FOOD INTAKE AND NUTRITIONAL STATUS OF A PRESCHOOL POPULATION IN SUBURBAN NAIROBI

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by

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DECLARATION

This Thesis is my original work and has not been presented for a degree in any other University.

Signed .....

Date 27. 2. 81.

This Thesis has been Submitted for Examination with my Approval as University Supervisor.

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Date 24/10/81

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CHAPTER I

INTRODUCTION

A very high proportion of people are suffering from malnutrition today. According to a report by UNICEF (1963) half of the population in developing countries suffer from malnutrition especially of the Protein-Energy deficiency type. The majority of those suffering from malnutrition were identified as children.

There has been awareness of the dangers and consequencies of malnutrition in Kenya for sometime. Efforts have been made and are still being made by both government and non government organisations in an attempt to combat malnutrition. Despite these efforts malnutrition is still a major public health problem in this country. Malnutrition retards physical growth, contributes to morbidity of children, and may finally cause death.

Deficient nutrition leads to low labour productivity as it affects work performance adversely. Tiredness, despair and apathy are associated with low energy intake. Poorly fed people therefore cannot participate fully in national development. This definitely slows down the country's rate of development.

The economic development of this country has not kept pace with the rate at which the population is growing. When population growth rate is higher than economic growth, the countries resources become strained.

The annual rate of economic growth averaged 4.7% between 1972 and 1977. The largest share of this increase has been used to provide goods and services needed by additions to the population. The little that remains is used on improving quality of life (Development Plan 1979/83).

Food shortage may result from the fact that:

1. Enough food to feed everybody is not produced.

2. Resources for purchasing food are limited.

3. Enough food is produced but has to be sold to provide resources for purchasing other required services.

Evidence of inadequate food intake may be present even where food is available. This may result from ignorance where people are not aware of body requirements, or where there is faulty absorption.

Deficiency of nutrients in the body contributes to the magnitude and severity of other body disorders (diseases) by undermining the bodys' resistance to them. This results

in funds being diverted from other development programmes to be used in improving health status of the people. This is done by buying more medicine, increasing health facilities and maintaining the sick.

Protein - energy malnutrition (PEM) is the commonest nutritional deficiency among children. PEM comes in various forms. The severest forms are marasmus and kwashiorkor. The less severe forms are referred to as mild or moderate PEM. The majority of the children suffer from mild or moderate types. When food intake deteriorates, these two advance to the more severe syndromes.

Certain groups of the population are more vulnerable to malnutrition than others. Such are the preschool children (0-5 years), adolescents and pregnant and lactating mothers. In the first group children from conception to the age of four years are hardest hit by deficiency. For them this is a period of rapid growth and therefore of elevated nutrient requirement.

Adolescents also have elevated nutrient requirement as this is also a period of accelerated growth. Furthermore not only are nutrients required for growth but also for

increased physical activity which is a characteristic of this period.

The pregnant and lactating mothers have special nutrient requirement. The pregnant mother provides nutrients for herself and the fetus. The lactating mother provides nutrients for the formation of breast milk as well as for herself.

It is vital that adequate nutriture is maintained in these special groups. Judging on the basis of their vulnerability if the nutriture of these groups is adequate, then it can be safely assumed that the nutritional status of the population is satisfactory.

Definitions: The following terms are defined as referred in this study.

Cluster: is a sequence of households containing not less than 200 people.

Household: is a group of people habitually sleeping and eating together within the same homestead. A homestead - contained as many households as there were heads.

Household Head is the person regarded as the main bread-winner and is looked upon as the head by the other members of the

if that person benefits from the intake of a well - balanced diet, it may be poor if he is deprived of an adequate amount of the essential nutrients. Nutriture in this study is a term used to mean the same thing as nutritional status.

Malnutrition is the pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients. This state being clinically manifested or detected only by biochemical, anthropometric or physiological tests (Jelliffe 1966).

Justification of the Study

The few studies that have been carried out in both the rural and urban areas in Kenya indicate that malnutrition is a major public health problem. It is the responsibility of the government to see to it that its people are properly fed; for no successful economic development can be achieved by people who live under conditions of poor health and nutrition.

The Government therefore needs ongoing information about the nutritional conditions of the population, and factors that influence them, as problems may not be defined and policies formulated in the absence of information.

Though this study was not done at the government's request, it was hoped that the government or any other interested organisations would be able to use the information provided as:

(a) a basis for decisions to be made in formulation of policies, in planning and management of programmes relating to improvement of food consumption pattern and nutritional status.

