MALNUTRITION AND ASSOCIATED RISK FACTORS IN UNDERFIVES ATTENDING LUGALO AND MWANANYAMALA MCH-CLINICS IN DAR ES SALAAM

BY

J. H. MWINULA, M.D.

DEPARTMENT OF PAEDIATRICS AND CHILD HEALTH

MUHIMBILI UNIVERSITY COLLEGE OF HEALTH SCIENCES

DAR ES SALAAM

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JUMA H. MWINULA, M.D. (DAR ES SALAAM) 1986

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I HAVE READ THE DISSERTATION AND DO APPROVE IT FOR FINAL SUBMISSION

A.E. Msengi
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PROFESSOR A. E. MSENGI, M.D., M.MED

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ABSTRACT

An unmatched case control study was carried out in Lugalo and Mwananyamala MCH-clinics between December 1994 and January 1995 in order to identify risk factors for malnutrition in underfives. The hypothesis was that the incidence of infections, inadequate food intake, low birth weight, poverty, wrong infant feeding practices, high parity of the mother, advanced and young maternal age, short birth interval and poor MCH attendance in malnourished children is similar to that of normal children. All children found to weigh less than 80% of the median weight-for-age according to Wellcome Trust classification were enrolled as cases and those who weighed 80% or more of the median weight-for-age were enrolled as controls. For every consenting case enrolled a control was also enrolled. 894 underfives were enrolled and one child was removed because he was aged below six months. Final sample had 893 children with a male to female ration of 1:0.97. Cases were compared with controls with respect to variables under investigation thought to be risk factors for malnutrition. Malnutrition was found to be associated with: Low birth weight (OR = 2.9, 95%CI = 1.9-4.5), fever on enrollment day (OR = 1.3, 95%CI = 1.0-1.7), amount of money spent on family food (OR = 2.2, 95%CI = 1.5-3.3), few total days of MCH-attendance (OR = 4.1, 95%CI = 2.1-8.4), female gender (OR = 1.7, 95%CI = 1.3-2.3), ignorance regarding interpretation of MCH growth curves for the normal child (OR = 1.3, 95%CI = 1.0 - 1.8) and for malnourished child (OR = 1.6,95%CI = 1.5 - 2.3),

absence of TV set (OR = 1.9, 95%CI = 1.1 - 3.2), absence of refrigerator (OR = 1.9, 95%CI = 1.3 - 2.9) and lack of breast feeding practice (OR = 1.5, 95%CI = 1.1 - 2.0); whereas high education status of mother was associated with good nutritional status (OR = 0.4, 95%CI = 0.2 - 0.9).

In conclusion low birth weight, presence of fever on day of enrollment, daily food expenditure of less than 1,000/=, being female, inability to interpret MCH growth curves, not breast feeding, low educational status of mother and not having electricity, TV-set and/or refrigerator were risk factors for developing malnutrition in underfives attending Lugalo and Mwananyamala MCH clinics. As a result, recommendations put forward aim to improve health education at MCH-clinics and to reduce incidence of low birth weight. The government and other relevant institutions should give priority to raising the socio-economic status of women.

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Since it is not possible to name all people who contributed in one way or the other in making this study a success, I would like to collectively thank them all. I am much indebted to all of them.

DECLARATION

I, Juma H. Mwinula, do declare that this dissertation is my own original work and that it has never been submitted for award of any degree in any other university.

Signature:.....

J. H. MWINULA (M.D.)

Date: 10th Nov 1995.

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ABBREVIATIONS

1.	AIDS	=	Acquired Immune deficiency Syndrome
2.	ARI	=	Acute respiratory tract infection
3.	BCG	=	Bacille Calmette Guerin
4.	Bwt	=	Birth weight
5.	CI	=	Confidence interval
6.	DPT	=	Diphtheria, Pertussis and Tetanus Toxoid
7.	EPI	=	Expanded Programmes on Immunization
8.	HIV	=	Human Immuno deficiency virus
9.	Ig	=	Immune globulin
10.	IL	=	Interleukin
11.	LBW	=	Low birth weight
12.	MCH	=	Maternal and Child Health
13.	MD	=	Doctor of Medicine
14.	M.M.C	=	Muhimbili Medical Centre
15.	M.MED	=	Master of Medicine
16.	MUCHS	=	Muhimbili University College of Health Sciences
17.	NCHS	=	National Centre for health Statistics
18.	OPV	=	Oral polio Vaccine

19.	OR	=	Odds ratio
20.	PEM	=	Protein energy malnutrition
21.	PHC	=	Primary Health Care
22.	SGA	=	Small for gestational age
23.	TFNC	=	Tanzania Food and Nutrition Centre
24.	TNF	=	Tumour necrosis factor
25.	TPDF	=	Tanzania People's Defence Forces
26.	TShs	=	Tanzania Shilling
27.	TV	=	Television
28.	UNICEF	=	United Nations Children's Fund
29.	WHO	=	World Health Organization

1.0 INTRODUCTION AND REVIEW OF LITERATURE

The concept of Primary Health Care (PHC) was adopted at the Alma Ata declaration of 1978 as a means of achieving health for all by the year 2000 through people's participation and at a cost that the community and country can afford. [1] One of the essential components of PHC is Maternal and Child Health (MCH) care.[2,3] Women of child bearing age and children under the age of five years are the two most vulnerable groups in the community that need special health attention. Women in the process of childbearing and rearing, and children in the process of growth are more vulnerable to a number of disorders which many cause death. Many international agencies and nations have contributed resources towards promotion of health of child bearing mothers and children in many developing countries.[4] In most of these countries special clinic programmes, such as the MCH clinics, have been established to promote the health of child bearing mothers and children under the age of five years.[5,6,7] Child growth monitoring and promotion is an essential element of all MCH-services. Growth is defined as "increase in the size of the body as a whole or of its separate parts, and is a continuous and uniform process.[5,6] Growth can be assessed by anthropometric measurements.

Growth faltering is an early sign of ill-health. In order to detect growth faltering, a continuous growth monitoring process is required. Growth monitoring at the MCH clinics refers to a regular and sequential weight and stature or length measurements of the child, recording the results on the growth chart and allowing growth or lack of it to be made visible. In most cases weight measurement is easier than height or length measurement. Therefore, for practical purposes, growth monitoring includes, in most cases, only weight measurement recorded on the "Road to Health chart".[3,5] Morley introduced the 'road to health chart' from the idea that a 'satisfactory growth' can be better checked by 'continuous growth monitoring'.[7] The 'road to health' chart was intended to help the health worker and the mother to understand and to recognize failure to gain weight shown visibly on the graph, as an indication of ill health needing appropriate investigation and action. Involving mothers in the process of child monitoring and promotion should make them be aware of the health status of their children, and give them an opportunity to seek attention early. There is a suggested sequence of five activities or tasks in growth monitoring which has to be undertaken by 'health teams' (including mothers)[5]. These are explained in the following paragraphs:-

Sequence of 5-activities or tasks in growth monitoring

Task 1 - Motivating the community:

The community, including religious and political leaders, and parents (particularly mothers) should be motivated to continue bringing their children to MCH clinics regularly until they are 5 years of age. Motivation can be achieved through religious gatherings, political meetings, special radio/television programmes and house visits by health workers and through health education during MCH visits.

Task 2 - Weighing the child:

This is a responsibility of the health workers. Mothers should be involved by participating actively in the whole exercise of weighing their children. They should start by striping their children naked, and making them wear clinic pants used for weighing. Each mother should hang her child under the Salter weighing scale, and she should, if possible, read the weight of her child to the health worker who is also looking on the scale at the same time.

Task 3 - Recording and plotting of weight:

The recorded weight of the child should be plotted on the growth chart. This again is the responsibility of the health worker. Mothers should be involved in how the chart is plotted. The health worker can assist the mother by first

describing the components of the growth chart, where age of child is in calendar months along the x-axis, and the weight is in kilograms along the y-axis. When the mother has understood this, then the health worker shows where the age of the child intersects with the weight recorded on the chart.

Task 4 - Interpretation of the growth curve:

This should be done by the same health worker who plotted the weight or by any other senior health worker available. It is better for the interpretation to be done in a sort of discussion with the mother so that the mother understands how to interpret the growth curve of her child. Mothers should be told what is an ideal growth curve, and that should be related to the growth curve of the particular child under discussion.

Task 5 - Taking action:

This is the responsibility of health worker, mother, and community. The action to be taken will relate to the growth curve and health status of the child. If the growth curve of the child is satisfactory, the mother should be praised, and encouraged to maintain the health status of the child and to continue bringing the child for growth monitoring. If, on the other hand, the growth of the child is unsatisfactory, the mother should be praised for whatever good things she did to the child, then she should be helped to identify by herself

what things she is able to do for her child, and should be encouraged to do so. Regarding the things which are outside her ability (e.g. drought or death of a householder etc.), the community should be involved to help to contain the situation. Community leaders, e.g. religious or political leaders should be involved from the beginning so that when action is required it may be easy to mobilize resources.

It is expected that continuous growth monitoring functions as a primary prevention against malnutrition because growth faltering can be detected early and appropriate action taken. However, the different tasks on this 5-stage sequence is usually the responsibility of the community health workers, who are overworked, minimally paid and have limited education and several other tasks to perform.[7] There is a lot to be desired for the quality of services rendered in these circumstances. Studies to assess nutritional status and associated factors in preschool children in Dar es Salaam, found out that, most mothers stopped attending MCH-clinics when their children were aged more than 1 year (Personal communication). In these studies, nutritional status among children attending MCH-clinics after 1 year was comparable to that of children who have stopped attending MCH-clinics.

1.1 Indices of nutritional status

Growth variables, including weight, height and mid-upper arm circumference can be used as indices for assessment of nutritional status. There are three main anthropometric indicators used in assessing nutritional status in children:-

- Weight-for-height - this measures body mass in proportion to length or height. When this is low, it indicates wasting.
- Height-for-age - measures linear growth over time and is an indication of stunting if low.
- Weight-for-age - measures body mass over time and it indicates underweight when low.

Weight and height measurements can be made with minimal equipment. Nutritional status as shown by anthropometric indicators is usually described as percentage of individuals below a specified cut-off-point. The median weight-for-age, height-for-age and weight for-height can be presented and expressed as a percentage of median, centiles or standard deviation (z-score) of a reference population.

