with rotavirus infection among children aged below five years presenting with rotavirus diarrhoea in hospital setting in Dar es Salaam.

2.0 LITERATURE REVIEW

2.1 Burden of diarrhoea in children

Diarrhoea is one of the leading causes of childhood mortality globally with the highest proportion of deaths occurring among children aged less than five years annually. Although there is a reported decline in mortality due to diarrhoea over the past 20 years the incidence is still high in the low-income countries (19).

In 2010 almost 1.731 billion episodes of diarrhoea occurred in children younger than 5 years of age in developing countries, with more than 80% of the episodes occurring in Africa and South Asia (50.5% and 32.5%, respectively). Global mortality may be declining rapidly, however the overall incidence of diarrhoea has only declined from 3.4 to approximately 2.9 episodes per child-year in the past 2 decades, and it is estimated to account for 23 million childhood disability-adjusted life years (20).

In 2015 the new global burden of diseases study reported diarrhoea to be the fourth most leading cause of death among children aged less than five years where 1.3 million deaths were reported to be a result of diarrhoea

A reduction of diarrhoea between 2005 and 2015 in sub-Saharan African countries was also reported where the mortality rate has reduced by more than 100 deaths per 100,000 in western (from 445 to 277 deaths per 100,000), eastern (from 243 to 131 deaths per 100,000), and southern sub-Saharan Africa (from 214 to 113 deaths per 100,000) (14).

In east African countries, including Kenya, there is an increase in urban migration resulting in rapid expansion of cities that has led to the creation of overcrowding in urban slums, low socioeconomic conditions, poverty, illiteracy, inadequate safe drinking water, poor sanitation, and malnutrition, all of which have given a raise to the rate of infectious diseases including diarrhoea among children (22).

Diarrhoeal diseases in Tanzania have contributed to the burden of deaths and disabilities among children aged less than five years, which accounted for approximately 9% of the total childhood deaths and 5.9% of disability-adjusted life years. (23).

2.2 Prevalence of Rotavirus associated diarrhoea in children

Rotavirus is the leading cause of mortality due to diarrhoea in children aged less than five years (19). Globally it is estimated that the number of Rotavirus deaths in children aged less than five years has declined from 528000 in 2000 to 215000 in 2013. Moreover, in 2013, an estimated 47 100 rotavirus deaths occurred in India which accounted for 22% of all rotavirus deaths that occurred globally. Four countries (India, Nigeria, Pakistan, and Democratic

Republic of Congo) accounted for approximately half (49%) of all estimated rotavirus deaths in 2013 (20). Almost half of all deaths occurring worldwide due to Rotavirus infection (230,000) are estimated to occur in Africa (21). A study done at Kiambu County Hospital (KCH) and Mbita District Hospital (MDH) in Kenya (2011 to 2013) found that most Rotavirus-associated diarrhoea were detected in suburban settings as compared with rural settings (29.6% at KCH vs. 11.2% at MDH). In both study areas, male patients (56.6% at KCH and 57.9% at MDH) were more likely to have rotavirus infection than female patients (43.4% at KCH and 42.1% at MDH (22).

The vaccine access and delivery global program reported that Rotavirus associated diarrhoea takes the lives of more than 8,100 Tanzanian children aged below five each year, accounting for approximately 6% of all deaths among children aged below five years in Tanzania.
It is also estimated that more than one-third of diarrheal disease hospitalizations of Tanzanian children below five years old are caused by Rotavirus (23).

Prior to introduction of rotavirus vaccine in Tanzania, the overall prevalence of Rotavirus associated diarrhoea among children presenting to hospital with diarrhoea was estimated to be 33.2% (in 2009), however this has reduced to 26.4% (in 2016) after the introduction of Rotavirus vaccine in the Expanded Program for Immunization (EPI) (5).

2.3 Severity of Rotavirus diarrhoea in children.

Children with severe rotavirus diarrhoea can become severely dehydrated and often need intravenous fluids or they are at risk of dying. In developing countries, this type of urgent health care is often difficult to access, therefore prevention of rotavirus infection through vaccination is critical and helps in saving children's lives. Vaccination offers the best hope for preventing severe rotavirus disease and the deadly dehydrating diarrhoea that it causes (23).

Rotavirus infection and malnutrition are the common problems in children in developing countries; however, the effect of nutritional status on susceptibility to rotavirus infection is still controversial. Some earlier studies from Africa have reported an association between wasting and severe forms of rotavirus diarrhoea (24) whereas findings from a study done in Dhaka (1993-2012) indicated that there is an inverse relationship between acute malnutrition (severe wasting) and childhood Rotavirus infection after controlling for climate, socio-demographic and sanitation practices among children aged under five years. This is probably due to the fact that rotavirus, a major pathogen responsible for acute watery diarrhoea, requires healthy intestinal epithelium for attachment and pathogenesis. Malnutrition results in

a decreased number of cells and impaired epithelial proliferation in the small intestinal mucosa, which then inhibits cellular attachment by the virus. However this disproportionate association was not observed for chronic malnutrition (stunting) (25).

2.4 Rotavirus vaccine.

The World Health Organization (WHO) recommends that rotavirus vaccine be included in national routine vaccinations programs, especially in areas where the disease is common(26). This should be done along with promoting breastfeeding, hand-washing, clean water and good sanitation. The vaccine is given by mouth and requires two or three doses and it should be given starting around six weeks of age.

Several countries that have implemented routine childhood vaccination against rotavirus have reported marked reduction in burden of severe childhood diarrhoea (27). Additionally, some countries including Mexico, Brazil, and Panama, have documented substantial decreases of 22%–50% in diarrhoea mortality among children aged less than five years of age following vaccine introduction (20).

Following introduction of rotavirus vaccine in Rwanda in 2012, admittance to hospital for diarrhoea decreased by 49% in 2013, and 48% in 2014. However, this reduction is still less than in developed countries. For example, in Finland, with equal coverage, the effect of rotavirus vaccination has been an 88% reduction of admittances to hospital for rotavirus associated diarrhoea (28). This may be attributed to the difference between the vaccine used in Rwanda from that used in Finland with a wide Rotavirus strains coverage.

Rotavirus vaccine (Rotarix) a monovalent, human, live attenuated vaccine containing one rotavirus strain of G1P[8] specificity was introduced in the United Republic of Tanzania in early 2013, with 2 doses given at the World Health Organization–recommended schedule of ages 6 and 10 weeks, along with oral Poliovirus vaccine. Rotarix is indicated for the prevention of Rotavirus diarrhoea caused by G1 and non-G1 types (G3, G4, and G9) when administered as a 2-dose series in infants and children.

Comparison of data 3 years before and 3 years after vaccine introduction has concluded that successful delivery of vaccine on the current World Health Organization Immunization schedule can reduce the number of hospitalizations among infants with diarrhoea in a resource-limited setting (29).