(b) analysis of causes and associated factors to permit a selection of preventive measures which may

be or may not be nutritional.

The study was aimed at describing the nutritional status of the population with particular reference to preschool children who are identified as being at risk. Children are very susceptible to nutritional deficiency. Their nutriture would reflect that of the community they belong to and were therefore studied inorder to be able to predict the nutriture of the whole population.

Planning of the Study

After selecting a topic for study and identifying study area, a research permit was obtained from the President's office.

To achieve the objectives of the study the following was done : some examinations were carried out, some information was collected on socio-economic factors and on the health of the children.

Tests

1. Anthropometric Measurements.
2. Examination for identification of nutritional deficiency signs.
3. Blood tests
4. Stool examination
5. Dietary intakes
6. Recording of teeth eruption and closure of fontanelle.

Personnel

Two Medical doctors assisted in fieldwork and the study as a whole. They assisted in any training required by the author and in training of field assistants.

Two field assistants were recruited and trained for a period of one month. They were given both theoretical and practical

training. Training mainly concentrated on field techniques and use of equipment. The practical training was done at the out-patient and child welfare clinics of Kangemi Health Centre

Medical Research Centre was requested and agreed to carry out the laboratory estimation of haemoglobin and haematocrit levels. Division of Vector - borne diseases (Ministry of Health) was requested and agreed to carry out Stool examination for identification of gastrointestinal parasites.

Contact with the Community

This was done with the help of the sub-chief of Kangemi during three different public meetings. It was during these meetings that the objectives and procedures of the study were clearly outlined to the community.

While training of field assistants was being done at the out-patient and child welfare clinics at Kangemi health Centre the oncoming study was mentioned to the mothers who had come for treatment and for clinics. The Medical Officer in charge of Kangemi Health Centre agreed to see any children who may be referred to her by the study team.

She also agreed to supply antihelminthic drugs to the study team. These drugs were to be administered to the children whose stools showed that they were infected with helminths.

Transport

Public transport was utilised for all transport requirements, including transportation of specimens to the laboratories. Although it was adequate it was inappropriate.

Equipments Used in the Survey

The equipment used in anthropometric measurements were:

1. Weighing scales
2. Portable Anthropometric board
3. Tape Measures
4. Skinfold calipers
5. Weighing baskets and pants.

Each equipment is described in relation to the examination for which it was utilised.

Scales

A Sturdy spring balance of Salter type model 235 weighing 25 kg x 100 g was used for assessing the weights of children. The same scale was used for weighing large quantities of food. Two additional scales Salter No. 59

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to weigh 4 kg. x 25g and a dietetic scale (Soehnle) to weigh 25g x 2g,, were used for weighing smaller quantities of food.

All these scales were easily transportable and very appropriate for field purposes.

Calibration

The scales were taken to Department of weights and measurements, Ministry of Commerce and Industry for calibration. The scales were taken there every six weeks preceeding every weighing season.

In order to be able to check the day to day accuracy of the scales, some metal blocks which had been weighed and stamped with their weights were used. The weights of these metals had been determined at the Department of Weights and Measurements.

Length Boards

A portable anthropometric board, (I20 cm. long) with a fixed tape measure which could be read to accuracy of 0.I cm. was used.
See Jelliffe (I966) p. 68 for description of the length measuring board.

Tape Measure

A narrow flexible non stretch tape made of fibre glass and reading to the accuracy of 0.I cm. was used for the following:

I. Head
2. Chest
3. Arm

) circumference measurements.

Skinfold Calipers

Harpenden skinfold calipers were used for:

I. Triceps skin-fold
2. Subscapular skin-fold measurements.

It read to an accuracy of 0.I mm.

All the equipment required was supplied by Medical Research Centre and Department of Community Health (Faculty of Medicine). Division of Vector-borne diseases supplied specimen containers required for stool collection.

Pilot Study

A pilot study was done for I0 days to test the questionnaire, to see whether it was clear to both the field assistants and to the respondents. Any questions that needed re-wording were rephrased.

Standardization of Techniques

Though standardization of techniques was taken into consideration as training of field assistants progressed, two days were set aside exclusively for this purpose. The main purpose was to make sure that the people involved in field survey carried out measurements in the same way and obtained similar results. This was especially in regard to the 'pinch' for skinfolds, in measuring of the circumferences, in reading of the scales and in measuring lengths.