The United States of America National Centre for Health Statistics (USA-NCHS) reference population has been adopted by WHO as the international anthropometric reference.[8,9] The cut-off point recommended by

WHO to designate low anthropometric values is less than minus two (-2) and less than minus three (-3) standard deviation (SD) from the median value of the reference population.[8-11]

1.2 Situation of health services in Tanzania

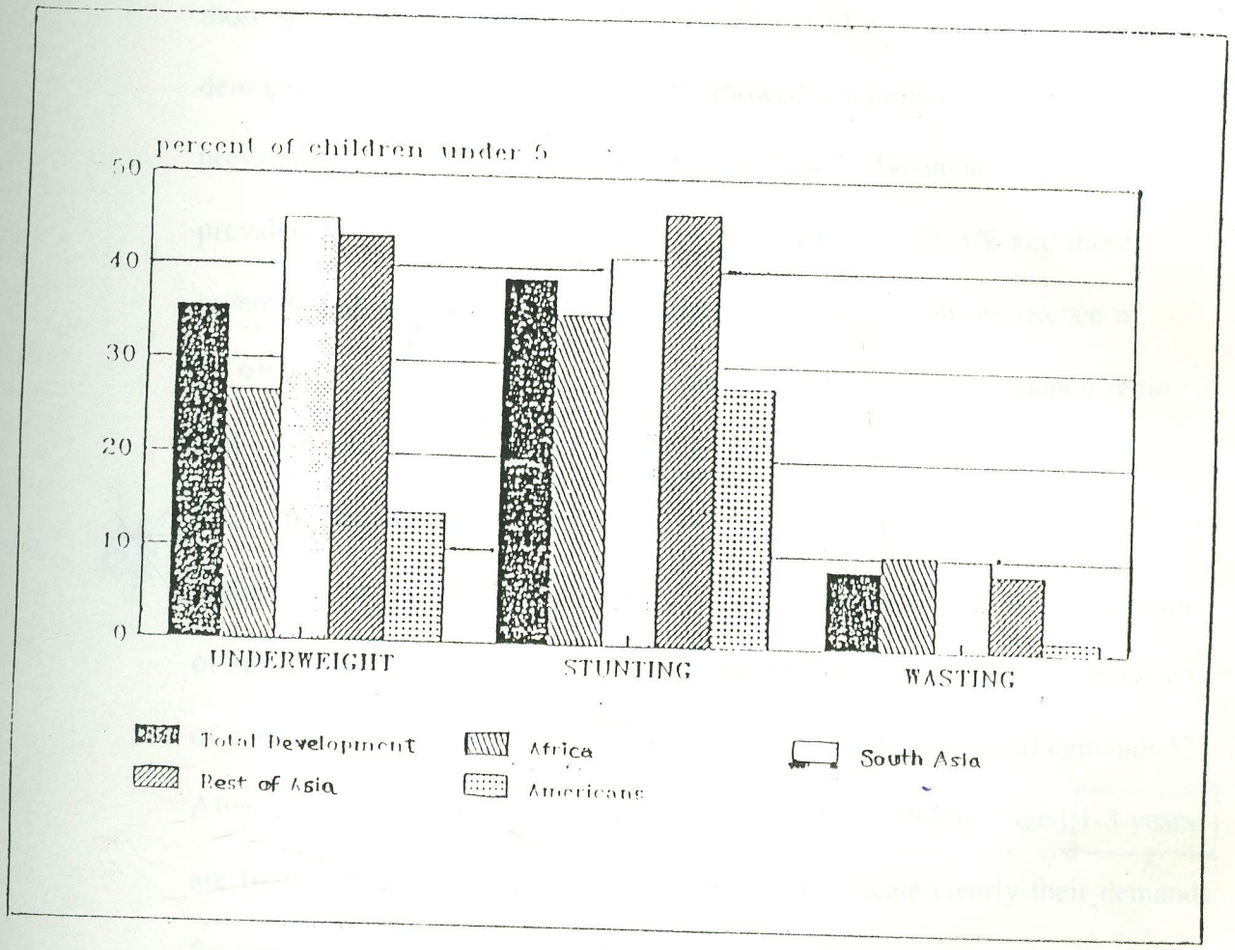
By the end of the 1970's about 72% of the rural population was within 5 Km of a health facility, and by 1988 Tanzania had achieved the goals of universal immunization.[4] Today, most of Tanzanian children have access to MCH services. Therefore with well functioning MCH services there is a hope to reduce the number of children who are malnourished and those dying under the age of five years.

1.3 Protein-Energy-Malnutrition

Protein-Energy-Malnutrition (PEM) is defined as a clinical syndrome caused by deficiencies in calorie and protein due to one or a combination of poor intake, impaired absorption, abnormal losses and infections.[12] PEM in children is one of the most widespread nutritional problems in many developing countries and is among the leading causes of morbidity and mortality.[12-16] Due to the process of growth, children are most vulnerable to the effects of malnutrition. It is reported that 36% (150 million) of children aged below 5 years in developing countries are underweight, 39% (163 million) are stunted, while 8% (35 million) are wasted. More than one in six

malnourished children are suffering from severe malnutrition in terms of their weight-for-age, that is, about 23 million children are severely malnourished.[17] Figure 1 shows the global and regional prevalence of malnutrition by weight-for-age, height-for-age and weight-for-height respectively.

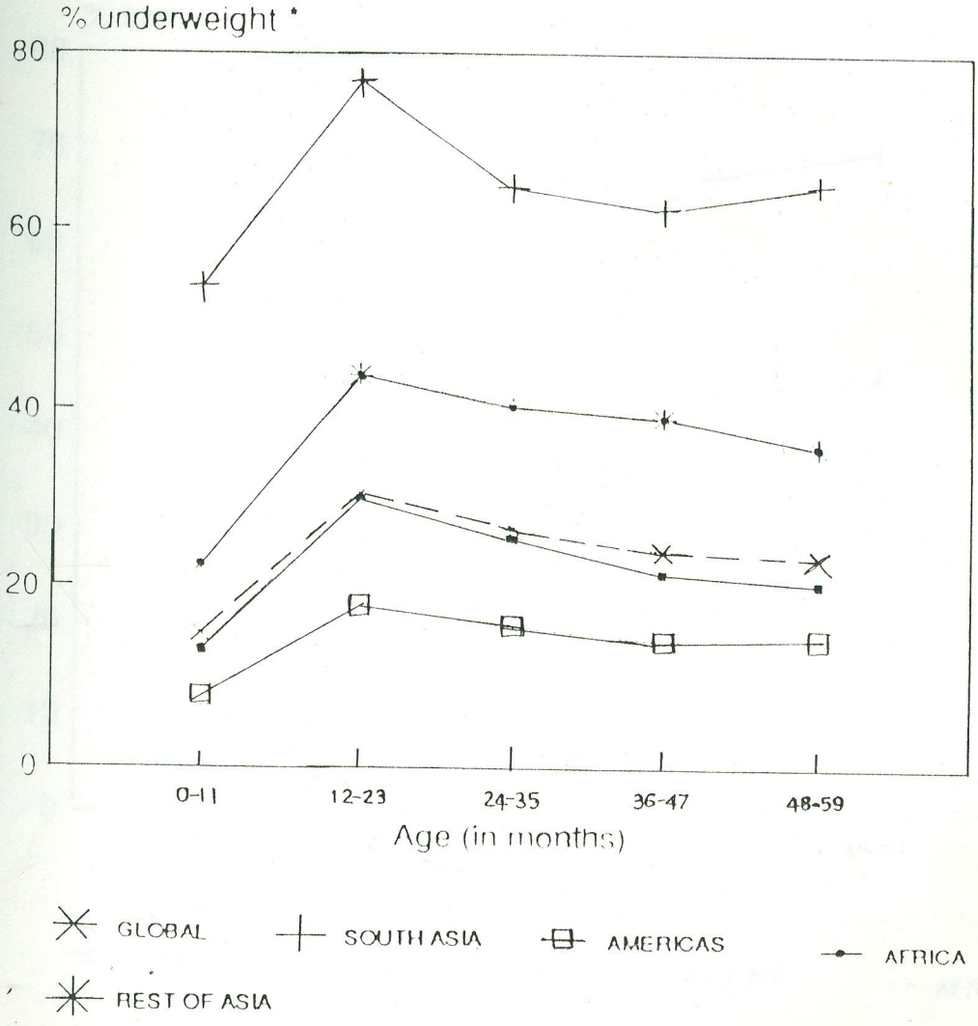
Figure 1. Prevalence of Malnutrition by Indicator



(Reproduced from Carlson, B.A., Wardlaw, T.M. A global regional and country assessment of child malnutrition. UNICEF staff working papers 1990;(7):29).