3.0 MATERIALS AND METHODS

3.1 Study design

This was a hospital based cross sectional study

3.2 Study area

This study was conducted in the Paediatrics inpatient and outpatient departments of 8 selected health facilities that attend paediatrics population from different socio-economic backgrounds presenting with diarrhoeal diseases among many other conditions. The facilities included; Muhimbili national hospital which serves as the national referral hospital, Amana, Temeke and Mwananyamala hospitals which are the regional referral hospitals and Health centres; Pugu, Mnazi mmoja, Buguruni and Tandale health centres in Dar es Salaam. These hospitals are located in the three administrative districts of Dar es Salaam; Ilala, Kinondoni and Temeke districts. From Ilala district, Muhimbili national hospital, Amana regional referral hospital and the additional feeder health centres including; Pugu, Buguruni and Mnazi mmoja were recruited for obtaining adequate sample size as well as increasing catchment. In Kinondoni district, where recent expansion has led to separation into two administration regions, Mwananyamala regional referral hospital was selected and Tandale health centre was also selected to represent the new Ubungo district. All the feeder health centres in Temeke district are within 1 to 2 kilometre of the hospital, thus easily accessible; therefore no health centres were selected in this district.

3.3 Study Duration

This study was conducted for 5months, from September 2018 to February 2019.

3.4 Study population

Study population consisted of Children aged below five years with diarrhoea attending both inpatient and outpatient departments of the selected hospitals.

3.5 Sample size

Sample Size was calculated using the Kish Leslie formula (30)

$$n = \frac{z^2 p(100-p)}{\varepsilon^2}$$

Where z=level of confidence

p=expected proportion

ε=margin of error (5%)

A cross sectional study done in Moshi, Tanzania involving children under five years of age with diarrhoea from January 2016 to May 2016 reported the prevalence of Rotavirus post vaccine period to be 26.4%. This prevalence was used to estimate sample size in this study.

$n= [1.96x1.96x26.4(100-26.4)]/5^2$

n= 298 children.

With 5% non-response rate, n= 298+15 =313 children

3.6 Sampling procedure

To facilitate data collection within a limit time convenient sampling technique was used in this study where hospitals were selected due to their well-established inpatients and outpatients' departments with high flow of children with diarrhoea coming from different localities.

Finally, children who met inclusion criteria were obtained among those attending or admitted within the selected health facilities consecutively as per patients flow until the intended sample size was achieved.

3.7 Inclusion criteria

- Children below five years of age with diarrhoea from inpatient departments of the selected hospitals.
- Children below five years of age with diarrhoea from outpatient departments of the selected hospitals.
- Children below five years of age with diarrhoea and who had received Rotavirus vaccine which has been documented in RCH card.

3.8 Exclusion criteria

- Children with no available RCH card at the time of the study.
- Children whose diarrhoea had resolved within 48 hours or more before the day of the study.
- Children whose parents or caregivers did not consent to participate in the study.

3.9 Variables

a) Dependent variable was rotavirus associated diarrhoea. This variable depends on some independent predictors (Factors). Overall proportion of Rotavirus infection was taken from those children who tested positive for the disease among all studied.

b) Independent variables were factors associated with rotavirus infection. These included Age of the child, Age of the mother, Gender, Malnutrition (severe wasting), Poor hygiene, poor sanitation and low maternal education.

3.10 Data collection.

Data was collected using a researcher-administered standardized structured questionnaire. (Appendix iii and iv).

Research assistants for this study were medical students and paediatrics nurses who were trained on how to extract data from the case files, conduct interview using a standardized structured questionnaire and detect the rotavirus infection in the stool sample by using the validated tools and appropriate standard operating procedures.

3.10.1 Pre-testing of tools and data collection

Questionnaires were pre-tested amongst 10 participants to ensure clarity and understanding of the questions by the participants. This helped to identify and address queries before actual data collection began, however data from the pre-test did not contribute towards the final data set.

Then data was collected by the principle investigator and research assistants. The screening tools comprised of questions about the socioeconomic and demographic characteristics of the children and their parents/caregivers, sanitation and hygiene practises as well as clinical assessment of diarrhoea including; the type of diarrhoea, associated symptoms, hydration status, nutritional status and the rotavirus infection test results.

3.10.2 Anthropometric measurements

Anthropometric measurements were taken including: length/height (cm), weight (kg), mid-upper arm circumference (cm). The child's weight was taken using a SECA scale to the nearest 100 grams. Height for children >24 months and length for children ≤ 24 months or unable to stand was measured to the nearest 0.1centimeter using a portable length board. The mid-upper arm circumference (MUAC) was measured using the WHO standard MUAC tape. The WHO growth standard charts were used to assess nutritional status in terms of weight for height or length and MUAC for age (wasting).

3.10.3 Hydration status

Research assistants were all thoroughly trained on assessment of hydration status using the IMCI guidelines.(31)

3.10.4 Specimen collection

A single fresh stool specimen was collected from each participant using wide mouthed sterile plastic container that was labelled with patient's identity sticker.

Following collection each stool specimen was tested immediately for presence of rotavirus antigen.

3.10.5 Rotavirus antigen detection

Rotavirus antigen was detected from each stool specimen by the principal investigator and research assistants using the commercially available CTK Biotech Onsite rotavirus antigen rapid test (Manufacturer: CTK Biotech, Inc. San Diego, USA. Date of Manufacture: 10th April 2018. Onsite ^{TM}). The relative sensitivity and specificity for this test are 100% and 97.2% respectively.

Following stool collection from a participant an aliquot of diluted stool sample was added to the sample well of the test cassette for antigen detection. Test results were then read within 15minutes and recorded appropriately. After interpreting the results, the used devices were disposed according to the standard infection and prevention control procedures.

3.11 Data management and analysis

Data entry and cleaning was done using SPSS software version 20. The principal investigator performed frequency and consistency checks routinely to ensure quality of data entered. Errors found during cleaning and consistency check were rectified through revising the questionnaires.

Analyses were done to produce descriptive and analytical results. Descriptive statistics (frequencies and measures of central tendency i.e. median) were used to summarize data. Charts and graphs were used in non-textual presentations. Overall proportion of children with Rotavirus infection was calculated and Contingency tables were constructed for bivariate analysis to explore factors associated with Rotavirus infection. Chi-square and Fisher's exact tests were used to determine significance difference between responses. Level of significance was set at $p \leq 0.05$.

Multivariate logistic regression was used to assess the risk factors, the model permit determination of having rotavirus infection in relation to associated factors. Factors with p-value 0.2 or less in bivariate analysis were posted in multivariable analysis. Odds ratios and 95% confidence intervals were used to report estimates of each studied factor. Factors with p-value equal to or less than 0.05 were considered statistically significant.

3.12 Ethical consideration.

Ethical approval to conduct the study was obtained from Ethics Review Committee of the Muhimbili University of Health and Allied Sciences. Written informed consent from the parent/caretaker was sought for all children prior to joining the study. In case the parent/caretaker could not read and write, the consent was read to the parent/caretaker by and independent person and a thumbprint was taken as proof of consent with an unbiased witness signing their testimony of the same on the consent form. Parents/caretakers of all children who participated in the study were given their rotavirus test results instantly and all children were treated according to the standard guidelines. Voluntary participation and the right to withdraw from the study at any time were emphasized.

