

**PREVALENCE OF AND FACTORS ASSOCIATED WITH DIARRHOEAL DISEASE
IN MODERATE TO SEVERELY MALNOURISHED CHILDREN AGED 6 TO 59
MONTHS AT MBAGATHI DISTRICT HOSPITAL**

**A dissertation submitted in partial fulfilment for the degree of Master of Medicine
(Paediatrics and Child health), University of Nairobi**

BY

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DECLARATION

This dissertation is my original work and has not been presented for the award of a degree in any other university.

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DEDICATION

I would like to dedicate this book to my husband, Jesse Ambundo and my children for their patience, help and support during the M.Med programme.

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NB: The content of this study is solely the responsibility of the author and doesn't necessarily represent the official views of the US National Institutes of Health

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DEFINITION OF TERMS

- **Diarrhoea:** More than 3 looser than normal stools in the preceding 24 hour period
- **Acute watery diarrhoea:** More than 3 loose stools per day lasting less than 14 days. No blood in stools.
- **Dysentery:** Blood in stool.
- **Persistent diarrhoea:** More than 3 loose stools per day lasting 14 days or longer.
- **Episode of diarrhoea:** 3 or more loose stools lasting more than a day and separated from another episode by 2 or more days without diarrhoea
- **Diarrhoea associated with recent antibiotic use:** Passage of loose stool associated with recent course of broad spectrum oral antibiotics.
- **Moderate malnutrition:** Low weight for height (between -2 and -3z scores).
- **Severe malnutrition:** Low weight for height (below -3z scores of median WHO growth standards); visible severe wasting; presence of nutritional edema and /or MUAC of less than 115mm.
- **Maternal nutritional assessment by Body mass index(BMI) as follows:**
 1. **Underweight:** BMI below 18.5
 2. **Normal:** 18.5-24.9
 3. **Overweight:** 25-29.9
 4. **Obese:** More than 30

LIST OF ABBREVIATIONS

1. **WHO** – World Health Organization
2. **MUAC** – Mid upper arm circumference
3. **.KNH – ERC** – Kenyatta National Hospital Ethics and Research Committee
4. **ELISA** – Enzyme linked immunosorbent assay
5. **HIV** – Human immunodeficiency virus
6. **CHERG** – Child Health Epidemiology and Reference Group
7. **ORS** – Oral rehydration salts
8. **A.V.P.U** – Alert.response to voice. Response to Pain.Unresponsive
9. **KDHS** – Kenya Demographic and Health Survey
10. **PCR**- Polymerase Chain Reaction
11. **AOR**- Adjusted Odds Ratio
12. **BMI**- Body Mass Index
13. **CI**- Confidence Interval
14. **ICDDR**- International Centre for Diarrhoeal Disease Research

ABSTRACT

Background: Diarrhoeal disease is one of the major causes of morbidity and mortality in developing countries particularly in children. Increasing evidence suggests that malnutrition is the underlying reason for the increased susceptibility to infections observed in these areas. The increased incidence and severity of diarrhoea 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.

Objective: To determine the prevalence of diarrhoea among 6- 59 month old moderately to severely malnourished children and the factors associated with diarrhoea among these children.

Study design: A three month hospital- based cross-sectional study.

Study setting: The study took place in paediatric outpatient unit at Mbagathi District Hospital that has a monthly average outpatient attendance of approximately 2600 for children less than 5 years. The paediatric department is run by two paediatric consultants and 5 paediatric clinical officers. The main catchment area for the hospital is Dagorreti Division encompassing Kibera slum with an under five- year- old population of 4960 and a total population of 39061. The clientele however, comes from all over Nairobi since it is the main fully functional district hospital within Nairobi.

Study population: This consisted of 6 to 59 month old moderately to severely malnourished children seeking treatment at Mbagathi District Hospital.

Methodology: Moderately to severely malnourished children were enrolled in the study after informed written consent was obtained from the guardian. The guardian's social- economic and demographic data, child's clinical history pertaining possible risk factors and physical examination findings were taken. The patient's HIV status was ascertained by PCR for those aged below 18 months and by ELISA for those aged above 18 months. Immunization status was ascertained by looking at the child- mother health booklet and by recall for those who didn't

have the booklet. All findings were recorded then analyzed using STATA. Logistic regression was used to determine independent factors.

Results

The average age (SD) of children in the study was 20.9 months (SD = 13). Infants were (36%) while above 1 year old were 98 children (64%). The mean anthropometric values were -2.73 for WHZ and 11.7 cm for MUAC. Severe wasting ($WHZ \leq -3$) was present in 56.4% (89/160) of children. Mean age for mothers was 27.1 years while the most commonly reported levels of formal education were primary (45.6%) and secondary (45%) level of education with less than 3% being illiterate.

Out of the 160 malnourished children, 75 had diarrhoea yielding a prevalence of 46.9%. Dysentery was 6.7% while persistent diarrhoea was 18.7%.

After adjustments were made for confounding variables, diarrhoea was approximately 5.3 times higher (95% CI 1.53-9.00) among children of single mothers compared to children of married mothers ($p = 0.004$). The odds ratio of diarrhoea declined from 1.00 in the lowest income group earning below Kenya Shillings (KShs) 5000 monthly to an odds ratio of 0.03 in household with incomes of KShs 15000 and above. Malnourished children who were not bottle fed had significantly lower risk of developing diarrhoeal disease compared to bottle fed children (OR = 0.27, 95% CI 0.08-0.92, $p = 0.037$). Similarly, guardians who did not wash hands with soap were 16 times more at risk of having children with diarrhoea than those who practiced hand washing with soap (OR = 16.33, 95% CI 4.29-62.23, $p < 0.001$). Children who drank unboiled or untreated water had higher risk of developing diarrhoea than those who treated or boiled first (OR=4.98, 95% CI 1.50-16.56, $P = 0.009$). There was no significant statistical association between breastfeeding and age at onset of complementary feeds and odds of diarrhoea (OR 2.0; CI 0.96-4.22; $P = 0.06$).

Conclusion

The prevalence of diarrhoea among moderate to severely malnourished children was 46.9%. Dysentery was 6.7% while persistent diarrhoea was 18.7%.

The factors that were found to be associated with diarrhoea in these children include reduced household income, maternal single marital status, use of bottle feeding, lack of proper hand washing practices and drinking unsafe water. Intensification of health education on these factors in the hospital is recommended and policy makers should create measures to combat poverty, improve literacy levels and encourage fully functional families.

BACKGROUND AND LITERATURE REVIEW

Introduction

Diarrhoea is a principal cause of morbidity and mortality in children < 5 years of age in developing countries where acute watery diarrhoea accounts for nearly two million diarrhoea related deaths annually in this age group¹. While mortality caused by diarrhoea has been decreasing worldwide over the last two decades mainly because of improved hygiene, morbidity attributable to diarrhoea has remained relatively constant^{2,3}. It is estimated that almost 10 million children under the age of 5 years die every year and malnutrition is an underlying factor in 50 -60% of deaths^{4,5}. Even mild degrees of malnutrition have been found to double mortality due to pneumonia, malaria and diarrhoeal disease.

In Kenya, 35% of children under 5 years are stunted while the proportion of severely stunted is 14%. Seven percent of children are wasted and 2 percent are severely wasted whereas 16 percent of children are underweight and 4 % are severely underweight. These trends have not changed much over the last 10 years⁶.

There exists a vicious cycle between diarrhoea and malnutrition. Many studies have shown that malnutrition in association with frequent diarrhoeal episodes slows cognitive and physical development of children^{7,8}. Malnutrition predisposes to diarrhoea through impaired immune defence. Diarrhoeagenic pathogens on the other hand damage intestinal epithelium and reduce its absorptive function, leading to nutrient depletion and malnutrition⁹. The mortality rate of children with severe acute malnutrition admitted as inpatients has remained unacceptably high. Such high mortality has been attributed to either co-morbidities such as HIV infection or diarrhoea¹⁰.

Attempts to interrupt the vicious cycle focus on exclusive and prolonged breast feeding to counteract changes in the immune defence¹¹. Interventions such as breastfeeding and improved sanitation are expected to affect mortality and morbidity simultaneously¹².

Breastfeeding and good sanitation practices

The promotion of proper infant feeding practices and the improvement of environmental sanitation have been two important strategies in the effort to reduce diarrhoeal morbidity among infants. Breast-feeding protects infants by decreasing their exposure to water- and food borne pathogens and by improving their resistance to infection; good sanitation isolates faecal material from the human environment, reducing exposures to enteric pathogens¹³.

Immunization

Immunization is the process by which an individual's immune system becomes fortified against an agent (known as the immunogen). Currently, Kenya immunization program offers:

- BCG and Polio vaccines at birth.
- Diphtheria, Pertussis, Tetanus, Hepatitis B , pneumococcal, oral polio and Haemophilus influenza b vaccines at 6 weeks; 10 weeks and 14 weeks.
- Measles at 9 months.