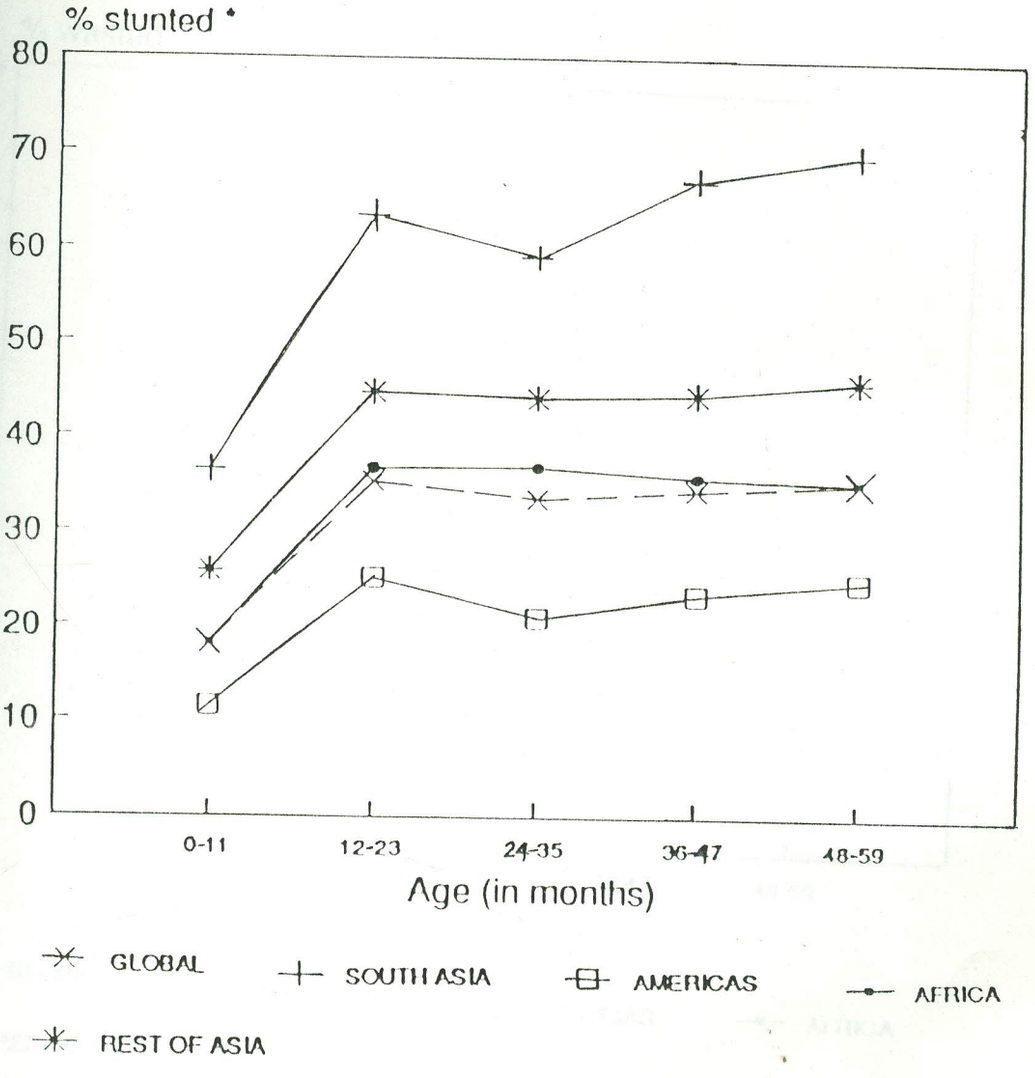
Studies to assess nutritional status among Tanzanian pre-school children in 1989, showed that the incidence of malnutrition was between 40-60% and those severely malnourished were 4-9% (Personal communication). A demographic health survey in 1991/92 showed a regional variation in the prevalence of malnutrition in underfive children in Tanzania. The overall prevalence of malnutrition in mainland Tanzania were 28.5% and those severely malnourished were 7%. Zanzibar had an overall prevalence of 39.9% and those severely malnourished were 12.3%. Dar es Salaam region had an overall prevalence of 19.9% and those severely malnourished were 4%.[18] In most developing countries, the prevalence of malnutrition was highest in the age group 1-3 years.[17-19] Prevalence in infants below 6 months of age is negligible. This could be explained by the fact that up to six months of age, breast milk alone may be adequate to meet all nutritional demands.[4,7] After 6 months, malnutrition rate starts to increase. Children aged 1-3 years are frequently affected because they can neither indicate clearly their demands for food nor can they fend for themselves when it comes to sharing food from the family pot, and breast milk alone is not sufficient to meet their body requirement. Figures 2a - c show the global and regional patterns of malnutrition by age. The highest prevalence of underweight, wasting and stunting is between 12 and 23 months.

Figure 2a: **Patterns of underweight by age.**



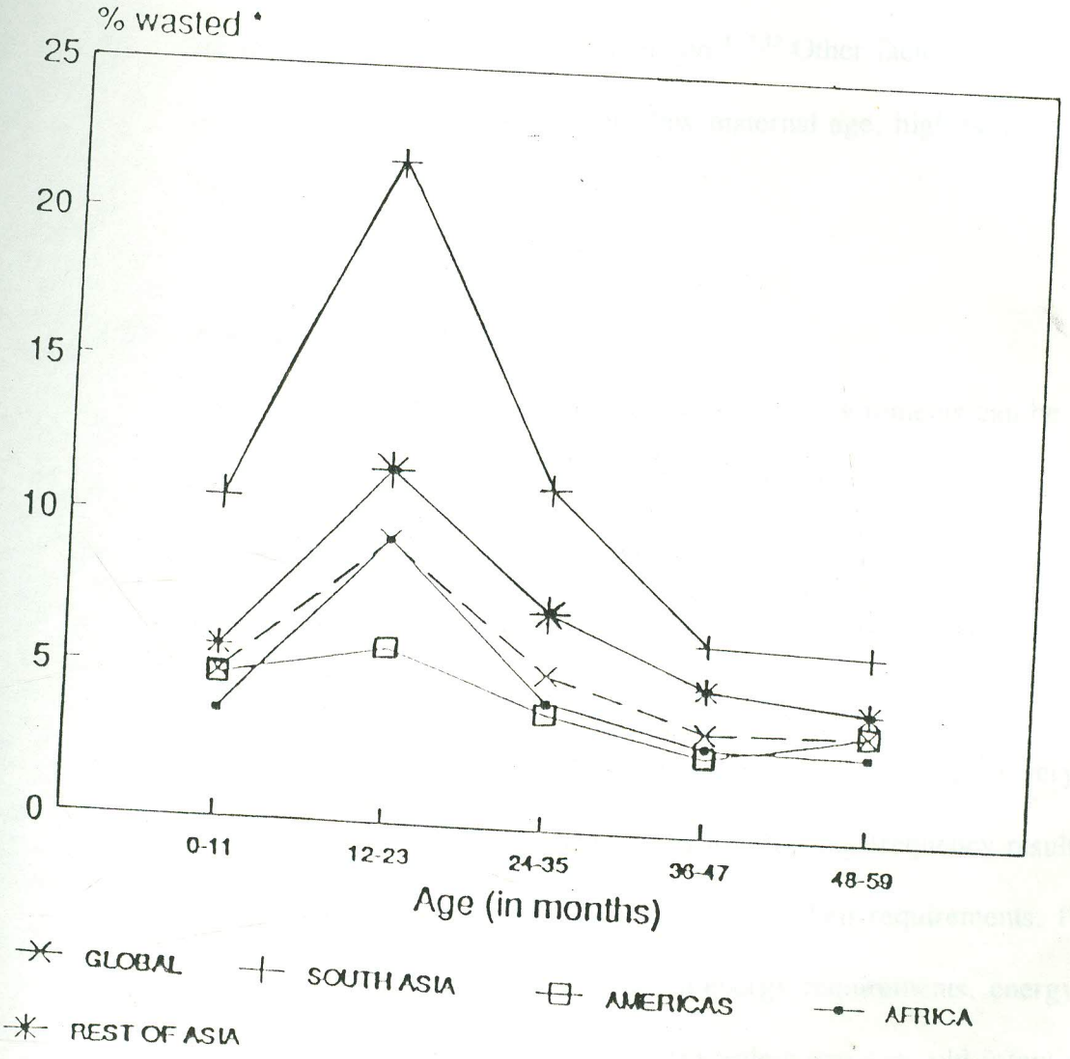
(Reproduced from Carlson, B.A., Wardlaw, T.M. A global regional and country assessment of child malnutrition. UNICEF staff working papers 1990;(7):29).

Figure 2b: **patterns of stunting by age.**



(Reproduced from Carlson, B.A. Wardlaw, T.M.: A global, regional and country assessment of child malnutrition. UNICEF staff working papers 1990;(7):30).

Figure 2c: **Patterns of wasting by age:**



(Reproduced from Carlson, B.A. Wardlaw, T.M.: A global, regional and country assessment of child malnutrition. UNICEF staff working papers 1990;(7):30).

1.4 Risk factors for malnutrition

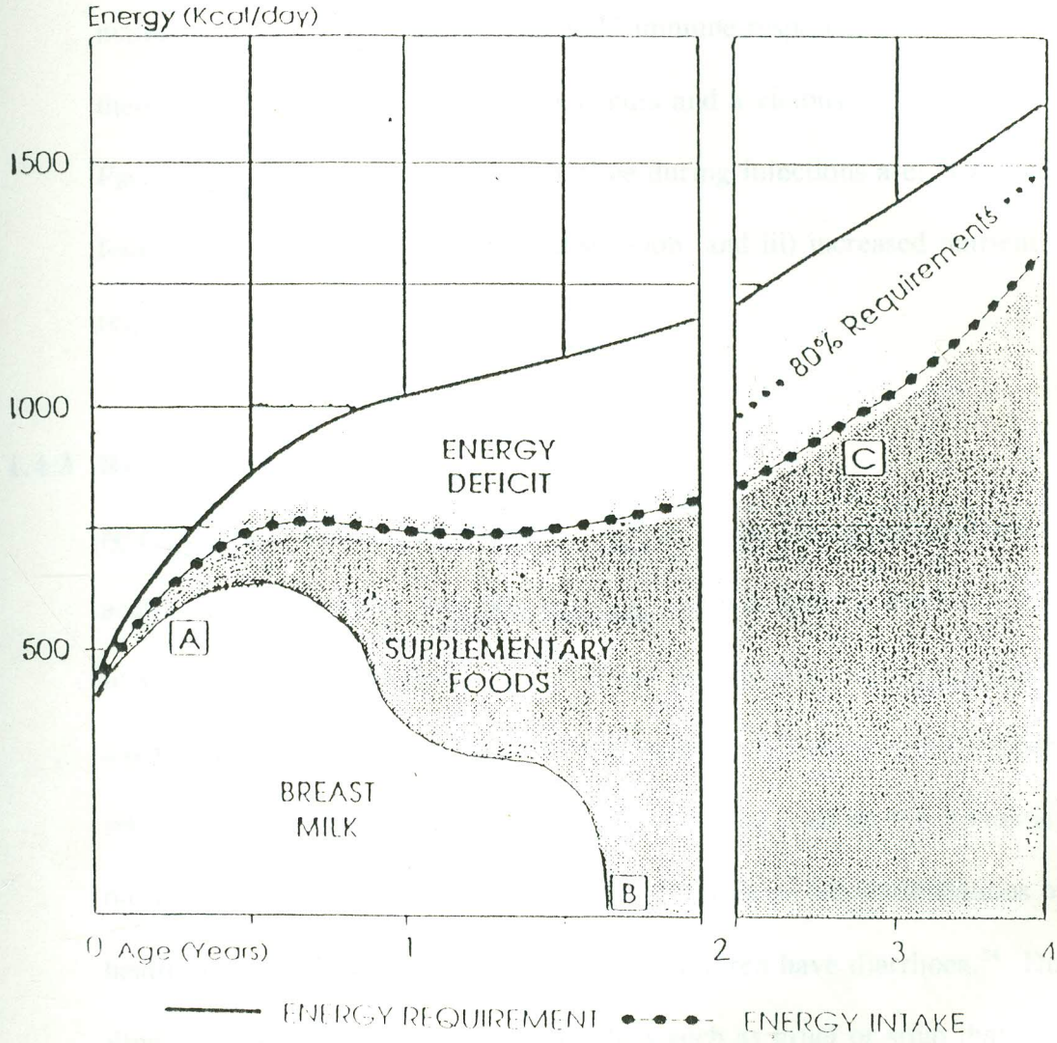
The two commonly associated factors for malnutrition in developing countries are inadequate food intake and infection.[4,13,15] Other factors include low birth weight, poverty, advanced or very low maternal age, high parity and close birth spacing.