4.0. RESULTS.

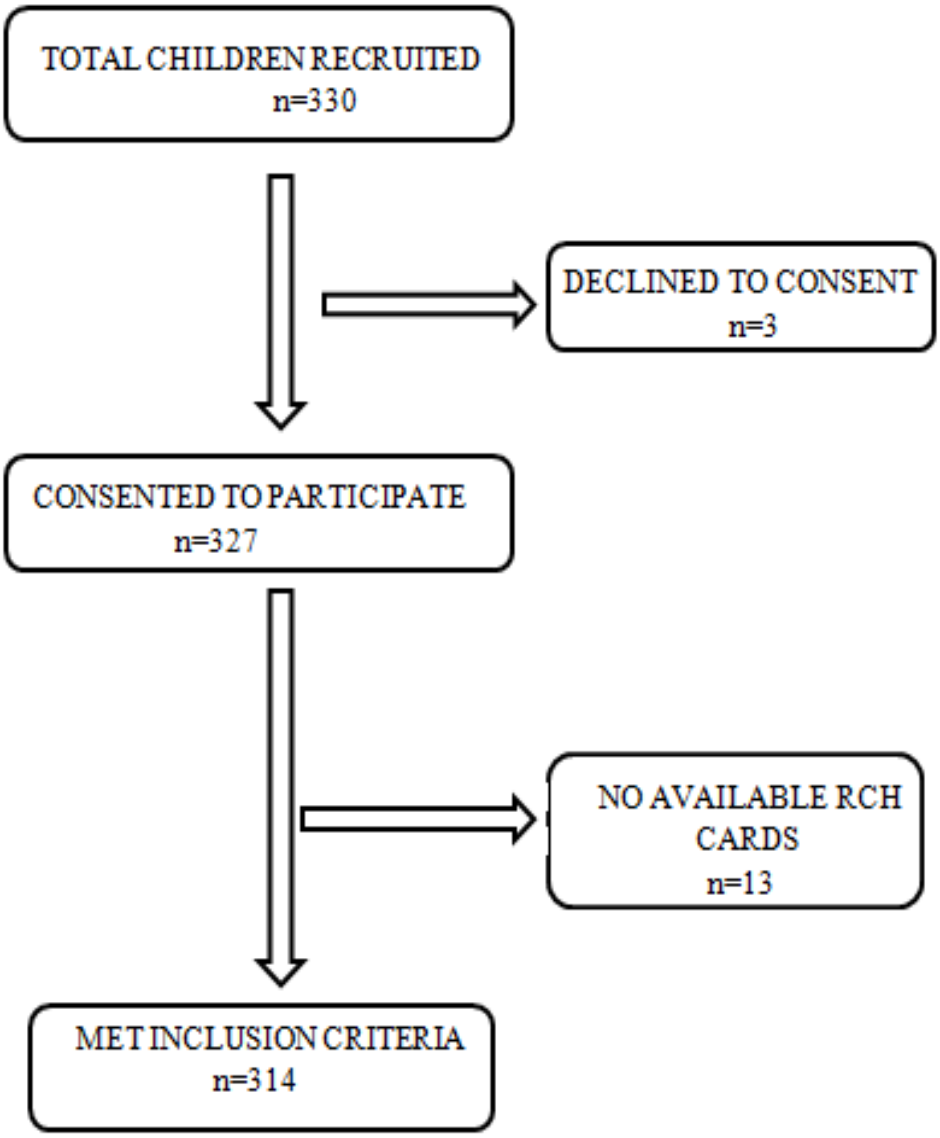


Figure 1: Flow diagram of children enrolled in the study

4.1 Baseline characteristics of children and mothers

A total of 314 children were included in the study. Age of children ranged between 2-59 months. Majority of the children were between >6-12 months old, n=111(35.4%) The median age was 12 months with an interquartile range of 8-19 months. Most of the mothers were aged between 21-30 years old, n=186(59.2%) with the median age of distribution being 27years and interquartile range of 23-32 years. Children who attended outpatient departments were 200 (63.7%), almost twice those from the inpatient departments and most of them were in Ilala district n=134 (42.7%).

Majority of children had completed Rotavirus vaccine doses, n=304(96.8%) and also majority of them

, n=240(76.4) had duration of diarrhoea of between 1-3days. Fewer children had severe dehydration, n=50 (15.9%) and only 13(4.1%) had severe Acute Malnutrition (as seen in Table 1).

Table 2 describes the hygiene practices and sanitation among mothers and children. Majority of mothers always washed hands before feeding the children n=173(55.1%), those who never washed hands after cleaning a child who has passed stool predominated n=140(44.6%). Most children were given un-boiled water for drinking at home, n=148(47.1%).

Table 1: Baseline Characteristics of children and mothers; Demographic and Clinical characteristics

Demographic characteristics of children and mothers			Clinical characteristics of study participants		
Variable	**Category**	**Frequency N=314**	**Variable**	**Category**	**Frequency N=314**
Age group of a child (months)			**Rotavirus vaccination status**		
	2-6	49(15.6)		Complete	304(96.8)
	>6 -12	111(35.4)		Incomplete	10(3.2)
	>12 -24	105(33.4)			
	>24 -59	49(15.6)			
	Median (IQR)	12(8,19)	**Duration of diarrhoea (days)**		
Sex of a child				1-3	240(76.4)
	Male	170(54.1)		4-7	57(18.2)
	Female	144(45.9)		8-14	14(4.5)
Age of mother (years)				>14	3(1.0)
	≤ 20	39(12.4)	**Stool consistency**		
	21-30	186(59.2)		Watery	224(71.3)
	>30-40	81(25.8)		Mucoid	88(28.0)
	>40-50	8(2.6)		Blood stained	2(0.6)
	Median (IQR)	27(23,32)	**Fever**		
Marital status of mother				Yes	183(58.3)
	Single	49(15.6)		No	131(41.7)
	Married	230(73.2)			
	Co-habiting	28(8.9)	**Vomiting**		
	Divorced	6(1.9)		Yes	139(44.3)
	Widowed	1(0.3)		No	175(55.7)
Education level of mother					
	None	20(6.4)	**Abdominal pain**		
	Primary	175(55.7)		Yes	90(28.9)
	Secondary	102(32.5)		No	224(71.3)
	College	17(5.4)	**Convulsion**		
Occupation of mother				Yes	14(4.5)
	Housewife	146(46.5)		No	300(95.5)
	Employed	46(14.6)	**Loss of consciousness**		
	Self-employed	118(37.6)		Yes	9(2.9)
	Peasant	4(1.3)		No	305(97.1)
Facility department			**Hydration Status**		
	Out-patient	200(63.7)		No dehydration	156(49.7)
	In-patient	114(36.3)		Some dehydration	108(34.4)
District				Severe dehydration	50(15.9)
	Kinondoni	107(34.1)	**Nutrition status (wasting)**		
	Ilala	134(42.7)		Normal	222(70.1)
	Temeke	73(23.2)		Mild	52(16.6)
				Moderate	27(8.6)
				Severe	13(4.1)

Table 2: Baseline characteristics of children and mothers; Hygiene practices and Sanitation

Variable	Category	Frequency N=314
Type of latrine used at home		
	Pit latrine	133(42.4)
	Flush latrine	181(57.6)
Hand-washing after toilet use		
	Always	162(51.6)
	Sometimes	127(40.4)
	No	25(8.0)
Hand-washing before feeding a child/ preparing child's meal		
	Always	173(55.1)
	Sometimes	110(35.0)
	No	31(9.9)
Hand-washing after cleaning a child who passed stool.		
	Always	81(25.8)
	Sometimes	93(29.6)
	No	140(44.6)
Tool for hand-washing		
	Water without soap	162(51.6)
	Water with soap	152(48.4)
Child's drinking water		
	Boiled	86(27.4)
	Un-boiled	148(47.1)
	Treated	8(2.6)
	Bottled	63(20.1)
	Exclusive breastfeeding	9(2.9)

NB: Always = mothers washing hands all the time.
Sometimes = mothers washing hands only in some occasions, not all the time.
No = mothers not washing hands at all

4.2 Proportion of Rotavirus diarrhoea

33/314 children had positive rotavirus infection test making an overall proportion of 10.5% as seen in figure 2.