RESEARCH SETTING

Situation This study was carried out in Kangemi which is one of Nairobi's suburban locations. Kangemi is situated approximately eight kilometres west of Nairobi city centre. It lies along the main Nairobi-Nakuru road (see map 1).

Administration Kangemi which is under Nairobi City administration is divided into plots which are alocated to people in three forms:-

1. Township
2. Satellite
3. Farmland

The township and satellite areas are mainly composed of small plots which are owned by individuals. Owners put up dwellings which are rented to people. These areas tend to be overcrowded. A few of these plots have small vegetable gardens.

Farmland plots are different from township and satellite plots. They are much larger in size and mainly house only the family of owners. They have a rural character where cattle rearing and crop production go on (both food-stuff and cash crops i.e. coffee, are grown).

Kangemi has a dual administration in that on one hand it is under a District Officer and directly under a sub-chief. On the other hand it is under the city council of Nairobi with an area councillor.

Population of Kangemi

In August I979 a population census was carried out in Kenya. Unfortunately figures are not yet available. Data from baseline survey done in I973 by the Central Bureau of Statistics is used to show the population structure.

Table I.I Percentage Distribution of Kangemi Population by Age and Sex

AGE-GROUP (years	MALE	%	FEMALES	%	TOTAL	%
0-4	2064	8.8	20I8	8.6	4082	I7.4
5-9	I337	5.7	I384	5.9	272I	II.6
I0-I4	I056	4.5	II73	5.0	2229	9.5
I5-I9	II26	4.8	I3I4	5.6	2440	I0.4
20-24	I689	7.2	I50I	6.4	3I90	I3.6
25-29	I736	7.4	962	4.I	2698	II.5
30-34	I290	5.5	563	2.4	I853	7.9
35-39	I056	4.5	422	I.8	I478	6.3
40-44	727	3.I	2II	0.9	938	4.0
45-49	563	2.4	I88	0.8	75I	3.2
50-54	305	I.3	I77	0.5	422	I.8
55-59	2II	0.9	70	0.3	28I	I.2
60+	258	I.I	I64	0.7	422	I.8

Persons falling under the following age groups are regarded as not capable of working 0-I4 years, and those aged 60 and over. The baseline survey findings as presented in table I.I indicate that 40.3 % of the people are not employable.

A later study by Mullick (I979) revealed a high dependency ratio of 312%. She also found a high rate of unemployment whereby 46% of the individuals aged 20 years and over were unemployed, and did not give the number of the employable people who were not employed.

Educational Status

Table I.2 Educational Status of Kangemi Sample Aged Five Years and Over

Years of Schooling	Number	Percent
0	624	I6.0
I-4	862	22.3
5-7	II75	30.3
8-I0	650	I6.8
II-I3	562	I4.5
Total	3872	I00.0

Table I .2 is used to indicate educational status of the sample population as found by Mullick (I979).

Income, Employment and Occupation Tate (I973) estimated from a sample population that the average income for the employed was six-hundred Kenya shilling per month and only 22% of the employed were getting over one-thousand shillings per month. Mullick (I979) found that only 54% of the people aged twenty years and over were employed.

Household Head and Size I5.7% of the households were headed by females, the rest 84.3% were headed by males. Out of all the households headed by males, I7.2 percent were male occupied only. It was also found that the average household size was 4.4 persons.
(Mullick I979).

Ethnicity

Table I.3 Ethnic Group of a Sample

Ethnic Group	Number	Percentage
Kikuyu	3II2	60.9
Baluhya	II9I	23.3
Luo	3I7	6.2
Akamba	206	4.3
Others	282	5.3
Total	5I05	I00.0

Source : Mullick (I979)

The ethnic groups in Kangemi are shown in table I.3. It is clear from the table that Kangemi residents are predominantly Kikuyu.

Amenities

Since I978 Kangemi has had a post office installed. There are approximately ten telephones operating in Kangemi Satellite and Township. These belong to individuals, schools, the Health Centre and one in the Social Hall.

There are a few individually owned television sets but there is one available for public viewing at the social hall. Over half the households have a radio receiver, while English and Swahili newspapers are available at the shopping Centre Other services available include, seven licensed bars, two night-clubs and two members clubs. Other activities take place in the social hall such as boxing and traditional dancing. There are two churches, one belonging to the Catholic church the other belongs to the Anglican church.