1.4.1 Inadequate food intake

From birth to 6 months of age, babies energy requirements can be met by breast feeding alone. From 6 months and above, energy intake begin to decrease due to bulkiness of supplementary food and low feeding frequencies[4]. Most Tanzanian babies' weaning foods are made from cereal or other starchy foods and the eating frequency is on average 2-3 times per day[4,18]. Energy density of most supplementary foods in developing countries is very low. The combination of low energy density and low feeding frequency results in total energy intake which is not sufficient to satisfy their requirements. Figure 3 shows a graphical relationship between energy requirements, energy intake and food supply in young children. For example a one year old infant requires about 1,000 Kcal/day, but the energy intake in most developing countries is about 750 Kcal/day which means, there is an energy deficit of about 250 Kcal/day. [4] Therefore between ages of 6 months to 2 years, when intake of breast milk is substantially reduced, children suffer most from inadequate

energy intake. During this period, they are consuming significantly less than 80% of their energy requirements.

Fig 3: **Energy requirement and energy intake of young children.**



[A] Supplementary foods start to become a significant part of diet. Energy requirements and intake begin to diverge due to bulkiness of supplementary food and low feeding frequency. Deficit is increased by impact of recurrent infections on appetite.

[B] Supplementary foods replace breast milk entirely.

[C] Child is stunted. As eating capacity increases, intake reaches equilibrium at about 80 per cent of requirements of normal-size child.

(Reproduced from Government of United Republic of Tanzania and UNICEF. Women and children in Tanzania: The situation analysis. 1st ed. UNICEF. Dar es Salaam Tanzania).

1.4.2 Infections

Repeated infections cause growth faltering leading to malnutrition. When malnutrition develops it lowers the body immune response to infection, therefore more episodes of infection occurs and a vicious cycle develops.[12,20-24] Factors contributing to nutritional decline during infections are: i) reduced food intake, ii) decreased nutrient absorption and iii) increased nutrient requirements.

1.4.3 Reduced food intake

Nutrient intake may be decreased by 30% or more during the first few days of acute illness because of anorexia, vomiting and withholding food or giving foods with reduced nutrient values.[22] Most infections induce anorexia which in most cases is centrally mediated by interleukin-1.[21,22] When vomiting occurs it inhibits attempts at feeding the child. Withholding food during illness is based on traditional believes about treatment of illnesses or recommendations by health personnel to "rest the bowel" when children have diarrhoea.[24] During illness, foods with reduced nutrient values such as gruel or soup that is diluted is given in the belief that diluted food is easier to digest.

1.4.4 Decreased absorption of nutrients

A number of infections impair nutrient absorption, especially in diarrhoeal disease, where absorption of nutrients may be reduced by about 30%. Greater impairment can occur with persistent diarrhoea reflecting a more extensive damage in the gut mucosa.[12,20,21,24] Damage to the absorptive epithelial cells (villi) reduces the total absorptive surface of the bowel and decreases brush border enzymes especially the disaccharidase. A decrease or deficiency of disaccharidase causes malabsorption of disaccharides particularly lactose. Bacterial overgrowth in the gut causes deconjugation of bile acids and this may lead to fat malabsorption. Rapid transit time due to diarrhoea is another contributory factor to the decrease in the nutrient absorption.[24]

1.4.5 Increased nutrients requirement during infection

Various antigens such bacteria, viruses, and fungi when they invade the body have the ability to stimulate the immune system to release pro-inflammatory cytokines predominantly from the phagocytic cells. The cytokines released include Interleukins-1 (IL-1), Interleukin - 6 (IL-6) and Tumor Necrotic Factor (TNF).[20,22] These cytokines have a widespread effect on a number of body metabolic functions including:-

(1) Increased proteolysis in muscles, skin and bone causing increased release of amino acids particularly glutamine.

(2) Increased hepatic gluconeogenesis.

Glutamine and glucose released in this way are important endogenous source of nutrition for the immune system.[22] These nutrients are also utilized to replenish energy lost during febrile illness, repair of damaged tissue and other metabolic derangements.

The deleterious effects of cytokines on the host include:-

(1) Increased loss of peripheral tissue components which results into body weight loss.

(2) In children, nutrients are diverted from the growth process, therefore, when infectious process is prolonged it results into growth faltering.

1.4.6 Altered immune function associated with malnutrition/infection

Severe forms of PEM are usually associated with immunologic insufficiency characterized by a decreased in total lymphocytic count of less than 1500.mm^3 and energy to skin test antigens.[12,16,20-23] Lymphocyte response is defective, and is associated with a decrease in size of tonsil and thymus.[13] There is hyperglobulinemia of IgE-class with lowered mucosal 1gA antibody response to viral vaccination. Some immunodeficiency manifestation in PEM are associated with micro-nutrient deficiencies. Zinc deficiency (due to zinc malabsorption) is associated with acrodermatitis enteropathica and deficiency

of biotin is associated with chronic candidiasis.

Other immunological deficiencies associated with PEM include lowered lysozyme which reduces local immunity against microbial colonization. Total hemolytic complement activity and neutrophil functions are decreased.[12,22] Diarrhoea and acute respiratory tract infections (ARI) are the commonest infections responsible for growth faltering, malnutrition and death among underfive children in developing countries.[2-7,21,24] Other infections include malaria, tuberculosis and the vaccine preventable diseases.

1.4.7 Diarrhoea

Diarrhoea is an important cause of malnutrition through reduced intake due to loss of appetite, decreased absorption of nutrients, direct loss of nutrients and altered metabolism.[21,24] Each episode of diarrhoea contributes to malnutrition and when episodes are recurrent and prolonged causes growth faltering and weight loss. In 1991/92 health survey statistics in Tanzania, the prevalence of diarrhoea in children aged below 5 years was 13%, of which 73% occurred in children aged less than 2 years. In Muhimbili Medical Centre (MMC) for the year 1992/93, acute diarrhoeal diseases contributed to 16.8% of all admissions and 27.5% of all deaths in the paediatrics wards.[25]

1.4.8 ARI

ARI is one of the commonest childhood infection accounting for about 40-60% of all paediatric hospital admissions in developing countries.[1-7,24] Children with ARI may develop feeding difficulties due to blocked nostrils, swollen tonsils or due to breathing difficulties. Periods of starvation induced by illness, anorexia and vomiting and increased metabolic requirements due to infection are the important underlying causes for nutritional deficiency in ARI.

1.4.9 Other infections

In 1992/93 malaria was the leading cause of hospital admission in the paediatric wards of Muhimbili Medical Centre. It contributed to 24.1% of all admissions and 11.1% of all deaths. Measles which used to be a common killer and a cause of malnutrition in many developing countries has significantly declined in importance as a result of the successful child immunization programmes. For the year 1992/93 at Muhimbili Medical Centre, measles contributed to only 1.2% of all admissions and 0.5% of deaths in the paediatric wards.[25]

1.4.10 Low birth weight (LBW)

A child with low birth weight is at a greater risk of increased incidence of diarrhoea, malnutrition and early death.[7,24] About 16.9% of babies in Tanzania are born with low birth weight.[16,18] It has also been shown that there is a reduced cellular immunity in both preterm and small for gestational age (SGA) babies.[23] LBW is also a predictor for future stunting.

1.4.11 Infant feeding practices

Bottlefed infants contract far more illnesses and are as much as 25 times more likely to die in childhood than infants who are breastfed for the first 4-6 months of life.[6,20] Incidence of sickness and death from bottle feeding increases with poverty. The expensive powdered milk are often overdiluted with unsafe water and fed to infants from unsterilized feeding bottles which may predispose to malnutrition and infection.[7] In contrast breast feeding is nutritionally perfect, always hygienic, promotes healthy growth, immunizes infants against common infections, helps to prevent dehydration and reduces the severity of respiratory infections.[4,7]

1.4.12 Poverty

Majority of Tanzanians are living in great poverty in the rural areas with high rates of child mortality and malnutrition[4,18] In a nutritional survey conducted in preschool children in Dar es Salaam in 1991 about 85% were from families of low socioeconomic status (Personal communication).

1.4.13 Birth spacing and birth order by children

Infant mortality increases significantly when births are more than seven, or the birth interval is less than 2 years.[4,7] It has also been shown that infant morbidity increases significantly when the number of children in a family with limited resources is more than four. According to the Tanzanian demographic health survey of 1991/92 the average birth interval was 33 months and the average number of births was seven. Given the economical situation of Tanzania, the high birth number entail high risk of malnutrition and death among underfive children.[4]

1.4.14 Maternal age and parity

Children are likely to be malnourished if they are born to mothers who are i) less than 18 years ii) more than 35 years or iii) who have had seven or more deliveries.[4,7] Mothers who are less than 18 years are both biologically and psychologically less prepared for child care and rearing. Mothers who aged above 35 years are likely to have more deliveries[4,7] and therefore less resources per child and hence increased risk for malnutrition.

1.5 Rationale for the study

Several nutritional studies have been conducted in children aged below five years in Tanzania.[28-33] Most of these studies were prevalence studies. For the past 17 years only one published study[14] tried to associate malnutrition (PEM) with etiological factors. Thus, a study on malnutrition and associated factors in children aged below five years is called for.

1.6 Hypothesis

The incidence of infections, inadequate food intake, low birth weight, poverty, wrong infant feeding practices, high parity of the mother (more than seven deliveries), advanced (above 35 years) and young (below 18 years) maternal age, short birth interval and poor MCH attendance in malnourished children is similar to that of normal children.

2.0 BROAD OBJECTIVE

To determine factors which could explain the occurrence of malnutrition among children aged between 6 months and 3 years attending Lugalo and Mwananyamala MCH-clinics in the region of Dar es Salaam.

2.1 Specific objectives

2.1.1 To determine the distribution of MCH attendance in underfives attending Lugalo and Mwananyamala MCH-clinics in Dar es Salaam region by age and sex.

2.1.2 To determine the prevalence of infections and its association with nutritional status among well nourished and malnourished children aged 6 months to 3 years attending Lugalo and Mwananyamala MCH - clinics in Dar es Salaam region.

2.1.3 To determine the immunization coverage and its association with nutritional status among wellnourished and malnourished children aged between 6 months to 3 years attending Lugalo and Mwananyamala MCH-clinics in Dar es Salaam region.

