PREVALENCE OF PROTEIN-ENERGY MALNUTRITION (PEM) AND ITS ASSOCIATED HOUSEHOLD-RELATED FACTORS

BY

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TABLE OF CONTENTS

	Page
Declaration ----------	i
Acknowledgements ----------	ii
Abstract ----------	iv
List of Tables ----------	vi
List of Plates ----------	x
List of Figures ----------	xii
Abbreviations Used ----------	xiv
Chapter One	1
The Problem of Malnutrition	1
The Research Hypothesis	7
Review of some Relevant Studies	14
Summary of the results of the Relevant Studies Reviewed	27
Chapter Two	33
Background Information on the study Area	33
The study Group ----------	45
The Research Assistants ----------	48
Data Collection ----------	50
Chapter Three	73
Results	73
The Households and the Respondents	74
The Study Group	74
Nutritional Anthropometry	77
Clinical Signs of PEM	79
The Nutritional Status of the Children	79
Laboratory Results	93
Dietary Results	95

Associations Between the Nutritional Status of children and different factors 99

Associations Between Some Factors 103

Summary of the Findings 106

Chapter Four 109

Discussion of the Findings 109

The Nutritional Status of the Children in Muputi 109

Variables Associated with Protein-Energy Malnutrition in Muputi 127

Chapter Five 143

Conclusions and Recommendations 143

Conclusions 143

Recommendations 146

Referances 151

ABSTRACT

The present study attempted to investigate the prevalence of protein-energy malnutrition (PEM) and its associated factors among young children 6 to 35 months old in a rural kamba community, Kenya. Data were collected by the questionnaire/interview method including personal observations. Anthropometric measurements of weight, length, and circumferences of the head, chest and mid upper arm were taken and compared to standards. Clinical signs of PEM observed included hair changes mental changes, skin changes, oedema and moonface but finally only oedema was considered when assessing nutritional status of the children. Laboratory investigations were made on serum prealbumin and serum transferrin, haemoglobin level, packed cell volume and helminthic ova and protozoal cysts in stools.

A total of 224 children were examined and 83(37.1%) of them had PEM as defined by a deficit in weight for age (less than 80% Harvard Standard) plus or minus oedema.

Acute PEM as defined by low weight for length ratio (less than 90% Harvard Standard) was evident in 89(39.7%) children. Chronic PEM (or nutritional dwarfism or stunting) determined by a deficit in length for age of less than 90 percent Harvard Standard was found in 50(22.3%) children. Low upper arm circumference for age (less than 80% Wolanski Standard) was found in only 14(6.3%) children.

The observed prevalence rate of PEM of 37.1 percent was significantly associated with low maternal school education (less than 5 years of schooling), occupation of head of the household, environmental hygiene, village location and sex and birth order of child. Recommendations of preventing and solving the problems of protein-energy malnutrition in the study area and in the country as a whole are made at the end.

LIST OF TABLES

		PAGES
TABLE I:	Summary of the results of the relevant studies reviewed ------	27-32
TABLE II:	Mean age in months of the Muputi children ----------	60
TABLE III:	Mean weight (Kg) for age of the Muputi Children ----------	77
TABLE IV:	Mean Length (Cm) for age of the Muputi Children ----------	78
TABLE V:	Mean Mid-upper arm circumference (UAC in Cm) for age of the Muputi Children -----	78
TABLE VI:	Number and Percentage of children below standards for weight, length, arm circumference and chest/head circumference ratio----------	80
TABLE VII:	Correlation coefficients of the anthropometric measurements by sex and age (in months)------	80
TABLE VIII:	Number of children with PEM, by age, both sexes combined-----	83
TABLE IX:	Prevalence of PEM by sex and Age ----------	83

		PAGES
TABLE X:	Prevalence of PEM by Village	85
TABLE XI:	Age distribution of wasting (absolute numbers), both sexes combined----------	87
TABLE XII:	Sex distribution of wasting (absolute numbers), by age----	87
TABLE XIII:	Age distribution of stunting (absolute numbers), both sexes combined ----------	88
TABLE XIV:	Prevalence of stunting by sex	88
TABLE XV:	Age distribution of both wasting and stunting (absolute numbers) both sexes combined ----------	89
TABLE XVI:	Sex and age distribution of both wasting and stunting (absolute numbers) among the children ----------	89
TABLE XVII:	Haemoglobin, haematocrit, prealbumin and transferrin of the children according to their nutritional status	94

PAGES

TABLE XVIII: Weaning Food by number of times mentioned according to the nutritional status of the children, both sexes, all ages combined ---------- 95

TABLE XIX: Weaning Food (mentioned most often) by age of introduction; according to the nutritional status of the children, both sexes, all ages combined------- 96

TABLE XX: Weaning Food (mentioned most often) by sex, all ages combined ---------- 97

TABLE XXI: Average frequency of food intake (in 24 hours) according to the nutritional status of the children ---------- 98

TABLE XXII: The associations between certain factors and the nutritional status of the Muputi children---------- 99-102

TABLE XXIII: i) Maternal School Education Vs environmental hygiene ------ 103

PAGES

ii) Maternal school education Vs sex of child ------ 103

iii) Maternal school education vs. village ---------- 103

iv) Maternal school education vs. age of child when breastfeeding stopped ----- 104

v) Village vs. environmental hygiene ---------- 104

vi) Village vs. occupation of head of household---------- 104

vii) Environmental hygiene vs. sex of child ---------- 105

TABLE XXIV: Summary of the results of the Muputi Study ---------- 106-108

TABLE XXV: Serum Prealbumin and Transferrin values observed in different studies all ages and both sexes combined--------- 120

LIST OF PLATES

		PAGE
PLATE I:	Landscape - Muputi Sublocation	64
	i) Vegetation and cultivated land ----------	64
	ii) Part of a seasonal stream (occasionally used as a source of water for household use)----------	64
PLATE II:	i) Mothers collecting maize and beans (Famine Relief) at the Chief's Camp, Uamani	65
	ii) Goat being slaughtered for sale (local consumption) at Uamani Market ----------	65
PLATE III:	Mothers and children at a clinic, Muputi Sublocation ----	66
PLATE IV:	Recumbent Length of a child being taken at a clinic, Muputi Sublocation ----------	67
PLATE V:	Head Circumference of a child being measured at a clinic, Muputi Sublocation ----------	68

		PAGE
PLATE VI:	Chest circumference of a child being measured, Muputi Sublocation ----------	69
PLATE VII:	A child being weighed at a clinic, Muputi Sublocation -----	70
PLATE VIII:	Medical Examination of a child by the Physician at a clinic at Uamani, Muputi Sublocation --	71
PLATE IX:	Blood sample of a child being taken from a fingerprick for examination----------	72

LIST OF FIGURES

		PAGE
FIGURE I:	Position of Machakos District in relation to major geographical divisions of Kenya	43
FIGURE II:	Map of Muvuti Location, Machakos District ----------	44
FIGURE III:	Age and Sex distribution of the Muputi Children ----------	76
FIGURE IV:	i) Upper arm circumference of male children ----------	81
	ii) Weight and height of male children ----------	81
FIGURE V:	i) Upper arm circumference of female children ----------	82
	ii) Weight and height of female children ----------	82
FIGURE VI:	Prevalence of PEM by age and sex	84
FIGURE VII:	Prevalence of PEM by village, all ages and both sexes combined	86
FIGURE VIII:	Prevalence of wasting and stunting among the children, by age, both sexes combined ----	90

PAGE

i) Wasting ---------- 90

ii) Stunting ---------- 90

iii) Both wasting and stunting - 90

FIGURE IX: Sex distribution of wasting and stunting by age ---------- 91

i) Wasting ---------- 91

ii) Stunting ---------- 91

FIGURE X: Birth order of the children Vs. PEM, all ages and both sexes combined ---------- 92

ABBREVIATIONS USED

PEM	-	Protein-Energy Malnutrition
UAC	-	Mid Upper Arm Circumference
L/A	-	Length for Age
W/A	-	Weight for Age
W/L	-	Weight for Length
C/H	-	Chest Circumference/Head Circumference ratio
HARVD. STD.	-	Harvard Standard
H.C.	-	Head Circumference
C.C.	-	Chest Circumference
DVBD	-	Division of Vector-Borne Diseases
C.B.S.	-	Central Bureau of Statistics (Kenya).

CHAPTER ONE

INTRODUCTION

INTRODUCTION:

This chapter consists of the following sections:-

1. The problem of malnutrition.
2. Objectives of the study.
3. The research hypotheses.
4. Review of some relevant studies.

1. THE PROBLEM OF MALNUTRITION

It is estimated that malnutrition affects between one-half and two-thirds of the World's human population (WHO, 1963; Hansen, et al, 1971). Child malnutrition has been and continues to be one of the major and most challenging problems in child health in the developing countries. A W.H.O. Expert Committee on Nutrition (Brock and Autret, 1952) declared child malnutrition to be "the most widespread nutritional disorder known in tropical and subtropical areas". The same point is echoed by, among many others,

research workers such as Antrobus (1971); Blankhart (1972); Bennett and Stanfield (1972); Jansen (1972); Brookens (1974); McLaren (1976); De Maeyer (1976).

In most of the developing world, the struggle against malnutrition is made difficult by such problems as scarcity of qualified medical personnel and poor transport facilities to the few available hospitals or other modern treatment centres (Blankhart, 1972). Bodahl, et al (1968) report that in Kenya, the physician/population ratio is roughly 1:10,000. Worse still, the paramedical staff such as nurses and health educators are very few. The result is that only very few cases of malnutrition, and most of these are the severe ones, receive medical attention. It is usually difficult to know precisely the extent of malnutrition in a country at any time. Prevalence surveys of malnutrition only give rough estimates and hospital records report most malnutrition deaths under other diagnoses, such as gastroenteritis, measles, tuberculosis, anaemia, and to a certain extent, bronchopneumonia (Blankhart, 1972).

In Kenya, it is estimated that Protein-energy Malnutrition (PEM) is a major contributing factor to half of the deaths of the under-five year old children. The hospital records of the years 1966 to 1968 (inclusive) showed that the case fatality rate of the severe cases of the syndrome (PEM) in Kenya was about 22 per cent, a rate found to be similar to that in Uganda and Zambia (Blankhart, 1972).

Malnutrition is caused by many interrelated factors. Most workers in the field of nutrition agree that socio-economic, environmental, agricultural, demographic and cultural factors as well as communicable diseases play a leading role in the causation of malnutrition (Vamoer, 1969; Tshabalala, 1969; Morley et al, 1968; Jelliffe, 1966, Blankhart, 1972; Namboze, 1964, 1967, and 1969; Slome, 1960; Addy, 1975; Latham, 1965; Bennett et al, 1967; Likimani, 1969; Bennett, 1971; Udani and Parekh, 1973; Jelliffe and Dean, 1959; Welbourn, 1959; Williams, 1962; F.A.O., 1966). McCrae (1966) concluded that certain environmental factors are more important than others in the causation and precipitation of malnutrition.

However, the causes of malnutrition vary with countries, communities and even with households of the same village (Lawson 1967). For the success of any intervention program, it is essential to identify the particular causative factors of malnutrition in a particular community (Jelliffe, 1969; Sarjur, et al, 1970; Grewal, et al, 1973; Williams, 1973; Ransome-Kuti et al, 1972).

The role a mother plays in the wellbeing of her children is unlimited. In addition to providing the young child with warmth, shelter, love and comfort, the mother has to feed both herself and the child with the right kind and amount of food to meet their nutritional requirements. Unfortunately, most mothers in the developing world do not always satisfy the nutritional demands of both themselves and their young children. This is either because of ignorance of the right kind of food to eat, poverty, cultural restrictions, or some other reasons. Omolulu (1972) points out that "the average African child starts life at a nutritional disadvantage - he is born with a low birth weight" which results mainly from "maternal malnutrition

especially during the last trimester."

The study carried out by Wray and Aguirrie (1969) revealed the fact that whereas social and demographic factors interact with poverty and ignorance in the causation of protein-energy malnutrition, "it is the mother who 'transmits' these factors, thus determining the nutritional status of the child. But the data suggested that she, in turn, is affected by some of these factors."

Reports of nutrition surveys done in some parts of Kenya associate the nutritional status of young children with various maternal factors such as education, marital status, and nutrition knowledge and practices (Devani, 1975; Chege, 1971/72).

2. OBJECTIVES OF THE STUDY

The present study attempts to carry out the following:-

2.1 To determine the prevalence of protein-energy malnutrition (PEM) in the 6 to 35-month old children of a rural community of Muputi Sublocation, Machakos District, Kenya.

2.2 To investigate the relationship between the nutritional status of the children and certain maternal, household and child-related factors.

2.3 To make recommendations aimed at improving the nutritional status of children in the community and the country, including practical suggestions for individual, family, group and community health education.

The objectives of the present study are justified mainly for the following reasons:-

a) Child malnutrition, particularly protein-energy malnutrition is a serious health problem in the developing countries of which Kenya is one.

b) The most vulnerable groups to malnutrition include pre-school children, (Standard, 1958; Jelliffe, 1968), especially the 6 to 36-month age group which experiences most of the nutritional problems associated with weaning (Welbourn, 1955).

c) Knowledge of the specific health problems and their causative/contributing

factors in a community partly determine the success of an intervention programme. It is postulated that such may be the case in Muputi Sublocation and the country as a whole.

3. THE RESEARCH HYPOTHESES

3.1 Statement of the research hypotheses

The present study attempts to test the following general hypotheses:-

3.1.1 There are certain important maternal characteristics that contribute to the nutritional status of a young child. Consequently, mothers with characteristics such as the following will tend to have malnourished (PEM) children:-

a) None or low formal education.

b) Poor nutrition knowledge and practices.

c) Unmarried.

d) Absent from the home during daytime.

e) Poor health.

3.1.2 Certain characteristics of a household in which a young child lives either directly or indirectly affect the nutritional status

of the child. It is postulated that household characteristics such as the following, will tend to have a negative effect on the nutritional status of a young child:-

a) Low socio-economic status.

b) Poor environmental hygiene.

c) Large number of children in the household.

d) Poor locality of the village where the household is situated.

3.1.3 There are certain child-related factors that influence the nutritional status of a young child. Such factors include:-

a) Sex of the child.

b) Birth order of the child.

c) Weaning practices.

d) Diet of the child presently.

e) Infectious, parasitic and other diseases a child may have.

f) Immunisations.

3.2 Definition and Explanation of the Maternal and Household Factors stated above.

For the purpose of the present study, the maternal and household factors were defined as follows:-

3.2.1 Maternal Factors.

a) Education

A mother's level of education was measured in terms of the number of school classes a mother completed, regardless of how long she might have taken to complete any particular class. Barker (1973) points out that though children and wives' social class should usually be taken from that of the father or husband, the frequency of some common childhood diseases may be more closely related to the social class, and therefore educational level, of the mother rather than the father.

b) Nutrition Knowledge and Practice.

Taking into account the fact that the fourth year medical students at the University of Nairobi conduct regular

nutrition surveys in Machakos District as part of their training, it was assumed that most mothers in the study area are aware of most aspects of health and nutrition education in one form or another.

A mother's knowledge and practice of good nutrition were assessed by the following criteria:-

(i) Her knowledge of "Ndumi" - the local kikamba name for kwashiorkor.

(ii) The causes of "Ndumi".

(iii) How it ("Ndumi") can be prevented.

(iv) Whether or not any of her children had suffered from "Ndumi".

c) Marital Status.

It was postulated that a married mother can look after her children better than a single mother. The marital status of a mother was defined in terms of whether or not a mother had a husband. Divorced, widowed and separated mothers were all considered single, in the same way as mothers who had never married.

d) Absence from home.

This was expressed in terms of:-

(i) All morning.

(ii) All afternoon.

(iii) All day (both morning and afternoon).

e) Health

Maternal health was determined by examining the kind and duration of diseases the mother may have had in the past two months. It was assumed that a period of two months was short enough for a mother to remember the state of her health.

3.2.2 Household Factors.

a) Socio-economic status.

There are various indices of socio-economic status (Barker, 1973; Bennett, 1971) and some of these have been used in different studies (Wray and Aguirrie, 1969; Grewal, et al. 1973; Ballweg, 1972). However, for the purpose of the present study, the following three indices were found to be appropriate in the study community.

(i) Number of heads of cattle owned.

(ii) Occupation of the head of the household.

(iii) The type of roof of the main house.

b) Environmental Hygiene

The following were the main indices of environmental hygiene:-

(i) Presence of a latrine.

(ii) Location of the kitchen - cooking place, i.e. whether separate building or in one of the rooms of the main house.

(iii) Room crowding - the ratio of persons in the household to the number of rooms available, other than the cooking area.

c) The number of children in the Household.

This included all the children, whether of the mother or not, who were presently, and had been living in the household for the past three months.

d) Village

Locality of a village was defined in terms of accessibility to modern health care centres. Inter-village comparisons were made as regards the nutritional status of the children as well as locality.

3.2.3 Child-related Factors.

In addition to the maternal and household factors, the following child-related factors were examined, and their influence on the nutritional status of the children determined:-

a) Sex of the child whether female or male.

b) Birth order of the child first, second and so on.

c) Weaning practices

(i) Weaning food - type of food

(ii) Bottlefeeding - whether or not child was bottlefed.

(iii) Age of child when supplementary feeding started

(iv) Age of the child when breastfeeding stopped.

d) The diet of the child at the time of the survey - 24-hour recall method.

e) Infectious, parasitic and other diseases a child had either at the time of the survey or in the past two months.

f) Immunisations a child has had.

4. REVIEW OF SOME RELEVANT STUDIES.

There are many studies, similar in certain aspects to the present study, that have been conducted in the world but very few in Kenya. In the following paragraphs, the methodology and sample characteristics of some of the studies will be reviewed, and the results will be summarised in Table I.

4.1 Studies done in Muvuti Location, Machakos District.

The studies to be reviewed in this section are similar to the present study from two points of view:-

a) The studies were done in the same Location and therefore, similar survey community.

b) The studies were partly concerned with the mother and her influence on the nutritional status of a young child.

4.1.1 Mureithi (1974). "Report on KAP (Knowledge, Attitude and Practice) Study on Nutrition in Kitunduni and Kaani Sublocations of Machakos District".

a) Objectives of the Study.

One of the objectives of the study was relevant to the present study because it concerned the part the maternal knowledge, attitude and practice of nutrition plays in protein-energy malnutrition of the 0 to 35-month old children in the community.

b) Methodology.

The study was conducted a week after the PEM prevalence survey in the same community. Kaani and Kitunduni Sublocations are both in Muvuti Location, as shown on Map 2. The study sample was selected from the respondents of the prevalence survey. Malnourished children

were matched for age (± 3 months) with normal children in the same study community. Data was collected by the interview/questionnaire method through home visits and 32 (45.7%) of the 70 children examined were malnourished.

4.1.2 Karanja, (1975), "Report on KAP Study on Nutrition in Kaani and Kivandini Sub-Locations of Muvuti Location of Machakos District."

a) Objectives of the Study

The main objectives of Karanja's study were:-

(i) To find out if mothers had adequate knowledge in the field of feeding small children.

(ii) To find out the attitude and practice of mothers with regard to breastfeeding, weaning pattern, supplementary foods and child spacing.

(iii) To determine the effect of certain socio-economic and

cultural factors in child nutrition.

(iv) To obtain guideline data for an action program to combat malnutrition.

b) Methodology

The study sample was selected from the respondents of the protein-energy malnutrition prevalence survey which was conducted two days earlier. The mothers of the 48 (30 percent) malnourished children (0-35 months old) served as the study group while mothers of the normal children of the same age group were the control group. The children in both groups were matched for age (± 3 months). Data was collected by the interview/questionnaire method through home visits.

4.2 Studies done in other parts of the World.

In this section, similar studies conducted in different parts of the World will be reviewed.

4.2.1 Wray and Aguirrie (1969) "Protein-Calorie Malnutrition in Candelaria, Colombia.

1. Prevalence: Social and Demographic Causal Factors".

a) Objectives of the Study.

The purpose of the study was "to assess the nutritional status of the total population of pre-school children (0-6 years old) in Candelaria and to obtain information about their families and other socio-economic factors contributing to their nutritional problems.

b) Methodology.

Candelaria, a small town in Colombia, and surrounded by rich agricultural lands, was the study area of Wray's and Aguirrie's survey. The survey was carried out in late 1963 and early 1964.

Two questionnaire record forms were used for data collection. The social and economic data record form included information on family census, mother's pregnancy history of the child in the sample, her educational and work status, family income and expenditure.
The second questionnaire record form included the basic identification and facts for each pre-school child, the

dietary, health history and findings on physical examination and measurements.

The survey teams of two collected data through home visits. Weight of the children was taken in kilograms using a spring scale (Detecto "Infantometer") and height or length of children was measured in centimetres on a plywood device. The nutritional status of the children was evaluated according to the classification proposed by Gomez, et al. (1955) 446 (40.8%) of the 1094 children examined had PEM.

4.2.2 Ballweg, (1972), "Family Characteristics and Nutrition Problems of Pre-school Children in Fond Parisien, Haiti".

a) Objective of the Study.

The study was designed "to explore the relationship between malnutrition among pre-school children and characteristics of family organisation".

b) Methodology.

The study was carried out during the months of May and June, 1970. The study

sample of 114 was composed of almost an equal number of randomly selected pre-school children in each of the four weight categories (based on the Gomez classification of malnutrition). The sample was selected from children who participated in a community weight survey of pre-school children conducted by the Bureau of Nutrition for the Republic of Haiti in 1969.

Using a structured interview schedule, data was collected on family size and structure, living arrangements, food consumption patterns and the extent to which a mother participated in the Fond Parisien Mothercraft program.

4.2.3 Grewal, Gopaldas and Gadre (1973)

"Etiology of Malnutrition in Rural Indian Pre-school children (Madhya Pradesh)

Objective of the Study.

"To screen out those specific factors which are definitely associated with malnutrition in the rural pre-school child."

Methodology.

1. The study group consisted of eighty-nine children (6 to 36 months old) whose ages were carefully assessed from 12 villages of one 'tribal' (Dhar) and one 'non-tribal' (Sehore) district of Madhya Pradesh state, India. 74 (83.1%) of the children were malnourished.
2. Anthropometric measurements taken included weight, height and mid-arm circumference.
3. A detailed clinical examination for signs of malnutrition was conducted.
4. Children were classified by their nutritional status. Weight for age compared to Indian Council of Medical Research averages and mean number of clinical signs including protein-energy malnutrition, anaemia and vitamin deficiencies were the major criteria for the assessment of the nutritional status of the

children. The 100 percent level of the Indian Council of Medical Research Standard of weight-for-age corresponds to the often used 80 percent level of the Harvard Standard of weight-for-age.