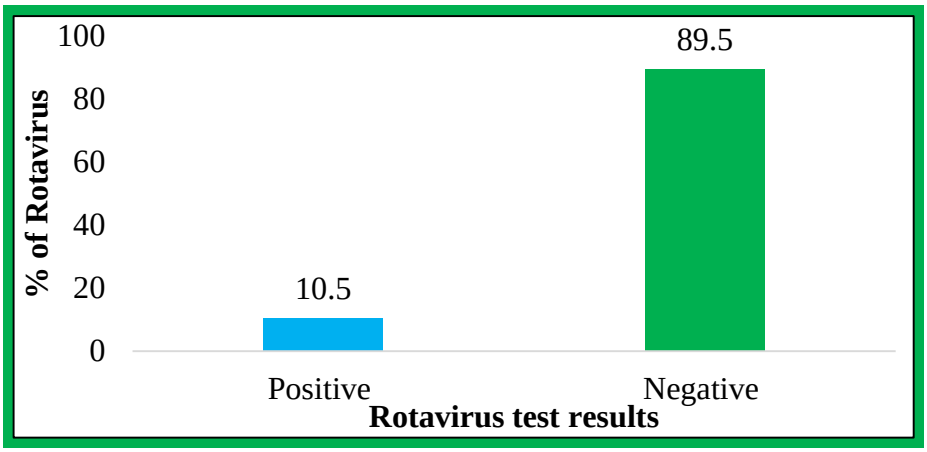


Figure 2: Proportion of Rotavirus diarrhoea

4.3 Proportion of Rotavirus diarrhoea in relation to age of the Child

The highest proportion of rotavirus diarrhoea 9/49(18.4%) was seen in those who aged between >24-59 months. (Figure 3)

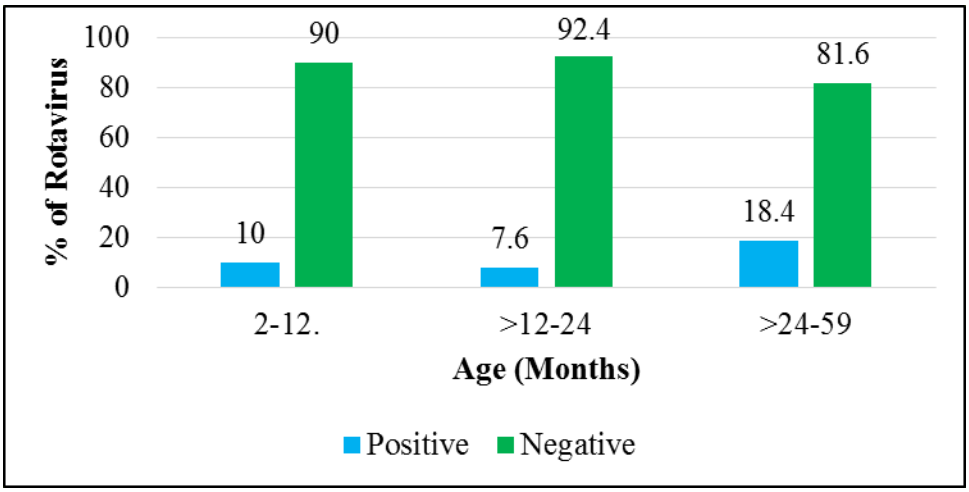


Figure 3: Proportion of Rotavirus diarrhoea in relation to Age of the child

4.4 Proportion of Rotavirus diarrhoea in relation to sex of the child

Among children who had Rotavirus diarrhoea, the proportion of male 19/170(11.2%) was slightly higher than that of female 14/144 (9.7%). (Figure 4).

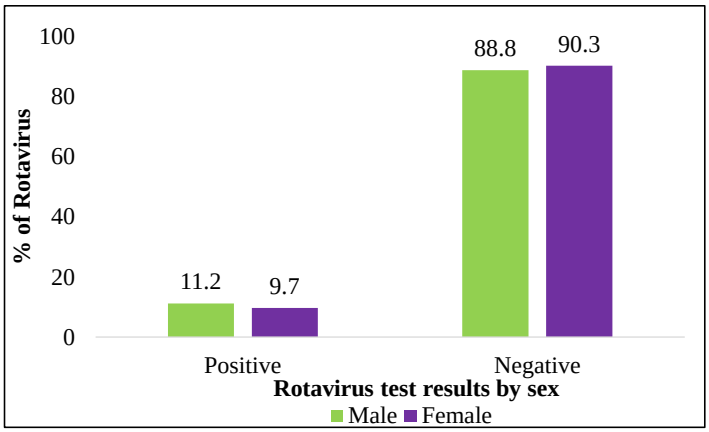


Figure 4: Proportion in relation to sex of the child

4.5 Portion of Rotavirus Diarrhoea in relation to district.

Among the three districts, the highest proportion of Rotavirus diarrhoea was seen in Ilala 23/134(17.2%) followed by Kinondoni 6/107(5.6%) and Temeke 4/73(5.5%). (Figure 5)

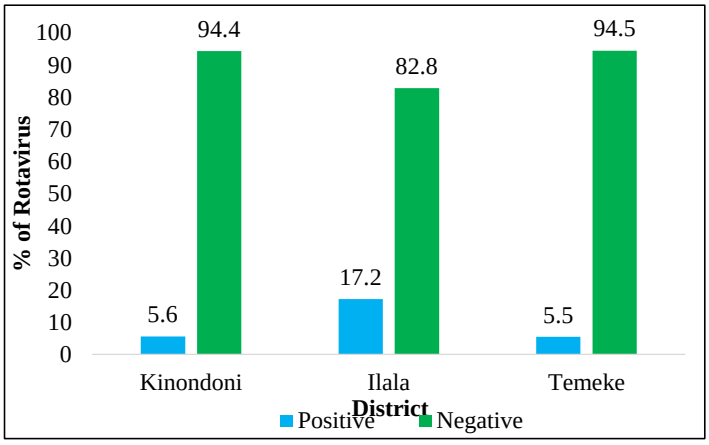


Figure 5: Proportion in relation to district

4.6 Clinical severity of Rotavirus diarrhoea among children aged less than five years with Rotavirus diarrhoea in Dar es Salaam hospital setting

From table 3, the most severe symptoms that were seen in children who tested positive for Rotavirus infection were vomiting (p value=0.018) and severe dehydration (p value=0.000). There was no significant difference in terms of convulsions (p value=0.637) and loss of consciousness (p value=0.245) among those who tested positive and negative for Rotavirus infection.