2.1.4 To determine the proportion of low birth weight children who are aged 6 months to 3 years attending Lugalo and Mwananyamala MCH-clinics in Dar es Salaam region.

2.1.5 To assess the socioeconomic status of families and its association with nutritional status among children aged 6 months to 3 years attending Lugalo and Mwananyamala MCH-clinics in Dar es Salaam region.

2.1.6 To determine distribution of maternal parity and its association with nutritional status among children aged 6 months to 3 years attending Lugalo and Mwananyamala MCH - clinics in Dar es Salaam region.

2.1.7 To determine distribution of maternal education and its association with nutritional status among children aged 6 months to 3 years attending Lugalo and Mwananyamala MCH-clinics in Dar es Salaam region.

2.1.8 To determine distribution of marital status of mother and its association with nutritional status among children aged 6 months to 3 years attending Lugalo and Mwananyamala MCH-clinics in Dar es Salaam region.

3.0 METHODOLOGY

3.1 Study design

An unmatched case-control study design was adopted. Cases were all children found to weigh less than 80% of the median weight - for - age (wt/age) category, and controls were those children found to weigh above 80% of the median wt/age according to the Wellcome Trust Classification.[27] Cases and controls were recruited consecutively: for every one case recruited, one control was also recruited. Weighing children which is routinely done at all MCH-clinics was done by health workers (not involved in the study) at respective MCH-clinics. Length or height measurement which is not routinely checked at MCH-clinics was measured by authors and assisted by two other doctors.

3.2 Description of study population and study area

The study population included all children aged between 6 months and 3 years attending Lugalo and Mwananyamala MCH-clinics during the study period (December 1994 to February 1995). The two MCH clinics were selected for convenience due to time and financial constraints. Two unpublished studies conducted in Dar es Salaam and Tanga regions an 1991 and 1992 showed that MCH attendance rate decreased abruptly after 3 years of age (Personal communication). Therefore to minimize bias on results among non MCH-attenders it was necessary to restrict the age of recruitment to 3 years.

3.2.1 **Lugalo MCH-clinic** is situated in Mwenge township about 100 metres from the main bus stop along Sam-Nujoma road, and is housed within Tanzania People's Defence Forces (TPDF) camps buildings.

The clinic offers MCH-services to residents of Mwenge, Makongo, Mikocheni and Lugalo barracks. The clinic is easily accessible and operates under supervision of Tanzania MCH-services of the Ministry of Health.

Statistics for Lugalo MCH clinic for the period of January to June 1994 regarding underfive MCH attendance were as follows:-

(i) Total attendance (0-5 years) = 7,434

(ii) Total attendance (0-12 months) = 2,461

On average 1,239 children underfive attended the clinic per month, of whom 33.1% are less than 1 year.

3.2.2 **Mwananyamala MCH-clinic** is a part of Mwananyamala District Hospital which is run by City Council of Dar es Salaam. The clinic is about 6 Km from Muhimbili Medical Centre, and is about 1 Km off Ali Hassan Mwinyi road (Bagamoyo road). The clinic serves residents of Mwananyamala, Kinondoni, Oysterbay, Msasani and Sinza. Statistics for Mwanayamala MCH-clinic for the period of January-June 1994 regarding underfive MCH-attendance were as follows:-

(i) Total attendance (0-5 years) = 17,974

(ii) Total attendance (0-12 months) = 8,597

On average of 2,996 children underfive attended the clinic per month, of whom 47.8% are less than 1 year.

3.3 Sample size estimation

Sample size was estimated using EPI INFO software. The malnutrition rate from previous studies in children aged below five years ranged between 40-60%.[18,19,31] Assuming a 95% Confidence Interval, power of 80% and the Odds Ratio of 1.5, the estimated sample size is 892. The calculation was based on a 2x2 table.

3.4 Recruitment

Recruitment and data collection was done by the author and assisted by two other doctors. Recruitment was conducted daily from Monday through Friday starting in the morning when the clinics opens and the exercise continued until all eligible children for that day had been seen. Saturdays, Sundays and public holidays were excluded because clinics were closed. The daily routine of the clinics was allowed to proceed normally. After the weigh in session, all MCH - cards were collected and cards of eligible children identified and respective mothers notified. Then a group discussion regarding the purpose and implication of the study was explained. Mothers who consented to participate were individually interviewed using standard questionnaire (appendix I) which sought for the following information:-

Age of both child and mother; sex and birth weight of the child, mother's parity and birth interval of the previous two children, education status of mother and father, marital status of the mother, feeding practices of the child; total number of clinic visits including the last three visits, household size; socioeconomic status of the family. Physical examination was done on every participating child. Children found to have a treatable condition were given prescription to obtain medicine from the hospital pharmacy. Children found to have a condition requiring admission or specialized care were referred to Muhimbili Medical Centre for further management.

3.5 Inclusion criteria

All children aged between six months and 3 years attending Lugalo and Mwananyamala MCH-clinics during the study period were eligible to participate.

3.5.1 Exclusion criteria

Exclusion criteria included age of the child less than six months and above 3 years, not accompanied by mother or guardian, non residents of Kinondoni district and unwillingness of the mother or guardian to participate in the study.

3.6 Data collection

3.6.1 Age of child was calculated in months as a difference between date of recruitment and date of birth which was obtained from the MCH card. Age of mother was recorded as declared by the mother herself. If mother did not remember her age, this was estimated to the nearest whole year using international or local events, or age at onset of menarche, etc.

3.6.2 Weight of lightly clothed children was measured by MCH attendants to the nearest 0.1 Kg using a Salter scale.

3.6.3 Height/Length was measured after all foot wear and head gear was first removed. For height measurements, each child was allowed to stand erect against a calibrated wall with a movable headpiece. With shoulders at equal level, eyes looking straight ahead, knees being supported by an assistant and heels firmly touching the wall then the headpiece was brought to touch the head firmly and height was recorded to the nearest 1 mm. Length was measured in children aged less than two years by lying the child flat on her/his back over a length board. The head of the child was brought to touch a fixed headpiece, with the child looking straight over the ceiling and an assistant supporting the knees, then a movable footpiece was brought to touch the heels firmly.

3.6.4 Feeding frequency

Feeding frequency was obtained from 24 hours recall by mothers. Information was sought for the following feeds: breastfeeding, bottle feeding, cows milk, infant formula, solid feeds (e.g. meat, fish, stiff porridge and other cereal foods) and other liquid drinks including tea, fruit juices, soft drinks and plain water.

3.7 Data presentation

3.7.1 Anthropometric indicators

Weight-for-age which measures body mass over time is presented in percentage of median standard according to Welcome Trust Working Party classification.[26]

3.7.2 MCH-attendance

MCH-attendance was recorded in scores of monthly visits. Children who have not missed any visit over the past three consecutive months were regarded as regular MCH-attenders. Children who have missed one or more consecutive visits over the same period were regarded as irregular MCH-attenders.

Example:

	MCH ATTENDANCE			
	October	November	December	January
Subject				
Child A	1	1	1	1
Child B	0	0	1	1
Child C	1	1	0	1

Where 1 = Attended; 0 = missed; Recruitment months = October-January /94.

Child A = Regular attender; child B and C = Irregular attenders. The total number of visits for each child was also recorded.

3.8 Statistical methods

The following variables were recorded from each recruited child

3.8.1 Dependent variables

- **Age (child/mother)**
- **Sex**
- **Birth weight (child)**
- **Health factors**
  - Vaccination status
  - History of diarrhoea - 2 weeks prior to recruitment
  - History of ARI - 2 weeks prior to recruitment
  - History of fever - 2 weeks prior to recruitment
- **Feeding practices**
  - Duration of exclusive breast feeding.
  - Duration of breast feeding.
  - Weaning age in months.
  - Feeding frequency (24 hours recall)

- **Socioeconomic/Demographic factors**

  - Marital status
  - Employment of mother/father
  - Household size
  - Educational status of mother/father
  - Income per month mother/father
  - Type of cooking stove
  - Other sources of income
  - Presence of electricity in the house
  - Possession of a refrigerator, radio and/or television
  - Presence of piped water in the vicinity of the house

- **MCH - visits**

  - Total number of visits
  - Regularity of visits over the last three months

3.8.2 Outcome variable

Malnutrition

This is defined as Wt/age below 80% weight for age of National standards (according to Wellcome Trust Working Classification).

3.9 Data Analysis

Data entry and data analysis was done using the following software: SPSS/PC, STATISTIX, EPIINFO, and EPI/ANTHRO.

Percentage of children with malnutrition was determined in diverse sub-groups or categories of variables. Odds ratio was calculated as a measure of the strength of association between two variables, risk factor and malnutrition. Odds ratio of 1 means that the exposure is not associated with malnutrition. An odds ratio of more than 1 means that there is an association between exposure and malnutrition. An odds ratio of less than 1 means that the factor in the sub-group has a protective effect when compared with the control group. The more an odds ratio differs from 1 the greater is the association. However, if in the confidence interval 1 is included then this association may have occurred by chance. When the confidence interval does not encompass 1 then the difference with the control group is significant. The magnitude of the difference determines whether it is a relevant difference.

3.10 Ethical considerations

The study was approved by the National AIDS Technical Advisory committee of the Ministry of health because HIV testing was simultaneously being done on another study titled "Association between carriage of oral yeasts, malnutrition, and HIV-1 infection among Tanzanian children aged 18 months

to 5 years". The author was a resident doctor in the Department of Paediatrics and Child Health - Muhimbili and was responsible for anthropometric and physical examination of all recruited children. The other researchers in this study were Denatl surgeons who were responsible for oral cavity examinations of all recruited children. Informed verbal consent was obtained from participating mothers after the purpose and implication of the study was explained to them.

3.11 Limitations of the study

First, unlike a longitudinal study, this case-control study could not be able establish if an association between risk factors and malnutrition is protective or not. Second, children attending the MCH-clinics is not representative of the community, since the sick children may not be brought to MCH clinic but are rather sent to hospital for treatment. Nevertheless, the design of the study does allow risk estimation in terms of odds ratio which estimates the strength of association between the risk factors and malnutrition.

4.0 RESULTS

4.1 Age and Sex

A total of 894 children aged between 6 months and 3 years were enrolled. During analysis one child (case) was found to be less than 6 months and was excluded from the study. Therefore the valid study population was 893, composed of 446 cases and 447 controls. The majority of study population (80.9% and 76.7% for cases and control respectively) consisted of children aged less than 24 months, with a sex ratio females to males of 1:1.03. Age distribution among cases were comparable to that among control (tables 1 and 2). Risk for malnutrition increased with age and the association was statistically significant (table 3a and 3b). The X^2 for linear trend was 34.153 and P-value <0.001.