5. Ecological factors that were investigated included:-

   a) Socio-economic status.

   b) Nutrient intakes - calculated from Indian food composition tables.

   c) Child rearing practices/attitudes.

   d) Frequency of illnesses.

4.2.4 Mndeme and Kreysler (1972)

"Report on a Nutritional Status Survey of pre-school children, in Five Villages of Mlola Division, Lushoto District, Tanga Region, Tanzania, Conducted 15-29 January 1970".

Objective of the study relevant to the present study.

"To elucidate the main health problems of the area on which an effective health education and home visiting programme can be based".

Methodology.

The study group consisted of 399 pre-school children, 12 percent of whom had PEM.

The survey method suggested by Jelliffe (1966) was adopted in the study. Data on social background regarding agriculture, pressing social village problems (eg. roads, water, transport) was collected by the questionnaire/interview method.

Weight of the children was taken using an Avery beam balance calibrated to 100 grams and whose accuracy was checked with known weights of 5 and 10 kilograms.

Body length of the children was measured on a length board with a centimetre scale.

Blood samples, taken by finger prick, were collected for haemoglobin measurements and for malarial parasites. Haemoglobin measurements were done by the Cyan method and measured in an Eppendorf photometre. Blood slides for malaria were stained the same day and examined shortly after in the Bumbuli laboratory.

Stool samples, taken by inserting glass tubes into the rectum, were examined for parasites such as hookworm and ascariasis.

Simple treatment was carried out whenever necessary while the serious cases were referred to the district hospital.

4.2.5 Morley, D.C.; Woodland, M.; Martin, W.J. and Allen, I. (1968).

"Heights and Weights of West African Village children from birth to the age of five".

The review of this study is based on Morley's (1973) summary of the study in another report. This is because the full report of the study could not be obtained in East Africa and attempts to get it from elsewhere proved unsuccessful.

a) Objectives of the Study.

It is not clear what the main objectives of the study were, but it appears that the authors attempted to identify the nutritionally "at-risk"

children in the area and be able to give appropriate recommendations.

b) Methodology.

Details of the methods used to collect data are not given in the summary. However, it is reported that two groups of children were examined. The children were identified by their weights at 6, 9 and 12 months of age. The two groups of children were selected using local centiles for weight whereby all children below the 10th percentile were included in Group A (malnourished) and all the children above the 50th percentile were in Group B (wellnourished). Various factors were examined and their association with malnutrition determined.

4.3 The results of the studies reviewed.

The table below illustrates the relevant findings of the studies reviewed. The table is constructed in such a way that the findings of the different studies on each of the factors investigated are listed together.

From the findings, it can be concluded that there are certain family characteristics - including maternal, household and other factors - that are associated with the nutritional status of young children. However, the associations vary with communities, as shown in the table.

..../27

TABLE I: SUMMARY OF THE RESULTS OF THE RELEVANT STUDIES REVIEWED ABOVE

Factor Investigated	Influence on the nutritional status of young children	Study, Year and Place
A. MATERNAL FACTORS		
1. Education	Associated	Mureithi (1974),Kenya.
	Associated	Mndeme and Kreysler (1972), Tanzania.
	Associated	Wray and Aguirrie (1969), Colombia.
	Not associated	Karanja (1975),Kenya.
2. Knowledge of and attitude to nutrition and family planning	Associated	Mureithi (1974), Kenya.
	Associated	Karanja (1975),Kenya.
3. Nutrition practices	Associated	Karanja(1975),Kenya.
4. Marital status	Associated	Mureithi (1974),Kenya.
	Associated	Morley, et al. (1968), Nigeria.
	Associated	Ballweg(1972),Haiti.
	Not associated	Mndeme and Kreysler (1972), Tanzania.
	Not associated	Karanja(1975),Kenya.
5. Age	Associated	Wray and Aguirrie (1969), Colombia.
	Associated	Ballweg(1972),Haiti.
6. Literacy	Associated	Wray and Aguirrie (1969), Colombia.
	Not associated	Ballweg(1972),Haiti.

TABLE I: CONT'D.

Factor Investigated	Influence on the nutritional status of young children	Study, Year and Place
7. Employment	Associated	Wray and Aguirrie (1969), Colombia.
	Associated	Grewal, et al. (1973), India.
	Not associated	Morley, et al. (1968), Nigeria.
8. Competence	Associated	Wray and Aguirrie (1969), Colombia.
9. Reasons for using the health centre for her child	Not associated	Grewal,et al. (1973), India.
10. Child spacing	Associated	Mndeme and Kreysler (1972), Tanzania.
	Associated	Wray and Aguirrie (1969), Colombia.
11. Attendance of Mothercraft Centre	Associated	Ballweg (1972), Haiti.

TABLE I: CONT'D.

	Factor Investigated	Influence on the nutritional status of young children	Study, Year and Place
B.	HOUSEHOLD AND OTHER FACTORS		
	1. Economic status	Associated	Wray and Aguirrie (1969), Colombia.
		Associated	Ballweg (1972), Haiti.
		Associated	Grewal, et al. (1973), India.
	2. Family structure	Associated	Grewal, et al. (1973), India.
	3. Family size	Associated	Mureithi (1974), Kenya.
		Associated	Wray and Aguirrie (1969), Colombia.
		Associated	Ballweg (1972), Haiti.
		Not associated	Grewal, et al. (1973), India.
		Not associated	Morley, et al. (1968), Nigeria.
		Not associated	Karanja (1975), Kenya.
	4. Availability of food	Associated	Grewal, et al. (1973), India.
	5. Tribal background	Associated	Mndeme and Kreysler (1972), Tanzania.
		Associated	Grewal, et al. (1973), India.
	6. One-parent family	Associated	Ballweg (1972), Haiti.
	7. Paternal Education	Associated	Mureithi (1974), Kenya.

B. CONT'D

8. Regular home visits by an employed father	Associated	Karanja (1975),Kenya.
9. Father's occupation	Associated	Karanja (1975),Kenya.
	Associated	Mndeme and Kreysler (1972), Tanzania.
	Not associated	Morley, et al. (1968), Nigeria.
10. Number of meals prepared for family members	Associated	Ballweg (1972),Haiti.
11. Weaning pattern including breastfeeding habits, supplementary food introduced, and age of child at weaning	Associated	Mureithi (1974), Kenya.
	Associated	Grewal, et al. (1973), India.
	Associated	Morley, et al. (1968), Nigeria.
	Associated	Wray and Aguirrie (1969), Colombia.
	Not associated	Karanja (1975),Kenya.
	Not associated	Mndeme and Kreysler (1972), Tanzania.
12. Person who feeds the child	Not associated	Grewal, et al. (1973), India.
13. Deaths among elder siblings, and family size before the birth of the child	Associated	Morley, et al. (1968), Nigeria.
14. Parental heights and weights	Associated	Morley, et al. (1968), Nigeria.

B. CONT'D.

15.	Religion of parents	Not associated Associated	Morley, et al. (1968), Nigeria. Mndeme and Kreysler (1972), Tanzania.
16.	Stillbirth and death rates among siblings	Not associated	Morley, et al. (1968), Nigeria.
17.	"Ideal" number of children perceived	Not associated	Grewal, et al. (1973), India.
18.	Twinning	Not associated	Morley, et al. (1968), Nigeria.
19.	Age of the child	Associated Associated	Wray and Aguirrie (1969), Colombia. Ballweg (1972), Haiti.
20.	Sex of the child	Associated Associated Associated	Wray and Aguirrie (1969), Colombia. Ballweg (1972), Haiti. Grewal, et al. (1973), India.
21.	Birth order of the child	Associated Associated Not associated	Morley, et al. (1968), Nigeria. Wray and Aguirrie (1969), Colombia. Grewal, et al. (1973), India.
22.	"Dangerous" age groups (2 years) of children	Not associated	Mndeme and Kreysler (1972), Tanzania.
23.	Birth weight of the child	Associated	Morley, et al. (1968), Nigeria.

B. CONT'D.

24.	Monthly weight increments during the first 6 months of life	Associated	Morley et al. (1968), Nigeria.
25.	Malaria prophylaxis	Associated Not associated	Mndeme and Kreysler (1972), Tanzania. Morley, et al. (1968), Nigeria.
26.	Intestinal parasites	Associated	Mndeme and Kreysler (1972), Tanzania.
27.	Frequency of past illness	Associated	Grewal, et al. (1973), India.
28.	Disease in the first year of life of a child	Associated	Morley, et al. (1968), Nigeria.

C H A P T E R T W O

THE STUDY AREA, MATERIALS AND METHODS

INTRODUCTION

The main topics for consideration in this chapter include:-

1. Background information on the study area.
2. The Study Group.
3. The Research Assistants.
4. Data Collection - materials and techniques used.

1. BACKGROUND INFORMATION ON THE STUDY AREA

1.1 Machakos District.

Administratively, Kenya is divided into 7 provinces which consist of 40 districts. Each district is divided into Divisions which are further subdivided into Locations and Sublocations. The Chief is the head or main administrator of a Location. A Sublocation may consist of as many as 4 to 7 or more villages.

There are socio-economic, cultural, climatic, geographical as well as dietary variations in the different parts of the country.

For instance, fish is a common item in the diet of most people in the Central and Western Provinces, but rare in the diet of the Central and Eastern parts of the country.

Machakos District, one of the 6 Districts in Eastern Province lies about 60 kilometres south-west of Nairobi (see Figure I) and covers an area of 14,156 sq. kilometres (Muchunga, 1977). The land is about 400 to 1,000 metres above sea level, except for some isolated ranges and hills such as the Kanzalu Range, Mbooni, Kilungu and Kiima Kimwe, which rise well over 2,000 metres. The Athi River, the major drainage system in Ukambani (Ndeti, 1972) forms a natural boundary between Machakos and Kitui Districts.

There are two rainfall seasons - the short rains (October to December) and the long rains (March to May). The annual rainfall ranges between 254 and 1270 mm (East African Rainfall Map, 1972). Unfortunately the amount of the rainfall received fluctuates from year to year, sometimes leading to long drought seasons and hence famine in the area.

Considering rainfall, Machakos District can be divided into three broad agricultural zones (Owako, 1969):-

a) Land of high potential.

b) Land of medium potential.

c) Rangeland.

b) The High-potential Zone

This zone lies mainly within the central hill-masses (at an altitude of 1,500 to 2,000 metres). The zone is characterised by its high annual rainfall (900 to 1,270 mm) and fertile soils (reddish-yellow sandy clay-loams on the hill-tops and red friable clays on the lower slopes) which have quite a high capacity for moisture retention (Owako, 1969). The vegetation, mostly evergreen consists of savannah forests interpersed with a variety of grasses. The agricultural activities include cash-cropping (coffee, wattle) dairy and subsistence farming.

c) The Medium-potential Zone.

This is found mostly at an altitude of about 900 to 1,500 metres, and occupies the major part of the Eastern Plains, the Yatta Plateau, the North Yatta Plains and parts of the Kikumbulyu Plains. The annual rainfall varies from about 762 to 1,016 mm. The soil is mainly red loamy,

alluvial and sandy in some parts. Subsistence farming predominates and the crops grown include cotton, tobacco, maize, beans and other food crops such as tomatoes.

d) The Rangelands.

These cover the Athi Kapiti Plains (1,585 to 1,645 metres in altitude) and most of the Kikumbulyu Plains which rise to an altitude of about 440 to 915 metres. Low rainfall (381 to 635 mm annually) and poor soils (mixed clay and sand in most parts) characterise this zone. In addition, the vegetation, mainly acacia commiphora bush, is a favourable habitat for tsetse flies - another major restrictive factor in the district (Owako, 1969). Grazing is widely carried out, as well as subsistence farming, and, cotton is grown as the main cash crop.

Out of Kenya's total population of 10,942,705 people, 707,214 (6.5%) were living in Machakos District (Kenya Population Census, 1969).

Children 0 to 4 years old in the District were 141,033 (19.9%) in total. The population density varies with the type of potential zones, thus a density of over 300 persons per square kilometre can be found in the highland zone and only about 10 persons per square kilometre in the drier lower zone.

1.2 Muvuti Location and Muputi Sublocation.

The words 'Muvuti' and 'Muputi' are used interchangeably by the residents of the area. However, for simplicity, this study will restrict the word 'Muvuti' to the name of the Location and 'Muputi' to that of the Sublocation.

The present study was carried out in Muputi Sublocation of Muvuti Location, Machakos District. Muvuti Location lies mainly within the Medium-potential Zone at an altitude of about 1219 to 1524 metres. The landscape is marked with deep gullies due to the excessive soil erosion in the area. Kiima Kimwe, a band of rock, forms the highest part of the Location.

Muvuti Sublocation is about three kilometres to the south-east of Machakos Town. It is a new Sublocation which was formed in 1974 for administrative purposes (as explained by the Chief of the location) from sections of other Sublocations. It is not yet officially on any map but its boundaries can be roughly outlined as illustrated in Figure II.

The nutrition surveys conducted in some parts of the location (Mureithi, 1974 and Karanja, 1975) revealed a prevalence rate of PEM of about 20 to 30 percent (the figures include various degrees of the syndrome) in the age group 0 to 35 months. This rate is high enough to warrant considerable concern. Severe PEM is encountered in only 1 to 2 percent of the 0 to 35-month old child population in some parts of Machakos District (Jansen, 1977).

The drainage system in the Sublocation is poor partly because of the low rainfall received in the area. The rivers except, for the Ikiwe river, are dry for most part of the year. Interestingly, such dry river systems form good

foot paths in the area.

The soil is mainly sandy and therefore unproductive. In some parts where the soil is not so poor, maize, beans, peas, millet, sorghum, tomatoes and green vegetables such as cabbage are grown. A few people have some 10 to 50 coffee trees. Fruits include mangoes, guavas and some oranges and lemons. Livestock kept include cattle, goats and sheep and hens. Unfortunately, because of the perennial drought conditions and the poor soil, the yields of the crops and livestock are so poor that famine is now a constant threat in the area, like in some other parts of the country. The Government is aware of the problem of famine and occasionally provides the people with some maize and beans through the Chief and the Sub-chief (see Plate II (i)). The people pay for the maize and beans by helping in the construction of a bridge, a road or a path, a school or church building, or a water tank in the area. The quantity of the maize or beans supplied is, however, too small to satisfy the nutritional needs of members of most households.

Transport in the Sublocation is quite poor because of lack of good roads, except for the Machakos-Masii road (now tarmac) which forms the northern boundary of the Sublocation (the Ikiwe River forms the southern boundary, see Figure II).

The population of Muvuti Location as at 1969 census was 17,486 with an average density of about 154 persons per square kilometre. The exact figure for the population of Muputi Sublocation is not known, though it can be estimated to be about 1,300 persons.

The inhabitants of Muputi Sublocation are mostly Kamba. In addition to being subsistence farmers, they carry out small-scale trades in charcoal, basket-work, and local brews. On market days (Mondays and Fridays) at Machakos town, most Muputi residents can be seen walking to the market to sell some of their farm produce (mainly tomatoes, mangoes, eggs, chicken) in order to get a few shillings for buying clothing, food (beans, maize, maize flour and even bread) or for school fees of their children. Most of the male members of the Muputi Community go to the market to "meet their fellow men and talk politics" which, certainly, may involve drinking off most the money they have.

1.3 The Akamba People

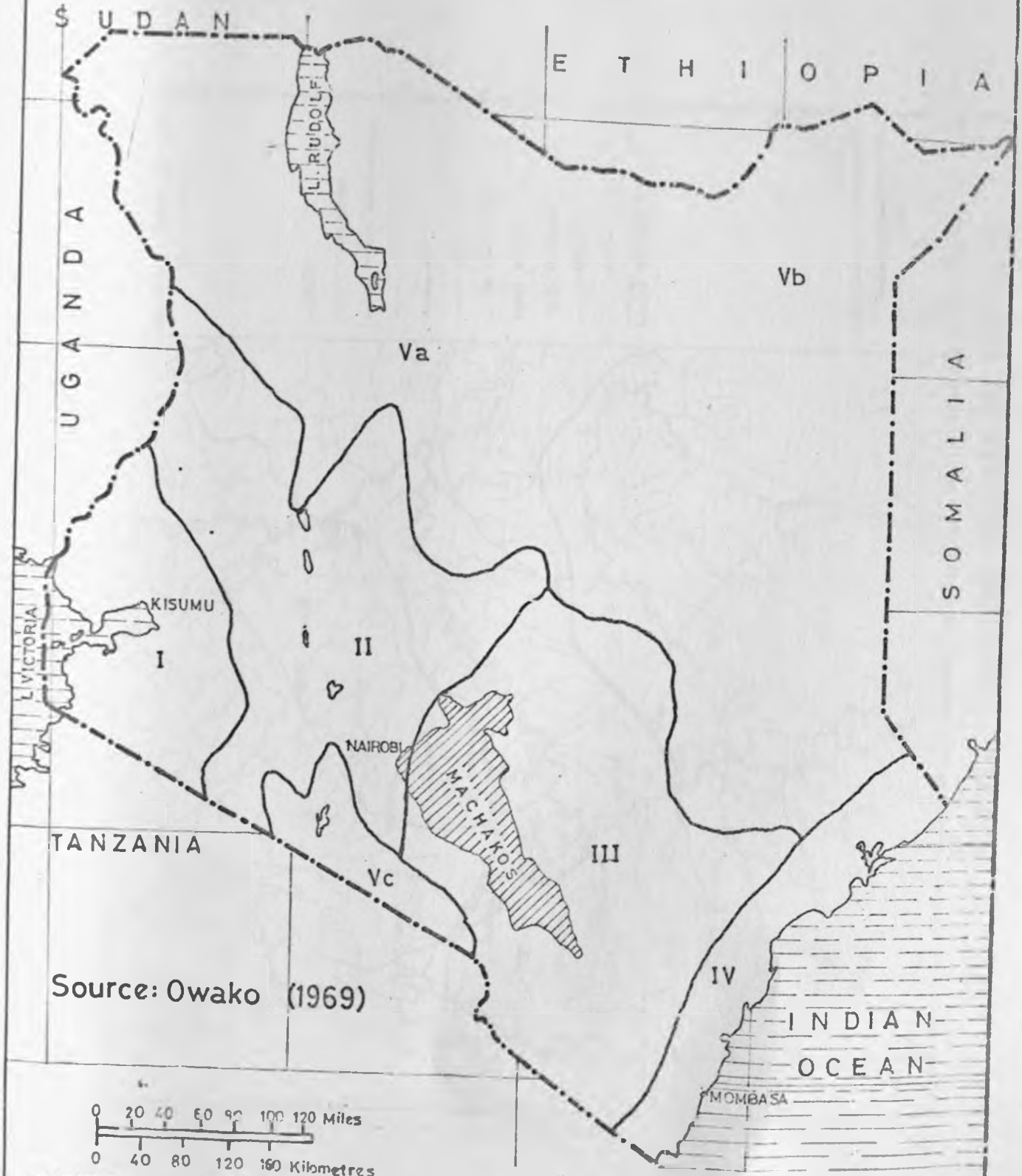
They are known for a number of things which include migrant labour (as demonstrated by their wide distribution throughout the country) and their skills in wood carving, which contributes to the country's foreign exchange. The Akamba are also very good acrobats and they are interesting to watch.

The Akamba ideas of witchcraft are learned in the family in that a child is exposed to the practices of witchcraft from early childhood and he grows up observing and practically participating in it. There are two categories of witchcraft among the Akamba - one concerned with the welfare and harmony of the community and the other that involved the opposite. The priest-doctor (mòndò mòé) of the first category heals and divines man's ailments and protects his property. For instance, "in traditional Akamba society, if rain came late, the Akamba women went to consult

the mondo moe" (Ndeti, 1972). Sorcerers or magicians belong to the second category of Akamba witchcraft. They are believed to be the cause of disharmony, deaths, illnesses and all aspects of evil in human society.

Traditionally, the Akamba people have developed adaptive mechanisms to meet the challenges of their environment. Defensive weaponary include a bow and a poisoned arrow (mosie), a spear and a shield. Adaptation or adjustment to the extremes of physical factors such as drought, poor soil and famine can be in the form of both short and long-term migration to better areas in search of wage employment, an agricultural system aimed at deflecting, absorbing or buffering the harmful effects of nature, carrying out of rainmaking ceremonies that ease the psychic stress of rain failure and sharing of food and property with extended families (Wisner and Mbithi, 1972; Kates and Wisner, 1971) and the carrying out of community harambee projects.