Measles is an important contributing factor for diarrhoea and malnutrition. Studies have shown that children suffered marked weight loss after measles attack; had less weight gain for three to four months after attack; diarrhoea is a common complication after measles and children experienced higher morbidity from it in post measles period¹⁴.

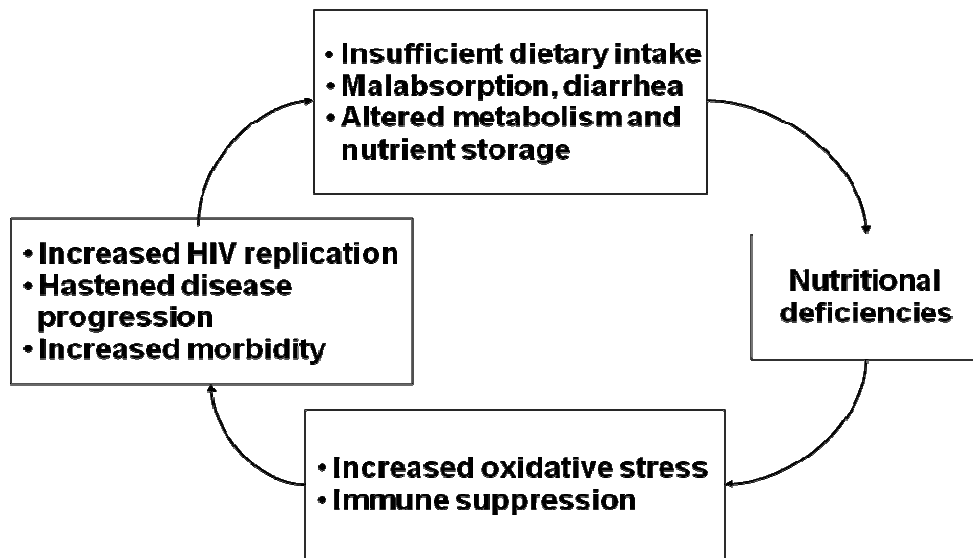
Socio-economic/ demographic factors

It is widely accepted that socio-economic wellbeing of a family is highly associated with the quality of food children feed on, how the food is prepared, the quantity and quality of water, refuse disposal, housing conditions and place of residence.¹⁵ Mothers with low education may not have prior knowledge on the importance of breastfeeding and maintaining a hygienic environment and therefore they need community health talks to inform them.

HIV/AIDS and Malnutrition/ Diarrhoea

Malnutrition and HIV form a vicious cycle where each condition worsens the other. This cycle results in weight loss, loss of muscle tissue and body fat, vitamin and mineral deficiency, reduced immune function and competence, increased susceptibility to secondary infections and more rapid HIV disease progression.

Figure 1: Relationship between HIV, malnutrition and diarrhoea

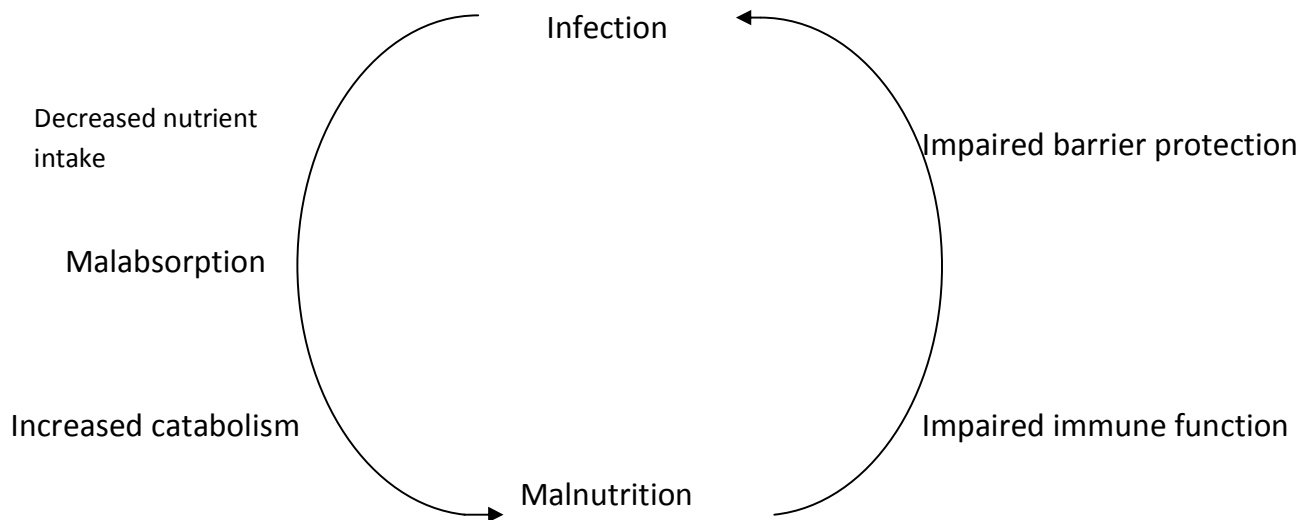


Diarrhoea is common among people with HIV. It can be a side-effect of anti-HIV drugs as well as some other medicines, such as antibiotics. Diarrhoea can also be caused by infections when the immune system is weak. HIV itself can also cause diarrhoea because of its effect on the gut¹⁶.

Diverse studies have shown that malnutrition increases the risks of infection and death. The most frequent causes of death in children under five years old are acute diarrhoea and acute respiratory infection¹⁷. However, as malnutrition rarely appears as a cause of death on death certificates, its impact is largely underestimated.

A great number of field studies have demonstrated that the relationship between infections and malnutrition is bidirectional¹⁷.

Figure 2: Relationship between infections and malnutrition



The above figure shows that infection has the potential to cause malabsorption, decreased nutrient intake due to either diminished appetite or vomiting and increased catabolism hence malnutrition. Malnutrition on the other hand can cause impaired immune function and impaired barrier protection leading to infection hence a vicious cycle.

Therefore the risk factors for diarrhoea in malnourished children involve multiple factors and several preventive programmes will be necessary to minimize the current state.

Malnutrition and diarrhoea

Opintan et al in Ghana in 2008 carried out a prospective cross sectional study to determine the prevalence and etiology of diarrhoea in Accra, Ghana for a period of 9 months on malnourished children aged below 5 years. Two hundred and eighty seven under 5 year old children were recruited with only 13 excluded from analysis because of insufficient data. Of the 274 children

whose data was analysed, 170 (62%) were with and 104 (38%) were without diarrhoea; there were more males 156 (56.9%) than females. Acute and persistent diarrhoea occurred in 85.3% (145/170) and 7.6% (13/170) of total cases, respectively¹⁸. Diarrhoea was found to be more among children aged 13 – 24 months. However risk factors were not sought out for in this study.

Nzioki et al in Kenyatta National Hospital in Kenya conducted a study on audit of care for children aged 6 – 59 months admitted with severe malnutrition and it was found out that the common co-morbid clinical conditions documented at admission were diarrhoea (70.3%) and pneumonia (51.5%)¹⁹. These findings differ slightly from those of the Ghana study which found less prevalence probably because the prevalence in Ghana cut across all types of malnutrition.

In Brazil, a longitudinal 10 year cohort study was carried out by Moore et al to determine association of acute and persistent diarrhoea and growth in the shanty town in Goncalves Dias amongst children aged <5years old. 414 children were followed up and episodes of diarrhoea per child per year were recorded. Nutritional assessment using WAZ, WHZ and HAZ was done at three months intervals. Maternal education and early weaning were significant risk factors for diarrhoea. Mothers who didn't complete primary school had a 2-fold higher incidence of diarrhoea (RR 2.1, 95% CI 1.23-5.56) than children whose mothers finished primary school. Age of weaning from exclusive breastfeeding was positively correlated with the age at first diarrhoea episode (Spearman's $\rho = 0.30$; $p = 0.005$), that is early weaning was associated with earlier onset of diarrhoea. Birth weight, family income, crowding and lack of a toilet in the home were not significantly associated with diarrhoea²⁰. This study also demonstrated that a first episode of diarrhoea is associated with undernutrition both before and after the illness providing further evidence of a vicious cycle of diarrhoea and malnutrition

In Bangladesh a 2 year case control study was carried out to determine risk factors associated with severe underweight among young children reporting for diarrhoea treatment in Dhaka hospital of international centre for diarrhoea disease research. Results of logistic regression analysis revealed that severely underweight children with diarrhoea were more likely to have undernourished mothers who were aged <19years old and completed <5years of education, had

a history of shorter duration of predominantly breastfeeding, discontinued breastfeeding and had a higher birth order and fathers who were unskilled day labourers; completed <5 years of education and came from poorer families²¹. Parental education, economic and nutritional characteristics, child feeding practices and birth order were found to be important risk factors for severe underweight and diarrhoea in this population and these characteristics could be used for designing and targeting preventive intervention programmes. This study however differs from the Brazilian study where family income and crowding were not found to be significant risk factors.