Table 1: Distribution of study population by sex:

Sex	Cases n (%)	Controls n (%)	Total n (%)	OR	95% C.I.
Male	196 (44.0)	257 (57.5)	453 (50.7)	1.0	
Female	250 (56.0)	190 (42.5)	440 (49.3)	1.7	1.3 - 2.3

Total valid cases = 446, total valid control = 447.

Sex ratio (M/F) = 1: 0.97

TABLE 2: Distribution of study population by age

Age (months)	Cases n	(%)	Control n	(%)	OR	95% C.I.
6 - 11	142	(51.4)	134	(48.6)	1.0	
12 - 17	115	(49.8)	116	(50.2)	0.9	0.7 - 1.3
18 - 23	104	(52.8)	93	(47.2)	1.1	0.7 - 1.5
24 - 29	44	(41.1)	63	(58.9)	0.7	0.4 - 1.0
30 - 35	41	(50.0)	41	(50.0)	0.9	0.6 - 1.6

Total valid cases = 446, total valid controls = 447.

4.2 Birth weight

The incidence of LBW of 14.8% for the whole population was higher among cases (71.2%) as compared to that among controls (28.8%) (table 3). A child born with weight equal to or greater than 2.5 Kg. was protected from developing malnutrition than a child whose both weight was less than 2.5 Kg. (OR=0.3, 95%CI = 0.2-0.5) (table 3). In 8.3% of the children were home deliveries therefore birth weight records were missing.

Table 3: Distribution of study population by birth weight

BWT (Kg)	Cases n (%)	Controls n (%)	Total n (%)	OR	95% C.I.
<2.5	94 (71.2)	38 (28.8)	132 (14.8)	1.0	
≥2.5	315 (45.8)	372 (54.2)	688 (76.9)	0.3	0.2 - 0.5
Unknown	37 (50.0)	37 (50.0)	74 (8.3)	0.4	0.2 - 0.7

Total valid cases = 446, total valid controls = 447.

4.3 Vaccination status

In general, the vaccination coverage against the six immunizable childhood diseases (Tuberculosis, Polio, whooping cough, tetanus, diphtheria and measles) was high in both cases and controls (Table 4 and 5). Vaccination coverage rate for children aged more than one year was higher (97.7%) compared to there below 1 year (78.7%). Vaccination coverage for measles in children aged below one year is lower because the dominator used included children below 9 months of age. There was no significant statistical association between vaccination status and malnutrition (table 6). However, from table 6 it would appear that not being vaccinated against measles is protective against developing malnutrition (OR = 0.5, 95% CI = 0.3 - 0.7).

Table 4: Vaccination status of study population by age (cases only)

Age (months)	BCG-scar (Yes)	BCG-scar (No)	DPT < 3	DPT 3	POLIO < 3	POLIO 3	Measles (Yes)	Measles (No)
6 - 11	86	3	5	84	4	85	43	44
12 - 17	125	4	4	126	4	126	115	1
18 - 23	109	1	1	109	3	106	107	1
24 - 29	61	5	1	66	2	65	62	4
30 - 36	47	0	1	49	0	50	49	0
Total	428	13	12	434	13	432	376	50

Table 5: Vaccination status of study population by age (control only)

Age (months)	BCG-scar (Yes)	BCG-scar (No)	DPT < 3	DPT 3	POLIO < 3	POLIO 3	Measles (Yes)	Measles (No)
6 - 11	179	5	7	180	9	178	74	109
12 - 17	96	5	2	99	2	99	97	4
18 - 23	85	2	0	86	1	86	85	2
24 - 29	38	2	1	39	0	39	40	0
30 - 36	32	0	1	31	0	32	32	0
Total	431	14	12	435	12	434	328	115

Table 6: Correlation of vaccination status with nutritional status

Predictor variable	Cases n (%)	Controls n (%)	OR	95% C.I.
BCG scar				
Yes	428 (97.1)	431 (96.8)	1.0	
No	13 (2.9)	14 (3.2)	0.9	0.4 - 2.1
DPT = 3	434 (97.3)	435 (97.3)	1.0	
DPT < 3	12 (2.7)	12 (2.7)	0.9	0.4 - 2.1
Polio = 3	432 (97.1)	434 (97.3)	1.0	
Polio < 3	13 (2.9)	12 (2.7)	1.0	0.4 - 2.4
Measles vacc.				
Yes	376 (88.3)	328 (74.0)	1.0	
No	50 (11.7)	115 (26.0)	0.5	0.3 - 0.7

4.4 Prevalence of diarrhoea

Although the prevalence rate of diarrhoea for the whole study population was similar among cases and controls (table 7), diarrhoea was more frequent in children aged below 24 months. Children with diarrhoea were more at risk for malnutrition (OR = 1.1), but this association was not statistically significant (table 8).

Table 7: Two weeks prevalence of diarrhoea by age:

Age group (months)	Cases Yes n (%)	Cases No n (%)	Controls Yes n (%)	Controls No n (%)
6 - 11	32 (35.9)	57 (64.1)	53 (28.3)	134 (71.7)
12 - 17	41 (31.8)	88 (68.2)	36 (36.0)	64 (64.0)
18 - 23	19 (19.2)	90 (80.8)	15 (17.2)	72 (82.8)
24 - 29	15 (22.7)	51 (77.3)	3 (7.7)	36 (92.3)
30 - 36	11 (22.0)	39 (78.0)	1 (3.1)	31 (96.9)
Total	118 (26.6)	325 (73.4)	108 (24.3)	337 (75.7)

Total valid cases = 443, total valid controls = 445.

Table 8: Correlation of diarrhoea with nutritional status

Diarrhoea	Cases n (%)	Controls n (%)	OR	95% C.I.
No	325 (49.1)	337 (50.9)	1.0	
Yes	118 (52.2)	108 (47.8)	1.1	0.8 - 1.5

4.5 Prevalence of ARI

The overall prevalence of ARI among study population was 44.5% and that for cases and controls were 46.0% and 43.0% respectively (table 9). ARI was found more frequently in children below 2 years of age (74.3%) than those aged 2 years and above. Although the risk for developing malnutrition was 1.1 times greater among children with ARI than those without, the difference was, however, not statistically not significant (OR = 1.1, 95% CI = 0.9 - 1.5).

Table 9: Two weeks prevalence of ARI by age group

Age group (months)	Cases		Controls	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)
6 - 11	49 (55.1)	40 (44.9)	89 (47.6)	98 (52.4)
12 - 17	65 (50.4)	64 (49.6)	47 (46.5)	54 (53.5)
18 - 23	47 (43.1)	62 (56.9)	33 (37.9)	54 (62.1)
24 - 29	21 (31.8)	45 (68.2)	13 (32.5)	27 (67.5)
30 - 36	22 (44.0)	28 (56.0)	10 (32.2)	21 (67.8)
Total	204 (46.0)	239 (54.0)	192 (43.0)	254 (57.0)

Total valid cases = 443, total valid controls = 446.

Table 10: Correlation of ARI with nutritional status

ARI	Cases n (%)	Controls n (%)	OR	95% C.I.
No	239 (48.5)	254 (51.5)	1.0	
Yes	204 (51.5)	192 (48.5)	1.1	0.9 - 1.5

4.6 Prevalence of fever

The overall prevalence of recent fever was 23.0% while that for cases and control were 25.3% and 22.4% respectively. The prevalence of fever on enrolment day was 50.3% for the cases and 43.6% for the controls. The risk for malnutrition among children with recent fever (within 2 weeks) and fever on recruitment day was 1.2 and 1.3 respectively. However, it was only fever on enrollment day that was significantly associated with malnutrition (OR = 1.3, 95% CI 1.0 - 1.7).

Age (months	Cases Yes n	(%)	Cases No n	(%)	Control Yes n	(%)	Control No n	(%)
6 - 11	27	(30.3)	62	(69.7)	47	(25.1)	140	(74.9)
12 - 17	32	(25.0)	96	(75.0)	20	(19.8)	81	(80.2)
18 - 23	26	(23.9)	83	(76.1)	16	(18.4)	71	(85.6)
24 - 29	17	(25.8)	49	(74.2)	10	(25.0)	30	(75.0)
30 - 36	10	(20.0)	40	(80.0)	7	(21.9)	25	(78.1)
Total	112	(25.3)	330	(74.7)	100	(22.6)	347	(77.6)

Total valid cases = 442, total valid controls = 447.

Table 12: Prevalence of fever on enrolment day by age

Age (months)	Cases		Controls	
	Yes	No	Yes	No
	n (%)	n (%)	n (%)	n (%)
6 - 11	49 (55.1)	40 (44.9)	92 (49.2)	95 (50.8)
12 - 17	73 (56.6)	56 (43.4)	46 (45.5)	55 (54.5)
18 - 23	54 (49.5)	55 (50.5)	33 (37.9)	54 (62.1)
24 - 29	31 (46.9)	35 (53.1)	12 (30.0)	28 (70.0)
30 - 36	16 (32.0)	34 (68.0)	12 (37.5)	20 (62.5)
Total	223 (50.3)	220 (49.7)	195 (43.6)	252 (56.4)

Total valid cases = 443, total valid controls = 447.

Table 13: Correlation of fever/recent fever with nutritional status

	Cases n	(%)	Control n	(%)	OR	95% C.I.
Recent fever						
No	330	(48.7)	347	(51.3)	1.0	
Yes	112	(52.8)	100	(47.2)	1.2	0.9 - 1.6
Fever-enrolment						
No	220	(46.6)	252	(53.4)	1.0	
Yes	223	(53.3)	195	(46.7)	1.3	1.0 - 1.7

4.7 Prevalence of breast feeding

Breast feeding rate among study population was high (70.6%) and it was significantly higher among controls (75.2%) than among cases (65.2%). Lack of breasting was highly associated with an increased risk for malnutrition, (OR = 1.5, 95% CI = 1.1 - 2.0) (Tables 14 and 15).

Table 14: Distribution of study population according to breast feeding status by age.