Table 2: Clinical severity of Rotavirus diarrhoea among children with Rotavirus infection in Dar es Salaam hospital setting

Variable	Rotavirus test results		P-value
	Positive N=33	Negative N=281	
Duration of diarrhoea (days)			
1-3	25(75.8)	215(75.8)	0.582*
4-7	8(24.2)	49(17.4)	
8-14	0(0)	14(5.0)	
≥14	0(0)	3(1.1)	
Convulsion			
Yes	2(6.1)	12(4.3)	0.648*
No	31(93.9)	269(95.7)	
Loss of consciousness			
Yes	2(6.1)	7(2.5)	0.242*
No	31(93.9)	274(97.5)	
Fever			
Yes	19(57.6)	164(58.4)	0.931
No	14(42.4)	117(41.6)	
Vomiting			
Yes	21(63.6)	118(42.0)	0.018
No	12(36.4)	163(58.0)	
Abdominal pain			
Yes	11(33.3)	79(28.1)	0.53
No	22(66.7)	202(71.9)	
Hydration status			
No dehydration	10(30.3)	146(52.2)	0.000
Some dehydration	10(30.3)	98(34.9)	
Severe dehydration	13(39.4)	37(13.2)	

*Fischer's exact test was used to find the difference in these variables

4.7 Factors associated with Rotavirus infection among children aged less than five years with Rotavirus diarrhoea in Dar es Salaam hospital setting.

Table 4 demonstrate factors associated with Rotavirus infection. Among those who tested positive for Rotavirus diarrhoea, children who came from Ilala district were more affected than those from the other two districts (p value=0.004).Other factors that were significantly associated with Rotavirus diarrhoea included; Using Pit latrine at home (p value=0.025), Occasionally washing hands before feeding a child or preparing a child's meal (p value=0.000) and using water without soap for hand-washing (p value=0.028). Nutritional status did not show any association with Rotavirus diarrhoea (p value=0.875).

Table 3: Bivariate analysis of factors associated with Rotavirus infection

Factor	Rotavirus test results		Association
	Positive N=33	Negative N=281	P-value
Age of a child (Month)			
2-12	16(10.0)	144(90.0)	0.123
>12-24	8(7.6)	97(92.4)	
>24-59	9(18.4)	40(81.6)	
Sex of a child			
Male	19(11.2)	151(88.8)	0.675
Female	14(9.7)	130(90.3)	
Age of mother			
17-25	10(7.5)	123(92.5)	0.072
>25-35	17(11.0)	137(89.0)	
>35-49	6(22.2)	21(77.8)	
Marital status of mother			
Living alone	2(3.6)	54(96.4)	0.089*
Living together	31(12.0)	227(88.0)	
Education level of mother			
No/primary Education	18(9.2)	177(90.8)	0.344
Secondary and above	15(12.6)	104(87.4)	

Occupation of a mother			
Peasant/housewife	14(9.3)	136(90.7)	0.093
Employed	9(19.6)	37(80.4)	
Self-employed	10(8.5)	108(91.5)	
District			
Kinondoni	6(5.6)	101(94.4)	0.006*
Ilala	23(17.2)	111(82.8)	
Temeke	4(5.5)	69(94.5)	
Type of latrines			
Pit latrine	20(15.0)	113(85.0)	0.025
Flush latrine	13(7.2)	168(92.8)	
Hand-washing after toilet use			
Always	15(9.2)	147(90.8)	0.747*
Sometimes	3(12.0)	22(88.0)	
No	15(11.8)	112(88.2)	
Hand-washing before feeding a child/preparing child's meal			
Always	10(5.8)	163(94.2)	0.000
Sometimes	13(41.9)	18(58.1)	
No	10(9.1)	100(90.9)	
Hand-washing after cleaning a child who passed stool			
Always	4(4.9)	77(95.1)	0.151*
Sometimes	11(11.8)	82(88.2)	
No	18(12.9)	122(87.1)	
Tool for hand-washing			
Water without soap	23(69.7)	139(49.5)	0.028
Water with soap	10(30.3)	142(50.5)	
Child's drinking water			
Boiled	5(5.8)	81(94.2)	0.113*
Un-boiled	15(10.1)	133(90.0)	
Bottled/treated	11(15.5)	60(84.5)	
Exclusive breast feeding	2(22.2)	7(77.8)	

Nutritional Status(wasting)			
Normal	25(11.3)	197(88.7)	0.932*
Mild	4(7.7)	48(92.3)	
Moderate	3(11.1)	24(88.9)	
Severe	1(7.7)	12(92.3)	

*Fischer's exact test was used to find association in these variables

4.8 Independent Factors associated with Rotavirus Diarrhoea.

Following adjustment for confounders as shown in table 5, Children whose mothers aged between >35-49 years were 4.1 times more likely to have Rotavirus diarrhoea as compared to those whose mothers aged 17-25 years (p value=0.05). Those who came from Ilala district were 4 times more likely to be infected with Rotavirus than those in Temeke district (p value=0.039). Other Factors that were independently associated with Rotavirus diarrhoea were mothers not washing hands before feeding the children or preparing a children's meal (AoR 8.5, p value=0.000) and children drinking commercially available bottled/home treated water (AoR 5.4, p value=0.020).

Table 4: Multivariate logistic regression to assess the associated factors for Rotavirus diarrhoea.

Factor	Rotavirus test results					
	Positive N=33	Negative N=281	CoR (95%Cl)	(P-value)	AoR(95%Cl)	P-value
Age of a child (Month)						
2-12	16(10.0)	144(90.0)	1.3(0.6-3.3)	0.51	1.0(0.3-2.9)	0.952
>12-24	8(7.6)	97(92.4)	REF		REF	
>24-59	9(18.4)	40(81.6)	2.7(1.0-7.6)	0.05	2.2(0.6-7.4)	0.225
Age of mother						
17-25	10(7.5)	123(92.5)	REF		REF	
>25-35	17(11.0)	137(89.0)	1.5(0.7-3.4)	0.311	1.2(0.4-3.4)	0.73
>35-49	6(22.2)	21(77.8)	3.5(1.2-10.7)	0.027	4.1(1.0-17.1)	0.05
Marital status of mother						
Living alone	2(3.6)	54(96.4)	REF		REF	
Living together	31(12.0)	227(88.0)	3.7(0.8-15.9)	0.08	4.8(0.9-26.4)	0.07

Occupation of mother						
Peasant/housewife	14(9.3)	136(90.7)	1.1(0.5-2.6)	0.807	1.1(0.4-3.3)	0.856
Employed	9(19.6)	37(80.4)	2.6(1.0-7.0)	0.05	2.8(0.8-10.4)	0.114
Self-employed	10(8.5)	108(91.5)	REF		REF	
District						
Kinondoni	6(5.6)	101(94.4)	1.0(0.3-3.8)	0.971	1.5(0.3-7.5)	0.593
Ilala	23(17.1)	111(82.8)	3.6(1.2-10.8)	0.024	4.0(1.1-10.4)	0.039
Temeke	4(5.5)	69(94.5)	REF		REF	
Type of latrines						
Pit latrine	20(15.0)	113(85.0)	2.3(1.1-4.8)	0.028	1.6(0.6-4.4)	0.337
Flush latrine	13(7.2)	168(92.8)	REF		REF	
Hand-washing before feeding a child						
Always	10(5.8)	163(94.2)	REF		REF	
sometimes	10(9.1)	100(90.9)	1.6(0.6-4.0)	0.293	1.2(0.4-3.5)	0.704
No	13(41.9)	18(58.1)	11.8(4.5-30.7)	0.000	8.5(2.6-28.1)	0.000
Hand-washing after cleaning a child who passed stool						
Always	4(4.9)	77(95.1)	REF		REF	
sometimes	18(12.9)	122(87.1)	2.8(0.9-8.7)	0.068	3.0(0.8-11.3)	0.101
No	11(11.8)	82(88.2)	2.6(0.8-8.4)	0.117	2.1(0.5-8.8)	0.319
Tool for hand-washing						
Water without soap	23(14.2)	139(85.8)	2.3(1.1-5.1)	0.031	1.5(0.6-3.9)	0.437
Water with soap	10(6.6)	142(93.4)	REF		REF	
Drinking water given to a child						
Boiled	5(5.8)	81(94.2)	REF		REF	
Un-boiled	15(10.1)	133(89.9)	1.8(0.6-5.2)	0.26	1.8(0.5-6.8)	0.351
Bottled/treated	11(15.5)	60(84.5)	3.0(1.0-9.0)	0.05	5.4(1.3-22.7)	0.020
Exclusive breastfeeding	2(22.2)	7(77.8)	4.6(0.8-28.4)	0.098	3.2(0.8-11.2)	0.111