Brussow et al carried out a cross-sectional study in 1620 Ecuadorian children aged less than five years old to determine nutritional and environmental risk factors for diarrhoeal diseases. He concluded that prevalence of diarrhoea varied with the age of the children. 6 – 23 months old showed the highest prevalence. The prevalence of diarrhoea was significantly associated with hygienic factors (quality of drinking water, sanitation and refuse system) but not with demographic factors (sex attitude population density, family size). Multivariate analysis revealed significant associations between both sanitation levels and nutritional levels but not by blood chemistry and diarrhoea prevalence. The findings here on population density and family size contradict Bangladesh study findings. However the study seems to agree with the Brazil results²².

Teklemariam et al in Ethiopia, 2000 carried out a population-based cross-sectional study on diarrhoeal morbidity in thirty two rural and urban areas of Keffa-Sheka zone, to determine the prevalence of diarrhoea in malnourished under-5 year old children and identify environmental risk factors. A total of 952 under five year old children living in the sampled households formed the study population. Data collected included demographic characteristics of the child, and information on environmental and housing variables. The overall diarrhoeal prevalence was 15%. Acute watery diarrhoea, dysentery, and persistent diarrhoea were responsible for 66%, 20%, and 14% of the episodes, respectively. Overall, a third of the diarrhoeal episodes were bloody and/or persistent. Young age (< 20 months), male gender, living in a house with fewer number of rooms, and obtaining water from storage containers by dipping showed statistically

significant association with diarrhoeal morbidity ($p < 0.05$). Type of water source, amount of water consumed, and latrine availability were not found to be significant risk factors ($p > 0.05$)²³.

KDHS 2008-2009 showed that seventeen percent of children experienced diarrhoea in the two weeks preceding the survey, and 3 percent had diarrhoea with blood. Diarrhoea prevalence was noted to increase with age, peaking at 6-11 months (30 percent), and then falls off. There were only small variations in the prevalence of diarrhoea by sex, residence, and wealth quintile. Nairobi had the lowest prevalence of diarrhoea (12 percent) and Coast province the highest (27 percent). Diarrhoea was less common among children whose mothers had some secondary education than among those whose mothers had less education. It was also found to be slightly less common among children who had an improved source of drinking water than among those with an unimproved water source. Diarrhoea was also slightly less common among children who used improved, private toilet facilities compared with those who used non improved or shared toilet facilities²⁴. This survey, however, did not look at the prevalence of diarrhoea and associated risk factors in the malnourished children.

Several studies have been done to determine prevalence of diarrhoea in malnourished children as well as risk factors for diarrhoea in general population of children. This study therefore hopes to determine the prevalence of diarrhoeal diseases in malnourished children as well as determine the associated risk factors ranging from social – demographic , economic , environmental to feeding and immunization practices in 6- 59 month -old children seen at Mbagathi district hospital. Determining the prevalence of HIV amongst malnourished children will hopefully provide information on how best to manage these children.

Reliable information on the magnitude, patterns and trends of causes of death of children aged less than 5 years helps decision-makers to assess programmatic needs, prioritize interventions and monitor progress. It is also crucial for planning and evaluating effectiveness of health services and interventions. Yet, data are very scarce in low-income settings where they are most needed and estimations are necessary for these areas.

STUDY JUSTIFICATION

Diarrhoea remains among the top five contributors to under 5 child mortality in developing countries. Knowledge of its burden in a hospital setting is essential for proper planning in the allocation of limited resources for reducing both morbidity and mortality. This is in line with Millennium Development Goal 4 which aims to reduce by two thirds, between 1990 and 2015 the under five mortality rate.

Malnourished children have weakened immune responses and are more likely to develop diarrhoeal illnesses than well nourished children hence they are at an increased risk of mortality.

There is limited local data on risk factors for diarrhoea in malnourished children since several studies have determined certain specified risk factors in general population of children yet diarrhoea prevalence in malnourished children is far much higher.

Identification of risk factors predisposing to diarrhoea in malnourished children, which are more often preventable, can considerably reduce mortality and frequent hospitalizations of these children through designing and targeting of preventive intervention programmes. This would in turn reduce congestion at not only Mbagathi District Hospital but many other health facilities in developing countries.

STUDY UTILITY

Knowledge of the disease burden and associated factors will help the policy makers to make informed decisions in terms of prevention of diarrhoeal illnesses in malnourished children hence reduction in morbidity as well as mortality.

The ability to identify factors associated with diarrhoea in malnourished children would enable health workers to manage patients appropriately and keep them under closer surveillance.

RESEARCH QUESTION

What is the prevalence and what are some of the factors associated with diarrhoea among moderate to severely malnourished children aged 6 to 59 months at Mbagathi District Hospital?

STUDY OBJECTIVES

PRIMARY OBJECTIVE

To determine the prevalence of diarrhoea among moderate to severely malnourished 6 to 59 month – old children at Mbagathi district hospital.

SECONDARY OBJECTIVE

To determine factors associated with diarrhoea among malnourished 6 to 59 month - old children at Mbagathi district hospital.

METHODOLOGY

Study Area

The study was conducted at Mbagathi District Hospital that has a pediatric ward with a bed capacity of 45. The hospital is run by two pediatricians and 5 pediatric clinical officers. It has a monthly average admission and outpatient attendance of approximately 340 and 2600 children less than five years old respectively. The main catchment area for the hospital is from Dagoretti Division of Nairobi which has an under five- year- old population of 4960 and a total population of 39061. This area encompasses Kibera slum. However, since Mbagathi is the main fully functional District Hospital within Nairobi, it receives many referral cases from many health facilities all over Nairobi.

Study Population

This consisted of children aged between 6 and 59 months seen in paediatric outpatient unit with features of moderate to severe malnutrition. Children were reviewed and those found to be -2 z-score or less with or without edema according to WHO weight for length or weight for height with mid upper arm circumference of 115mm or less were recruited in the study. Maternal nutritional status was determined by calculating the BMI as weight in (kg) / height².

Study Design

This was a cross-sectional study.

Subject Selection

Inclusion Criteria

Six to 59 month old children with moderate and severe malnutrition seen at paediatric outpatient unit in Mbagathi District Hospital.

Children whose parents or guardians consented to participation in the study.

Exclusion Criteria

Patients whose parents or guardians did not give consent for participation in the study.

Patients known to have cardiac, hepatic and renal diseases, malignancies, and chronic intra-abdominal surgical conditions.

Study Period

The study was carried out over a period of three months from March 2012 to June 2012.

Study Outcomes

The study achieved the following outcomes:

- Determination of prevalence rates of diarrhoeal illness in malnourished children classified as acute watery, persistent and dysentery.
- Description of the some of the factors associated with diarrhoea in malnourished children in the hospital under study.

Sample Size

- Sample size was determined as follows
- Fisher's Prevalence formula: $N = \frac{Z^2 P(1-P)}{D^2}$

$$D^2$$

- N = minimum sample size
- Z = standard normal deviate for 95% confidence interval (= 1.96)
- P = the expected prevalence of diarrhoea (Based on Ghana study, the prevalence of diarrhoea in malnourished children was found to be 62%).¹³
- D= degree of precision (7.5%). This was used because the study period is only 3 months and therefore might not be feasible to sample 362 children if a precision of 5% was to be used.
- $N = 1.96 * 1.96 * 0.62(1-0.62) / 0.075 * 0.075$
- N= 160

Sampling Method

Consecutive sampling method was used among moderately and severely malnourished under 5 year old children seen at Mbagathi Hospital. Patients were recruited everyday from 8 am to 8 pm by research assistants. For evaluation of factors associated with diarrhoea, patients who were malnourished with diarrhoea were compared with those without diarrhoea.