Reported Diseases The following were the top most common diagnosis at Kangemi Health Centre as reported by Mullick (I978)

I. Upper respiratory tract infection
2. Pneumonia
3. Diarrhoeal diseases
4. Helminths infestation
5. Measles
6. Protein energy malnutrition

7. Sexually trasmitted diseases

8. Burns.

Nutritional Problems Due to lack of records, data was not available on the magnitude of malnutrition in Kangemi. Yearly reports from the Medical Officer at Kangemi Health Centre have indicated that many malnourished children were seen at the Clinic there and that those affected were usually children up to the age of three years (Mullick 1978).

Food Availability Various food-stuffs were available at Kangemi. Vegetables, fruits and dried fish were available at the markets. Whole maize, maize-meal and wheat flour, were available at both the markets and at the shops. Meat was available at the two butcheries in Kangemi, they got their meat from the slaughter house at Dagoretti. One of the butcheries was selling pork twice a week. Groceries such as tea leaves, milk, eggs, cooking fats and oils were also available at the shops.

Environmental Sanitation The only means of excreta disposal were poorly maintained pit-latrines. These latrines were used on communal basis, that is more than one or two households were using one latrine. Defecation by preschool children was indiscriminate. The children defecated just anywhere. The fecal matter was either collected by mothers to be thrown away or

was left to be eaten by dogs or chicken.

For most households refuse was usually left scattered indiscriminately around the houses, but a few poeple burnt theirs. The City Council had not made any arrangement for refuse collection and disposal in this area.

Water Source Majority of the people used pipe water, but a few used water from the river. (Some also used rain water during the rainy season).

Housing The majority of the houses in Kangemi have walls made of timber slabs usually with concrete floors, but a few have mud floors. The roofs are made of corrugated iron sheets. There were a few houses with mud walls, flattened tins roofs, and earthen floors. Very few houses were built of stone. Stone buildings were mainly commercial buildings.

According to Mmella (1977) who did a study of housing in Kangemi, the houses were overcrowded and were poorly ventilated.

CHAPTER 2

LITERATURE REVIEW

PROBLEM OF MALNUTRITION

In a WHO proposed budget (1976-77) it was estimated that 400 million people in the world periodically suffer from hunger and malnutrition. The majority of the people suffering from malnutrition live in developing countries. An example of groups of people who are likely to suffer from malnutrition is given as identified here in Kenya (Development plan 1979-83). These groups are:-

1. People whose incomes are particularly low. 72% of the total Kenyan population fall under this group. (the average income of these people is not quoted). However, it is estimated that 22% of the people in this group have a household income of about 90/= per month.

2. The urban poor: this group includes the unemployed, and also those who have an income of less than 700/= per month.

3. The pastoralists: who are approximately 700,000 in number. These people do not get enough to eat, they concentrate on cattle herding and do not involve themselves in crop production.

4. The preschool children, pregnant and lactating mothers. These groups have special nutrient requirement.

Schaefer (1960) identified protein-energy malnutrition, Xerophthalmia, nutritional anaemia, endemic goitre and rickets as common deficiency disease with PEM being the commonest of them all.

Due to the magnitude of PEM, the need for a common definition and a standard criterion that could be applied was realised. This need was emphasised by a joint FAO/WHO expert committee on nutrition (1971). A request was made for classifications and various people came up with proposals.

The components of PEM have been identified as kwashiorkor, marasmus, marasmic-kwashiorkor and underweight. Basing its proposal on these components a Wellcome Working party came up with one of the classifications being used today. This is illustrated in table 2.1 below:-

Table 2.1 Classification of PEM Suggested by the Wellcome Working Party. (Waterlow 1976)

Weight as % Standard (havard)	Oedema	
	Present	Absent
60-80%	Kwashiorkor	Underweight
60%	Marasmic-Kwashiorkor	Marasmus

The classification shown in table 2.1 is based on the presence or the abscence of oedema.

A classification of PEM had been suggested earlier by Gomez (1956) that divided PEM into 3 categories

1st degree 90-75% of Havard Standard
2nd degree 75-60% and
3rd degree less than 60%.

Gomez's classification did not take into consideration the fact that oedema is evidence of advanced PEM, and that it increases body weight (Waterlow 1976).

A third classification was suggested by Jelliffe (1966) which was similar to Gomez's but with different cut-off points, where cases above 80% Havard standard were classified normal:-

1st degree 80-70%
2nd degree 70-60%
3rd degree less than 60%.