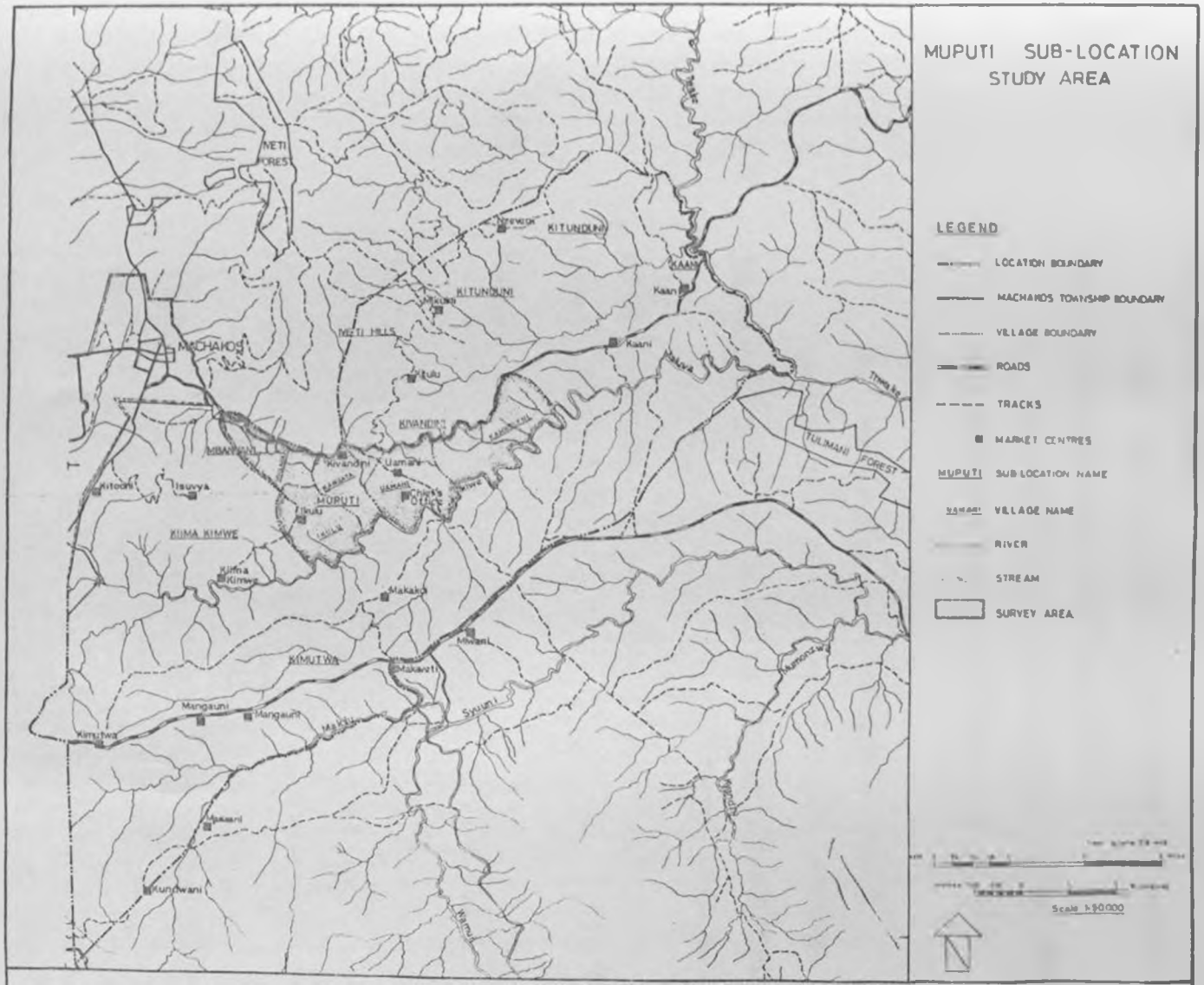
FIGURE I



POSITION OF MACHAKOS DISTRICT IN RELATION TO MAJOR GEOGRAPHICAL DIVISIONS OF KENYA.

I Lake Region.
II Central Rift and associated Highlands.
III Eastern Foreland Plateau.
IV Coast Region.
V Semi-arid (a)Northern (b)North-Eastern (c)Southern Kenya.

Figure II



MAP OF MUVUTI LOCATION MACHAKOS DISTRICT

2. THE STUDY GROUP

Each child in the survey had to fulfil the following basic requirements:-

1. He or she was a resident of Muputi Sublocation most, if not all, of the time.
2. He or she was between 6 and 35 months old at the time of the survey.

2.1 Age Assessment of the Children in the Survey

A combination of methods was used to assess, as accurately as possible, the chronological age of each child in the survey.

2.1.1 Mother's Memory

A mother was asked the date of birth of her young child on three occasions; during the registration of the children, during the interviews and filling in of the questionnaire record forms, and at the clinic. If a mother gave the same date on more than one occasion, it was most likely the date was the correct one. However, if the mother gave the same year and the same month more than once, it didn't matter much whether or not she gave different dates of the month.

2.1.2 Documentary Evidence.

There were few mothers who had documentary evidence for the birth dates of their children. However, for the ones who had it, it served as a good cross-check on the mother's memory. Most mothers who had documentary evidence, had it in the form of a notebook which contained dates of important family events. A few had hospital cards on which the birth of date of the children were indicated.

2.1.3 Dental Eruption.

Bailey, as quoted by Jelliffe (1966) suggested the use of dental eruption to assess approximately the chronological age of a young child. To the number of erupted teeth a child had, 6 was added and the total gave the approximate minimum age (in months) of the child. However, the use of this method was made difficult in cases where some of the teeth of a young child had been removed as "a cure for diarrhoea" and a mother was unwilling to reveal the fact and the number of teeth removed.

2.1.4 The Local Calender.

A local calender of some of the most important events in the Location was drawn up. A mother was asked when her young child was born according to the local calender and whatever event on the calender she referred to, the approximate age of the children was calculated and compared to the dates given using the other methods.

2.2 Registration of the Children.

Using the outlined (above) methods of assessing the chronological age of a young child, a house to house census of all the children living in the Sublocation and who were between 6 and 35 months old was taken. This was done with the help of the local leaders in the study area.

In four of the five villages in the study area, all the registered children were included in the survey. In the fifth village (Ikulu), and one with the highest number of registered children, a systematically selected random sample of

only half of the children was included in the survey. This was found necessary because of the limited time and manpower. Using a list of the registered children in the village, every other child on the list was selected. The study group had a total of 263 children.

3. THE RESEARCH ASSISTANTS

3.1 Selection of the Research Assistants.

One of the problems that the author was faced with in the study concerned the research assistants. Inability to speak and understand the local language of the survey community was a major handicap to the author. It was therefore necessary to have research assistants who knew the local language and the study area and ones who would be trusted by the community. Research assistants from the study community were most appropriate.

A week before the survey, the Chief of Muvuti Location and the Sub-chief of

Muputi Sublocation were requested to contact all the school leavers in Muputi Sublocation (Study area) to be interviewed for assisting in the survey. The main objective of getting most, if not all, of the school leavers in the study area was to give the author an opportunity to select the best, both academically and in personality. Unfortunately, only two school leavers, a boy and a girl, were contacted and, since two research assistants were required, the two that appeared had to be taken on for the survey. Worse still, the girl got another job in Machakos Town and she had to leave in the middle of the survey. This meant that a replacement had to be found and trained immediately, which was not very easy.

3.2 Training of the Research Assistants.

It was strongly emphasised throughout the survey that for the success of the survey, it was important for every member of the survey team to observe good

personal relations with the survey community, be interested in the survey and meticulous about every aspect of data collection.

The leader of the survey team (author) was responsible for training and supervising the research assistants. The objectives and the importance of the survey (as far as the health of the community was concerned) were clearly explained. Each research assistant was given the questionnaire to read and understand. Each question in the questionnaire was carefully explained and simplified as much as possible for the research assistants to understand and be able to interpret it correctly. Since all the anthropometric measurements were to be taken by the author, it was necessary only briefly to describe the techniques employed.

4. DATA COLLECTION

Data was collected mainly by the interview/questionnaire method and personal observation through home visits and at the improvised clinics.

4.1 The Survey Forms.

The questionnaire record forms were constructed, typed and pre-tested in a pilot study some time before the actual survey. The mother or mother-substitute of each child was the respondent, and the questionnaire was filled in by the survey team.

There were three categories of survey forms as described below:-

4.1.1 Survey Form One.

This survey form was the questionnaire that referred to the family and the home of each child. It included the general data on socio-economic status, cooking facilities, food storage facilities, and environmental hygiene.

4.1.2 Survey Form Two.

The second survey form referred to the child. Data collected included the dietary information, immunisations, results of the nutritional anthropometric measurements, child's history as regards birth and health, laboratory examination results and clinical signs of PEM.

4.1.3 Survey Form Three.

This was the survey form for the mother on which the following data was recorded:-

a) Maternal education.

b) Maternal knowledge and practices of nutrition.

c) Daily activities of the mother.

d) Health of the mother.

e) Maternal use of health services both for herself and her children.

f) Parity of the mother including number of living and dead children.

g) Maternal attitude to and practice of Family Planning.

h) Maternal marital status and, if married, for how long.

i) Maternal age.

4.2 The Field Work.

Various categories of officials were contacted for approval of the survey, long before any data was collected. The first contact with the survey community was through local meetings (barazas). Two of

such meetings were held during which the local leaders and the survey community were introduced to the survey team, and given a careful explanation of the purpose and importance of the survey. Co-operation of the community was emphatically requested.

Information and the relevant advice were sought from the local leaders on the local attitudes and possible reactions to the methods and techniques to be employed in the survey. This was very important because, as Jelliffe (1966) points out, it is essential for the success of any community nutrition survey.

4.2.1 Home Visits.

With the help of the Headman in each village, each member of the research team visited the homes of the registered children. After interviewing the mother (or mother-substitute) of the child and filling in the questionnaire record forms, each child was issued with a card for identification. The respondents were asked to take the children concerned for

medical examinations and anthropometric measurements at the improvised child welfare clinics on the specified dates.

Any relevant information and observations made during the home visits were recorded for each child. Revisits to some of the households were made whenever necessary to collect data.

4.2.2 Medical examinations of the children and nutritional anthropometric measurements.

Originally two improvised clinics for the children were planned for, but two other clinics were found necessary for the children who failed to turn up at any of the first two clinics. Two of the clinics were held at Uamani shops for the children in Kamweleni, Uamani and Kangata villages (as shown in Figure II). The rest of the clinics were held at Ikulu church for the children in the villages of Ikulu and Mwanyani. The flow of patients at the clinics was based on the four major categories of activities that took place at the clinics.

Stage One: Nutritional anthropometry

After identifying and registering each child for attendance at the clinic, and filling in the dietary survey section of Survey Form Two, the children were measured and weighed.

Anthropometric measurements were carried out by the author for all the children examined. More than one reading of some measurements were taken whenever necessary and the average of the readings for a particular measurement recorded for the particular child. The techniques employed in the anthropometric measurements were based on Jelliffe (1966). The measurements were then compared to standards such as the Harvard Standards for weight and height and the Wolanski Standard for arm circumference as quoted by Jelliffe (1966).

a) Length measurements (L)

Recumbent length of each child was taken in centimetres using a metal board with a fixed measuring tape. The metal board was placed flat on a flat table and the child

laid straight on the board with his head firmly fixed against the fixed head-piece and his eyes looking vertically. While the mother of the child was firmly holding the child's head in position, a second person extended and firmly held the knees down with the toes pointing directly upward. The main observer then took the reading (to the nearest 0.1 cm) by moving the sliding foot piece and holding it firmly against the child's heels, as illustrated in Plate IV.

b) Head Circumference (H.C.)

The child was made to sit comfortably on his mother's lap before the measurements were taken. With the help of a research assistant, the head of the child was held steadily in an upright position. The measuring tape was held firmly round the frontal bones just superior to the supra-orbital ridges, passed round the head at the same level on each side and laid over the maximum occipital prominence at the back. The reading was taken to the nearest 0.1 cm. Plate V illustrates the head circumference of a child being measured.

c) Chest Circumference (C.C.)

The child was held firmly in an upright position on the mother's lap. The measuring tape was then gently but firmly passed round the child's chest at the nipple line. The measurement was read (to the nearest 0.1 cm) when the child was quiet, relaxed and breathing normally (see Plate VI). The chest/head circumference ratio was calculated and recorded for each child.

d) Mid-Upper Arm Circumference (UAC)

With the child sitting comfortably in an upright position and his/her left arm hanging freely, the arm circumference was measured mid-way between the tip of the acromial process of the scapula and the olecranon of the ulna. The measurement was done by the same measuring tape as for the other measurements and it was read to the nearest 0.1 centimetre.

e) Weight Measurement (WT)

Weight, of all the anthropometric measurements, was the most difficult to take because most of the children were so frightened that they struggled, kicked and cried much more

than they did during the linear measurements. It was mainly because of this that the children were weighed after the linear measurements had been taken.

The Salter scales calibrated to 20 kilograms were checked for accuracy with known weights before every clinic. The scales were suspended by use of a strong rope, from the roof of the building where the clinic was being conducted. Each child, dressed in only a pair of strap pants was suspended from the scales as shown in Plate VII. The reading was taken and recorded (to the nearest 0.1 kilogram) as soon as the child and the scales stopped oscillating. More than one reading were taken and the average of the readings recorded for the most unco-operative children.

Stage Two: Clinical Signs and Symptomatic Treatment of Diseases.

The nutritional anthropometric measurements were followed by medical examinations of the children by the same physician (for the majority of the children) as illustrated in Plate VIII.

Past history of the child's health, and any clinical signs of protein-energy malnutrition were recorded on the medical form for each child. Treatment was given as required. The few seriously ill children were referred to the Machakos General Hospital (the nearest hospital to the community).

The immunisations each child had had were recorded mainly by asking the mother and confirmed by the child's child-welfare clinic card (for the few cases who had the cards) and by the scars for Smallpox and BCG. After the clinical examination, each child proceeded to the third and final stage where blood samples were collected for haemoglobin and haematocrit as well as for serum protein examinations.

Stage Three: Laboratory Investigations.

A sample of about half of the children in the original study sample (263) was randomly selected by sytematically selecting every other child on the list. However, blood and stool specimens were collected from only 95 children due mainly to lack of co-operation from the children and a few mothers.

a) Stool Examination

The day before the clinic, the mothers of the selected children were issued with clean specimen bottles, covered and clearly labelled with the name of the village, and the child's name, sex, age, and number. The mothers were instructed to collect fresh stool specimens of the children early in the morning of the clinic day so as to arrive at the clinic whilst fresh. This was necessary to avoid overnight hatching of ova and false negatives in the case of light infections. The fact that the survey area is a very hot one, there are chances of excessive heat drying the stool and destroying certain larvae like strongyloides.

On arrival, the specimens were fixed and preserved in 4 percent formal saline solution and transported to the Machakos Department of Vector Borne Diseases (DVBD) laboratories at the end of the day. The stools were examined for helminthic and protozoal cysts by technicians trained in parasitology in the DVBD laboratories. The Formal-Ether

Concentration method, which is Ritchie's modified method, (Ridley and Hagwood, 1956, as reported by Kabuleeta 1976) was used. The method, though tedious, bulky and time consuming, is considered the most reliable and very sensitive for both ova and cysts. The disadvantage is, however, the amoebic tophozoites may not be identified as they destroyed during fixation or encyst on the introduction of the fixative.

b) Blood Examination.

(i) Haemoglobin

For haemoglobin estimations, peripheral blood was used from a finger prick. The haemoglobin level was estimated on the spot using the Spencer Haemoglobinometer by an experienced Medical Technologist (Plate IX). Three readings of each specimen were taken and a mean of them recorded.

(ii) Packed Cell Volume (PCV)

More blood was collected in microhematocrit heparinized capillary tubes and sealed over a burning flame. The

packed cell volume was determined in the nutrition laboratory of the Medical Research Centre, Nairobi by the Laboratory Technologist of the laboratory. The Microhaematocrit technique was used and read off the Hawksley Scale on the same night. This was necessary because after the first collection of the capillary blood, when left at 4°C overnight, the blood was found haemolysed. This necessited a repeat of both haemoglobin and packed cell volume.

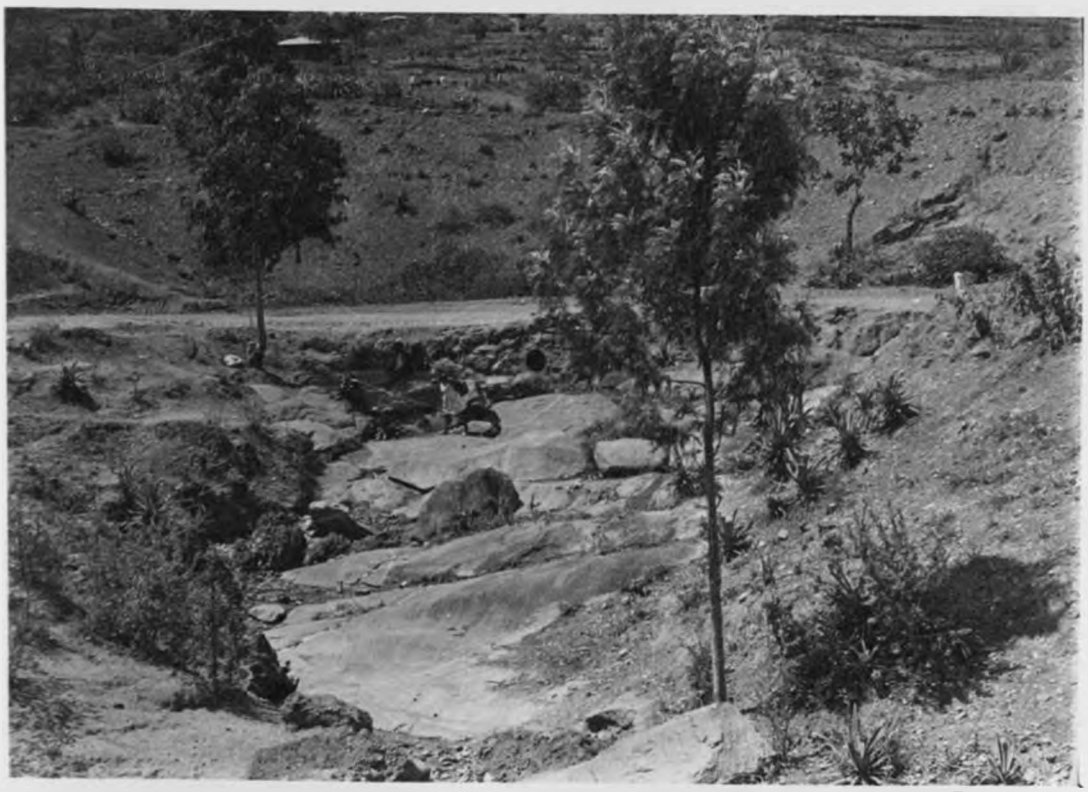
From the readings of the haemoglobin level and the packed cell volume, the mean corpuscular haemoglobin concentration (MCHC) could be calculated as a cross check on the haemoglobin results.

(iii) Serum Proteins

Additional blood was collected (from the same finger prick) for serum prealbumin and transferrin estimation in the Medical Research Laboratory using the Manchini Radial Diffusion Test as reported by van Rens (1977).

The test is however, time consuming (each test takes one week). Agarose is used because it is purer than agar and the sulphate groups are removed from the agarose as they normally interfere with radial immunodifusion tests.

PLATE I: LANDSCAPE - MUPUTI SUB-LOCATION.
(i) VEGETATION AND CULTIVATED LAND.



(ii) PART OF A SEASONAL STREAM (OCCASIONALLY USED AS A SOURCE OF WATER FOR HOUSEHOLD USE).

PLATE II. (i) MOTHERS COLLECTING MAIZE AND BEANS (FAMINE RELIEF) AT THE CHIEF'S CAMP, UAMANI.

(ii) GOAT BEING SLAUGHTERED FOR SALE (LOCAL CONSUMPTION) AT UAMANI MARKET.

PLATE III: MOTHERS AND CHILDREN AT A CLINIC, MUPUTI SUB-LOCATION.

PLATE IV: RECUMBENT LENGTH OF A CHILD BEING TAKEN AT A CLINIC, MUPUTI SUB-LOCATION.

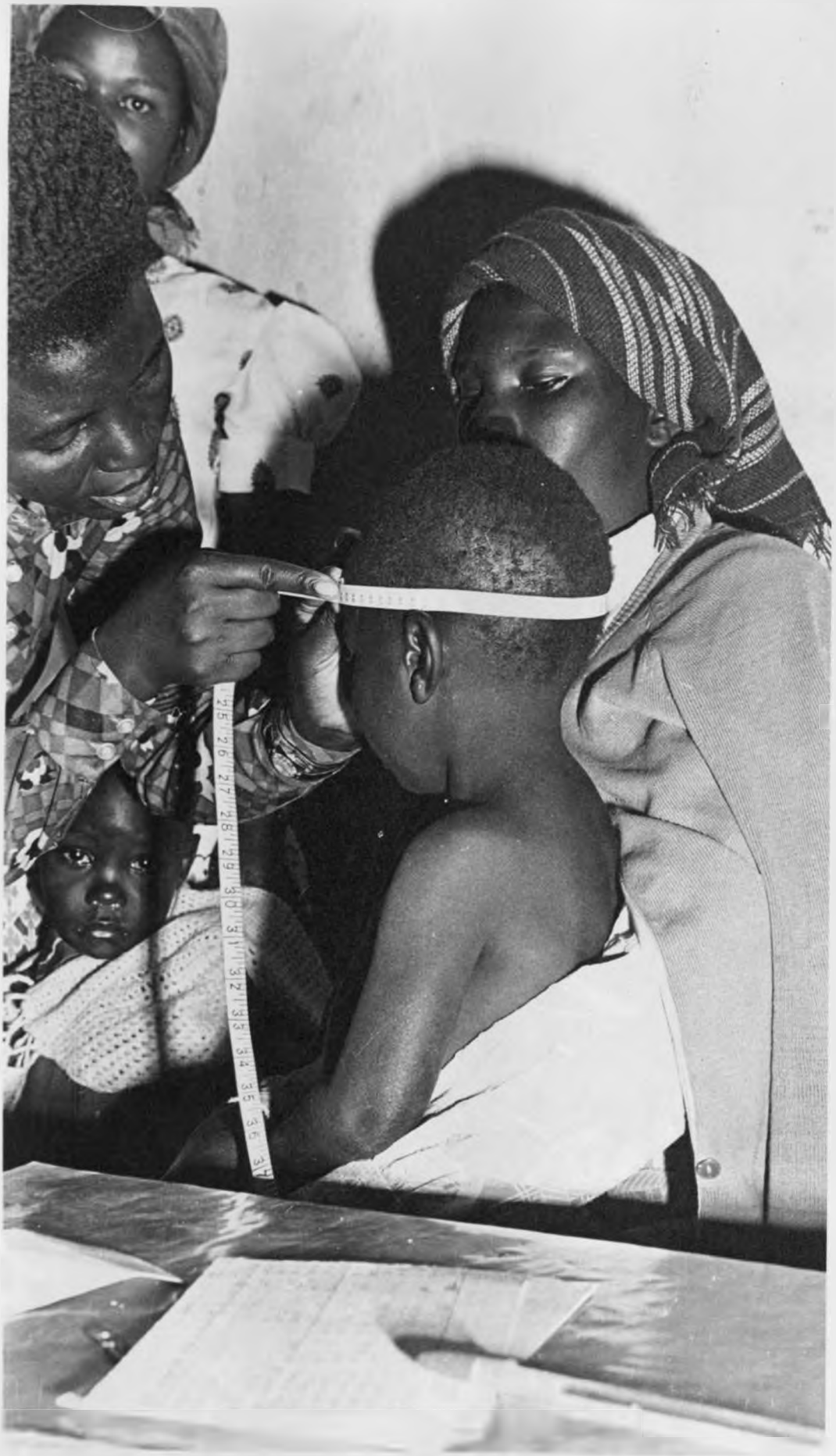


PLATE V: HEAD CIRCUMFERENCE OF A CHILD BEING MEASURED AT A CLINIC, MUPUTI SUB-LOCATION.