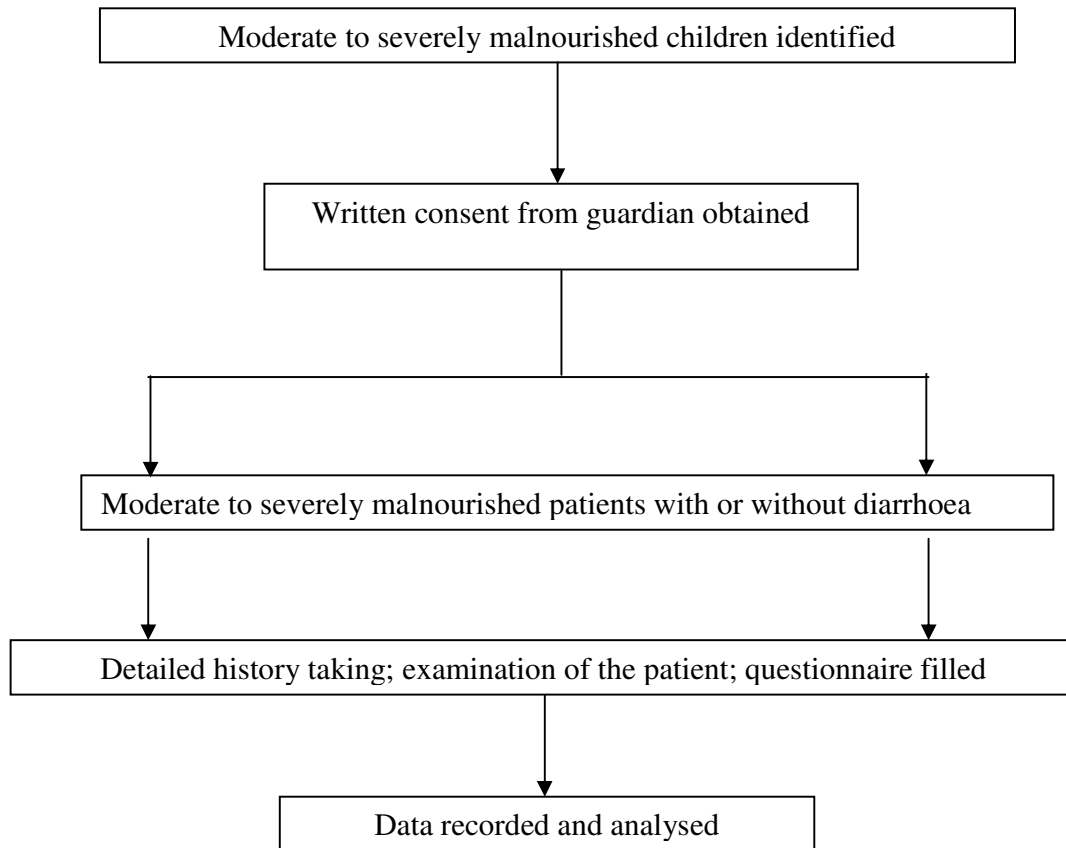
Study Procedures

Children aged 6 to 59 months with moderate to severe malnutrition as per their weights and heights or lengths and MUAC were reviewed at Mbagathi District Hospital outpatient clinic. A questionnaire, translated in a language that was understood by the mother or guardian was

administered to children in the outpatient clinic. The questionnaire was used for seeking the following information:

- Social demographic data of the guardians
- Passage of loose stool, colour, frequency and duration
- Maternal age, educational level and her marital status
- Paternal age and educational level
- Number of total persons staying with the patient at home
- Number of persons below 5 years staying with patient at home
- Residential house in terms of number of rooms and the building structural material
- Source of water, preparation for use and storage
- Routine hand washing practices i.e before eating and after visiting the toilet as well as routine use of soap
- Immunization status of the child (ascertained by child mother health booklet and recall by the guardian in its absence)
- Breastfeeding practices (length of breastfeeding)
- Use of bottle feeding
- HIV status of each child (this was determined by HIV ELISA for children aged above 18 months and by PCR for those aged less than 18 months).
- The child was examined for the presence of dehydration by assessing the level of consciousness and capillary refill time; nutritional edema and fever.

STUDY PROCEDURE FLOW CHART



Data Storage, Analysis and Presentation

Data was coded, cleaned, verified and analyzed using STATA. Categorical data assessed included patient's age, gender and residence, caregiver's marital status, level of education and occupation, type of diarrhoea, maternal nutritional status, child's HIV status, breastfeeding practices, hand washing practices, source of water and storage, immunization status of the child, use of bottle feeds. Quantitative or continuous data included child's and caregiver's age, duration of diarrhoea, diarrhoeal frequency.

Prevalence of diarrhoea was described by simple proportion. Children without diarrhoea were compared to those with diarrhoea to determine the univariate correlates of diarrhoea in malnutrition. Categorical data were then tabulated. Mean, median and standard deviation were

used to summarise the data. Statistical testing was done using Chi square test for categorical variables and for continuous data comparisons of means and medians was done using Student's t test and Mann Whitney U test respectively. Tests of associations were performed using Chi-square test for categorical variables. Logistic regression analysis with inclusion of variables found to be significant were carried out to determine independent determinants of diarrhoea in malnourished children. Data was presented using pie chart and tables.

Ethical Considerations

A written approval from the ethical and research committee of Kenyatta National Hospital and Mbagathi District Hospital were obtained before embarking on the study. Before enrolling each child, informed written consent was obtained from parents or guardians. No child suffered prejudice for declining to participate or withdrawing from the study. There were no risks to any participant from this study. There were no added costs to parents or guardians whose children were participants.

Control of errors and biases

1. The questionnaire was pretested on a sample population to ensure validity of the questionnaire before commencement of the study
2. The research assistants were trained and provided with standard definitions of terminologies used in the questionnaire to ensure uniform interpretation.
3. Data collected were assessed on a daily basis and entered into a pre-programmed computer. The data entered were crosschecked to ensure validity.

Role of Research Assistants

There were two research assistants, both of whom were clinical officer interns pursuing their internship in the paediatric wards at certain district hospitals other than Mbagathi District Hospital. One was identifying patients, taking anthropometric measurements, getting the clinical history as outlined in the study procedures and examining them on the signs of dehydration.

The other assistant was offering pre- and post-test counseling to the guardian and conducting a rapid HIV test for children aged 18 months and above as well as taking blood sample for PCR from those children aged less than 18 months.

The assistants performed these roles after one day training on the study procedure and they were closely supervised and assisted by the principal investigator.

RESULTS

A total of 160 children with moderate to severe acute malnutrition at Mbagathi District Hospital were recruited in the study. Table 1 provides a full description of the socio-demographic characteristics of the participants. The average age (SD) was 20.9 months (SD = 13). Infants were (36%) while above 1 year were 98 children (64%). As shown in Table 1, most participants were male (59.2%, n = 93), firstborns (38.8%, n = 62) and 105 (65.6%) participants were from households with between 3 and 4 household members. Ninety-three percent (n= 150) of the malnourished children were either only child in the household or had a single sibling under five years and most participants were fully immunised for age (96.3%, n = 154).

Table 1: Socio-demographic characteristics of children:

Child level socio-demographic factor		Frequency (%)
Index child's birth order	First	62(38.8%)
	Second	52(32.5%)
	Third	32(20.0%)
	Fourth	9(5.6%)
	Fifth onwards	5(3.1%)
Child's sex	Male	93(59.2%)
	Female	64(40.8%)
Household size (number of persons)	2	3(1.9%)
	3 to 4	105(65.6%)
	5 and above	52(32.5%)
Number of under fives in household	1 to 2	150(93.8%)
	3 to 4	10(6.3%)
Age-specific immunization status	Fully immunised	154(96.3%)
	Not fully immunized	6(3.8%)

The maternal characteristics are presented below in Table 2. (43.8%) interviewed mothers were aged from 26 to 35 years. The most commonly reported levels of formal education were primary

(45.6%) and secondary (45%) level of education with less than 3% being illiterate. Mean age for mothers was 27.1 years. One-hundred and twenty-four (77.5%) mothers of malnourished children reported that they were married.

Table 2: Parental socio demographic characteristics:

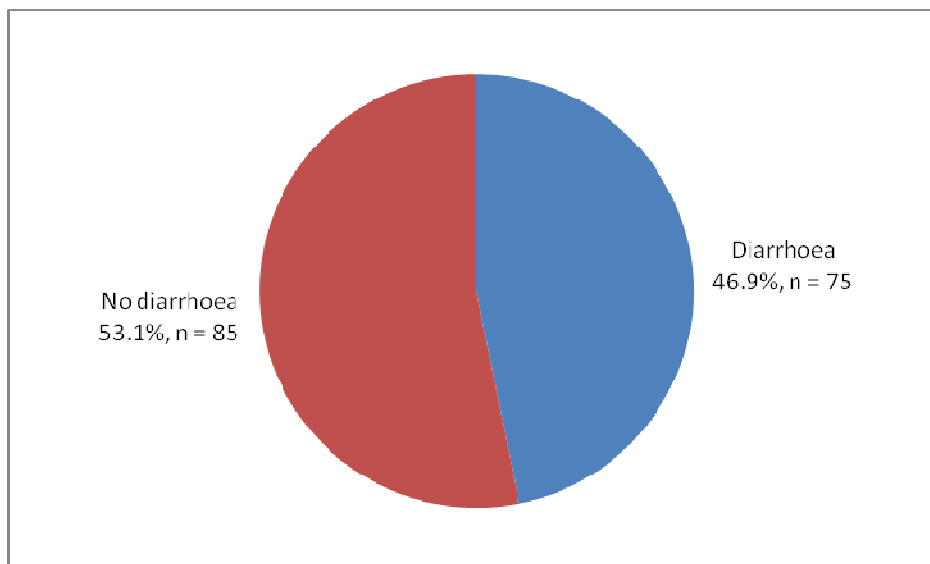
		Frequency (%)
Maternal characteristic		
Maternal age	16 – 20	16(10.0%)
	21 – 25	62(38.8%)
	26 – 35	70(43.8%)
	>36 yrs	12(7.5%)
Maternal education level	Illiterate	4(2.5%)
	Primary	73(45.6%)
	Secondary	72(45.0%)
	College	11(6.9%)
Marital status	Married	125(78.2%)
	Single	35(21.8%)
Paternal characteristic		
Paternal education	Primary	48(38.4%)
	Secondary	65(52%)
	College	12(9.6%)
Estimated net monthly income		
	<Ksh 5000	40(25.2%)
	Ksh 5001 – 10000	71(44.7%)
	Ksh 10001 – 15000	36(22.6%)
	>Ksh 15000	12(7.5%)

Table 2 shows that 65 (51.6%) spouses of the mothers who reported that they were married had secondary education. Seventy-one (44.7%) of the households providing information on the monthly income reported a net income of between Kshs 5000 and Kshs 10000

Prevalence of diarrhoea among malnourished children

Figure 1 shows the prevalence of diarrhoea among children aged 6-59 months at Mbagathi District Hospital. Out of the 160 patients in the hospital participating in this study, 75 patients had diarrhoea yielding a prevalence of 46.9% for diarrhoea among moderate to severe acutely malnourished paediatric patients.