Abbreviations: CoR – Crude odds ratio, AoR – Adjusted odds ratio, CI – Confidence Interval.

5.0 DISCUSSION

The high burden of Rotavirus diarrhoea among children aged less than five years has been well documented with the majority of mortality occurring in developing countries.

This study was conducted among 314 participants with the aim of assessing the proportion of Rotavirus diarrhoea, its severity and associated factors among children aged less than five years in Dar es Salaam hospital setting.

The proportion of children with Rotavirus diarrhoea among under-five children in this study was almost comparable to that in the study done in Nigeria in 2016 (32). This similarity could be attributed to the fact that both studies were carried out in hospital settings with similar study population.

In contrast to the findings from this study, a proportion of Rotavirus infection among under-five children with diarrhoea was found to be higher in a study that was done in Moshi in 2017(5). The variation in geographical characteristics between Moshi and Dar es Salaam regions may explain the difference in proportion of Rotavirus diarrhoea between these two regions.

Before the introduction of Rotavirus vaccine in the country in January 2013 the proportion of Rotavirus diarrhoea in Dar es salaam was much higher (7) than the one in this study.

Furthermore previous studies had also reported a similar trend of reduction in Rotavirus infection among under-five children during pre-vaccine years (2009-2012) and post-vaccine years(2014-2015) in which the Rotavirus positivity rates had dropped significantly in Tanga and Mwanza regions respectively (33).

This trend of proportion from pre-vaccine to post-vaccine era is attributable to the good coverage of Rotavirus vaccine across country which was also clearly seen in this study where all participants had received the vaccine and only a few had received incomplete doses of vaccine.

The clinical spectrum of severe Rotavirus infection includes profuse watery diarrhoea with vomiting and fever that often lead to severe dehydration with shock, electrolyte imbalance, coma and death. Neurological manifestations including convulsions have also been reported (34).

Although there's a substantial decline in the proportion of Rotavirus diarrhoea evidenced by the findings from this study following the introduction of Rotavirus vaccine in our country six years ago two of the most commonly reported clinical symptoms of severe disease were found to be significant among children who had positive test results for the disease, these were vomiting and severe dehydration, similar symptoms were also reported in Nigeria in 2016(32), however, fever, convulsions and loss of consciousness were not the main clinical findings among those who had Rotavirus infection in this study.

Persistence of severe symptoms of Rotavirus diarrhoea in this study even after the introduction of vaccine may be attributable to the diversity of Rotavirus strains circulating in children aged less than five years with diarrhoea in sub-Saharan Africa from pre to post vaccine years which was also observed in a study done in Zambia from 2008 to 2015(35). These newly evolving Rotavirus genotypes have also been reported in a pre-vaccination study done in Tanzania in which the phylogenetically related vaccine strain genotype G1 predominated but there was the emergence of other new genotypes (G8 and G12) (7).

In this study age of the mothers between 35-49 years was found to be independently associated with Rotavirus diarrhoea when compared to that between 17-25 years. These results contradict the ones which were reported in previous study done in the US in which age distribution of the mothers did not have any association with Rotavirus infection on their children(36). This finding could be explained by the fact that children of older mothers are mostly under non-maternal care at home including the housemaids and older siblings who might not be practising hands hygiene as much as the mother would be.

On the other hand our study did not find any significant association between age distribution of the children and Rotavirus diarrhoea contrary to the findings in a study done in Nigeria in which the most affected age group of children was 7-12 months(32), the continuous evolvement of the human rotavirus strains which cut across all age groups of under-five children may explain such finding in our study(35).

We observed a significant variation in Rotavirus infection across the three districts in Dar es Salaam. Participants from Ilala district had the highest proportion of Rotavirus diarrhoea compared to those from Temeke and Kinondoni districts. The difference in terms of location, population density, social economic status, infrastructure and water supply between Ilala district and the other two districts may have contributed to such findings in this study. On the other hand, this heterogeneity could be due to a wide range of geographical distribution of the

Rotavirus genotypes and serotypes as the one reported in an earlier study done in south Africa, 1994 (37). However, we did not come across any previous study which reports on similar geographical variation in Dar es Salaam.

Review of scientific literatures makes it clear that faecal-oral is the main route of transmission of Rotavirus infection in which the virus spreads through contaminated hands, objects and occasionally food and water(34). In this study Children whose mothers never washed hands before preparing their foods or feeding them as well as children who drank commercially available bottled or home treated water were significantly infected by Rotavirus. The higher proportion observed among those who drank commercially available bottled or home treated water may be explained by the transferring of the virus from the contaminated hands to the bottles during opening or to the feeding cups. These ways of contamination are consistent with those previously reported in the Rotavirus scientific review in 2018(38).

The proportion of Rotavirus infection was found to be higher in children who had normal nutritional status. This finding conforms to the virulent characteristics of Rotavirus which depends on a healthy intestinal epithelium for attachment and pathogenesis. However, we did not find any significant association between Rotavirus infection and nutritional status in regression model, similarly studies done in Mwanza Tanzania, 2012 (24) and Northwest Angola, 2017(24) reported the same observation.

5.5 Strength of the study.

1. This study covered multiple tiers of health facilities from the level of national hospital to the health centres hence results are representative of the burden of Rotavirus diarrhoea among children aged less than five years in Dar es Salaam hospitals.
2. Rotavirus infection in this study was detected using a directly observed rotavirus antigen rapid test which has the relative sensitivity and specificity of 100% and 97.2% respectively, hence good diagnostic accuracy.

5.6 Limitation of the study

This was a hospital based study and therefore the statistical results obtained cannot be generalized to the entire population of Dar es Salaam.

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Rotavirus diarrhoea among children less than five years of age in Dar es Salaam hospital setting is still prevalent even though there's a decline in the proportion to 10.5% from 32.5% which was reported before the introduction of Rotavirus vaccine, furthermore, even at high vaccine coverage severe forms of the disease manifested by vomiting and severe dehydration are still persistent.