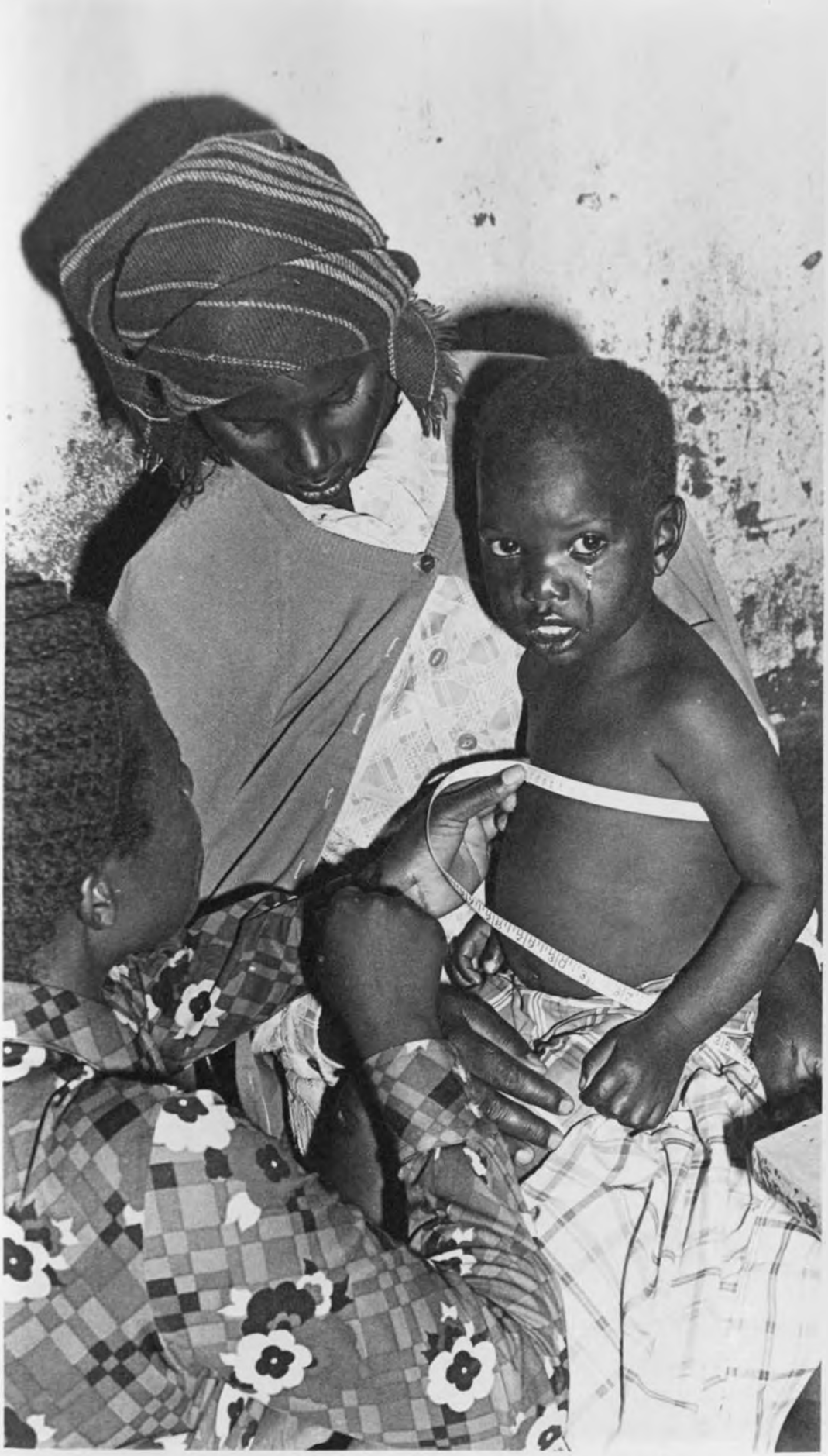


PLATE VI: CHEST CIRCUMFERENCE OF A CHILD BEING MEASURED, MUPUTI SUB-LOCATION.

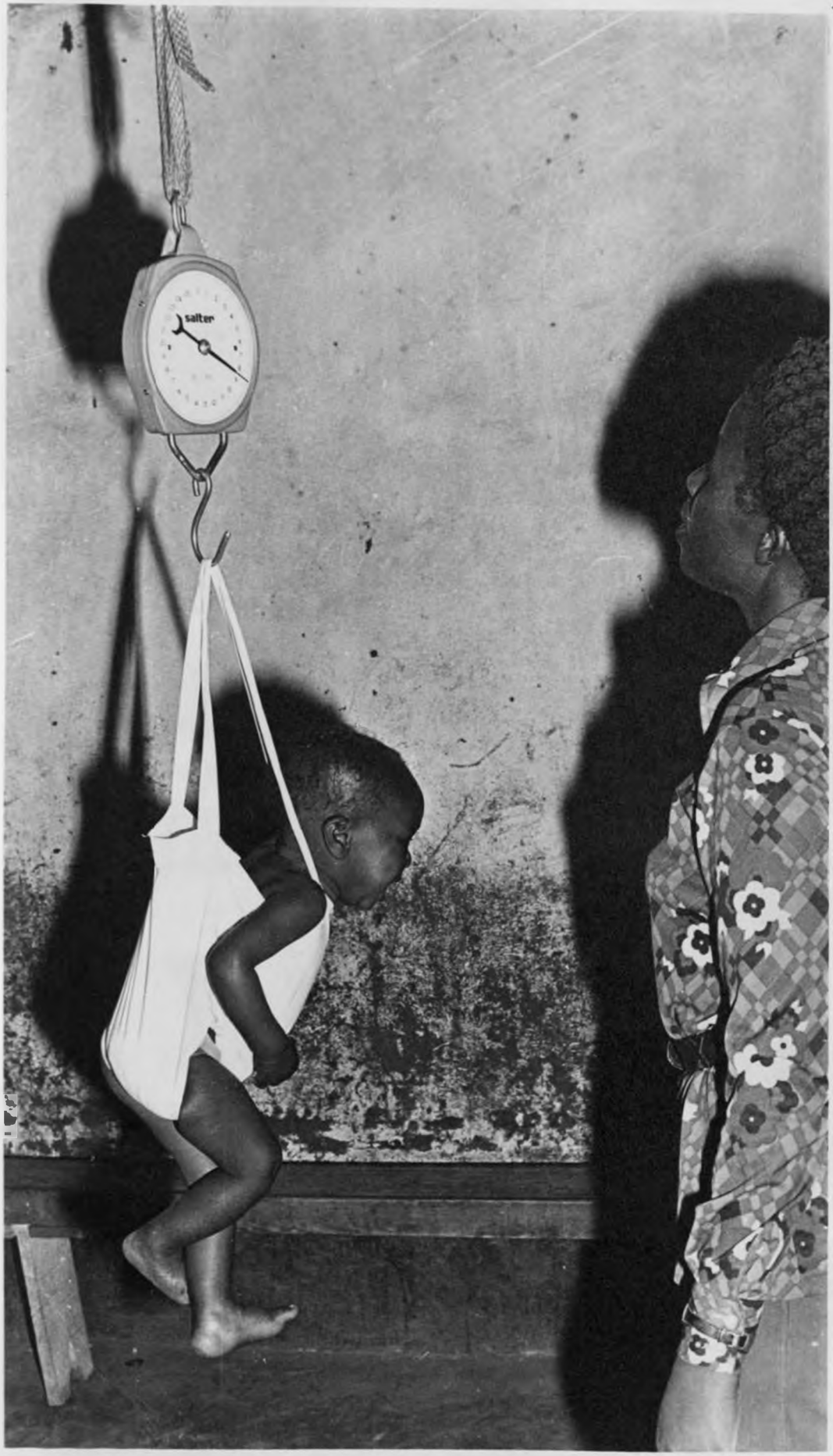


PLATE VII: A CHILD BEING WEIGHED AT A CLINIC, MUPUTI SUB-LOCATION.

PLATE VIII: MEDICAL EXAMINATION OF A CHILD BY THE PHYSICIAN AT A CLINIC AT UAMANI, MUPUTI SUB-LOCATION.

PLATE IX: BLOOD SAMPLE OF A CHILD BEING TAKEN FROM A FINGER-PRICK FOR EXAMINATION.

CHAPTER THREE

RESULTS

INTRODUCTION

The findings of the present study are presented under the following headings:-

1. The households and the respondents.
2. The study group (the children).
3. Nutritional anthropometry.
4. The clinical signs of PEM.
5. The nutritional status of the children.
6. Laboratory results.
7. The dietary survey results.
8. Associations between different factors and PEM among the children.
9. Associations between some factors.
10. Summary of the findings.

Analysis of data was done manually except for the correlation coefficients of the different anthropometric measurements which were calculated by the use of the University of Nairobi computer. The significance of associations between variables was tested using the Chi-square (X^2) test at the five percent level of significance.

1. THE HOUSEHOLDS AND THE RESPONDENTS

A total of 182 households were surveyed and there were 184 respondents (there were two mothers in each of two of the households). 180 of the respondents were the actual mothers of the children while the remaining 4 were grandmothers who were looking after their young grandchildren. The mothers of the 4 children were still at school.

2. THE STUDY GROUP (THE CHILDREN)

Although 263 children were originally included in the study, it was possible to collect data on only 224 (85.2%) children. The reasons why 39 children were excluded from the study were:-

(a) Migration (12 children).

(b) Temporary change of domicile (19 children).

(c) Hospitalisation due to diarrhoea (2 children).

(d) Incomplete data due to unco-operative respondents (6 children).

The final study group was composed of 108 (48.2%) male and 116 (51.8%) female children. The children were divided into five 6-month age groups for analysis purposes.

Ages and Sex of the Study Group

The children ranged from 6 to 35 months in age with a mean age of 21.2 months. The table below shows the age distribution of the children and the mean age for each age-group.

TABLE II: MEAN AGE IN MONTHS OF THE MUPUTI CHILDREN.

Age of children in months	All Children		Male Children		Female Children	
	No. Examined	Mean Age in mths.	No. Examined	Mean Age in mths.	No. Examined	Mean Age in mths.
6-11	33	9.2	16	9.0	17	9.4
12-17	50	14.7	27	14.6	23	14.7
18-23	49	20.6	25	20.2	24	21.0
24-29	43	26.4	20	26.9	23	26.0
30-35	49	31.8	20	31.6	29	32.0
TOTAL	224	21.2	108	20.5	116	21.8

The mean age of the female and the male children is almost similar in all age groups. (X^2 (4) = 0.04 $P > 0.05$).

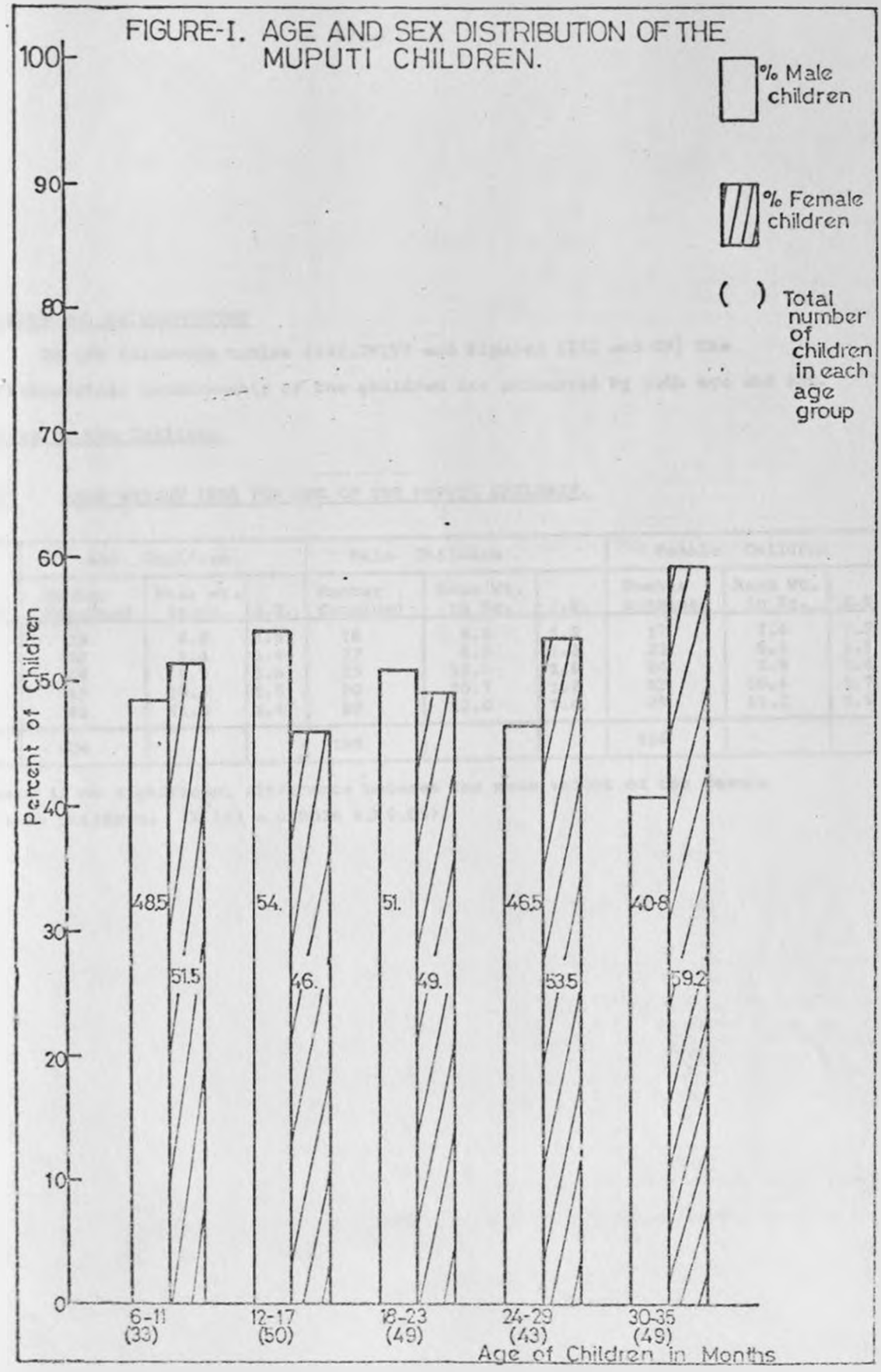


FIGURE-I. AGE AND SEX DISTRIBUTION OF THE MUPUTI CHILDREN.
% Male children
% Female children
( ) Total number of children in each age group
Percent of Children
100
90
80
70
60
50
40
30
20
10
0
48.5
51.5
54.
46.
51.
49.
46.5
53.5
40.8
59.2
6-11 (33)
12-17 (50)
18-23 (49)
24-29 (43)
30-35 (49)
Age of Children in Months

3. NUTRITIONAL ANTHROPOMETRY

In the following tables (III,IV,V) and Figures (III and IV) the anthropometric measurements of the children are presented by both age and sex.

3.1 Weight of the Children.

TABLE III: MEAN WEIGHT (KG) FOR AGE OF THE MUPUTI CHILDREN.

Age in months	All Children			Male Children			Female Children		
	Number Examined	Mean Wt. in Kg.	S.D.	Number Examined	Mean Wt. in Kg.	S.D.	Number Examined	Mean Wt. in Kg.	S.D.
6-11	33	8.0	1.6	16	8.5	1.2	17	7.6	1.9
12-17	50	9.4	1.4	27	8.8	1.3	23	8.6	1.5
18-23	49	9.9	1.6	25	10.0	1.8	24	9.9	1.4
24-29	43	10.5	1.5	20	10.7	1.2	23	10.4	1.7
30-35	49	11.5	1.4	20	12.0	1.4	29	11.2	1.5
TOTAL	224			108			116		

There is no significant difference between the mean weight of the female and the male children. ($X^2(4) = 0.0036$ $P > 0.05$).

3.2 Length of the Children.

TABLE IV: MEAN LENGTH (CM) FOR AGE OF THE MUPUTI CHILDREN

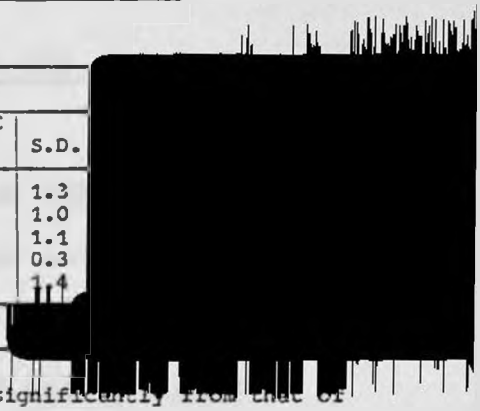
Age in months	All Children			Male Children			Female Children		
	Number Examined	Mean Length in Cm.	S.D.	Number Examined	Mean Length in Cm.	S.D.	Number Examined	Mean Length in Cm.	S.D.
6-11	33	68.9	4.7	16	70.6	4.8	17	67.3	4.7
12-17	50	73.4	5.2	27	73.8	4.3	23	72.9	6.2
18-23	49	79.7	5.7	25	79.6	5.2	24	79.8	6.1
24-29	43	83.1	5.0	20	82.9	4.7	23	83.3	5.2
30-35	49	86.6	5.1	20	88.7	4.7	29	85.1	5.4
TOTAL	224			108			116		

The mean length of the female children is not significantly different from that of the male children. ($X^2(4) = 0.09$ $P > 0.05$).

3.3 Mid-Upper Arm Circumference of the Children.

TABLE V: MEAN MID-UPPER ARM CIRCUMFERENCE (UAC IN CM) FOR AGE OF THE MUPUTI CHILDREN.

Age in months	All Children			Male Children		
	Number Examined	Mean UAC in Cm.	S.D.	Number Examined	Mean UAC in Cm.	S.D.
6-11	33	14.6	1.3	16	14.8	1.3
12-17	50	14.4	1.0	27	14.4	1.0
18-23	49	14.6	1.1	25	14.4	1.1
24-29	43	14.8	1.7	20	15.1	0.3
30-35	49	14.9	1.2	20	15.1	1.4
TOTAL	224			108		



The mean UAC of the female children does not differ significantly from that of their male counterparts. $X^2(4) = 0.02$ $P > 0.05$).

4. CLINICAL SIGNS OF PEM

Clinical signs of PEM were rare among the children. The few that were observed were not always easy to identify particularly those related to hair, skin and mental changes. The observed clinical signs of PEM were:-

Hair changes	(10 children)
Oedema	(3 children)
Mental changes	(5 children)
Skin changes	(4 children)
Moonface	(2 children)

For the purpose of the study, only oedema, of all the clinical signs, was considered when assessing the nutritional status of the children.

5. THE NUTRITIONAL STATUS OF THE CHILDREN

Introduction.

The classification of PEM in the present study was based on weight for age and the presence of oedema (Jelliffe, 1966). Children whose weight for age was below 80 percent of the Harvard Standard, and/or had oedema, were regarded as having PEM.

The duration and acuteness of PEM were determined using length for age and weight for length, respectively, as proposed by Waterlow (1976). For comparison, the children were also classified according to the UAC for age and the ratio of the chest/head circumferences as illustrated below.

TABLE VI: NUMBER AND PERCENTAGE OF CHILDREN BELOW STANDARDS FOR WEIGHT, LENGTH, ARM CIRCUMFERENCE AND CHEST/HEAD CIRCUMFERENCE RATIO.

Age in months	No. Examined	No. <80% Wt/A HVD. STD.+OEDEMA		No. <90% L/A HVD. STD.		No. <90% Wt/L HVD. STD.		No. < 80% UAC/A WLSKI. STD.		No. < 1 C/H CIRC. RATIO	
		No.	%	No.	%	No.	%	No.	%	No.	%
6-11	33	11	33.3	7	21.2	8	24.2	2	6.1	9	27.3
12-17	50	19	38.0	7	14.0	24	48.0	2	4.0	26	52.0
18-23	49	17	34.7	10	20.4	20	40.8	2	4.1	9	18.4
24-29	43	17	37.5	13	30.2	22	51.2	4	9.3	4	9.3
30-35	49	19	38.8	13	26.5	15	30.6	4	8.2	2	4.1
TOTAL	224	83	37.1	50	22.3	89	39.7	14	6.3	50	22.3

No. = Number of children
HVD STD. = Harvard Standard
Wt/A = Weight-for-Age
Wt/L = Weight-for-Length
UAC/A = Mid-Upper Arm Circumf. for Age
WLSKI STD= Wolanski Standard
C/H CIRC.= Chest Circumference/Head Circumf.

5.1 Correlations between the anthropometric measurements

TABLE VII: CORRELATION COEFFICIENTS OF THE ANTHROPOMETRIC MEASUREMENTS BY SEX AND AGE (IN MONTHS)

Measurements	Males					Females				
	6-11	12-17	18-23	24-29	30-39	6-11	12-17	18-23	24-29	30-39
Weight vs Age	0.60	0.48	0.34		0.09		0.54	0.29		
Length vs Age		0.80			0.10			0.22		
UAC vs Age	0.21	0.36	0.36	0.15			0.30		0.25	
Weight vs Length	0.76		0.87	0.70			0.90			
Weight vs UAC					0.75			0.47		
Length vs UAC	0.34	0.34	0.48	0.42	0.20		0.60	0.30		

The above findings, though few, confirm the observations of studies on human growth (Pechevis 1974; Illingworth, 1968; McGregor et al, 1968; Bayley, 1956).