Age (months)	Breast feeding status			
	Cases		Controls	
	Yes	No	Yes	No
	n (%)	n (%)	n (%)	n (%)
6 - 11	85 (95.5)	4 (4.5)	185 (98.9)	2 (1.1)
12 - 17	115 (89.8)	13 (10.2)	89 (88.1)	12 (11.9)
18 - 23	74 (68.5)	34 (31.5)	53 (61.6)	33 (38.4)
24 - 29	13 (20.3)	51 (79.7)	3 (7.9)	35 (92.1)
30 - 36	1 (2.1)	47 (97.9)	3 (9.7)	28 (9.3)
Total	288 (65.9)	149 (34.1)	333 (75.2)	110(24.8)

Total valid cases = 437, total valid controls = 443.

Table 15: Correlation of breast feeding with nutritional status

Breast feeding	Cases n (%)	Controls n (%)	OR	95% C.I.
Yes	288 (46.4)	333 (53.6)	1.0	
No	149 (57.5)	110 (42.5)	1.6	1.2 - 2.1

4.8 Weaning age

Majority of children in the study population (74.9) were weaned between 1-4 months of age. Weaning age among cases was comparable to that among controls. Children who were weaned less than 4 months had an increased risk for malnutrition (OR = 1.4, 95% CI = 1.0 - 1.9) (Table 16).

Table 16: Correlation of weaning age (in months) with nutritional status

Weaning age (months)	Cases n (%)	Controls n (%)	OR	95% C.I.
> 4	81 (44.5)	101 (45.5)	1.0	
1 - 4	342 (52.3)	312 (47.7)	1.4	1.0 - 1.9
< 1	19 (51.3)	18 (48.7)	1.3	0.7 - 2.7

Total valid cases = 442, total valid controls = 431.

4.9 Feeding frequency

4.9.1 Breast feeding

Frequency of breast feeding was high among both cases and controls. The younger the infant the higher the rate of breast feeding. 29.4% of the study population were not breast feeding at time of the study (34.1% for the cases and 24.8% for the controls). Majority of children below 2 years among both cases and controls were still breastfeeding. However, the rate of breastfeeding was not associated with increased risk for malnutrition (OR = 0.8, 95% CI = 0.6 - 1.1) (table 17).

4.9.2. Artificial feeding (cow's milk or infant formula)

Only a very small proportion of the sample were on infant formula (6%) or cows' milk (17.0%). Consumption of infant formula or cows' milk was not associated with increased risk for malnutrition (Table 17).

4.9.3. Solid foods

54.8% of all children enrolled were given solid food less than 4 times per day and 45.2% were given more than 4 times per day. There was no observed correlation between frequency of feeds and risk of malnutrition. (table 17).

Table 17: Correlation between infant feeding with nutritional status

Predictor variable	Cases n (%)	Controls n (%)	OR	95% C.I.
Breast feed. frequency				
8+	170 (48.3)	182 (51.7)	1.0	
4 - 7	105 (43.0)	139 (57.0)	0.8	0.6 - 1.1
1 - 3	14 (53.8)	12 (46.2)	1.3	0.6 - 2.8
Solid food freq.				
7+	8 (57.1)	6 (42.9)	1.0	
4 - 6	192 (49.7)	194 (50.3)	0.7	0.3 - 2.2
< 4	238 (49.1)	247 (50.9)	0.7	0.3 - 2.1
Infant formula				
No	421 (50.1)	420 (49.9)	1.0	
Yes	25 (48.0)	27 (52.0)	1.0	0.6 - 1.7
Cows' milk				
No	362 (49.5)	369 (50.5)	1.0	
Yes	78 (52.0)	72 (48.0)	1.1	0.8 - 1.6

4.10 Socio-economic factors

4.10.1 Marital status

Most mothers who were interviewed were married (71.3% and 71.8% for cases and controls respectively) (table 18). Children of mothers who were single and those who were divorced or widowed had an increased risk for malnutrition, however the occurrence was statistically not significant (OR = 1.7, 95% CI = 0.7 - 4.3).

Table 18: Correlation of marital status of mother with nutritional status

Marital status	Cases n (%)	Controls n (%)	OR	95% C.I.
Married	318 (49.7)	321 (50.3)	1.0	
Single	37 (52.1)	34 (47.9)	1.1	0.7 - 1.8
Cohabiting	76 (47.8)	83 (52.2)	0.9	0.6 - 1.3
Divorced/ Widow	15 (62.5)	9 (37.5)	1.7	0.7 - 3.9

4.10.2 Mothers' income

Most mothers interviewed had no employment (were house wives) and among employee only 3% had their monthly income above Tshs. 20,000. Although the risk for developing malnutrition was greater among children whose mothers' monthly income was less than Tshs. 20.000, the association was not significant (table 19).

Table 19: Correlation of income of mother with nutritional status

Income of mother (TShs)	Cases n (%)	Controls n (%)	OR	95% C.I.
Unemployed	399 (50.2)	396 (49.8)	1.0	
< 20,000	38 (54.3)	32 (45.7)	1.2	0.7 - 1.9
20-40000	6 (27.3)	16 (72.7)	0.4	0.1 - 1.0
50,000+	3 (50.0)	3 (50.0)	1.0	0.2 - 5.0

4.10.3 Educational status of mothers

The majority of the mothers in the study population had completed primary education (table 20). Children whose mothers had secondary or higher education were at a reduced risk for developing malnutrition than those who did not. This protective risk was statistically significant (OR = 0.4, 95% CI = 0.2-0.9) (table 20).

Table 20: Distribution of study population by education status of mother

Education status of mother	Cases n (%)	Controls n (%)	OR	95% C.I.
No education	40 (57.1)	30 (42.9)	1.0	
1° incomplete	31 (44.9)	38 (55.1)	0.6	0.3 - 1.2
1° complete	345 (51.3)	327 (48.7)	0.8	0.5 - 1.3
Secondary +	30 (36.6)	52 (63.4)	0.4	0.2 - 0.8

Total valid cases = 446, total valid controls = 447.

Informal education included in "No education"

1° incomplete means not completed primary education.

1° complete means completed primary education.

4.10.4 Presence of electricity and piped water in the house

45.7% of the cases lived in a house with electricity versus 54.3% among the controls. Not having electricity in the house was significantly associated with increased risk for malnutrition (OR = 1.5, 95% CI = 1.1 - 1.9). However availability of piped water in the house vicinity was approximately equal among cases and controls (table 21).

Table 21: Correlation of electricity and piped water with nutritional status

Electricity/ p-water	Cases n (%)	Controls n (%)	OR	95% C.I.
Electricity				
Yes	232 (45.7)	275 (54.3)	1.0	
No	212 (55.2)	172 (44.8)	1.5	1.1 - 1.9
Piped water				
Yes	261 (47.4)	290 (52.6)	1.0	
No	183 (53.9)	156 (46.1)	1.3	1.0 - 1.7

4.10.5 Possession of Refrigerator, Radio and TV set

83.9% of the mothers interviewed acknowledged to possess a radio in the house. There was no significant difference among cases and controls (49.3% and 50.7% for cases and controls respectively). Possession of a refrigerator or television set was uncommon. Among the control group there was significantly more families with refrigerator or TV set than among cases. Absence of a TV set or a refrigerator in a family was significantly associated with an increased risk for malnutrition (table 22).

Table 22: Correlation of family possession of refrigerator, radio and TV set with nutritional status of the children.

Predictor variable	Cases n (%)	Controls n (%)	OR	95% C.I.
Refrigerator				
Yes	47 (36.1)	83 (63.9)	1.0	
No	397 (51.1)	362 (48.9)	1.9	1.3 - 2.9
Radio				
Yes	369 (49.3)	380 (50.7)	1.0	
No	77 (53.5)	67 (46.5)	1.2	0.8 - 1.7
TV				
Yes	26 (35.6)	47 (64.4)	1.0	
No	414 (51.2)	394 (48.8)	1.9	1.2 - 3.1

4.10.6 Parity and birth interval

Majority of mothers had less than 4 births (83.9% for cases and 80% for controls). High parity was not associated with increased risk for malnutrition (table 23). Birth interval among study population was 25 months for most mothers, and short birth interval was not associated with increased risk for malnutrition (OR = 1.4, 95% C.I. 0.4 - 4.8).

Table 23: Correlation of parity and birth interval with nutritional status

Predictor variable	Cases n (%)	Controls n (%)	OR	95% C.I
Parity				
1	195 (51.3)	185 (48.7)	1.0	
2 - 3	177 (50.8)	171 (49.2)	1.0	0.7 - 1.3
4 - 6	59 (45.0)	72 (55.0)	0.8	0.5 - 1.2
7+	12 (41.4)	17 (58.6)	0.7	0.3 - 1.4
Birth Interval (months)				
< 17	9 (45.0)	11 (55.0)	1.0	
18 - 24	21 (53.8)	18 (46.1)	1.4	0.5 - 4.2
25+	413 (50.0)	413 (50.0)	1.2	0.5 - 3.0

4.10.7 Food expenditure per day

Among controls, 74.4% spent more than Tshs. 1,000.00 per day for food compared to 61.8% of the cases who spent more than Tshs.1,000.00 per day. Families who spent less than Tshs. 1,000.00 per day had two times increased risk of having a malnourished child. There was an increase in the risk of developing malnutrition with a decrease in the amount of money spent on food (table 24). The X^2 - test for linear trend was 18.787 and P.value < 0.00001.

Table 24: Correlation of house hold food expenditure with nutritional status

Food expenditure	Cases n (%)	Controls n (%)	OR	95% C.I.
> 1500	75 (40.1)	112 (59.9)	1.0	
1000-1500	198 (47.8)	216 (52.2)	1.4	1.0 - 1.9
< 1000	169 (59.9)	113 (40.1)	2.2	1.5 - 3.3

X^2 for linear trend: 18.787, P-value < 0.00001.

4.11 MCH-attendance

Generally, the total MCH-visits among cases and controls for each age group was comparable. Among children aged 12-24 months, majority of them had total visits of between 12-23 (table 25). As regards irregular MCH-attendance, there was an increased risk for malnutrition among cases as compared to controls. (OR=1.2; 95% CI=0.9-1.6).