Waterlow (1976) also gave classification by McLaren & Read and Kunawiti & McLaren using weight for height for age. Weight for height, above 90% was regarded as normal, 90-85% mild PEM, 85-75% moderate PEM and less than 75% as severe PEM. Height for age above 95% was normal, 95-90% mild PEM, 90-85% moderate and below 85% severe PEM.

Gomez, F. et al (1956) Journal of Tropical Pediatrics 2.77.

Marasmus is attributed to dietary inadequacy of calorie while kwashiorkor is a disease that results from unavailabity of protein in the body. Protein deficiency would result from inadequate intake of protein food or from utilisation of protein as energy where calorie intake is deficient. Kwashiorkor tends to affect young children who have been weaned onto a staple diet of low protein value.

Presence of severe kwashiorkor or marasmus represents only a small fraction of all malnourished children. For where there is evidence of these severe forms of PEM, there are many more children with moderate and mild forms, as indicated by findings reported by, Jelliffe and coworkers (I975), Gopalan (I975), DeMaeyer (I976) and Reynes (I977).

Demaeyer (I976) reviewed information from 25 surveys done since I966 on children aged 0-5 years. These surveys were done in I7 different countries in Latin America, Africa and Asia (Japan and China were excluded when reviewing data from Asia). He came up with the following estimates. In Latin America, severe forms of PEM affected 0.5-6.3% of the children, while moderate forms affected 3.5-32.0%. In Africa, severe forms affected I.7-9.8% while moderate forms affected 5.4-44.9%. In Asia severe forms affected I.I-20.0% while moderate forms affected I6.0-46.4%. The ranges are given because incidence of PEM varies from country to country.

It was reported in I963 (Report by UNICEF) that more than half the preschool children in developing countries suffer from malnutrition. Jelliffe and coworkers (I975) estimated that mild PEM affected 2/3 of child population while severe syndromes affected I-7% of the children.

In an attempt to show the magnitude of malnutrition, data from some of the developing countries is given.

In India, there are nearly 85 million children below the age of five years. According to Gopalan (I975), 80 to 90% of these children exhibit varying degrees of growth retardation, while between 2-3% exhibit severe forms of PEM. Vitamin A deficiency was evident in 3-5% of the children.

In Philippines, Reynes (I977) collected weight data on children aged between 0-6 years. He regarded 9I-II0% weight-for-age as normal, 76-90% as first degree, 6I-75% as second degree and 60% and below as third degree PEM. His findings indicated that only 28% of the children under study were of normal weight and growth. A great proportion of the children (the actual figure was not given) had first degree PEM. Second degree PEM affected 20%, while third degree affected 6%. He found that children had normal growth upto the age of five months, and that they started developing first degree malnutrition at 6-II months. Second degree malnutrition was found to strike one to three year olds, while

third degree PEM had the highest prevalence rate among the two year olds. Reynes also assessed the children's nutriture by sex. He found that 31% of the boys and less than 24% of the girls had normal growth.

Community surveys in Tanzania by Kimati (1973), revealed that 25% of the children under five years were suffering from malnutrition. He also found that 50% of the children admitted for various diseases into paediatric wards had PEM of a certain degree.

Wharton (1971) found that various degrees of PEM affected 30% of the children in Uganda.

Here in Kenya Bohdah, Gibbs and Simmons (in the period between 1964-8) found that 26% of the children under five years had mild PEM while 10% had severe PEM. Steenbergen (1976) found that 16% of the children she examined had mild PEM, 24% had moderate PEM while 13% had stunted growth.

According to findings by Central Bureau of Statistics (1977) on the Kenya Nutrition, it was found that 33% of rural children aged between 1-4 years were malnourished as they were

below 80% weight-for-age of the Harvard Standard.

All this goes to show that PEM is an major public health problem, in the developing countries.

Causes of Malnutrition

The cause of malnutriton can be summed up by its definition as given by Jelliffe (1966): "Malnutrition is a pathological state resulting from a relative or absolute deficiency or excess of one or more of the essential nutrients." Evidence from various studies has shown that **prevalent types of malnutrion in de-**veloping countries are those resulting from deficiency of nutrients rather than excess intake of nutrients.

The deficiency may result from inadequate food intakes or from poor utilisation of food in the body. Poor utilisation may result from chemical nature of food or due to infections. However it is impossible to attribute malnutrition to a single factor.