FIGURE IV

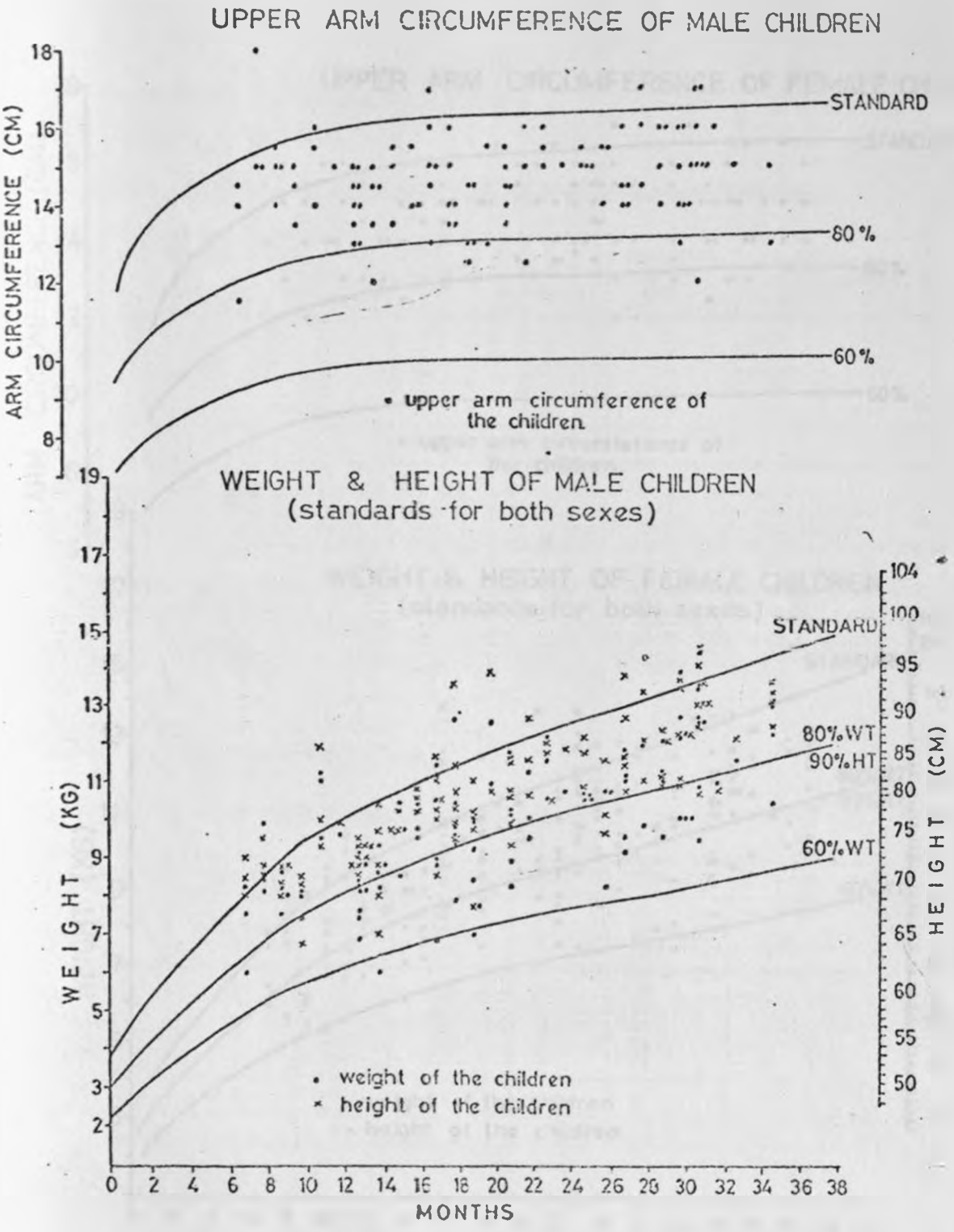
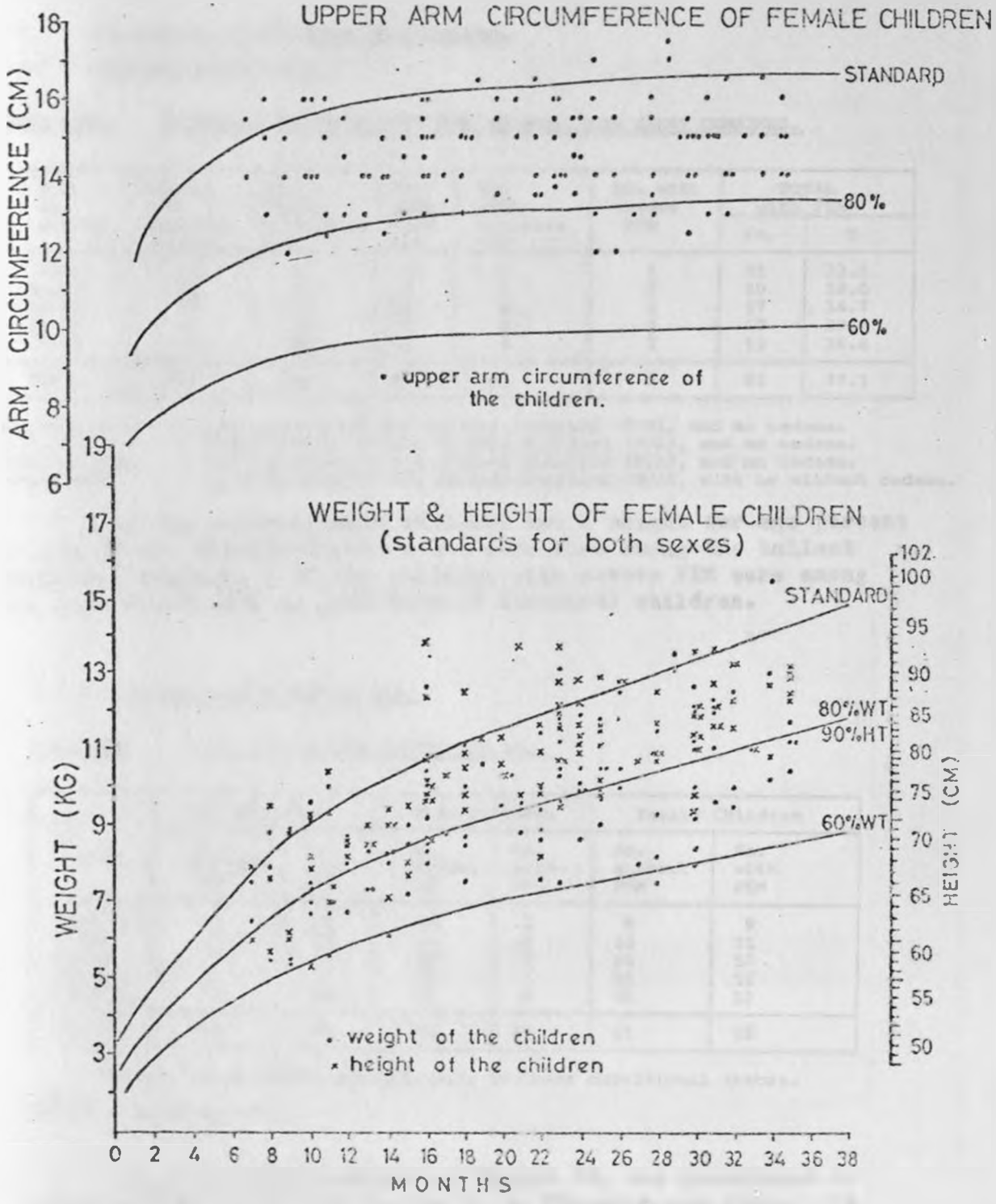

UPPER ARM CIRCUMFERENCE OF MALE CHILDREN
ARM CIRCUMFERENCE (CM)
18
16
14
12
10
8
STANDARD
80 %
60 %
• upper arm circumference of the children
WEIGHT & HEIGHT OF MALE CHILDREN
(standards for both sexes)
WEIGHT (KG)
19
17
15
13
11
9
7
5
3
2
HEIGHT (CM)
104
100
95
90
85
80
75
70
65
60
55
50
STANDARD
80%WT
90%HT
60%WT
• weight of the children
× height of the children
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
MONTHS

FIGURE V


UPPER ARM CIRCUMFERENCE OF FEMALE CHILDREN
ARM CIRCUMFERENCE (CM)
STANDARD
80%
60%
• upper arm circumference of the children.
WEIGHT & HEIGHT OF FEMALE CHILDREN
(standards for both sexes)
WEIGHT (KG)
HEIGHT (CM)
STANDARD
80%WT
90%HT
60%WT
• weight of the children
× height of the children
MONTHS

5.2 Prevalence of PEM Among the Children.

5.2.1 Both Sexes Combined.

TABLE VIII: NUMBER OF CHILDREN WITH PEM, BY AGE, BOTH SEXES COMBINED.

Age in months	Number of observations	No. Well-nourished	No. with mild PEM	No. with moderate PEM	No. with severe PEM	TOTAL with PEM	
						No.	%
6-11	33	22	5	5	1	11	33.3
12-17	50	31	13	4	2	19	38.0
18-23	49	32	10	6	1	17	34.7
24-29	43	26	12	4	1	17	39.5
30-35	49	30	13	4	2	19	38.8
TOTAL	224	141	53	23	7	83	37.1

Wellnourished = $\geq$90 percent of the Harvard Standard (W/A), and no oedema.
Mild PEM = 80-89 percent of the Harvard Standard (W/A), and no oedema.
Moderate PEM = 70-79 percent of the Harvard Standard (W/A), and no oedema.
Severe PEM = $\leq$60 percent of the Harvard Standard (W/A), with or without oedema.

6 of the wellnourished children had a weight for age percent of 110 of the Harvard Standard and were also among the tallest children, whereas, 5 of the children with severe PEM were among the undersized (L/A of $<$90% Harvard Standard) children.

5.2.2 Prevalence of PEM by Sex.

TABLE IX: PREVALENCE OF PEM BY SEX AND AGE.

Age in months	All Children		Male Children		Female Children	
	No. without PEM	No. with PEM	No. without PEM	No. with PEM	No. without PEM	No. with PEM
6-11	22	11	14	2	8	9
12-17	30	19	19	8	12	11
18-23	32	17	18	7	14	10
24-29	27	17	15	5	11	12
30-35	30	19	14	6	16	13
TOTAL	141	83	80	28	61	55

The two sexes differ significantly in their nutritional status.

($X^2(1) = 10.17$ $P<0.05$).

From the table above and Figure IX, the prevalence of PEM is shown to be high in the 12 to 17-month age group. It declines in the 18 to 23-month age group but steadily rises in the third year of life and reaches a peak between 24-29 months of age. However these are not significant ($X^2(4) = 0.45$ $P>0.05$).

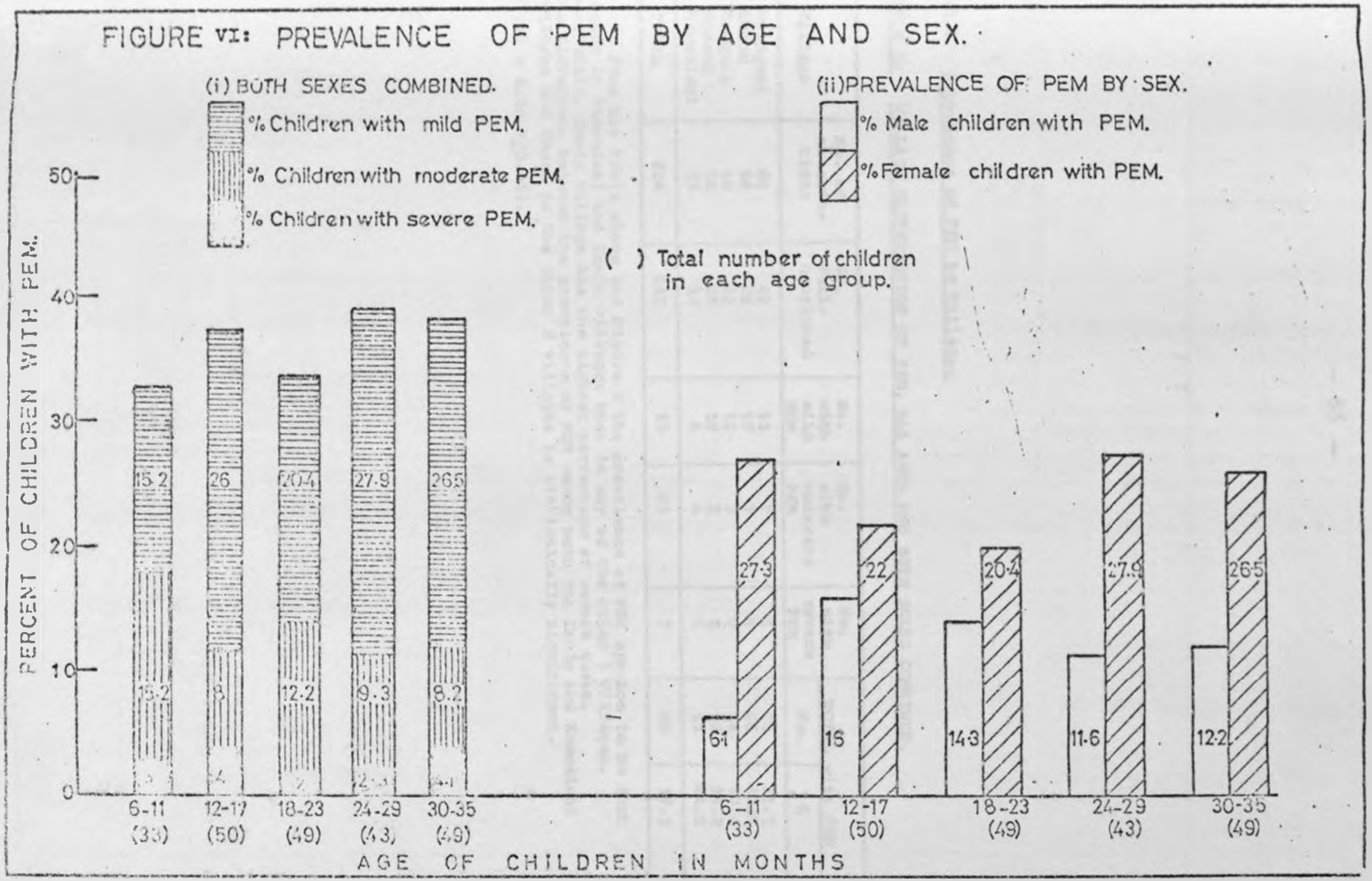


FIGURE VI: PREVALENCE OF PEM BY AGE AND SEX.
(i) BOTH SEXES COMBINED.
% Children with mild PEM.
% Children with moderate PEM.
% Children with severe PEM.
( ) Total number of children in each age group.
(ii) PREVALENCE OF PEM BY SEX.
% Male children with PEM.
% Female children with PEM.
PERCENT OF CHILDREN WITH PEM.
0
10
20
30
40
50
15.2
26
26.4
27.9
26.5
15.2
8
12.2
9.3
8.2
6-11 (33)
12-17 (50)
18-23 (49)
24-29 (43)
30-35 (49)
6.1
27.3
16
22
14.3
20.4
11.6
27.9
12.2
26.5
6-11 (33)
12-17 (50)
18-23 (49)
24-29 (43)
30-35 (49)
AGE OF CHILDREN IN MONTHS

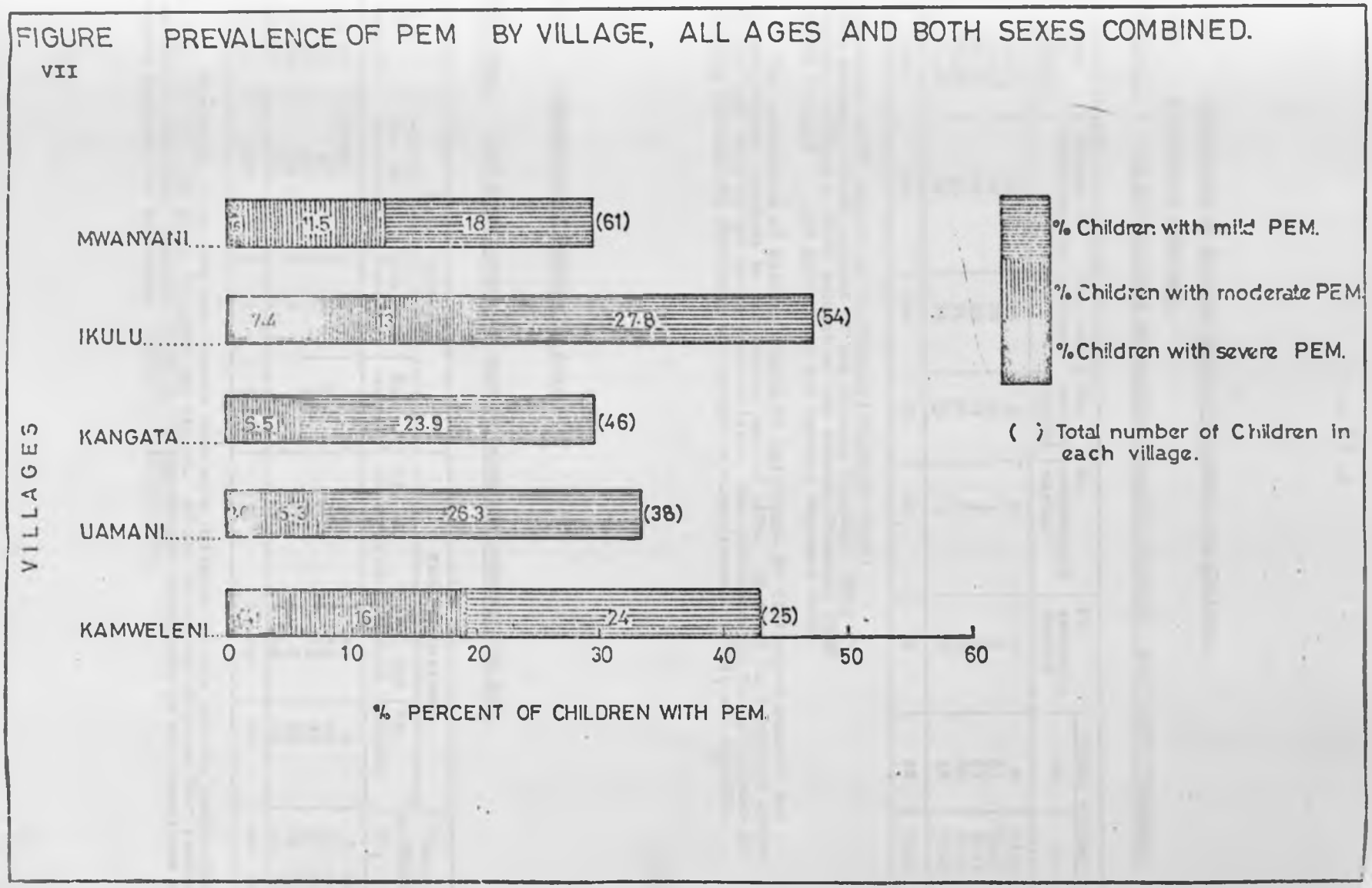
5.2.3 Prevalence of PEM by Village.

TABLE X: VILLAGE DISTRIBUTION OF PEM, ALL AGES AND BOTH SEXES COMBINED.

Village	No. of observations	No. well-nourished	No. with mild PEM	No. with moderate PEM	No. with severe PEM	TOTAL with PEM	
						No.	%
Mwanyani	61	42	11	7	1	19	31.1
Ikulu	54	28	15	7	4	26	48.1
Kangata	46	32	11	3	0	14	30.4
Uamani	38	25	10	2	1	13	34.2
Kamweleni	25	14	6	4	1	11	44.0
TOTAL	224	141	53	23	7	83	37.1

From the table above and Figure X the prevalence of PEM appears to be much higher in Kamweleni and Ikulu villages than in any of the other 3 villages. More still, Ikulu village has the highest percentage of severe cases. The difference between the prevalence of PEM among both the Ikulu and Kamweleni children and those in the other 3 villages is statistically significant. $X^2(1) = 4.38$ $P < 0.05$).

FIGURE VII PREVALENCE OF PEM BY VILLAGE, ALL AGES AND BOTH SEXES COMBINED.



5.3 Prevalence of Wasting (Acute PEM) Among the Children.

5.3.1 Both Sexes Combined.

TABLE XI: AGE DISTRIBUTION OF WASTING (ABSOLUTE NUMBERS), BOTH SEXES COMBINED.

Age in months	Number of observations	No. not wasted	No. mildly wasted	No. moderately wasted	No. severely wasted	TOTAL wasted	
						No.	%
6-11	33	25	6	2	0	8	24.2
12-17	50	28	21	1	0	22	44.0
18-23	49	28	17	4	0	21	42.9
24-29	43	21	17	5	0	22	51.2
30-35	49	34	12	3	0	15	30.6
TOTAL	224	136	73	15	0	88	39.3

Not wasted $\geq$ 90 percent of the Harvard Standard (W/H)
Mild wasting = 80-89 percent of the Harvard Standard (W/H)
Moderate wasting = 70-79 percent of the Harvard Standard (W/H)
severe wasting $<$ 70 percent of the Harvard Standard (W/H).

The prevalence of wasting (Table XI and Figure XI (i)) rises sharply and remains almost constant in the second year of life. It drops to a certain extent in the last half of the third year of life. The difference in the prevalence of wasting between the different age groups is significant. ($X^2(4) = 8$ $P<0.05$).

5.3.2 Prevalence of Wasting by Sex.

TABLE XII: SEX DISTRIBUTION OF WASTING (ABSOLUTE NUMBERS), BY AGE.

Age in months	Male Children			Female Children			Total wasted	
	No. of observations	No. not wasted	No. wasted	No. of observations	No. not wasted	No. wasted	No.	%
6-11	16	13	3	17	12	5	8	24.2
12-17	27	15	12	23	13	10	22	44.0
18-23	25	15	10	24	13	11	21	42.9
24-29	20	13	7	23	8	15	22	51.2
30-35	20	16	4	29	18	11	15	30.6
TOTAL	108	72	36	116	64	52	88	39.3

Generally, there are more female than male children who are wasted, particularly in the 6 to 11- and 24 to 35-month age groups. Of the 88 wasted children 59.1 percent are female children. However, there is no significant difference in the prevalence of wasting between the two sexes. ($X^2(4) = 2.49$ $P>0.05$).

5.4 Prevalence of Stunting (Chronic PEM) Among the Children.

5.4.1 Both Sexes Combined.

TABLE XIII: AGE DISTRIBUTION OF STUNTING (ABSOLUTE NUMBERS), BOTH SEXES COMBINED.