Figure 3: Prevalence of diarrhoea among malnourished children



The clinical presentation of all malnourished children and those with malnutrition and diarrhoea presented in Table 3 shows that 27 (16.9%) of malnourished patients were unable to take solid food or fluids including breast milk. Out of these, 74% (n=20) had diarrhoea.

Among the children with diarrhoea (n = 75), 14 (18.7%) children presented with persistent diarrhoea lasting more than 2 weeks and only five (6.7%) had blood stained stool (Table 3).

Table 3: Diarrhoea symptomatology:

	Frequency	Percent
Inability to take fluids/ solids/breast feed (n = 160)		
Yes	27	16.9
Diarrhoea	20	7.4
No diarrhoea	7	2.6
No	133	83.1
Duration of loose stool (n = 75)		
<2 weeks	61	81.3
>2 weeks	14	18.7
Stool color (n = 75)		
Yellow	54	72.0
Greenish	16	21.3
Blood stained	5	6.7

Clinical examination of malnourished children

The mean anthropometric values were – 2.73 for WHZ and 11.7 cm for MUAC. Table 3 shows the prevalence of malnutrition according to nutritional indices. Severe wasting (WHZ \leq - 3) was present in 56.4% (89/ 160) of patients with moderate to severe malnutrition and MUAC < 11.5 was present in 54(34.6%).

Table 4: Classification of malnutrition severity by nutritional indices:

		Frequency (%)	Diarrhoea	No diarrhoea
Nutritional index				
WHZ	-2sd	66(43.6%)	22(29.37%)	46(56.1%)
	-3sd	63(39.9%)	37(49.3%)	26(31.7%)
	-4sd	26(16.5%)	16(21.3%)	10(12.2%)
MUAC	< 11.5	54(34.6%)	35(9.6%)	20(24.7%)
	>11.5	102(65.4%)	40(54%)	61(75.3%)

There were no statistically significant differences in the prevalence of $WHZ \leq -3$ among males (48.9%) and females (36.5%), $\chi^2 = 2.3$; $p = 0.13$. Similarly, the prevalence of $MUAC < 11.5$ did not differ among male (31.9%) compared to female (38.7%) patients, $\chi^2 = 0.8$; $p = 0.38$.

Risk factors associated with diarrhoea among malnourished children

Risk factors were determined by comparing malnourished children who presented with diarrhoea to those who did not have diarrhoea. The findings of this analysis are presented below.

There was no significant association between the gender of a child and diarrhoea (OR= 0.90, 95% CI 0.47-1.74, $p = 0.76$). The birth order and immunization status of a malnourished child were not significantly associated with diarrhoea (Table 5).

Table 5: Patient characteristics and prevalence of diarrhoea:

	Diarrhoea		OR	95% CI	P value
	No	Yes			
Birth order					
1 st	34(60.7%)	22(39.3%)	1.00		
2 nd	19(38.8%)	30(61.2%)	2.44	1.11-5.4	0.03
3 rd	16(50%)	16(50%)	1.54	0.6-3.7	0.33
4 th	4(44.4%)	5(55.6%)	1.93	0.5-8.0	0.36
5 th or greater	2(50%)	2(50%)	1.60	0.2-11.7	0.68
Fully immunized child					
Yes	81(53.2%)	71(46.8%)			
No	1(20%)	4(80%)	N/A	N/A	N/A
Gender					
Male	44(50%)	44(50%)	1.00		
Female	31(52.5%)	28(47.5%)	0.90	0.47-1.74	0.76

Parental factors and household income and diarrhoea

Among the parental factors investigated in this study, two factors: maternal marital status and household income showed a statistically significant association with the development of diarrhoea in malnourished children. Diarrhoeal risk was approximately 3.7 times higher (95% CI

1.53-9.00) among children of single mothers compared to children of married mothers ($p = 0.004$). Household income showed a strong association with diarrhoea with a consistent trend towards reducing risk of diarrhoea with increasing household income. The probability of developing diarrhoea declined from 1.00 in the lowest income group earning below Kshs 5000 monthly to 0.03 in household with incomes of Kshs 15000 and above (Table 6).

Table 6: Parental socio-demographic characteristics and diarrhoea prevalence:

	Diarrhoea		OR	95% CI	P value
	Yes	No			
Maternal age					
16 – 20	9(60.0%)	6(40.0%)	1.00		
21 – 25	28(49.1%)	29(50.9%)	0.62	0.20-2.04	0.46
26 – 35	32(47.06%)	36(52.94%)	0.59	0.19-1.85	0.37
>36 yrs	6(60.0%)	4(40.0%)	1.00	0.20-5.12	1.00
Maternal education level					
Illiterate	3(75.0%)	1(25.0%)	2.4	0.24-24.1	0.47
Primary	39(55.7%)	31(44.3%)	1.00	-	-
Secondary	31(46.9%)	35(53.1%)	0.70	0.4-1.38	0.31
College	2(20.0%)	8(80.0%)	0.20	0.04-1.00	0.05
Maternal marital status					
Married	54(43.9%)	69(56.1%)	1.00		
Single	25(71.4%)	10(28.6%)	3.70	1.53-9.00	0.004
Paternal education					
Primary	26(54.2%)	22(45.8%)	1.00		
Secondary	27(41.5%)	38(58.5%)	0.63	0.30-1.36	0.25
College	1(8.3%)	11(91.7%)	0.08	0.01-0.67	0.02
Monthly income					
<Ksh 5000	28(80.0%)	7(20.0%)	1.00		
Ksh 5000 – 10000	36(52.9%)	32(47.1%)	0.28	0.11-0.73	0.01
Ksh 10000 – 15000	10(27.8%)	26(72.2%)	0.10	0.03-0.30	<0.001
>Ksh 15000	1(8.3%)	10(91.7%)	0.03	0.002-0.23	<0.001

Nutrition and environmental factors and diarrhoea

There was no significant statistical association between breastfeeding and age at onset of complementary feeds and odds of diarrhoea (OR 2.0; CI 0.96-4.22; P= 0.06). Mothers who were not breastfeeding commonly reported that milk was insufficient for baby. Other reasons were mother had to go to work, baby refused breastfeeding and ‘baby too old to continue breastfeeding’. There was no statistical significance between diarrhea and the type of house the family of malnourished children lived in.

Table 7: Nutrition and environmental factors and diarrhoea

Variable	Levels	Diarrhoea		OR	95%CI	P
		Yes	No			
Breast feeding (children less than 2 years)	Yes	41(48.2%)	44(51.8%)	1.0		
	No	30(65.2%)	16(34.8%)	2.0	0.96-4.22	0.06
House type	One	60(61.2%)	38(38.8%)	1.0		
	Two	14(28%)	36(72%)	0.25	0.12-0.52	<0.001
	>3	1(11.1%)	8(88.9%)	0.08	0.01-0.66	0.02
House walls	Mud	9(64.2%)	5(35.8%)	1.00		
	Cemented	39(41.0%)	56(59.0%)	0.39	0.12-1.24	0.11
	Iron sheets	25(54.3%)	21(45.7%)	0.66	0.19-2.28	0.51
House floor	Mud	14(66.7%)	7(33.3%)	1.00		
	Cemented	60(44.8%)	74(55.2%)	0.41	0.15-1.07	0.068
Household size (number of persons)	1 to 2	2(66.7%)	1(33.3%)	1.00		
	3 to 4	47(45.2%)	57(54.8%)	0.41	0.04-4.68	0.48
	5 and above	26(52%)	24(48%)	0.54	0.05-6.36	0.63
Number of U5 in household	1 to 2	68(46.2%)	79(53.8%)	1.00		
	3 to 4	7(70%)	3(30%)	2.71	0.67-10.89	0.16
Maternal nutritional status (malnutrition)	None	70(47.6%)	77(52.4%)	1.00		
	Mild	4(57.1%)	3(42.9%)	1.47	0.31-6.87	0.62
	Moderate		1(100%)	NA	NA	NA
	Severe		1(100%)	NA	NA	NA

No association was also found between household size (OR 0.41; CI 0.04- 4.68; P=0.48); number of persons below 5 years (OR 2.71; CI 0.67-10.89; P=0.16); maternal nutritional status (OR 1.47; CI 0.31-6.87; P=0.67) and odds of diarrhoea. There was however 2.7 times increased risk of developing diarrhoea in a household with more than one under five persons compared to those which had just one (Table 7).