Socio-economic Factors: The relationship between nutritional and economic status has been demonstrated by Ramlingaswam (1974), Mckenzie (1974), Dwyer and Mayer (1975) and Latham (1975). Bohdah and Simmons (1969) carried out a study on African, Asian and European children in an elite (Nairobi) Kindergarten. They found that all the children were normally developed for their

age. They did not find any clinical deficiency signs attributable to malnutrition. This is in contrast to findings of nutrition surveys carried out in low income groups. Such studies have been done by Jackson (1966), Central Bureau of Statistics (1977) and Steenbergen (1978). The findings of these studies indicated deficit in growth with evident deficiency signs. Janes (1974) studied the growth of two groups of children in Ibadan (Nigeria). One group came from the highest social class in Ibadan, whose environment was generally good. The other group came from the lowest social class and was living in a poor environment.

She found a big difference in growth of these two groups. She observed a difference of an average of 9 cm. in their height. The height velocity curves showed that growth was faster in the upper class than in the lower class children.

All this goes to show that nutritional level of a population is primarily a socio-economic matter which permits high or low access to adequate amounts of foods. Food choice is therefore related to income whereby, the rich can have a more adequate, varied and palatable diet than the poor, consequently poverty leads to restricted food intake.

Graham (1972) studied the influence of education and marital status of mothers on growth of poor slum children. He found

insignificant differences between physical growth, as judged by height of those children whose parents had no education and those whose parents had only I-4 years of education. The mean height quotient of the children whose mothers had completed five years of education was significantly higher than of those children whose mothers had 0-4 years of education. At the same time Graham found no difference in height quotient between the children of mothers who had children from various partners and those who had them from specific partners.

Agriculture

Suitable climate, rainfall and fertile soils are essential for crop production. For this reason limited agricultural production goes on in dry areas. Only I5% of the total land area of Kenya has good rainfall and high agricultural portential, the rest 85% is semi-desert and arid land.

Bennett and Stanfield (I972) attributed dietary inadequacy to small plot size in relation to family food demand. In this case, the land becomes too small for the number of people dependent on it, as the family size grows.

Labouisse (I974) noted that global nutritional status is deteriorating with the worlds need for food becoming greater than ever. The essential characteristic of the world situation today

he went on to claim, is a sharp rise in demand for food due to population increase while food production has not kept pace with population increase. This has resulted in a food deficit situation with an estimated 200 million people starving (Unicef 1963).

It was indicated in the Kenya Development Plan(1979-83) that there is enough food to satisfy nutritional requirements for all and yet people are not consuming enough. Several factors contribute to this namely:

(a) Poor food distribution within the country.

(b) Food may be grown but is not available for home consumption, especially by those dependent on small plots of land and have limited income. In such cases food may have to be sold to be able to purchase other required services.

(c) Lack of sufficient purchasing power affect food availability especially in low income groups.

Availability of food at national level depends on a country's economic level. This means its ability to buy or purchase food. A country may therefore be growing sufficient food to feed its people but the food may not be available for consumption, as it nas to be sold to raise resources for purchasing other services. On the other hand a country may not be growing food for its people but has the resources to purchase the food from growers.

There is need to mention that nutrient deficiency in the body does not only result from inadequate food intakes and effects of infections. Chemical nature of food and inter-nutrient relationship may also affect nutrient availability for their optimum utilisation by the body

Beaton (I964) found that inter-relation of nutrients affected nutrient utilisation. He found that certain carbohydrates present in foodstuffs can react chemically with amino-groups rendering amino-acids (particularly lysine) unavailable to the body. For example, he found that low protein diet was better utilised by rats when sucrose was replaced by starch. He also found that when carbohydrate, fat and protein were eaten separately, urinary nitrogen output was two grams greater than when meals consisted of a mixture of the portions. Cuthbertson and Munro (I939) and Munro (I949) found that carbohydrate induced nitrogen retention when given within an interval of four hours.

Munro and coworkers (I959) revealed that presence of carbohydrate in a meal causes release of insulin which induced deposition of incoming amino-acids. They also found that carbohydrate was needed for synthesis of non-essential amino-acids as well as for utilisation of dietary protein. Beaton (I964) found that thiamine deficiency prevented animals from making full use of calories supplied by food. Loss or gain of weight was related to thiamine ingestion. Findings by Blaxter (1964) indicated that rats on thiamine deficient diet, had fat gain which was 32% less than that of rats which had a sufficient intake of thiamine.