Age in months	Number of observations	No. not stunted	No. mildly stunted	No. moderately stunted	No. severely stunted	Total stunted	
						No.	%
6-11	33	26	6	1	0	7	21.2
12-17	50	44	6	0	0	6	12.0
18-23	49	39	8	2	0	10	20.4
24-29	43	30	13	0	0	13	30.2
30-35	49	36	12	1	0	13	26.5
TOTAL	224	175	45	4	0	49	21.9

Not stunted = $\geq$ 90 percent of the Harvard Standard (L/A)
Mild stunting = 80-89 percent of the Harvard Standard (L/A)
Moderate stunting = 70-79 percent of the Harvard Standard (L/A)
Severe stunting = $<$70 percent of the Harvard Standard (L/A)

The third year of life appears to be the most affected, with the peak of prevalence of stunting appearing in the first half of the third year. Surprisingly, there is a higher prevalence of stunting in the 6 to 11-month age group than in the second year of life among the Nuputi children. The difference in the prevalence of stunting between the different age groups is significant. ($X^2(4) = 5.28$ $P < 0.05$).

5.4.2 Prevalence of Stunting by Sex.

TABLE XIV: SEX DISTRIBUTION OF STUNTING (ABSOLUTE NUMBERS), BY AGE.

Age in months	Male Children			Female Children			Total Stunted	
	No. of observations	No. not stunted	No. stunted	No. of observations	No. not stunted	No. stunted	No.	%
6-11	16	15	1	17	11	6	7	21.2
12-17	27	24	3	23	20	3	6	12.0
18-23	25	21	4	24	18	6	10	20.4
24-29	20	13	7	23	17	6	13	30.2
30-35	20	17	3	29	19	10	13	26.5
TOTAL	108	90	18	116	85	31	49	21.9

Considering all the stunted children together, the female children (63.3%) appear to be more affected than the male children (36.7%) though the difference is not significant. ($X^2(4) = 2.34$ $P > 0.05$).

5.5 Wasting and Stunting Combined.

5.5.1 Both Sexes Combined.

TABLE XV: AGE DISTRIBUTION OF BOTH WASTING AND STUNTING (ABSOLUTE NUMBERS), BOTH SEXES COMBINED.

Age in months	Number of observations	No. neither wasted nor stunted	No. wasted but not stunted	No. stunted but not wasted	No. both wasted and stunted
6-11	33	20	6	5	2
12-17	50	24	19	3	4
18-23	49	24	15	4	6
24-29	43	17	13	4	9
30-35	49	26	10	8	5
TOTAL	224	111	63	24	26

Severity of malnutrition as determined by a combination of both wasting and stunting is prevalent in the children of all the different age groups. Older children, particularly 18 to 35 months of age appear to be the most affected. The prevalence of severity of malnutrition has its peak (20.9%) in the first half of the third year of life, an observation similar to the one made when wasting and stunting are considered separately. (see Figure XI).

5.5.2 Prevalence of Both Wasting and Stunting by Sex.

TABLE XVI: SEX AND AGE DISTRIBUTION OF BOTH WASTING AND STUNTING (ABSOLUTE NUMBERS) AMONG THE CHILDREN

Age in months	No. neither wasted nor stunted		No. wasted but not stunted		No. stunted but not wasted		No. both wasted and stunted		TOTAL number of children	
	M	F	M	F	M	F	M	F	M	F
6-11	12	8	3	3	1	4	0	2	16	17
12-17	14	10	10	9	1	2	2	2	27	23
18-23	13	11	8	7	2	2	2	4	25	24
24-29	10	7	3	10	3	1	4	5	20	23
30-35	13	13	4	6	3	5	0	5	20	29
TOTAL	62	49	28	35	10	14	8	18	108	116

No.= Number of Children M= Male Children F= Female Children

There are more female children with severe malnutrition, (both acute and chronic combined) (15.5%) than the male children (7.4%). This observation is similar to that made when considering PEM on the basis of low weight for age and the presence of oedema (see Table IX and Figure IX (i)).

FIGURE VIII PREVALENCE OF WASTING AND STUNTING AMONG THE MUPUTI CHILDREN, BY AGE, BOTH SEXES COMBINED.

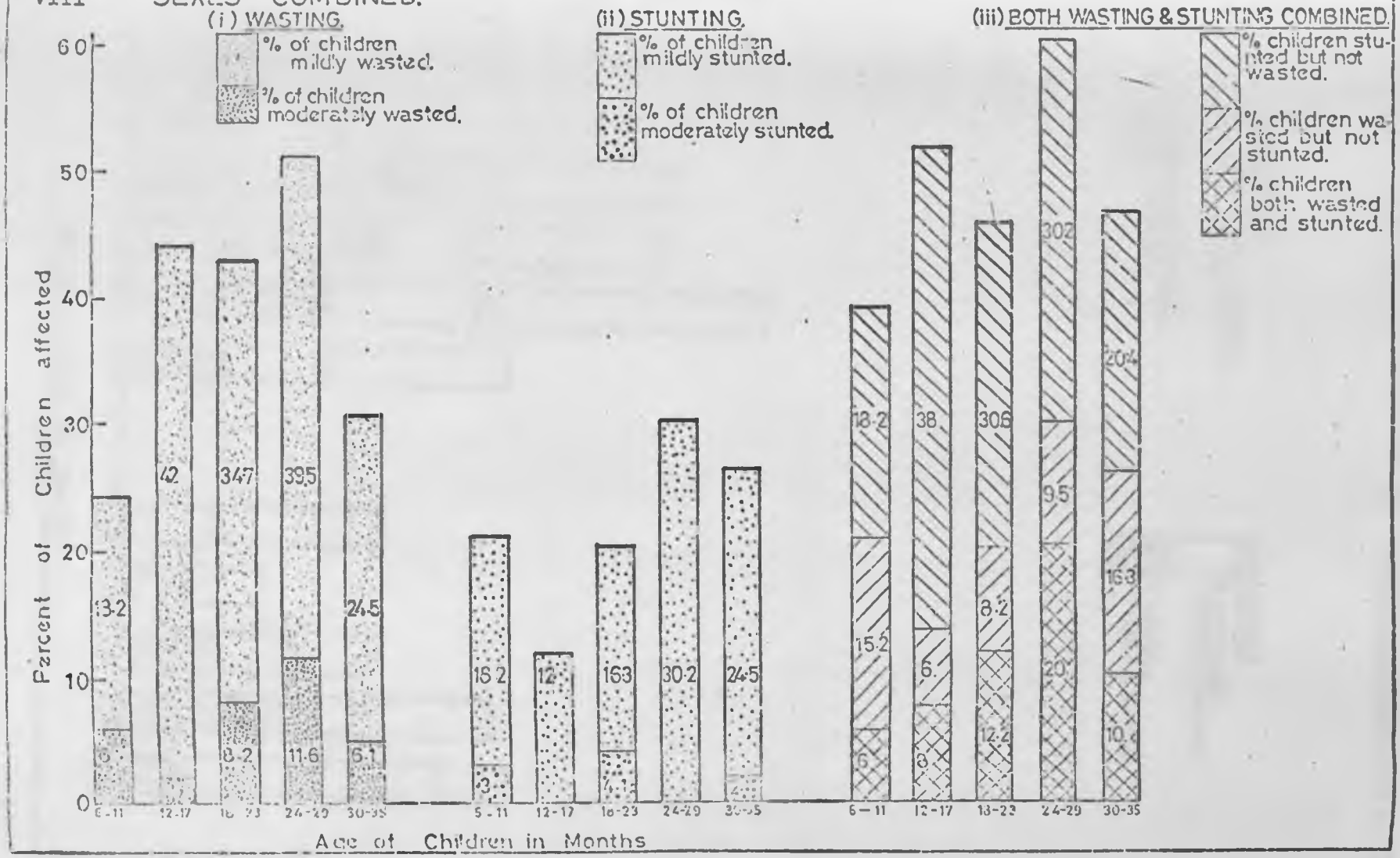


FIGURE IX: SEX DISTRIBUTION OF WASTING & STUNTING BY AGE

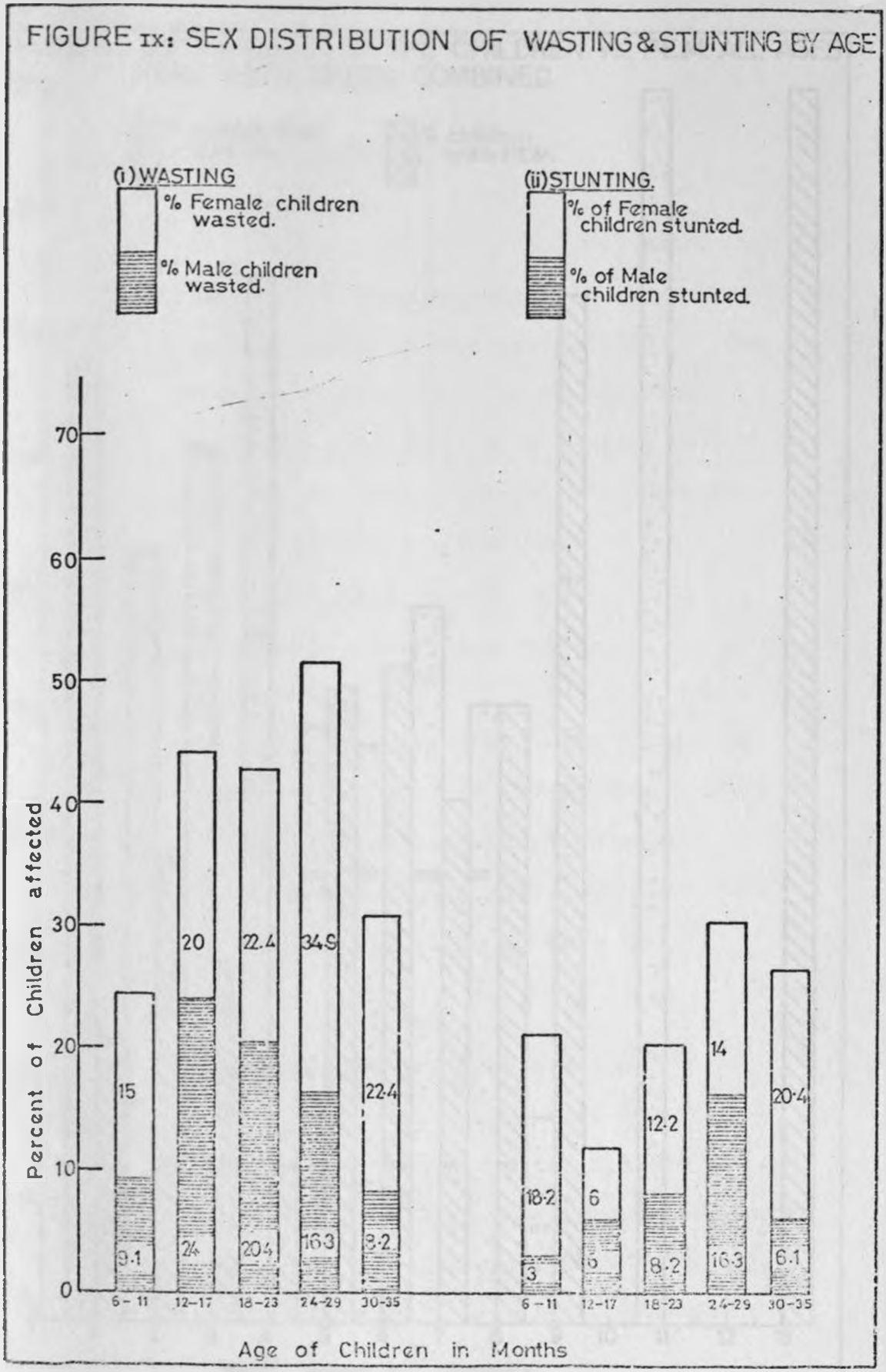
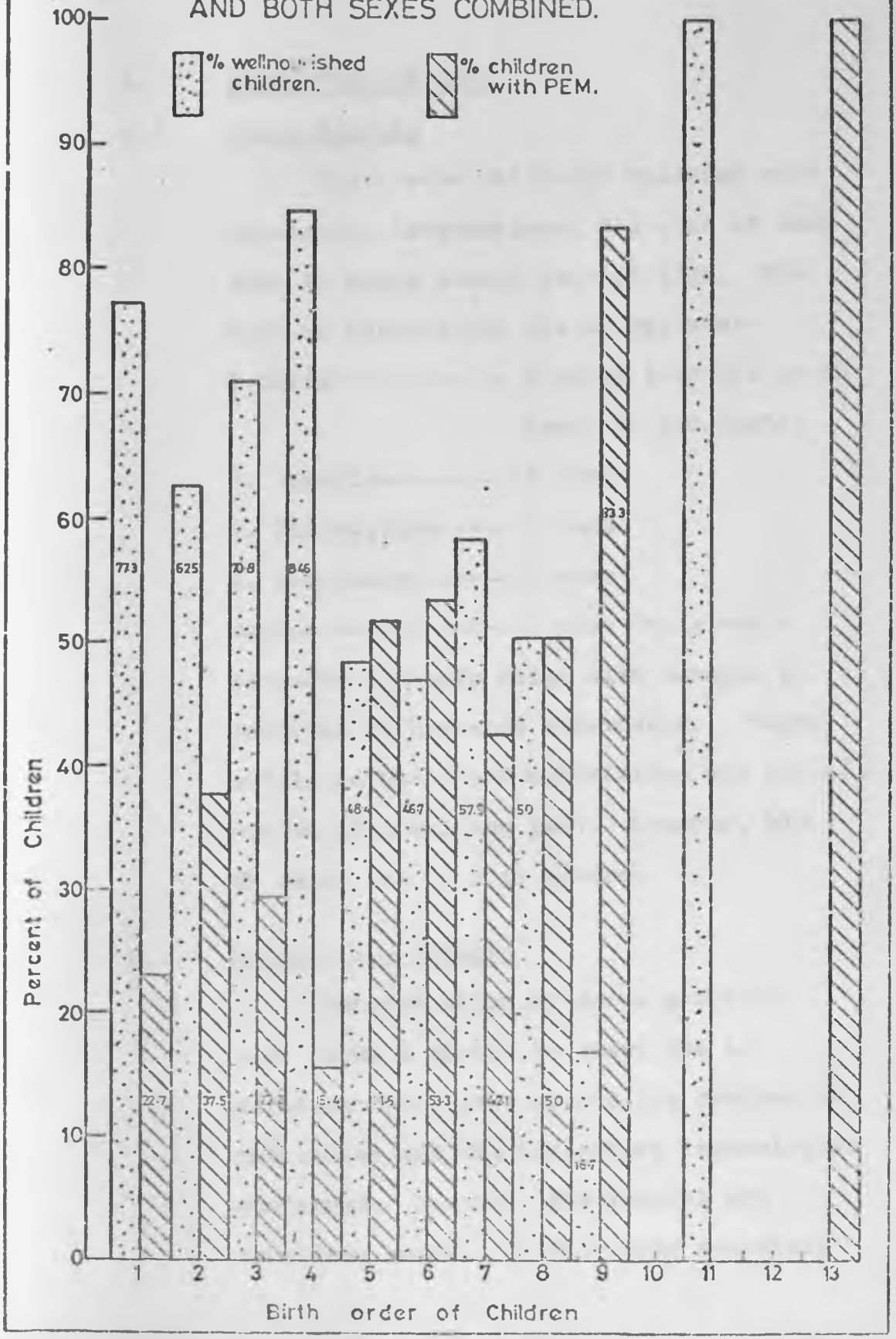


FIGURE X BIRTH ORDER OF THE CHILDREN Vs. PEM. ALL AGES AND BOTH SEXES COMBINED.



6. LABORATORY RESULTS

6.1 Stool Results

There were 14(15.9%) children with helminthic infestations, 8(57.1%) of whom were in their second year of life. The type of infestation was as follows:-

Ascaris---------- 8 cases (two had an Hb level of ⩽10.5gm%).

G. Lamblia--------- 4 cases

E. Histolytica----- 1 case

E. Vermicularis---- 1 case

Hookworm---------- 1 case (this was a 19-month old male child with ascaris in addition to hookworm infestation. Worse still, he had frank kwashiorkor and had not started walking yet). However, his Hb level was 11.1 gm percent.

6.2 Haematology Results

Determination of serum proteins took about 8 months to start due to unforseen problems, beyond the control of the author and the Laboratory Technologist concerned. However, the results are tabulated below. It was found necessary

to combine the ages of all the children as there were very few children in some age groups, particularly among the children with protein-energy malnutrition.

TABLE XVII: HAEMOGLOBIN, HAEMATOCRIT, PREALBUMIN AND TRANSFERRIN OF THE CHILDREN ACCORDING TO THEIR NUTRITIONAL STATUS.

Nutritional Status	Number Examined	Haemoglobin (gm%)		Haematocrit (gm%)		Prealbumin mg%		Transferrin mg%			
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	≥330	<330
Wellnourished	57	8-13.8	11.7	32-46	37.3	9.1-26.2	16.4	246-593	353.1	40	17
Children with PEM	31	8-14	11.6	31-42	37.1	7.2-24	15.3	208-480	316.4	10	21

There were 12(13.6%) children with a haemoglobin level of less than 10.5gm%. Four (33.3%) of these children had mild protein-energy malnutrition. From the table above, the two groups of children are similar in the mean levels of their haemoglobin, haematocrit and prealbumin. However, there is a significant difference between the transferrin levels of the two groups of children ($X^2 = 11.78$ $P < 0.05$).

7. DIETARY RESULTS

7.1 Weaning Food

Various weaning foods were mentioned by the mothers of the 224 children. However, maize, wheat, beans and milk (of all kinds) were mentioned more often than the rest, as illustrated in the table below.

TABLE XVIII: WEANING FOOD BY NUMBER OF TIMES MENTIONED ACCORDING TO THE NUTRITIONAL STATUS OF THE CHILDREN, BOTH SEXES, ALL AGES COMBINED.

Weaning Food	Wellnourished Children (141)	Children with PEM (83)	TOTAL (224)
Maize	104	62	166
Wheat	47	28	75
Millet/ Sorghum	10	12	22
Bananas	8	1	9
Potatoes	0	1	1
Rice	1	0	1
Beans	41	17	58
Milk	70	47	117
Eggs	7	5	12
Meat	1	1	2
Orange	13	1	14

( ) Total number of children in each group.

TABLE XIX: WEANING FOOD (MENTIONED MOST OFTEN) BY AGE OF INTRODUCTION: ACCORDING TO THE NUTRITIONAL STATUS OF THE CHILDREN, BOTH SEXES, ALL AGES COMBINED.

A. MAIZE

	< 6 months		≥ 6 months		TOTAL	
	No.	%	No.	%	No.	%
Well-nourished	51	49	53	51	104	100
Children with PEM	30	48.4	32	51.6	62	100
TOTAL	81	48.8	85	51.2	166	100

B. WHEAT

	< 6 months		≥ 6 months		TOTAL	
	No.	%	No.	%	No.	%
Wellnourished	31	66	16	34	47	100
Children with PEM	19	67.9	9	32.1	28	100
TOTAL	50	66.7	25	33.3	75	100

C. BEANS

	< 6 months		≥ 6 months		TOTAL	
	No.	%	No.	%	No.	%
Wellnourished	24	58.5	17	41.5	41	100
Children with PEM	11	64.7	6	35.3	17	100
TOTAL	35	60.3	23	39.7	58	100

D. MILK

	< 6 months		≥ 6 months		TOTAL	
	No.	%	No.	%	No.	%
Wellnourished	31	44.3	39	55.7	70	100
Children with PEM	25	53.2	22	46.8	47	100
TOTAL	56	47.9	61	52.1	117	100

From the tables above, both groups of children are introduced to the different types of weaning foods at more or less the same time. That is, generally, there are almost as many children with PEM as there are wellnourished children who are introduced to maize, wheat, beans, and milk either before or after six months of age.

TABLE XX: WEANING FOOD (MENTIONED MOST OFTEN) BY SEX, ALL AGES COMBINED.

Weaning Food	Male Children (108)		Female Children (116)		TOTAL (224)	
	No.	%	No.	%	No.	%
Maize	80	48.2	86	51.8	166	100
Wheat	40	53.3	35	46.7	75	100
Beans	30	51.7	28	48.3	58	100
Milk	50	42.7	67	57.3	117	100

The weaning food for both the male and female children is almost similar.

7.2 Twenty-Four Hour Recall Diet of the Children.

TABLE XXI: AVERAGE FREQUENCY OF FOOD INTAKE (IN 24 HOURS) ACCORDING TO THE NUTRITIONAL STATUS OF THE CHILDREN.

Type of Food	Nutritional Status of Children and Average Frequency of Food Intake	
	Wellnourished	Malnourished
Maize	3.06	2.12
Millet/Sorghum	0.05	0.05
Bananas	0.11	0
Potatoes	0.01	0
Bread	0.01	0
Milk	0.77	0.78
Beans	0.19	0.14
Eggs	0.01	0
Oranges	0.01	0

From the table above, it appears that the wellnourished children have a wider variety of both carbohydrate and protein foods than do the children with PEM. However, the difference is statistically not significant. (X^2 (1) = 0.17, $P > 0.05$).

Apart from beans, maize is the main source of energy and milk of protein in the diet of the Muputi children.

	Factor Investigated	Nutritional Status of Children			COMMENTS
B.	Household Factors	Well-nourished	Children with PEM	TOTAL	
1.	Indicators of Social Economic Status a. Total Number of Cattle				
	4 or more	42	16	58	X^2=5.13
	1 to 3	42	36	78	
	None	57	31	88	P> 0.05
	TOTAL	141	83	224	
	b. Occupation of H/H Hold				
	Salaried job	58	19	77	X^2=8.07
	Self employed	23	15	38	
	Subsistence farmer	60	49	109	P<0.05
	TOTAL	141	[illegible]	[illegible]	
	c. Roof of main house				
	Corrugated iron	105			
	Grass/Tin	36			
	TOTAL	141			
2.	Environmental Hygiene				
	Good	108			
	Poor	33			
	TOTAL	141			
3.	Number of Children in the household				
	1-3	68			
	4+	73			
	TOTAL	141			
4.	Village				
	Ikulu & Kamweleni	42			
	All the other 3 villages	99			
	TOTAL	141			

8. ASSOCIATIONS BETWEEN THE NUTRITIONAL STATUS OF CHILDREN AND DIFFERENT FACTORS.

TABLE XXII: THE ASSOCIATION BETWEEN CERTAIN FACTORS AND THE NUTRITIONAL STATUS OF THE MUPUTI CHILDREN.