Table 25: Frequency of total MCH-visit by age group

Age group	Total MCH-visits < 6 Ca	< 6 Co	6 - 11 Ca	6 - 11 Co	12 - 23 Ca	12 - 23 Co	24+ Ca	24+ Co	Total Ca	Total Co
6-11	18	44	63	132	3	3	0	2	84	181
12-17	3	6	55	38	70	55	0	1	128	100
18-23	3	4	8	12	95	70	1	1	107	87
24-29	3	3	3	1	42	26	16	5	64	35
30-36	0	1	4	2	10	10	35	18	49	31
Total	27	58	133	185	220	164	52	27	432	434

Ca = Cases, Co = Conttrols

Table 26: Correlation of total MCH-visits with nutritional status

Total MCH visits	Cases n (%)	Controls n (%)	OR	95% C.I.
< 6	27 (31.7)	58 (68.3)	1.0	
6 - 11	133 (41.8)	185 (58.2)	1.5	0.9 - 2.6
12 - 23	220 (57.3)	164 (42.7)	2.9	1.8 - 4.8
24+	52 (65.8)	27 (34.2)	4.1	2.2 - 7.9

Table 27: Correlation of MCH-visits with nutritional status

Status of MCH visits	Cases n (%)	Controls n (%)	OR	95% C.I.
Regular	265 (48.1)	286 (51.9)	1.0	
Irregular	180 (52.8)	161 (47.2)	1.2	0.9 - 1.6

4.12 Maternal knowledge of MCH-card

67.9% and 62.2% of mothers in both study groups (cases and controls respectively) knew the uses of an MCH-card (table 28). However, 30% and 36% of the cases and controls respectively did not know the uses of an MCH-card.

Table 28: Knowledge regarding MCH-card by nutritional status

Responses	Cases n (%)	Controls n (%)	Total n (%)
+Health welfare card	101 (47.8)	110 (25.5)	214 (23.9)
+ID card	31 (43.1)	41 (9.2)	72 (8.1)
*Vacc. card	19 (50.0)	19 (4.2)	38 (4.2)
*Growth monitor	222 (50.1)	217 (48.5)	448 (50.1)
*Weight check	62 (57.4)	42 (10.5)	109 (12.2)
+Other	9 (56.2)	7 (1.5)	16 (1.8)
+Don't know	2 (40.0)	3 (0.7)	5 (0.5)

Total valid cases = 446, total valid controls = 447.

ID card = Identification card

Vacc. card = Vaccination card

* = uses of MCH-card

+ = not uses of MCH-card

Table 29: Information given to mothers regarding uses of MCH card

	Cases	Controls	OR	95% C.I.
Response	n (%)	n (%)		
Yes	250 (52.3)	228 (47.7)	1.0	
No	192 (47.2)	215 (52.8)	0.8	0.6 - 1.1

Total valid cases = 442, total valid controls = 443.

4.13 Interpretation of MCH-growth curves

48.0% and 52.0% of mothers among cases and controls respectively could identify a normal and abnormal growth pattern from MCH-cards. The different was not statistically significant. However, when mothers who could not interpret a growth pattern correctly were considered, 29.4% in the cases group could not interpret the growth pattern correctly as compared to 23.7% in the control group. The difference was statistically significant.

Table 30: Correlation of mothers' knowledge of growth curve with nutritional status

	Cases n (%)	Controls n (%)	OR	95% C.I.
Graph A				
Correct	315 (48.0)	341 (52.0)	1.0	
Incorrect	131 (55.3)	106 (44.7)	1.3	1.0 - 1.8
Graph B				
Correct	320 (47.5)	354 (52.5)	1.0	
Incorrect	115 (59.3)	79 (40.5)	1.6	1.2 - 2.2

4.14 Health education for the previous three months prior enrollment

- **Individual counselling**

In both groups individual counselling was not routinely given to mothers or guardians attending MCH-clinics (table 31). Having or not having received health education had no direct association with nutritional status of the child (OR = 1.4, 95% C.I. = 0.8-2.5).

Table 31: Individual counselling (Health Education)

Response	Cases		Controls		OR	95% C.I.
	n	(%)	n	(%)		
Yes	20	(41.6)	28	(58.4)	1.0	
No	418	(50.0)	418	(50.0)	1.4	0.8 - 2.5

Total valid cases = 438, total valid controls = 446.

- **Group health education**

  It was noted that most mothers missed group health education sessions given at the beginning of MCH clinic. The health education topics that were frequently taught included: family planning, vaccination, child nutrition and child care (table 32).

Table 32: Health education topics for the months of October, November and December, 1994

Total Topic	Cases						Control		
	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec
No education	245	310	402	231	311	303	476	621	785
F. Planning	81	53	12	103	44	11	184	97	23
Vaccination	15	14	7	22	18	14	38	32	21
MCH	4	3	2	4	3	2	8	6	4
AIDS	4	4	3	5	2	3	9	6	6
Malaria	5	3	1	7	5	0	12	8	1
Hygiene	5	4	9	3	6	5	8	70	14
Ch. nutrition	56	29	2	46	33	11	102	62	13
B/ feeding	5	8	1	6	4	4	11	12	5
Diarrhoea	5	2	2	5	6	7	10	8	9
Child care	18	12	3	12	15	4	30	27	7
Total	443	444	444	444	447	444	887	889	888

5.0 DISCUSSION

Majority of the malnourished children (cases) were aged between 1 and 2 years, which is in keeping with findings of other studies.[13,16,19] This is the age when breastmilk alone is not sufficient and the child cannot clearly express its demands for food nor can it fend for itself when it comes to sharing food from the family pot. At the same time mothers often stop attending MCH clinic from the age of one year because either the child has completed vaccinations or the child is not sick.[7] Overall the risk for malnutrition was higher among girls than boys (Table 1). This finding is in agreement with previous two studies in preschool children in Dar es Salaam.[19] This pattern may be explained, at least partly, by sexual preference for boys which is deeply embedded in the African culture.

The significant association found between low birth weight (LBW) and malnutrition in the present study is in keeping with findings of previous studies.[6,24] It is known that children born with low birth weight have an increased risk for infections and illnesses for several months or even years after birth.[6,24] The lack of association between vaccination status and malnutrition can be explained by the high vaccination coverage in both cases and controls. This indicates the success that has been achieved by the Expanded Programme on Immunization (EPI) which is currently being implemented in the country.

The association between diarrhoea and malnutrition has been well described. Children with malnutrition are susceptible to diarrhoea nd diarrhoea precipitates children into malnutrition. In this study, the two weeks prevalence of diarrhoea was similar in the two study groups (Tables 7 and 8) and there was no association between the presence of diarrhoea and malnutrition. This is not surprising because the study protocol did not look into the number and duration of diarrhoea episodes which have been associated with malnutrition in previous studies.[24,27]

The prevalence of ARI was high in both cases (46.0%) and controls (43%). However, there was no association between the two weeks prevalence of ARI and malnutrition. This is contrary to previous studies which have clearly described association between recurrent ARI and malnutrition. In this study the number and duration of ARI episodes was not considered.

Children with fever on recruitment day were found to have a significant higher risk for malnutrition (table 12). Presence of fever as a symptom could indicate infections or other debilitating conditions.[12,20,22,27] Both total MCH visits and attendance in the last 3 visits had a positive influence on the nutritional status of the child (Tables 26 and 27). Mothers with high number of MCH visits are likely to have a higher compliance to MCH programmes, and will therefore have received more health education

sessions. Several problems were recognized regarding the monthly health education sessions conducted at the clinics. Theses problems included:-

(1) irregular sessions

(2) late attendance by mothers at the clinic

(3) individual health education was seldom given.

Regarding the parameters used to assess socioeconomic status, possession of a television set, refrigerator and electricity were significantly associated with decreased risk for malnutrition. This is expected since individuals who can afford such items belong to high socioeconomic status. Lack of safe water and poor sanitation are adverse living conditions which have strongly been associated with infections and malnutrition.[24] Unsafe drinking water, for example, is a major problem in many developing countries and is the main reason for the high prevalence of diarrhoeal diseases in these communities.[7,24] Lack of association between availability of piped water in the household and malnutrition in this study is probably due to the fact that the study was conducted in urban setting where the majority of people have access to piped water as shown in Table 21.

Mother's education had a significant influence on the child's nutrition. Children of mothers with secondary school education or above had significantly lower risk for developing malnutrition compared to those with either primary education or no education. This could imply that education

of the mother could be a proxy for household economic resources. Presumably, mothers with high education have low number of deliveries, long birth intervals and start to bear children at an appropriate age. However, there was no association between either parity or birth interval with malnutrition was foud. This lack of association is probabbly due to the small number of mothers with extremely high parity (seven or more children) and short birth interval (less than seventeen months).

The amount of money spent for food was found to be associated with the nutritional status of a child in the family. Children from families which spent less than one thousand shillings per day had a higher risk for developing malnutrition. In an urban society like this one, food availability is largely determined by family monetary income. Supplementary sources of food like agricultural produce, is very minimal and the observed association between food expenditure and nutritional status is to be expected.

In this study, majority of the mothers from both groups understood the use of the MCH card and were able to interpret correctly growth curves of their children. Mothers knowledge regarding MCH - card could be an indicator of the effectiveness of health education in the community (table 28). It seems that those mothers who could not understand the use of MCH - card and interpret the growth curves were not able to take appropriate action.

The high prevalence of unemployment among mother/guardian in this study (50.2% for cases and 49.8% for the controls) could explain at least partly the paradox between unemployment of mothers and malnutrition of their children.

Children from mothers who were single, widowed or divorced had an increased risk for malnutrition, though not significant, because of lack of support from fathers. Financial or material support is crucial especially where women unemployment rate is high as was the case in this study. However the lack of statistical significance is probably due to the small number of mothers in this category.

6.0 CONCLUSION

From this study it is possible to conclude that low birth weight, presence of fever on the day of enrollment, expenditure of less than 1,000.00 Tshs for food per day, being female, inability to interpret MCH - growth curves, not breast feeding, low educational status of mother and not having electricity, TV - set and/or refrigerator, are risk factors for developing malnutrition in children below 5 years attending Lugalo and Mwananyamala MCH - Clinics.

7.0 RECOMMENDATIONS

- Group health should routinely be provided every MCH - session, and time for health education should be adhered to and known to the mothers.

- Individual counselling to mothers should be provided appropriately.

- Health education topics should be selected according to prevailing health problems in the community.

- In order to reduce the incidence of low birth weight pregnant mothers should start antenatal visits early, reduce strenuous/hard work, get enough time to rest and should eat good nutritious diets.

- The government and other relevant institutions dealing with women affairs should give priority to women employment so as to raise the economic status of women in the country as a whole. Furthermore, women should be motivated to engage themselves in small scale activities like catering service, tailoring and home crafts, etc.

7.1 Further studies are recommended as follows:-

- Diarrhoea and ARI attack rates and its association with nutritional status in underfives.

- To determine frequency, quality and quantity of supplementary foods and association with nutritional status in underfives.

- A prospective community based study to identify the risk factors investigated in this study for association with nutritional status in underfives.

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