Environmental and hygiene factors and prevalence of diarrhoea in malnourished children

Use of bottle feeding and hand washing practices were significantly associated with odds of diarrhoea. Malnourished children who were not bottle fed had significantly reduced risk of developing diarrhoeal disease compared to bottle fed children (OR = 0.20, 95% CI 0.1-0.5, $p < 0.001$). On the other hand the odds of diarrhoea among parents who did not wash hands with soap was 10 fold higher than that of review who practiced hand washing with soap (OR = 10.5, 95% CI 4.3-25.9, $p < 0.001$). Malnourished children who drank water without either boiling or chemical treating had higher risk of developing diarrhoea than those who treated or boiled first (OR=3.6, 95% CI 1.62-7.93, $P 0.002$). There was no statistical association between water source and development of diarrhoea among malnourished children (Table 8).

Table 8: Environmental and hygiene factors and prevalence of diarrhoea:

	Diarrhoea		OR	95% CI	P value
	Yes	No			
Bottle use					
Yes	29(76.3%)	9(23.7%)	1.00		
No	43(40.2%)	64(59.8%)	0.20	0.1-0.5	<0.001
Soap used for handwashing					
Yes	7(15.2%)	39(84.8%)	1.00		
No	68(65.3%)	36(34.6%)	10.5	4.3-25.9	<0.001
Method of water preparation					
Boiled	30(42.9%)	40(57.1%)	1.00		
Chlorinated	10(31.3%)	22(68.7%)	0.61	0.25-1.46	0.27
Drank as it is	35(72.9%)	13(27.1%)	3.6	1.62-7.93	0.002
Water source					
Piped	65(50%)	65(50%)	1.00		
Borehole	3(42.9%)	4(57.1%)	0.75	0.16-3.5	0.71
Other	7(53.8%)	6(46.2%)	1.06	0.37-3.7	0.79

Clinical findings and HIV status of children with and without diarrhoea

Table 9 shows that the odds of diarrhoea were significantly higher among children with altered consciousness (AVPU = P), compared to children who were alert (OR = 3.42, 95% CI 1.0 to 11.4, p = 0.04). Oedema and impaired circulation state as evidenced by delayed capillary refill were more in malnourished children presenting with diarrhoea. Diarrhoea did not show statistically significant associations with either Elisa HIV test results (OR = 0.53, 95% CI 0.22-1.24) or PCR results (OR = 0.25, 95% CI 0.04-1.52) although there was a trend towards lower odds of diarrhoea in the group of malnourished children with negative Elisa and/ or PCR tests.

Table 9: Clinical findings and HIV status and prevalence of diarrhoea:

	Diarrhoea		OR	95% CI	P value
	No	Yes			
Elisa HIV/PCR test					
Positive	11(39.2%)	17(60.8%)	1.00		
Negative	54(55.1%)	44(44.9%)	0.53	0.22-1.24	0.14
Level of consciousness					
A	66(55.4%)	53(44.6%)	1.00		
V	5(33.3%)	10(66.7%)	2.49	0.8-7.73	0.11
P	4(26.7%)	11(73.3%)	3.42	1.0-11.4	0.04
U	-	1	-	-	-
Capillary refill					
<2 secs	80(51.9%)	74(48.1%)	-	-	-
2 - 3 secs	0	6(100%)	-	-	-
Oedema					
Present	0	5(100%)	-	-	-
Absent	79(51.0%)	76(49%)	-	-	-

Table 10: Multivariate (Logistic regression) analysis of associated factors:

	Odds Ratio	P value	95% Confidence interval	
Child age (months)	1.02	0.472	0.96	1.08
Single mothers	5.32	0.037	1.11	25.62
Net house hold income:				
Kshs 5000- 10000	0.83	0.78	0.22	3.13
Kshs 10000-15000	0.19	0.036	0.04	0.90
>Kshs 15000	0.17	0.248	0.01	3.48
No bottle use	0.27	0.037	0.08	0.92
No hand washing with soap	16.33	<0.001	4.29	62.23
Water preparation:				
Chemical treated	2.01	0.325	0.50	8.11
Boiled	4.98	0.009	1.50	16.56

After adjustment to confounding variables, the risk of single marital status was 5 times that of married. Household income maintained the same trend as in univariate analysis. There was a demonstration that lack of use of bottle feeding reduced the diarrhoeal risk. Children who were not bottle fed had 0.27 times risk of developing diarrhoea compared to those who used bottles (P=0.037; 95% CI 0.08-0.92). Odds of developing diarrhoea amongst children whose guardians did not use soap for hand washing was 16 times. Diarrhoea among children who drank unboiled water was approximately 5 times more than those who boiled (table 10).

DISCUSSION

Prevalence

The results of our study showed that the prevalence of diarrhoea among moderately to severely malnourished children at Mbagathi hospital was 46.9% (n=75). The prevalence found in this study is lower than the prevalences reported by Opintan et al in Ghana in 2008 (62%)¹⁸, and Nzioki at Kenyatta National Hospital in Kenya (70.3%)¹⁹. This could be because this study involved both moderate and severe forms of malnutrition conducted in an outpatient setting unlike the previous Kenyan (Nzioki) study that included only children with severe malnutrition conducted in an inpatient setting. However this study found a higher prevalence compared with

15% in Ethiopian study by Teklemariam et al²³ and this could be attributed to the fact that the later was conducted in a community setting.

Persistent diarrhoea was found in 18.7% (n=14 out of 75) of malnourished cases. This shows a higher prevalence than Opintan's Ghana study that found a prevalence of 7.6% but was comparable to Teklemariam's Ethiopian study (14%). Generally malnourished children have impaired barrier protection, impaired immune function as well as risk of malabsorption hence more prone to persistent and infective diarrhoea. Persistent diarrhoea accounts for significant morbidity and an established risk of a vicious cycle of diarrhoea and malnutrition¹⁶. Blood stained stool (dysentery) was present in 6.7% of malnourished children. This prevalence was lower than the 20% found in Ethiopian study by Teklemariam et al.²³

Risk factors

It was demonstrated that there was a decreasing trend towards lower odds of diarrhoea in the group of malnourished children whose parents went beyond primary school. This is comparable with the Brazil study by Moore that determined that mothers who didn't complete primary school had a 2-fold higher incidence of diarrhoea (RR 2.1) than children whose mothers finished primary school²⁰. These findings are not different from Bangladesh study which concluded that children of mothers who completed <5 years of education had almost 3 fold higher incidence of diarrhoea (AOR = 2.7, 95% CI 1.9 – 3.8) than those who completed >5 years²¹. Although it is well documented that level of maternal education is positively associated with risk of diarrhoea in children, little information is available specifically on the importance of paternal education. Our finding that paternal education is a risk factor is in agreement with the study done in Bangladesh²¹, that showed that fathers who completed <5 years of education had 1.5 increased risk of having a child presenting with diarrhoea (AOR = 1.5, 95% CI 1.2 – 2.2). Illiterate or less educated parents usually have less knowledge on childrearing practices and optimal environmental and personal hygiene and they generally have less status in the society thereby rendering them less capable of providing adequate child care and accessing formal health services. These group of mothers also may have less problem solving skills leading to an

inability to support their infants when basic requirements are limited which in turn leads to compromised hygienic and nutritional levels.

Odds of diarrhoea were 5.7 times higher among children of single mothers compared to children of married mothers. The single mothers were either widowed, divorced or they dropped out of school due to teenage pregnancy. Some of these mothers tend to leave their children with caretakers who are poorly trained on child care and are poorly paid as they look for odd jobs to meet the family needs since they are the sole bread winner. Some who can't afford caretakers carry their infants to their workplace which often is unhygienic hence predispose the infants to risk of diarrhoea. These mothers also tend to breastfeed their infants less because they lack adequate time. Time and money constraints may also have an effect on early health care seeking.

The study showed a strong association with diarrhoea with a consistent trend towards reducing odds of diarrhoea with increasing household income. This finding is in line with Bangladesh study that found out that malnourished children who came from poorer families were likely to have diarrhoea. Low household income was likely to affect choice of residential place with inadequate environmental hygiene. However, this study contradicts Brazil study that found out that family income was not significantly associated with diarrhoea²⁰.

Use of bottle feeding was significantly associated with odds of diarrhoea. This is in agreement with study results published in rural Malaysia by Knight²⁶. They demonstrated that bottle feeding increased diarrhoeal incidence by 8 fold (OR=8.07, P=0.05). These findings are comparable and come at a time when there are campaigns by public health ministry to encourage breastfeeding, cup feeding and discourage use of bottle feeding in order to combat diarrhoeal disease. Cup feeding was in fact found not to be associated with diarrhoea in Malaysian study. Use of bottle feeding poses a greater risk for diarrhoea transmission because of inadequate hygienic practices in terms of poor sterilization techniques. Cup feeding offers a better option to children who are not breastfeeding exclusively because of the simplicity of cleaning.