A		Factor Investigated	Nutritional Status of Children			COMMENT
		Maternal Factors	Well-nourished	Children with PEM	Total	
	1.	Maternal school Education				
		0- years	43	36	79	X^2=10.
		1-4 years	38	29	67	
		5 or more	60	18	78	P/0.05
		TOTAL	141	83	224	
	2.	Maternal Nutritional Knowledge				X^2=0.1
		None/Poor	135	81	216	
		Good	6	2	8	P> 0.05
		TOTAL	141	83	224	
	3.	Maternal Marital Status				
		Married	126	74	200	X^2=0.0
		Single	15	9	24	
		TOTAL	141	83	224	P>0.0
	4.	Absence of Mother from home during daytime				X^2=2.4
		Not at all	54	25	79	
		Half daytime	49	28	77	P>0.0
		All daytime	38	30	68	
		TOTAL	141	83	224	
	5.	Maternal Health in Past two months				X^2=0.5
		Good	108	59	167	
		Poor	33	24	57	P>0.0
		TOTAL	141	83	224	

	Factor Investigated	Nutritional Status of Children			COMMENTS
B.	Household Factors	Well-nourished	Children with PEM	TOTAL	
1.	Indicators of Social Economic Status a. Total Number of Cattle				
	4 or more	42	16	58	X^2=5.13
	1 to 3	42	36	78	
	None	57	31	88	P > 0.05
	TOTAL	141	83	224	
	b. Occupation of H/H Hold				
	Salaried job	58	19	77	X^2=8.07
	Self employed	23	15	38	
	Subsistence farmer	60	49	109	P<0.05
	TOTAL	141	83	224	
	c. Roof of main house				
	Corrugated iron	105	52	157	X^2=2.94
	Grass/Tin	36	31		
	TOTAL	141	83		P > 0.05
2.	Environmental Hygiene				
	Good	108	45		
	Poor	33	38		
	TOTAL	141	83		
3.	Number of Children in the household				
	1-3	68	31		
	4+	73	52		
	TOTAL	141	83		
4.	Village				
	Ikulu & Kamweleni	42	37	79	X^2=5.0
	All the other 3 villages	99	46	145	P<0.05
	TOTAL	141	83	224	

	Factor Investigated	Nutritional Status of Children			COMMENTS
C.	Child-Related Factors	Well-nourished	Children with PEM	Total	
1.	Sex of Child				
	Male	80	28	108	X^2=10.17
	Female	61	55	116	
	TOTAL	141	83	224	P<0.05
2.	Child's Birth Order				
	1-4	93	33	126	X^2=13.5
	Others	48	50	98	
	TOTAL	141	83	224	P<0.05
3.	Weaning Practices:				
	a. Weaning Food				
	"Good"	97	51	148	X^2=0.95
	"Poor"	44	32	76	
	TOTAL	141	83	224	P > 0.05
	b. Bottle Feeding				
	No	62	48	110	X^2=3.48
	Yes	79	35	114	
	TOTAL	141	83	224	P > 0.05
	c. Age of child when supplementary feeding started				
	0-5 months	75	46	121	X^2=0.03
	6 or more months	66	37	103	P > 0.05
	TOTAL	141	83	224	
	d. Age of child when breastfeeding* stopped				
	≤12 months	59	22	81	
	>12 months	64	51	115	
	TOTAL	123	73	196	
4.	Current Breast-feeding				
	Breastfeeding	51	36	87	X^2=0.85
	Not breastfeeding	90	47	137	
	TOTAL	141	83	224	P > 0.05

*This includes all children who were over one year of age and still breastfeeding.

C. CONT'D

5.	Person who feeds the child				
	Mother	78	42	120	$X^2=0.30$
	Other people	24	18	42	
	Self	39	23	62	$P>0.05$
	TOTAL	141	83	224	
6.	Immunisations of the children $\geq$ 12 mths old				
	All	68	36	104	$X^2=3.65$
	Some	33	17	50	
	None	18	19	37	$P>0.05$
	TOTAL	119	72	191	

It appears from Table XXI above that most of the factors investigated are not significantly associated with protein-energy malnutrition in young children of Muputi Sublocation.

9. ASSOCIATIONS BETWEEN SOME FACTORS

TABLE XXIII: (i) Maternal School Education Vs. Environmental Hygiene.

Maternal Education	Environmental Hygiene		
	Good	Poor	Total
5 or more years	69	9	78
0-4 years	84	62	146
TOTAL	153	71	224

$X^2 = 21.055$, $P < 0.05$

(ii) Maternal School Education Vs. Sex of Child.

Maternal Education	Sex of Child		
	Male	Female	Total
5 or more years	37	41	78
0-4 years	71	75	146
TOTAL	108	116	224

$X^2 = 0.29$, $P > 0.05$

(iii) Maternal School Education Vs. Village.

Maternal Education	Village		
	Kamweleni and Ikulu	All other 3 villages	Total
5 or more years	23	55	78
0-4 years	56	90	146
TOTAL	79	145	224

$X^2 = 1.75$, $P > 0.05$

(iv) Maternal School Education Vs. Age of Child when breastfeeding stopped.

Maternal Education	Age of child when breast-feeding stopped		
	≤12 months	>12months	Total
5 or more years	32	35	67
0-4 years	46	82	128
TOTAL	78	117	195

$X^2=0.26$ $P > 0.05$

(v) Village Vs. Environmental Hygiene

Environmental Hygiene	Village		Total
	Ikulu & Kamweleni	All the other 3 villages	
Good	46	107	153
Poor	33	38	71
TOTAL	79	145	224

$X^2=5.72$ $P < 0.05$

(vi) Village Vs. Occupation of Head of Household

Occupation of Head of Household	Village		Total
	Ikulu & Kamweleni	All the other 3 villages	
Salaried job and self employed	34	81	115
Subsistence farmer	45	64	109
TOTAL	79	145	224

$X^2=3.37$ $P > 0.05$

(vii) Environmental Hygiene Vs. Sex of Child.

Environmental Hygiene	Sex of Child		
	Male	Female	Total
Good	75	78	153
Poor	33	38	71
TOTAL	108	116	224

$X^2 = 1.25$ $P > 0.05$

There are no significant associations between most of the factors investigated, except for village and environmental hygiene.

10. SUMMARY OF THE FINDINGS

TABLE XXIV: SUMMARY OF THE RESULTS OF THE MUPUTI STUDY

	Factor	Influence on Nutritional Status of Children	Remarks
1.	Maternal Level	Has an effect	Mothers with more years of schooling (5 or more) have better nourished children than mothers with less years of schooling. The relationship is significant.
2.	Occupation of Head of a Household	Has an effect	A head of a household with a salaried job stands a better chance of having wellnourished children than does a subsistence farmer or a self employed person. The relationship is significant.
3.	Environmental Hygiene	Has an effect	Children living under satisfactory hygienic conditions such as a latrine, separate kitchen and low ratio of people to rooms in the household

TABLE XXIV: CONT'D

			are likely to be better nourished than children in poor hygienic conditions. The relationship is significant.
4.	Sex of a child	Has an effect	Male children are more likely to have a better nutritional status than female children. The relationship is significant.
5.	Birth Order of a child	Has an effect	Younger children of 1 to 4 (low) birth orders tend to be better nourished than children of a higher birth order (5 or higher).
6.	Village	Has an effect	There is a higher prevalence of PEM among children in both Ikulu and Kamweleni villages than in the other 3 villages and the difference is significant.
7.	Age of a child when breast-feeding stopped	Has no effect	
8.	Maternal Marital Status	Has no effect	

TABLE XXIV: CONT'D

9.	Maternal Nutritional Knowledge	Has no effect	
10.	Maternal Health	Has no effect	
11.	Absence of mother from the household during daytime	Has no effect	
12.	Number of heads of cattle	Has no effect	
13.	Roof of mainhouse	Has no effect	
14.	Immunisations a child has had	Has no effect	The difference is not significant.
15.	Age of a child when supplementary feeding is started	Has no effect	
16.	Current breastfeeding	Has no effect	
17.	Person who feeds the child	Has no effect	
18,	Number of children a mother has	Has no effect	
19.	Bottlefeeding	Has no effect	

C H A P T E R F O U R

DISCUSSION OF THE FINDINGS

INTRODUCTION

The findings of the present study will be discussed under the following headings:-

1. The nutritional status of the children in Muputi.
2. Variables associated with PEM in Muputi.

1. THE NUTRITIONAL STATUS OF THE CHILDREN IN MUPUTI.

1.1 Problems of Assessment.

The author was faced with the problem of selecting the most appropriate method of assessing the nutritional status of the children. Various authors, as discussed by Waterlow (1976), have proposed different methods of assessing pre-school malnutrition, and as may be expected, there are advantages and disadvantages of each one of them. Nutritional anthropometry in surveys is widely recognized (Jelliffe, 1966 and 1967; Bailey, 1963; McLaren and Read, 1972 and 1973;

Gurney et al, 1972; Jansen, 1977; Christakis, 1973; Jelliffe and Welbourn, 1963; Seoane and Latham, 1971; Jelliffe and Jelliffe, 1971; Jelliffe et al, 1975; Dugdale, 1971). However, it is often difficult to decide on the indices to use. Multivariate analysis has been proposed by some research workers (Robinow and Jelliffe, 1966; Lamb et al, 1967; Shepherd et al, 1969; el Lozy, 1971). This has proved complicated and long, though successful (Bartlett, 1965).

In this study, positive correlations between certain measurements (Table VII) were observed as summarised below:-

1. For most of the age groups, there is a high positive correlation between:-

   a) Weight and Age

   b) Length and Weight

   c) Length and Upper Arm Circumference

   d) Weight and Upper Arm Circumference

2. For most of the age groups, however, there is little correlation between:-

   a) Length and Age

   b) Upper Arm Circumference and Age.

These observations are similar to those made by other authors such as Rutishauser (1969) and Shakir et al (1972). Kanawati and McLaren (1970) also found a close correlation between the ratio of upper arm circumference to head circumference and weight for age. Such findings may serve as a guide when deciding on the indices to use in a nutritional study.

Weight-measurements, as opposed to linear measurements, have been shown to be the most sensitive to malnutrition (Jelliffe, 1966, and 1967; Cuthbertson and Morley, 1962; McCance, 1964; Morley, 1968). Thus, deficit in height or length (nutritional dwarfing) very often indicates longstanding mild-to-moderate malnutrition. Nutritional dwarfing, or stunting can be considered as an adaptative mechanism of the body to the adverse nutritional circumstances. The more or less normal body proportions make it difficult to assess the nutritional status of such people. Rendle-Short (1971) points out that such children (with misleading 'normal' body proportions) "are functioning at the limit of

their resources and a minor infection or other upset may be sufficient to tip the balance. Sudden death is common in these children".

Wiersinga and van Rens (1973) found out that "height falters simultaneously with faltering in weight, although it came to a slower halt than weight did". Péchevis (1974) also points out that "in healthy children, height and weight progress in a similar and more or less parallel fashion, while their parting usually indicates some abnormal phenomenon".

The ratio of the chest circumference to head circumference has been proposed for assessing protein-energy malnutrition in pre-school children (Jansen, 1959 and 1973; Reynaldo et al, 1975; Péchevis, 1974). On the average, the head circumference is larger than the chest circumference until the age of 6 months. In this study, there were 50(22.3%) children who had the ratio (C.C./H.C.) of less than 1. Half of these

children had a weight for length ratio of less than 90 percent, while 26(52%) of the children were below 80 percent, weight for age of the Harvard Standard, indicating some degree of wasting. A further 14(28%) of the children had a deficit in length for age, a sign of a history of prolonged protein-energy-malnutrition. It may be possible that some of these children had such poorly developed chests that their heads were larger than their chests for longer than usual.

Using the upper arm circumference as an index of protein-energy-malnutrition, only 14(6.3%) children were found to be affected (see Table VI above). This is a similar observation to Jansen's (1976) in the same district. The sensitivity and specificity values of upper arm circumference as an index were 14.5 and 98.6 percent, respectively (calculation based on McCusker, 1974) when compared with the prevalence if weight for age and oedema are taken as the most accurate

indices. These values, together with the fact that upper arm circumference is relatively age-independent, prove the importance of the index as a specific (but not very sensitive) public health measure in screening out severe cases of protein-energy malnutrition. Various other research workers are of the same opinion (Burgess and Burgess, 1969; Cook, 1969; Blankhart, 1969; McKay, 1969; Young, 1969; Gurney, 1969; Kanawati et al, 1969; Bennett, 1969; Eksmyr, 1969; Arnhold, 1969; Beghin, 1969; Hofvander and Eksmyr, 1969; Jelliffe and Jelliffe, 1969 ; C.B.S. 1977).

There are certain drawbacks in the use of nutritional anthropometry. Firstly, lack of local standards for comparison in the developing world is a problem that most nutrition research workers experience in these countries. Worse still, as Acheson (1966) points out, growth standards are not constant in the various geographical areas. However, it has been observed by some research workers, that western norms are applicable to most races (Hansen et al, 1971; Ford, 1964; Bodhal et al 196

Stuart and Stevenson, 1959; King et al, 1963; Jelliffe, 1966). Secondly, lack of knowledge of the precise chronological age of most of the children in the developing countries poses a big problem in the use of age-dependent measurements. In this study, although a combination of methods were used (see Chapter Two) to determine the age of the children, the author is reluctant to claim complete success as coincidence may have played a part in some cases. As a result, the observed prevalence rate of protein-energy malnutrition of 37.1 percent (according to a deficit in weight for age and presence of oedema) may not be absolutely correct though it compares quite well with the rates observed elsewhere in the District (Waihenya, 1973; Jivanjee, 1971; Kanyuira, 1973; Karanja, 1975) and other parts of the country (Blankhart, 1970 and 1971). These rates are however, comparatively lower than the rates found in other parts of the developing countries such as Ethiopia (Arhammar, 1969).

The cut-off point for protein-energy malnutrition may lead to differences in the results. For instance, when the cut-off point for PEM, using UAC for age as an index, was raised to 85 percent of the standard, 42(18.8%) children were found to have PEM. Not only that, but also the sensitivity and specificity of an index may be affected when the cut-off point is raised (McCusker, 1974).

When the Gomez classification (1956) was applied to the Muputi children, the following results were obtained:-

Wellnourished ----------	70	children	31.25%
1st degree malnutrition ------	98	"	43.75%
2nd degree malnutrition ------	51	"	22.77%
3rd " " ------	5	"	2.23%
Total	224	children	100%

Thus with the Gomez classification, a prevalence rate of PEM (all grades) of 68.8 percent was observed. The same results were obtained with Bengoa's modification (1970) of the Gomez classification except that the number of children with 3rd degree malnutrition rose to 7, because

of the two oedematous children, who, because of their weight had been included in the group of children with 2nd degree malnutrition.

The Wellcome Classification (Waterlow, 1976) was found to be similar to the one proposed by Jelliffe. However, in this study, it was found necessary to differentiate between mild and moderate PEM, as illustrated in Table VIII (Chapter Three).

The use of the clinical signs of protein-energy malnutrition proved unsuccessful for a number of reasons. For instance some of the children had brownish hair, not necessarily because they had PEM but mainly because the hair was either dirty or naturally like that. Worse still, 16(7.1%) of the children had their crown hair shaven just before the survey. Signs of psychomotor changes proved unreliable because almost all the children reacted negatively to the anthropometric measurements and the medical examinations by screaming and kicking. This

led to difficulties in differentiating between children who were miserable or irritable because of PEM and those who were so because of other reasons. Skin changes due to PEM, were generally uncommon. In addition, there were a few children with a rough skin either because of the dry weather at the time of the survey or some other reasons. Clinical signs such as hepatomegaly were not observed in any of the children. It became necessary, therefore, to consider only oedema (in addition to weight for age) when classifying PEM, as it was easier to identify besides being characteristic of kwashiorkor (Gopalan, 1968; Jelliffe, 1966; Bengoa, 1973; De Maeyer, 1976).

Serum prealbumin or T.B.P.A. (Thyroxine-binding prealbumin) has been proposed as a sensitive indicator of protein deficiency (Ingenbleek et al, 1972 and 1975), so has serum transferrin (Antia et al, 1968; McFarlane et al, 1969; Garib et al, 1971; Grant et al, 1973; Masawe and Rwabwogo-Atenyi, 1973). Ingenbleek et al, (1972) attributes

the high sensitivity of prealbumin (T.B.P.A.) to an inadequate protein intake to:-

a) biosynthesis of T.B.P.A. by the liver, which reacts promptly to protein deficiency,

b) the richness of T.B.P.A. in tryptophan, which is very important in the control of protein synthesis,

c) the rapid turnover-rate of the protein (especially in the presence of infectious diseases).

Low serum prealbumin levels were observed in children with frank kwashiorkor and severe liver steatosis (Ingenbleek et al, 1972). Tsung et al, (1975) found low transferrin concentrations in cases of "anaemia resulting from malignancy, chronic disorders and cirrhosis of the liver and high or normal in patients with iron deficiency anaemia and in pregnant women or women who were taking birth-control pills". Reduction of transferrin in severe kwashiorkor has also been reported by other authors including Antia et al, (1968) and McFarlane et al, (1969),

and the levels increased from 0.72 ± 0.65 mg/ml. to 1.81 ± 0.41 mg/ml. on recovery in the children in the latter study. As no local standards were available, the data published by Ingenbleek et al, (1972 and 1975); Vahlquist et al, (1975) were used for comparison as shown in the table below (Table XXV).

TABLE XXV: SERUM PREALBUMIN AND TRANSFERRIN VALUES OBSERVED IN DIFFERENT STUDIES ALL AGES AND BOTH SEXES COMBINED

	Present Study (1977)	Ingenbleek et al (1972)	Ingenbleek et al (1975)	Vahlquist et al (1975)			
Country	Kenya	Senegal	Senegal	Sweden			
Age of Children	6-35 Months old	18-30 Months old	18-30 Months old	Newborns	10 mths old	16 mths old	24 mths old
Prealbumin (mg%)							
Mean	16.01	22.31	22.4	12.8	19.6	18.5	17.9
Range	7.2 to 26.2	15.8 to 29.8	15.7 to 29.6	6.0 to 24.3	•	•	•
Transferrin (mg%)							
Mean	340.17		338	165	200	253	245
Range	208 to 593	•	224 to 663	93-269	•	•	•

•No values were given.

It appears that the values of serum prealbumin for the Muputi children are lower than those observed elsewhere (except for the values for newborns). However, the values for transferrin are comparatively higher. Such differences are expected because, as Ingenbleek et al (1972) points out, there are variations due to physiological, pathological, ethnic and geographical conditions.

The significant difference between the transferrin levels of the wellnourished and the malnourished (PEM) children (Table XVII) can be said to confirm what Ingenbleek et al (1975) observed - that transferrin has intermediate sensitivity to an alteration in nutritional status.

1.2 Prevalence of PEM in Muputi.

All the 5 PEM forms (Bengoa, 1973) were identified. Acute PEM in terms of a deficit in either weight for age

or weight for length (Table VI) was the most prevalent. Chronic PEM as measured by a deficit in length for age (Table XIII) was observed in 49(21.9%) children. Poor nutrition apart, undoubtedly, other factors played a role, such as repeated infectious and parasitic diseases. Hereditary factors may also be involved (Bennett, 1971).

Seasonal variation in the rate of growth of children has been demonstrated in various studies (Lawson, 1967; Sundaraj et al, 1969; Tanner, 1968; Reynolds and Sontag, 1944; Mashall, 1971) and in Gambian children (McGregor et al, 1968). In Muputi, like in some other parts of the country, there are marked wet and dry seasons and in the past decade there has been a tendency for prolonged spells of drought. The seasonal shortage of food is a contributing factor to the prevalence of PEM in the area, as has been observed in other parts of the district (Jansen, 1976).

Severe PEM in the form of kwashiorkor and marasmus was observed in 7(3.1%) children out of which 4 had marasmus, 1 had marasmic-kwashiorkor, and 2 had kwashiorkor. The rate of severe PEM in Muputi appears to be slightly higher than some of the rates observed in other parts of Machakos (Jansen, 1977; C.S.B., 1977 and Uganda (Rutishauser, 1972), but lower than in Algeria (proceedings report, 1970) where about 16.6% was found in the 0-4 year olds. When expressed in terms of a combination of both acute and chronic PEM (Table XV), severe PEM was observed in 26(11.6%) children. It is not easy to explain this high rate of severe PEM. However, it appears that these children suffer from malnutrition early in life as indicated by the 49(21.9%) stunted children in Table XIII. The poor nutritional status of the children is further aggravated during periods of famine - now an annual catastrophy in Machakos and some other parts of Kenya. At the time of the survey, the survey community was already experiencing famine and

though the government was supplying them with maize and beans, the quantities were not enough for all members in most households. The children are the immediate victims of such food shortages and the effects are more pronounced in an already malnourished or borderline child. This is a sad situation because chances of such children recovering completely from the consequences of PEM are debatable. McWilliam and Dean (1965) illustrate in their follow-up study that even with improved feeding, a child who has suffered from PEM takes long, if at all, to regain his normal pattern of growth and development. In the first sentences of his speech, Seffar (1970) points out that "a poorly-fed country cannot have the necessary dynamism for economic and social development. Undernutrition and malnutrition have in fact, very unfavourable repercussions on the physical and intellectual out-put of adult workers". In Muputi, some of the affected children may adapt themselves to the seemingly

perpetual problem of malnutrition to such an extent that their physical measurements are proportional. Such children may grow into small-sized adults, and this in turn, has its own social, economic and other forms of repercussions. Worse still, some of the malnourished children may suffer from permanent impairment of mental and intellectual abilities as observed elsewhere (Hoorweg, 1976; Latham and Cobos, 1971; Birch et al, 1971; Birch, 1972; Botha et al, 1968). Abnormal physical development in malnourished children has also been observed by other researchers such as McWilliam and Dean (1969); Krueger (1969); Suckling and Campbell (1957); Cravioto and Licardie (1973); Stanfield (1975).

Certainly, something should be done to prevent such a high prevalence rate of protein-energy malnutrition in Muputi, but before relevant recommendations can be made, the possible contributing factors to the syndrome will be examined.