The independent associated factors of Rotavirus diarrhoea from this study are; Age of the mother between >35-49 years (AoR 4.1, p value=0.05), Geographical distribution-living in Ilala district (AoR 4, p value=0.039), Mothers not washing hands before feeding the children or preparing children foods (AoR 8.5, p value=0.039) and Children drinking commercially available bottled or home treated water (AoR 5.4, p value=0.02)

6.2 Recommendation

From the findings in this study we recommend the following;

1. Longer term community based cohort studies are needed to determine the prevalence of Rotavirus diarrhoea among children aged less than five years in the recent post vaccine period and to assess its association with the geographical variation across districts and regions.
2. Provision of health education particularly on proper hand hygiene, sanitation and safe drinking water to parents/caretakers is essential for reduction of contamination and Rotavirus infection transmission among under-five children.

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APPENDICES

Appendix i. Consent form – English

ROTAVIRUS ASSOCIATED DIARHHOEA AMONG UNDER 5 CHILDREN WITH DIARRHOEA IN THE HOSPITAL SETTING IN DAR ES SALAAM, TANZANIA.

Introduction:

Hello, my name is..... We are conducting a study to assess proportion of rotavirus associated diarrhoea, its severity and association with nutritional status among children aged below five years in Dar es salaam hospital setting. The findings from this study will help to determine whether or not the diarrhoea cases seen in hospitals are mainly a result of rotavirus infection, and if so, how severe the infection is currently after introduction of vaccine against rotavirus infection in children, as well as to determine whether or not rotavirus infection has an effect on nutritional status of the affected children, hence improve planning and appropriate management of children with rotavirus associated diarrhoea.

We have approached you because your child has diarrhoea, and therefore s/he is a potential candidate to participate in this study. If you agree for your child to participate in this study, we will ask you some questions related to your child and your family. In case you have any question regarding this study please contact me on 0713546495.

Participation is voluntary:

You are invited to participate in this study because your child has diarrhoea, however it is your choice to participate or not to. You may also decide to participate and if not willing to continue doing so then withdraw at any time, your child will still continue to receive appropriate medical care at this hospital.

The number of children expected to participate:

This study is expected to include a total of 313 children with acute diarrhoea seen at MNH, Temeke, Mwananyamala and Amana regional referral hospitals as well as Buguruni, Pugu, Mnazi Mmoja and Tandale Health centres.

Duration of participation: You and your child will participate only once during course of this study. However, your contact details will be taken so that the results of your child can be

given to you. In case your child requires further treatment, you will be asked to make a follow up visit for the child to receive treatment.

Study procedures: If you agree for your child to participate in this study, we will ask you some questions related to your child and your family. We will do physical assessment on your child including: height/length, weight and MUAC measurements. We will also gather information about your child's illness from the medical records. In addition, we will collect stool sample from your child to test for the presence of Rotavirus. We do not anticipate any side effects from participating in the study.

Will I be paid for participating? Participation in this study is voluntary. There will be no monetary incentive for your participation in the study. Neither will you need to pay in order to participate.

Confidentiality: All the information obtained from this study will remain confidential. We will use hospital registration and study ID numbers for identification of study participants, no names will be used in this study or in future publications resulting from this study. Names will appear on this consent form only, which will be kept separately by the investigator, away from other case report forms.

Do you have any questions?

Statement of consent

I ……. have read the contents of this consent form, or this consent form has been read to me. All my questions have been answered and I have been offered a copy of this consent form. I voluntary allow my child to participate in this study

Parent's/ guardian signature ……. Date: ……

Consent declaration by a witness of the parent/guardian who cannot read or write

I ……..have witnessed the accurate reading of this consent form to parent/guardian of the potential child for the study. The parent/guardian had the opportunity to ask questions which were answered fully. I confirm that the parent/guardian has voluntarily allowed his/her child to participate in the study

Witness's signature ……..……. Date:……

Parent's/Guardian's thumb print



Appendix ii.Consent form – Kiswahili

ROTAVIRUS ASSOCIATED DIARHHOEA AMONG UNDER 5 CHILDREN WITH DIARRHOEA IN THE HOSPITAL SETTING IN DAR ES SALAAM, TANZANIA.

Utangulizi:

Habari, jina langu ni..... .....Tunafanya utafiti ili kuchunguza uwiano wa kuhara kutokanako na virusi vya rota, ukali wake na uhusiano wake na hali ya lishe kati ya watoto wa umri chini ya miaka mitano katika mazingira ya hospitaliza Dar es Salaam. Matokeo ya utafiti huu yatasaidia kutambua kama kesi za kuhara ambazo zinaonekana katika hospital ni matokeo ya maambukizi ya virusi vya rota, na kama ni hivyo, kuna ukali wa kiasi gani wa maambukizi hayo sasa baada ya kuanzishwa kwa chanjo dhidi ya maambukizi ya rotavirus kwa watoto, na pia kuangalia kama maambukizi ya rotavirus yanaathiri hali ya lishe ya watoto walioathirika na virusi hivyo, hivyo kuboresha mipangilio na usimamizi sahihi wa matibabu ya watoto wenye kuhara kutokana na virusi vya rotavirus.
Kwa sababu mtoto wako anaharisha anaweza kushiriki katika utafiti huu. Ikiwa unakubaliana na mtoto wako kushiriki katika utafiti huu, tutakuuliza baadhi ya maswali yanayohusiana na mtoto wako na familia yako. Endapo una swali lolote kuhusiana na utafiti huu tafadhali wasiliana nami kwa kupitia nambari 0713546495.

Kushirikini kwa hiari:
Unaalikwa kushiriki katika utafiti huu kwa sababu mtoto wako anaharisha, hata hivyo ni chaguo lako kushiriki au kutoshiriki. Endapo utaamua kutoshiriki au kujitoa wakati wowote, mtoto wako ataendelea kupokea matibabu sahihi katika hospital hii.

Idadiya watoto wanaotarajiwa kushiriki:
Utafiti huu unatarajiwa kuwa na jumla ya watoto 314 walio na ugonjwa wa kuharisha wanaotibiwa katika hospital ya taifa ya Muhimbili, hospital za rufaa za Temeke, Mwananyamala na Amana pamoja na vituo vya afya vya Buguruni, Pugu, Mnazi mmoja na Tandale.

Muda wa ushiriki: Wewe na mtoto wako mtashiriki mara moja tu wakati wa utafiti huu. Ikiwa mtoto wako anahitaji matibabu ya zaidi utaombwa kurudi tena kwenye kituo cha afya.

Taratibu za utafiti huu: Ikiwa unakubaliana na mtoto wako kushiriki katika utafiti huu, tutakuuliza baadhi ya maswali yanayohusiana na mtoto wako na familia yako. Tutafanya uchunguzi unaohusisha upimajiwa :urefu, uzito na vipimo vya mzunguko wa mkono. Pia tutakusanya habari kuhusu ugonjwa wa mtoto wako kutoka kwenye kumbukumbu za matibabu. Pia tutapima choo chamtoto wako kuangalia maambukizi ya virusi vya Rota. Hatutarajii madhara yoyote yatokanayo na mtoto wako kushiriki katika utafiti huu.

Je, nitalipwa kwa kushiriki?

Kushiriki katika utafiti huu ni kwa hiari. Hakutakuwa na malipo yoyote ya fedha kwa kushiriki kwako katika utafiti. Wala hautahitaji kulipa ili ushiriki.