Odds of diarrhoea among patients whose mothers did not wash hands with soap were 16 fold higher than those who practiced hand washing with soap ($p < 0.001$). This is in keeping with the Malaysian study that suggested that households that didn't wash hands with soap after toilet

visits had increased risk of diarrhoea (OR 2.8; P=0.05) This may have reflected overall poor hygienic practices.

This study showed that there was statistical significance between odds of diarrhoea and lack of water preparation for drinking. In the local setting water is prepared by either boiling or having it chlorinated. However mothers who reported that they drank water as it was irrespective of the source had increased risk of diarrhoea. There was however no association between the source of water and diarrhoea development. This study generally agrees with Teklemarian study in Ethiopia that found out that type of water source was not a significant risk factor although those who obtained water from storage containers by dipping showed statistical significance. The Malaysian study also agrees to these findings in that it found that households not boiling drinking water and children drinking that water were leading risk factors of diarrhoea transmission (OR=15, P=0.02 and OR=3.13, P=0.001, respectively) .

There was no significant statistical association between breastfeeding and age at onset of complementary feeds and odds of diarrhoea (OR 2.0; CI 0.96-4.22; P= 0.06). There was however a reducing trend towards less odds of diarrhoea and increasing period of breastfeeding. This is in keeping with Malaysian and Bangladesh studies that found out that children who had a history of shorter duration of predominantly breastfeeding (< four months, AOR = 2.3, 95% CI 1.6 – 3.3) or discontinued breastfeeding (AOR = 2.0, 95% CI 1.1 – 3.5) were at a 2 fold increased risk of developing diarrhoea.

In respect to clinical features, a considerable proportion of children under study were unable to drink or feed (n=26; 15.3%) and out of these a significant proportion (74%) had diarrhoea. This correlates with altered level of consciousness that was found to be 14.6% for those who could only respond to pain. This necessitates the need to always stock appropriate fluids in the outpatient clinic to aid in management.

CONCLUSIONS

1. The prevalence of diarrhoea amongst moderately to severely malnourished 6-59 month old children reviewed at Mbagathi District hospital was at 46.7%. Persistent diarrhoea was present in 18.75% while dysentery was seen in 6.7%.
2. The major risk factors for diarrhoeal disease amongst malnourished children were: low household income, single maternal marital status, use of bottle feeding, poor hand washing practices, drinking untreated or unboiled water and low parental education.

RECOMMENDATIONS

Health education among guardians to malnourished children should be intensified in the hospital to discourage bottle feeding, encourage proper hand washing practices as well as proper preparation and storage of drinking water.

Long term measures that the government should consider include promotion of fully functional families, improvement in socioeconomic status as well as encouraging students to go beyond primary educational level.

STUDY LIMITATIONS

1. The study required recall on the part of the respondents and answers for these might have been influenced by recall bias. This was minimized by using a well validated instrument for assessment and giving participants enough time before answering to reflect and think through a sequence of events in their children's life history.
2. The study depended on the willingness of the participants to provide accurate and truthful information. This was addressed by taking time to explain to the guardian about the need for accurate information and potential benefits of the study to the child and other similar children.
3. Time duration for the study was short hence used a smaller sample size and reduced the power of the study.

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APPENDIX 1: DATA COLLECTION TOOL

Social-Demographic data:

1. Study Identification number.....
2. Date of Birth.....Age in months.....
3. Birth order.....
 - 1ST ()
 - 2ND ()
 - 3RD ()
 - 4TH ()
 - 5TH Onwards ()
4. Sex :
 - M ()
 - F ()
5. Total Number of siblings.....
6. Number of siblings below 5 years.....
7. Maternal age.....
 - <15 yrs ()
 - 15-20 ()
 - 20- 25 ()

- 25- 35 ()
- > 35 yrs ()

8. Maternal educational level.....

- Illiterate ()
- primary()
- secondary ()
- college ()

9. Mother's marital status.....

- married ()
- single ()

10. Maternal height.....

- weight.....

11. Paternal educational level.....

- illiterate ()
- primary ()
- secondary ()
- college ()

12. Approximate total monthly net income.....

- <KSH 5000 ()
- KSH 5000 -10000 ()

- KSH 10000 -15000 ()

- > KSH 15000 ()

13. Residential place.....

14. Type of residential house:

- Number of rooms (1.....2.....>3.....)

- mud ()

- permanent ().

15. Source of water

- piped ()

- borehole ()

- other (specify).....

16. Preparation of drinking water.....

- boiled ()

- chlorinated ()

- other ()

- drank as it is ()

17. Immunization status:

- BCG.....(yes / no)

- Pentavalent.....(yes / no)

- pneumococcal.....(yes / no /)

- measles.....(yes / no)
- Is immunization complete as per age?

18. Breastfeeding or not (for those less than 2 years old)

- yes ()
- no ()

19. If yes, onset of complementary feeds...

- from birth ()
- 1 month-3 months ()
- 3 months -6 months ()
- > 6 months old ().

20. If not breastfeeding, when stopped and why.....

Symptomatology

21. Refusal to take fluids/solids/breast feed

- Yes ()
- No ()

22. Passage of loose stool

- Yes()
- No()

23. If yes

- frequency in 24hrs 1-3 ()

- > 3 times

24. Duration

- 1 week ()

- 1-2 weeks ();

- > 2 weeks ()

25. Stool colour.....

- yellow ()

- greenish ()

- pale ()

- blood stained ()

Examination findings:

26. Height/Length Weight.....

27. Standard deviation/ Z score(Weight for height).....

28. MUAC.....

29. Respiratory rate.....Heart rate.....

30. Temperature.....High() normal () low ()

31. ELISA/rapid HIV test (for 18 months and above).....Positive() Negative()

32. PCR test (For 18 months or less).....Positive () Negative ()

33. Nutritional Oedema

- Yes ()
- No ()

34. Level of consciousness (A V P U)

35. Capillary refill (< 2 secs, 2 – 3 secs, >3 secs)

36. Mucus membranes ; dry () wet ().

APPENDIX 2: TIME FRAME

Number	Activity	Estimated Time
1	Proposal Development and Presentation	Dec 2011 to Jan 2012
2	Submission of proposal for ethical approval	Feb 2012
3	Pretesting and seeking permission	Feb to March 2012
4	Data Collection	April to July 2012
5	Data Analysis	Aug 2012-Dec 2012
6	Thesis writing	Jan -Mar 2013
7	Thesis submission	April 2013

APPENDIX 3: INFORMATION CONSENT FORM FOR PARTICIPATION IN THE STUDY

Study Identification Number: _____

Date: _____

Study title:

Prevalence and risk factors of diarrhoeal diseases amongst malnourished children aged 6-59 months attending care at Mbagathi District Hospital.

Investigator's statement

I am a postgraduate student at the University of Nairobi – Department of Paediatrics. I am asking you and your child to participate in a research study. The purpose of this consent form is to give you information you will need to help you decide whether to participate in the study. Please read this form carefully. You are free to ask any questions about the study. The investigator will be available to answer any questions that arise during the study and afterwards.

Brief description of Study

Diarrhoea and malnutrition are some of the common illnesses affecting children in sub-Saharan Africa. The study aims to determine the prevalence and risk factors of diarrhoeal diseases amongst malnourished children aged 6-59 months attending care at Mbagathi District Hospital. The study is being done by doctors from the University of Nairobi and the Mbagathi District Hospital with the help of researchers from PRIME-K(Partnerships In Innovative Medical Education for Kenya).

- The procedure of the study will entail measuring both your weight, height as well as mid upper arm circumference and your child's. Then we shall ask you questions on the following aspects in order for us to depict possible risk factors: Social demographic data of the guardian, passage of loose stool by the child, stool's color, frequency and duration,

number of times the patient has had diarrhoea in the last 3 months, maternal age, educational level and her marital status, paternal age, educational level, number of total persons staying with the patient at home, number of persons below 5 years in the household, residential house in terms of number of rooms and the structural material, source of water, preparation for use and storage, routine hand washing practices i.e before eating and after visiting the toilet as well as routine use of soap, immunization status of the child (ascertained by child mother- health booklet and recall by the guardian in its absence) breastfeeding practices (exclusively breastfed for how long, complementary feeds introduced at what age, when breastfeeding was stopped) and use of bottle feeding.

- HIV exposure status of your child (this will be ascertained by HIV ELISA for children aged above 18 months and by PCR for those aged less than 18 months) will also be determined. This is important because the HIV virus causes the body's immune system, which is supposed to defend it from diseases, to malfunction. Children exposed to HIV are at high risk of infectious diseases like diarrhoea and this can henceforth predispose them to malnutrition. The test will require a small amount of blood to be removed from the child and taken to the laboratory for assessment. The test is generally safe and will be done with your permission.
- The child will then be examined for the presence of dehydration by assessing the level of consciousness and capillary refill time; nutritional edema and fever.