2. VARIABLES ASSOCIATED WITH PROTEIN-ENERGY MALNUTRITION IN MUPUTI.

Introduction

This study failed to prove significant associations between protein-energy malnutrition and most of the factors investigated (see Table XXIV). However, the study proved that maternal school education, occupation of the head of the household, environmental hygiene of the household, village, as well as sex and birth order of the child are significantly associated with childhood protein-energy malnutrition in Muputi. So did age of the child when breastfeeding stopped.

2.1 Maternal School Education.

Of the 78 children whose mothers had five or more years of schooling, only 18(23%) had PEM as opposed to the 36(45.6%) affected of the children whose mothers never went to school. This finding confirms the hypothesis that the nutritional status of a young child is directly influenced by maternal level of school education.

Generally, an educated mother is expected to be more health-conscious and therefore more likely to keep her children in a better hygienic condition than an uneducated mother. In so doing, the educated mother protects her children from infectious and parasitic diseases, the main aggravating factors to suboptimal malnutrition (Salomon, et al, 1968; Cutting and Cutting, 1971; Scrimshaw, et al, 1967).

A mother who can write and read stands a better chance than an illiterate mother, of understanding, appreciating and probably practicing the teaching in the nutrition and health education program she may be exposed to. In cases of artificial feeding, an educated mother would understand the instructions given of preparing artificial feeds much more than an uneducated mother.

Nyerere (1975) remarks that "formal education in school or adult classes system is no substitute for the informal education provided by life experiences". However, there

are certain aspects of child care based on life experiences which are not conducive to the health of a child. It is such aspects that need to be corrected or modified by the formal education system.

Durojaiye (1973) sees education as a means of occupation, whereas, Blaugh (1972) points out that "people with more education earn more on average the world over even when the family background factors are held constant". Not only that, but an educated mother has better chances of marrying an educated and probably working man, thus bettering her socio-economic status.

Maternal school education appears to have no significant association with most of the other factors (see section 9 of Chapter Three above). This is not surprising as there may be other more important factors that are involved but were not investigated (mainly because they were beyond the scope of this study), for instance, genetic factors and attitudes of

the male head of the household towards for instance environmental sanitation. The same is true of the choice of village to settle the household. In other cases, the insignificant associations could have been due to other reasons, which may include small sample size.

Breastfeeding is on the decline in various parts of the world, particularly in urban areas (Bader, 1976). The trend is partly due to the growing socio-economic pressure which forces women to go to work even before their babies are six months old, and partly because some mothers just refuse to breastfeed claiming it is "out of fashion" or that the practice will ruin the shape of their breasts. The so-called "Women's Liberation Movement" seems to play a role in discouraging breastfeeding (Helsing, 1975), which is a pity. However, there are movements as reported by Tompson (1975) such as the La Lèche League, the Nursing Mothers of Australia, Ammehjelpen,

and the advertisement of "Breast-Feeding is Best for Baby", by the Zambia Government (Wade, 1974) which are doing a good job of promoting breastfeeding.

In Muputi, tradition and education seem to play a role in determining when a mother should stop breastfeeding. Of the 117 children who stopped breastfeeding at the age of more than one year, 72(61.5%) had mothers with some school education. Thus, it seems that mothers who never went to school tended to stop breastfeeding much earlier (when the children are less than one year old), and the reasons they gave included:-

a) "another pregnancy" (29 cases).

b) "The child is too big" (7 cases).

c) Poor health of the mother (5 cases).

d) "Has no milk" (4 cases).

Most (about 80 percent) of the educated mothers said they stopped breastfeeding because they felt "the child was too big".

Interestingly, bottlefeeding was very commonly practised by the educated mothers, as demonstrated by 80(70.2%) of the 114 bottlefed children who had mothers with some school education. Of these 80 children, 47(58.8%) had mothers with five or more years of schooling. Is it possible that the educated mothers in Muputi are more health-conscious, as a result of which they use the bottle as a supplement to the breast. Many mothers may feel the need to bottlefeed their children, considering the fact that most of the mothers are fulltime housewives. Such mothers often leave their younger children at home with other members of the household while they go to carry out their daily activities like fetching water, looking for firewood, cultivating and going to the market. Not only that, but breastfeeding alone is not sufficient for a growing child after the age of about four to six months. Studies on human lactation, as reported by Müller (1975) show that in malnourished mothers, secretion

of breastmilk is insufficient (Rutishauser, 1974; Bailey, 1965; Martinez and Chavez, 1971; Belavady, 1963). Apart from poor nutritional status of the mothers both during and after pregnancy, social, cultural, psychological and emotional other factors may influence lactation (Bader, 1976; Jansen, 1977).

It should be pointed out that bottlefeeding can be dangerous to a young child's health, particularly in situations where poor socio-economic conditions prevail and where the majority of mothers are illiterate (Bennett and Stanfield, 1972; De Maeyer, 1976; Omululu, 1972 and 1975; Namboze, 1964, 1967 and 1969; Vamoer, 1969; McLaren, 1966; Welbourn, 1958; Tshabalala, 1969; Jelliffe 1969; Tarnow-Mordi, 1974; Gupta and Mwambe, 1976; McGregor et al, 1968; Scrimshaw et al, 1968).

2.2 Socio-economic Status versus PEM

Two of the three indices used to measure socio-economic status in this study were not significantly related to the nutritional status of the children.

However, a significant association was observed between the occupation of the head of the household and the prevalence of PEM. 75 percent of the children living in households headed by working (salaried jobs) people were wellnourished as opposed to 55 percent of the children in households with subsistence farmers as heads. Though this is only one indicator of socio-economic status, its significant association with child-nutrition confirms what other authors have pointed out (Bennett and Richmond, 1963; Victor et al, 1971; Jelliffe and Jelliffe, 1972; Wray and Aguirrie, 1969; Desai, 1970; Ballweg, 1972; Grewal et al, 1973). The hypothesis that an educated mother has a better chance of marrying a working man with a salaried job was proved in this study where 65 percent of the married mothers with five or more years of schooling had working husbands. This may further explain why most of the children of such mothers were wellnourished.

In Muputi, like in most dry parts of the country, food is scarce which means that a household headed by a working person stands a better chance of buying food (to supplement whatever is produced from the family shamba) to ensure an adequate food supply for the members. It is only assumed that the food bought is nutritious and that food distribution between the household members is fair enough for the good nutritional status of the young children. Alternatively, a household with a reliable source of income can afford to adopt innovations aimed at improving the agricultural potential of the land owned, and hence, maintain a good food supply for the household members. A person with a cash income is also more likely to change her or his food habits.

It was found that 59.5 percent of the children in both Ikulu and Kamweleni, came from households headed by subsistence farmers as opposed to the 37 percent of the children

from similar households in the rest of the Sub-location. The association between occupation of head of the household and village was not significant. However, the relatively higher percentage of non-working heads of households in the two villages may help explain the high prevalence rate of protein-energy malnutrition in these two villages. Similarly, maternal level of school education appears to be a contributing factor. Of the 78 children whose mothers had five or more years of school education, 55(70.5%) came from the other three villages (Mwanyani, Uamani and Kangata). The relationship though not significant, may partly explain the observed inter-village differences in nutritional status of the children, an observation made elsewhere (Bennett and Alozie, 1967; Oomen, 1958).

Considering accessibility, Ikulu village is nearer to Machakos Town than is Kamweleni village (Figure II). Unfortunately, Ikulu is on the slopes of Kiima Kimwe hill

and there are no good roads, as a result of which there is no public transport system to the village. The rest of the other villages are near the main Masii-Machakos road which has some regular means of transport. In the case of Kamweleni village, other contributing factors may have a role, such as lack of cash for transport for mothers to regularly take their children to the maternal and child welfare clinic - an important practice for proper follow up of a mother and her young children. Alternatively, some mothers may not be motivated enough to take their children to such clinics. This was evidenced by the lack of co-operation shown by some mothers in these two villages (Kamweleni and Ikulu) during the survey.

Environmental hygiene was significantly associated with the locality of the villages. Of the 153 children from households with 'good' environmental hygiene, 107(69.9%) were from the other three villages (Kangata, Uamani and Mwanyani). It appears that the

households in both Kamweleni and Ikulu have substandard environmental hygiene which may be dangerous to the health of a young child. In this study, a highly significant relationship was observed between environmental hygiene and protein-energy malnutrition ($X^2(2) = 11.07$ $P < 0.05$).

The dangerous synergism between infection and PEM is well known (WHO, 1963; Marsden and Marsden, 1965; Omululu, 1961; Mata et al, 1971; Morley et al, 1966; Scrimshaw et al, 1967-1968; Morley et al, 1969; Cutting and Cutting, 1971; Cutting and Kumari, 1970; Frood et al, 1971; Salomon et al, 1968; Lowenstein, 1967; Platt et al, 1961). There was no association between the prevalence of PEM and helminthic infestation in the present study. This finding may be the result of either the small sample selected or the fact that a quantitative laboratory investigation of the parasites was not carried out. Alternatively, probably the area was too dry to favour the transmission of some of the helminths and so infestations were always very light, if they occurred at all.

Sex of the Children Versus PEM

There was a strikingly significant difference between the nutritional status of the male children and that of the female children 25.9 percent of the male children were malnourished as opposed to 47.4 percent of the female children. This observation is similar to those of Wray and Aguirrie (1969); Ballweg (1972); Grewal et al, (1973) C.B.S. (1977) and Yousif (1967). However, Lal (1952) found the reverse in his study. Whether the finding in this study is the result of cultural factors, such as the tendency for parents to have a more positive attitude to the male than the female children as observed in certain communities (personal observations of the author) or to the different physiological make up of the two sexes which may lead to the male children to have a better appetite and hence eat more than the female children, remains questionable. Various studies have shown that female children generally have lower birth weights than male children

(Bennett and Alozie, 1967; Omululu, 1975). This disadvantage may be a contributing factor to a higher prevalence of PEM among the female than the male children.

Birth Order of the Child Versus PEM (Figure X)

Of the 126 children who were below the fifth birth order, only 26.2 percent had PEM compared to 51 percent of the children of the higher birth orders. This may be the result of the tendency for most mothers to observe strictly good child care with their first few children and then relax as the number of children increases. In Muputi, there is no evidence to prove this, but, it may be speculated that the mothers in Muputi are not very much different from other mothers on this particular issue.

Alternatively, if the birth order of the child is considered as an indicator of the approximate number of living children a mother may have, the observation can be explained in terms of mother's workload.

That is, the more children a mother has, the heavier the workload. This may have negative physical and psychological effects on the mother, as child care is only one of the many daily household chores a mother, particularly in the rural areas of most developing countries, is expected to carry out. In addition, the more children there are in a household, the more mouths a mother has to feed, and this is not always easy, particularly under conditions of food shortage. The younger child may suffer the consequences like not getting all the attention required for proper growth and development.

It should be pointed out that the factors that the author chose to investigate in this study are not the only important ones. There are many others (Jelliffe and Jelliffe, 1972; Morley et al, 1968) which were excluded mainly because of the limited time and personnel and because some of them were too

expensive to investigate. For instance, the psychological characteristics of the mother, the amount and quality of maternal child care practices, details of the cultural, traditional and religious influences on child weaning and feeding, quantitative and qualitative food intake of the child as well as the actual food distribution between the different household members, needed investigation for proper conclusions.

Growth retardation has also been attributed to organic disease (Harris, 1974 Lacey and Parkin, 1974), severe emotional deprivation which may lead to failure of growth hormone release (Powell et al, 1967), and poor home environment (Lacey and Parkin, 1974). It would be quite interesting to examine these factors and their effect on the nutritional status of young children in Muputi.

C H A P T E R F I V E

CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS

The findings of this study may lead to the following conclusions:-

1. Protein-energy malnutrition (PEM) is prevalent in Muputi Sub-location. The prevalence rate of PEM in Muputi is similar to those observed in most parts of Machakos District, Central Province, and Western Province (Blankhart, 1972). The rate is however, lower than the rates observed in Turkana (65%), Nuu, in Kitui (45%), Mbooni and Iveti in Machakos District (55% each), some parts of Coast Province (over 40%).

2. The prevalence rate of PEM of 37.1% in Muputi Sub-location is high enough to warrant concern among health personnel in the country and among other Government agencies.

3. Maternal level of school education, socio-economic status and the environmental hygiene of a household and certain child-related factors such as the sex and birth order of the child are significantly associated with the nutritional status of a young child in Muputi, and probably in the country in general, and any other community in the developing world.

4. It appears that even within the same community, there are village variations in the nutritional status of young children and this may be attributed to a number of factors including, ecological as well as socio-economic. In this study the two villages with the highest prevalence rates of PEM also had households headed mostly by subsistence farmers as opposed to cash-earning people in the rest of the sublocation. There were also more uneducated mothers in the two villages. These findings support the theory that nutritional status could be used as an indicator of socio-economic status.

5. In this study, it has been possible to identify some of the contributing factors

to malnutrition in Muputi Sub-location. It has also pointed out that there are village variations in the nutritional status of children of the same community, an observation made by other research workers such as Bennett and Alozie (1967). The failure of this study to find any significant associations between most of the factors investigated, particularly those related to the weaning and feeding of a young child, leaves openings for further research in the field of child malnutrition.

6. Other factors such as drought and its related problems including increased vulnerability of the people, particularly the young children to malnutrition (Mbithi and Wisner, 1972) because of food shortage, and lack of adequate clean water may have played a part in the poor nutritional status of the children.

2. RECOMMENDATIONS

1. The significant association between maternal level of school education and protein-energy malnutrition in this study may suggest a great need for an education campaign directed mainly towards the girls in the area and the country as a whole.

2. The government should consider extending the free education system beyond the four years of schooling, because, in Muputi, like in most parts of the country, parents cannot afford to educate their children adequately due to lack of school fees. Educating a child to a level such as standard four leaves much to be desired, as such a child cannot get a job to support himself or herself and the family.

3. Basic nutrition and child care should be introduced into the curriculum of primary and secondary school education and all schools should teach these

subjects as early as the second year of schooling. This would, to a certain extent, enable the school leavers to bring up better nourished families whether they get jobs or not.

4. Children should be introduced to solid foods (nutritious, rich in protein as well as calories) early (4 to 6 months) but gradually.

5. Breastfeeding (with supplementation) for at least one year of age of the child, (and preferably into the second year of life) should be the rule for every mother. Bottlefeeding should be practised only if necessary and it should be done under adequate hygienic conditions. The dilution of the bottlefeeds should be such that it does not endanger the health of the child.

6. Environmental hygiene of households can be improved if the people are exposed to free health education. This can be done by the health personnel at Barazas, community centres and by home visits. The latter may

prove to be more effective because some mothers may not be able to attend these classes outside their homes, either because of distance or a heavy household workload.

7. Mothers in Ikulu and Kamweleni villages may need special attention from the health personnel because of the high prevalence rate of malnutrition observed in these two villages. The mothers may need to be motivated to observe proper child care practices. Mothers also need to know that the female children are more prone to malnutrition (possibly because of the lower birth weight) and hence need extra attention.

8. A more detailed and well designed research into the effects of parental attitude to a child, dietary intake of the child, as well as parasitic, infectious and other diseases on the nutritional status of the young child should be carried out either in the same community or a similar community in the country. The effect of hereditary

and environmental factors on the growth and development of children still need to be differentiated to be able to explain better some of the findings in nutrition surveys, and hence for proper conclusions to be made.

9. Nutrition education of the mothers particularly at home may improve the nutritional status of the children.

10. The secular trend for growth in most parts of the world has tended to be upwards, that is, higher birth weights, heavier and taller individuals especially because of the improved environmental conditions and nutrition. In Muputi, it is difficult to predict the secular trend because of the increasing drought, overcrowding, poverty, famine and deteriorating soil conditions. Intermarriages with members of other communities or tribes may change the genetic background to growth. Longitudinal and repeated studies will be necessary to show the secular trend of the area.

11. It is recommended that the health authorities start a nutritional surveillance system, using weight-for-age, or upper-arm-circumference in order to detect Protein-Energy-Malnutrition, so that curative and preventive measures can be taken as soon as possible. Attention should also be paid to the nutritional status of the pregnant mother, as inadequate food intake may cause insufficient weight gain during pregnancy, resulting in a low birth weight of the newborn; morbidity and mortality rate are higher among these children than among "normal" ones.

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DOCUMENT I - GENERAL INFORMATION FORM

1. Location----------

2. Sublocation----------

3. Village ----------

4. Household No. ----------

5. Name of Head of Household----------

6. Occupation of Head of Household----------

7. Years spent at school by Head of Household ---------

8. Relationship of Head of household to the child.

---

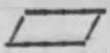
9. Housing conditions

a) Number of people in household

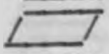
b) Total number of rooms excluding kitchen

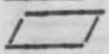
c) Average number of people per room

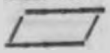
d) Total number of houses with roof made of:

(i) Corrugated sheet 

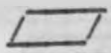
(ii) Grass/leaves 

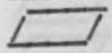
(iii) Flattened tins 

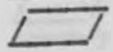
(iv) Tiles 

(v) Others (specify) 

e) Kitchen (location).

(i) Separate building 

(ii) Within the main house 

(iii) On verandah of main house 

10. Environmental Hygiene

a) Latrine - Present ☐ Absent ☐

b) Dry waste disposal

(i) Scattered ☐
(ii) Burnt ☐
(iii) Heaped compost ☐

11. Water Source

(i) Spring ☐
(ii) River ☐
(iii) Roof catchment ☐
(iv) Tap ☐

12. Livestock kept

	1	2	3	4+
a) Cattle	☐	☐	☐	☐
b) Goats	☐	☐	☐	☐
c) Pigs	☐	☐	☐	☐
d) Hens	☐	☐	☐	☐

13. Cash crops grown

	< 1 acre	1 acre	2 acres	3+ acres
Coffee	☐	☐	☐	☐
Tea	☐	☐	☐	☐
Sisal	☐	☐	☐	☐
Sugarcane	☐	☐	☐	☐

14. Food crops grown

	< 1 acre	1 acre	2 acres	3+ acres
Legumes	☐	☐	☐	☐
Cereals	☐	☐	☐	☐
Roots/tubers	☐	☐	☐	☐
Greenleafy vegetables	☐	☐	☐	☐
Tomatoes	☐	☐	☐	☐
Carrots	☐	☐	☐	☐
Fruits	☐	☐	☐	☐

DOCUMENT II: FOR THE CHILD

1. Village
2. Name of Head of Household
3. Name of child
4. Number of child
5. Age of child
6. Number of teeth of child
7. Birth order of child
8. Anthropometric measurements
   a) Weight /___/ Kg
   b) Height /___/ cm
   c) Upper Arm Circumference /___/ cm
   d) Chest Circumference /___/ cm
   e) Head Circumference /___/ cm
   f) Chest/Head circumference ratio /___/
9. Clinical signs of Protein Energy Malnutrition
   a) Oedema
   b) Moonface
   c) Mental changes
   d) Associated deficiency diseases (specify)
10. Laboratory Investigations
    a) Haemoglobin level ----------gm%
    b) Packed Cell Volume----------
    c) Stool (specify parasites)
       (i)
       (ii)
    d) Prealbumin mg%
    e) Transferrine mg%

DOCUMENT II: CONT'D

11. Immunisations child has received.

		Yes	No
a)	BCG	☐	☐
b)	Smallpox	☐	☐
c)	Measles	☐	☐
d)	DPT	☐	☐
e)	Polio	☐	☐

f) Where was the child immunised?

12. Dietary Data

a) Does the child still breastfeed? Yes ☐ No ☐

b) If Yes, how many times did the child breastfeed yesterday?

(i) On demand ☐
(ii) Once ☐
(iii) Twice ☐
(iv) Thrice ☐
(v) I don't know ☐

c) If No, at what age did the child stop breastfeeding? ☐ months

d) Did you ever bottlefeed this child? Yes ☐
No ☐

e) Does the child get supplementary feeding?
Yes ☐ No ☐

f) If Yes, at what age of the child was supplementary feeding introduced? ☐ Months

g) List the foods that were introduced.

DOCUMENT II: CONT'D

h) What did the child eat yesterday?

(use Table below)

	Food	Number of Times	Method of Feeding	Fed by	Comments
1.					
2.					
3.					
4.					
5.					

i) If child was not fed by mother, why?

(i) Mother away from home ☐

(ii) Mother sick ☐

(iii) Mother present but very busy or tired ☐

j) Did child feed well yesterday? Yes ☐ No ☐

k) If no, give reasons

(i) Child lost appetite

(ii) Child crying

(iii) Child satisfied

(iv) Don't know

l) Has the child been feeding well for the last week? Yes ☐ No ☐

m) If No, give reasons as in (k) above.

13. Has this child suffered from any serious disease lately? Yes ☐ No ☐

(Specify the disease and duration)

DOCUMENT III - FOR THE MOTHER

1. Village
2. Head of Household
3. Name of child
4. Number of child
5. Name of mother
6. Age of mother
7. Occupation of mother
8. Years mother spent at school
9. Marital status of mother - Married ☐ Single ☐
10. How many living children does mother have?
11. How many pregnancies has mother had?
12. Do you know kwashiorkor? ("Ndumi")

    Yes ☐ No ☐

13. If Yes, what causes it?

    (i) Poor food ☐
    (ii) God/Nature ☐
    (iii) Witchcraft ☐
    (iv) Don't know ☐
    (v) Others (specify)

14. How can it (kwashiorkor) be prevented?
15. Has any of your children suffered from it?

    Yes ☐ No ☐

16. If Yes, how was she/he cured?
17. What is the use of immunisations?

DOCUMENT III - CONT'D

18. How long were you away from the child yesterday?

(i) Not at all ☐
(ii) All day (morning + afternoon) ☐
(iii) All morning ☐
(iv) All afternoon ☐

19. Where did you go?

20. How many days a week are you away from home all day?

(i) 1-2 days ☐
(ii) 3 " ☐
(iii) 4 " ☐

21. When you go away from home, do you take the child with you? Yes ☐ No ☐

22. If No, whom do you leave the child with?

(i) Grandparent ☐
(ii) Relative ☐
(iii) Neighbour ☐
(iv) Older children ☐
(v) Father ☐
(vi) Others (specify) ☐

23. Have you been unwell of late?

Yes ☐ No ☐

24. If Yes, what did you suffer from?

25. When you are unwell, who takes care of the child?

(i) Mother ☐
(ii) Father ☐
(iii) Relative ☐
(iv) Older children ☐
(v) Other (specify)