Usiri:

Taarifa zote zitakazopatikana kutoka kwenye utafiti huu zitaendelea kuwa siri. Tutatumia namba ya hospital na namba ya utambulisho ya utafiti,hakuna majina yatakayotumika katika utafiti huu au katika machapisho ya baadaye yatokanayo na utafiti huu. Majina yataonekana kwenye fomu hii ya idhini tu, ambayo itahifadhiwa na mtafiti mbali na fomu nyingine.

Je! Una maswali yoyote?

Taarifa ya idhini

Mimi.....nimesoma au nimesomewa yaliyomo katika fomu hii ya idhini. Maswali yangu yote yamejibiwa na nimepewa nakala ya fomu hii ya idhini. Mimi kwa hiari yangu ninaruhusu mtoto wangu kushiriki katika utafiti huu

Sahihi ya mzazi / mlezi .....Tarehe: …….

Azimio la kibali na shahidi wa mzazi / mlezi ambaye hawezi kusoma au kuandika

Mimi ....nimeshuhudia usomaji wa fomu hii ya kibali kwa mzazi / mleziwamtoto. Mzazi / mlezi alikuwa na nafasi ya kuuliza maswali ambayo yalijibiwa kikamilifu. Ninathibitisha kwamba mzazi / mlezi amemruhusu mtoto wake kushiriki katika utafiti

Sahihi ya Shahidi..... .....Tarehe:…….

Kidole cha Mzazi / Mlezi



Appendix iii.Questionnaire – English

1. Interview code number
   _____
2. Facility department
   _____
3. Date of admission/OPD attendance
   _____
4. Date of interview
   _____
5. Place of Interview
   _____
6. District
   _____
7. Place of residence
   _____
8. Date of birth
   _____
9. Age of child_____(months)
10. Sex of a child
    1. Male
    2. female
11. Age of caretaker
    _____(years)
12. Marital status of caretaker
    1. single
    2. Married
    3. Co-habiting
    4. Divorced
    5. widowed
13. Education of caretaker
    1. No formal education
    2. Primary education
    3. Secondary education
    4. Higher education
14. Occupation of caretaker
    1. Housewife/husband
    2. Employed
    3. Self-employed/business
    4. Farmer
15. Date of diarrhoea onset
    _____
16. Duration of diarrhoea
    _____(days)
17. Stool consistency
    1. Watery
    2. Mucoid
    3. Bloody stained
18. Rotavirus vaccine status
    1. complete
    2. incomplete
19. introduction of new food?
    1. Yes
    2. No
20. Other family member/neighbour with diarrhoea
    1. Yes
    2. No

21. Type of Latrine
    1. Flush latrine
    2. Pit Latrine
22. Hand washing habits
    1. After visiting toilet – *Yes, No, Sometimes*
    2. Before feeding the child/preparing their food – *Yes, No, Sometimes*
    3. After cleaning child's stool – *Yes, No, Sometimes*.
23. Tool for hand washing
    1. Plain water
    2. Soap and water
    3. Others
24. Type of drinking water
    1. Boiled
    2. Un-boiled
    3. Treated
    4. Bottled
25. Source of drinking water
    1. Tap
    2. Well/dam
    3. Unknown
26. Convulsion during diarrhoea
    1. Yes
    2. No
27. Loss consciousness during diarrhoea
    1. Yes
    2. No
28. Other Related Symptoms
    1. Fever
    2. Vomiting
    3. Abdominal pain
    4. No any other related symptom

<u>To be completed by the investigator</u>

29. Hydration Status
    1. No dehydration
    2. Some dehydration
    3. Severe dehydration
30. Nutritional status
    1. Normal
    2. Mild wasting
    3. Moderate wasting
    4. Severe wasting
31. Rotavirus antigen detection
    1. Positive
    2. Negative

Thank you for participating!

Appendix iv. Questionnaire - Kiswahili

1. Namba ya mshiriki

_____

2. Mfumo wa huduma ya afya

1. Mgonjwa wa nje (OPD)
2. Mgonjwa wa Ndani (IPD)

3. Tarehe ya kulazwa/Kliniki

_____

4. Tarehe ya Mahojiano

_____

5. Mahali pa mahojiano

_____

6. Wilaya

_____

7. Makazi ya mshiriki

_____

8. Tarehe ya kuzaliwa

_____

9. Umri wa mtoto _____ (miezi)

10. Jinsia ya mtoto

1. Kiume
2. Kike

11. Umri wa mama /baba/ mlezi

_____ (miaka)

12. Hali ya ndoa ya mama /baba/ mlezi

1. Hajaolewa/ Hajaoa
2. Ameolewa/ Ameoa
3. Wanaishipamoja (hawajaoana)
4. Talaka
5. Mjane

13. Elimu ya mama /baba/ mlezi

1. Hakuna elimu rasmi
2. Elimu ya Msingi
3. Elimu ya Sekondari
4. Chuo Kikuu / elimu ya chuo.

14. Kazi ya mama / baba/ mlezi

1. Mama wa nyumbani
2. Ameajiriwa
3. Amejiajiri / biashara
4. Mkulima

15. Tarehe ya kuanzakuhara

_____

16. Muda wakuhara _____ (siku)

17. Aina ya kinyesi

1. Majimaji
2. kamasi
3. kimechanganyika na damu

18. Haliyachanjo ya Rotavirus

1. Amemaliza (dozi 2)
2. Hajamaliza (dozi 1)

19. Je, mtoto alipewa chakula kipya ndani ya masaa matatu kabla yakuanza kuharisha?

1. Ndiyo
2. Hapana

20. Je, kuna mtumwingine yoyote katika familia / jirani anayeharisha?

1. Ndiyo
2. Hapana

21. Je mnatumia aina gani ya choo nyumbani?

1. Choo cha shimo
2. Choo cha kuvutamaji

22. Je huwa unanawa mikono
    1. baada ya kutoka chooni– *ndio, hapana, mara nyingine.*
    2. Kabla ya kumlisha mtoto – *ndio, hapana, mara nyingine.*
    3. Baada ya kumbadilisha mtoto nepi/ kumsafisha akitoka kujisaidia –*ndio, hapana, mara nyingine.*
23. unatumia nini kuosha mikono?
    1. Maji tu
    2. MajinaSabuni
    3. nyinginezo _____
24. Aina ya maji ya kunywa
    1. Yaliyochemshwa
    2. Yasiyochemshwa
    3. Yaliyowekwa dawa
    4. Ya kununua (chupa)
25. Chanzo cha maji ya kunywa
    1. Bomba
    2. Kisima/ Bwawa
    3. Hakijulikani
26. Je, amepata degedege ndani ya kipindi cha kuharisha
    1. Ndio
    2. Hapana
27. Je, amepoteza fahamu ndani ya kipindi cha kuharisha
    1. Ndio
    2. Hapana
28. Dalili nyinginezo alizonazo mtoto
    1. Homa
    2. Kutapika
    3. Maumivu ya tumbo
    4. Hakuna dalili nyinginezo

<u>Mtafiti achunguze na kujaza yafuatayo.</u>

29.Hali ya maji mwilini
    1. hajapungukiwa na maji
    2. Amepungukiwa kiasi
    3.Amepungukiwa sana
30. Hali ya lishe (Uzito kwa Urefu)
    1. Yakawaida
    2. Imepungua kidogo
    3. Imepungua kiasi
    4. Imepungua sana
31. Kipimo cha Rotavirus kwenyechoo
    1. Chanya (+)
    2. Hasi (-)

Asante kwa kushiriki