Your participation in this study will help us identify the burden of diarrhoea and identify risk factors associated with it in malnourished children. The results of this study will help health workers in this facility and beyond to improve care given to all children with malnutrition. It will also provide you with information on the current burden of diarrhoeal illnesses and associated risk factors and the steps you can take to prevent morbidity.

All the information obtained will be held in strict confidentiality. Any information that may identify you or your child will not be published or discussed with any unauthorised persons. We will however discuss overall findings regarding all children who participated in the study without revealing you or your child's identity. No invasive procedures will be done on your child as part of the study. Your participation in this study is purely voluntary and there is no monetary gain. It

will not cost you financially to participate in this study. You are free to withdraw from the study if you so wish without any penalty.

If you have any questions about the study or your participation in the study you can contact the principal investigator, Dr. Phoebe Wamalwa, 0721 268356.

If you have any questions on your rights as a research participant you can contact the Kenyatta National Hospital Ethics and Research Committee (KNH- ERC) by calling 2726300 Ext. 44355

I confirm I have explained to the parent/caregiver all relevant information about the study as indicated above.

Interviewer's SignatureDate

I confirm the above study has been explained to me. I agree to have my child and I participate in the study. I have had a chance to ask questions about the research, to which satisfactory answers have been given. I understand I can withdraw from the study at any time without any penalty.

Guardian's Signature..... Date.....

APPENDIX 4: TAKING ANTHROPOMETRIC MEASUREMENTS.

Taking a Child's Weight

1. Before weighing the child take all his/her clothes off.
2. Zero the weighing scale (i.e. make sure the arrow is on 0).
3. Place the child on the weighing scale.
4. Make sure the child is not holding onto anything.
5. Read the child's weight. The arrow must be steady.
6. Record the weight in kg to the nearest 100g e.g. 6.6kg
7. Do not hold the scale while reading the weight.

Taking a Child's Length

For children less than 87 cm, the measuring board is placed on the ground.

1. The child is placed lying down along the middle of the board.
2. The assistant holds the sides of the child's head and positions the head until it firmly touches the fixed headboard with the hair compressed.
3. The measurer places her hands on the child's leg, gently stretches the child and then keeps one hand on the thighs to prevent flexion.
4. While positioning the child's legs, the sliding foot-plate is pushed firmly against the bottom of the child's feet.
5. To read the height measurement, the foot-plate must be perpendicular to the axis of the board and vertical.
6. The height is read to the nearest 0.1 cm.

Taking a Child's Height

1. The child stands, upright against the middle of the measuring board.
2. The child's head, shoulders, buttocks, knees, and heels are held against the board by the assistant.
3. The measurer positions the head and the cursor.
4. The height is read to the nearest 0.1 cm.

5. Measurement is recorded immediately.

Taking a child's Middle Upper Arm Circumference (MUAC)

MUAC is an alternative way to measure thinness (alternative to weight for height). It is especially used for children 6 months to 5 years old.

How to Measure MUAC

1. Ask the mother to remove any clothing covering the child's left arm.
2. Calculate the midpoint of the child's left upper arm: first locate the tip of the child's shoulder with your fingertips.
3. Bend the child's elbow to make the right angle.
4. Place the tape at zero, on the tip of the shoulder and pull the tape straight down past the tip of the elbow.
5. Read the number at the tip of the elbow to the nearest centimeter. Divide this number by two to estimate the midpoint.
6. Mark the midpoint with a pen on the arm.
7. Straighten the child's arm and wrap the tape around the arm at the midpoint. Make sure the numbers are right side up and the tape is flat around the skin.
8. Inspect the tension of the tape on the child's arm. Make sure the tape has the proper tension and is not too tight or too loose.
9. With the tape in correct position on the arm with the correct tension, read and call out the measurement to the nearest 0.1cm.
10. Immediately record the measurement.

APPENDIX 5: STANDARD OPERATING PROCEDURES FOR RAPID HIV TESTING

1.0 Introduction

Rapid testing involves a series of two serological tests done to determine the HIV status of a patient who, in the case of PIDTC has issued informed consent and undergone pre test counseling either directly or through a legal proxy.

2.0 Abbreviations

HIV-Human Immunodeficiency Virus

PIDTC-Provider- Initiated Diagnostic Testing and Counselling

ELISA-Enzyme linked immunosorbent Assay

3.0 Equipment/Materials

3.1 Disposable latex gloves

3.2 Spirit swabs

3.3 Sterile lancet

3.4 Determine HIV-1/2(Inverness Medical) testing kit

3.5 SD Bioline HIV 1/2 3.0(Standard Diagnostics Inc) testing kit

3.6 Chase buffer

4.0 Procedure

After pre test counseling for HIV and having obtained verbal consent to test:

- Glove and wash hands to remove glove powder
- Swab patient's finger with 3 different spirit swabs and prick it using a sterile lancet
- Wipe away first drop of blood and allow another to gather
- For determine Assay, drip 2 drops of blood (50ul) onto the test pad and apply 1 drop of chase buffer. Allow the test to develop for 15 minutes and interpret the results. A positive result is indicated by the appearance of 2 lines on the test strip and a negative

by the appearance of one on the proximal portion. Any other result is invalid and the test is repeated.

- For SD Bioline Assay, a 20ul capillary pipette is provided, immerse the open end in the blood drop and release pressure to draw blood into the capillary pipette to the black line. Add the drawn specimen into the sample well and add 4 drops (120ul) of assay diluents. As the test begins to work purple color is seen moving across the results window at the center of the test device. Interpret the results in 15-20 minutes. The presence of only the control line © within the results window indicates a negative result. The presence of 2 lines as control line © and Test line 1 (1) within the results window indicates a positive result for HIV 1. Presence of control line © and test line 2 (2) indicates a positive result for HIV 2. The presence of 3 lines; control line ©, testline 1 and test line 2 indicates a positive result for HIV 1 and /or HIV 2. The absence of a control line © within the results window indicates an invalid result.

A test result is considered positive when both tests are positive and negative when both tests are negative. A discordant result will be repeated using ELISA based Vironostika HIV Uni-Form 11 Ag/Ab test (Sensitivity=100% and Specificity= 99.9%) manufactured by biomerieux, Bosedin Netherlands.

APPENDIX 6: STANDARD OPERATING PROCEDURES FOR DRIED BLOOD SPOT COLLECTION AND HANDLING

1.0 Introduction

Children less than 18 months of age who test positive for HIV 1 and 2 antibodies will undergo a DNA PCR test to confirm the presence of HIV viral DNA in whole blood. The procedure through which this is performed is detailed below.

2.0 Abbreviations

HIV-Human Immunodeficiency Virus

DNA- Deoxyribonucleic Acid

DBS- Dried Blood Spot

PCR- Polymerase Chain Reaction

3.0 Materials/Equipment

3.1 Disposable latex gloves

3.2 Spirit swabs

3.3 Sterile lancet

3.4 DBS plate

4.0 Procedure

The DBS card is clearly labeled with the appropriate identification number. The circles are not touched with fingers or anything else.

- Warm the area of the body that is to be pricked.(For an infant aged 1-4 months and less than 6 kgs use the heel of the foot. For infants aged 5-10 months and less than 10 kgs use the toes preferably and for larger infants use the finger).
- Wear gloves and wash hands
- Position baby with the foot downward
- Clean area to be pricked and dry for 30 seconds

- Prick area using a lancet
- Wipe away first drop of blood and allow a large drop of blood to collect.
- Fill the entire circle with a drop. Fill at least 2 circles
- Clean the foot and allow it to dry and clot in free air. Do not apply a bandage.
- Do not touch or smear the DBS, allow it to dry horizontally for at least 3 hours.
- Transport the specimen to the laboratory where PCR will be performed to determine the presence / absence of HIV viral DNA.

APPENDIX 7: ETHICAL APPROVAL LETTER



UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke
Link: www.uonbi.ac.ke/activities/KNHUoN



KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/109

14th May 2012

Dr. Phoebe Wamalwa
Dept. of Paediatrics & Child Health
School of Medicine
University of Nairobi

Dear Dr. Wamalwa

Research proposal: "Prevalence and risk factors on diarrhoeal disease in malnourished children aged 6 to 59 months at Mbagathi District Hospital" (P48/02/2012)

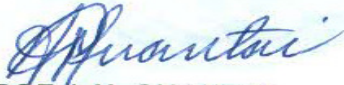
This is to inform you that the KNH/UoN-Ethics & Research Committee (ERC) has reviewed and **approved** your above revised research proposal. The approval periods are 14th May 2012 to 13th May 2013.

This approval is subject to compliance with the following requirements:

- a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
- b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
- c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
- d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
- e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
- f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
- g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN -ERC website www.uonbi.ac.ke/activities/KNHUoN

Yours sincerely



PROF A.N. GUANTAI
SECRETARY, KNH/UON-ERC

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 The Principal, College of Health Sciences, UON
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