It is therefore evident that food consumption may be satisfactory but due to other intervening factors its benifits to the body may be lowered.

Effects of Malnutrition on Children

Mortality

Malnutrition is an important cause or a contributory cause of childhood mortality in developing countries. In WHO proposed budget for 1976-77, it was showed that malnutrition was responsible for more than 55% of all the deaths of children under five years in Latin America. Cravioto and Delicardie (1976) ascribed the high mortality rate in developing countries to malnutrition, after comparing data on child mortality from Mexico to that of U.S.A.

Kimati (1973) carried out a survey in a Paediatric ward in Tanzania. The findings indicated that severe PEM caused 7.5% of the deaths while 50% of all the children who died had PEM as a contributory factor.

In Uganda Wharton (1971) estimated that between 5000-7000 children die yearly as a result of Malnutrition.

Ground (1964) did a survey in Kenya on child Mortality in fifteen different hospitals. He found that PEM caused 9.9% of the deaths while kwashiorkor caused 9.1%. The same survey indicated that 47% of the children who died in these hospitals had PEM at the time of admission. He also

found that PEM was present in 63% of the deaths caused by gastro-enteritis while gastro-enteritis was a contributory cause of death in 23% of the kwashiorkor deaths. His survey was limited to children aged 0-5 years.

Khan (I966) found that PEM caused I8.7% of child mortality at Kenyatta Hospital. Likimani (I969) and Atlas (I973) claimed that malnutrition was the 4th leading cause of death in Kenya, with the age group under five affected most.

Apart from retarding population growth, mortality rate affects the economy of a country. Through death, there results loss of human capital. Since most deaths result from illness a lot of money is used in treating and rehabilitating cases, Malnutrition therefore contributes adversely to the countries economy.

Mental Performance

Malnutrition has its adverse effect on mental development and performance. Its impact is related to age at which the child suffers from malnutrition. There is evidence that human beings have critical periods of central nervous system development. During this period the effect of any damage such as, malnutrition may affect the future pattern of development and maintain a scar or deficit into adult life. The most critical period occurs during the maximum period of growth of brain. This period is from 6th intra-uterine month to the end of first year of life after birth (Stanfield I972).

Hughes (1970) found that at birth the human brain is approximately 40% of its adult weight. It increases to 70% after one year and to 80% by age of two years. Cravioto and Robles (1965) revealed that malnutrition after 12-18 months of age is less demaging than after birth. Further brain development was found to occur in third year of life as reported by Stanfield (1972). Studies carried out by Hughes (1970) in Mulago Hospital Uganda revealed that the brains of those who had malnutrition were 13% lighter when compared to the brains of those who had not suffered from malnutrition. He found that by doing brain autopsy, and then weighing and comparing the weights of those who were malnourished to that of those who were not malnourished. Caback and Najdanvic (1965) found no correlation between age at the time the child suffered from kwashiorkor and subsequent intelligence quotient. It was found that intellectual skills were adversely affected by kwashiorkor and that biochemical changes which occur during severe malnutrition affect learning ability. Cravioto and Robles (1965), Cravioto and Delicardce (1976) and Richardson (1973). Findings by Nuuga (1977) lead to the conclusion that kwashiorkor victims have lower levels of intellectual performance when compared to children who had not suffered from kwashiokor.

Malnutrition also results in motivation and personality changes. These changes reduce adult-child interaction which affects stimulation for learning; maturation and inter-personal relationships (Cravioto & Delicardie 1976).

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Malnutrition and Physical Growth

Malnutrition results in retardation of physical growth. The degree of retardation depends on the severity of malnutrition. The most important and easily detected type of malnutrition affecting physical growth is PEM.

Jelliffe (1966) recognised the fact that growth is influenced by biological determinants such as sex, intrauterine environment, birth order parental size, genetic and environmental factors. He however claimed that physical dimensions and body size are much more influenced by nutrition (especially in the early years of childhood when growth is most rapid) than any other factor.

Most of the other factors especially the socio-economic and environmental factors affect physical growth indirectly as they affect food availability, and food intake directly. So these other factors should also be viewed in relation to food intake.

Jackson (1966) observed that growth of the under-privileged children was accelerated when their food intake was improved.

Janes (1974) carried out a study on two groups of Nigerian children; an elite group and a poor group. She observed a difference of 9 cm. between the groups with the elite group having superior heights. She also compared maturation rate and found that the elite group matured earlier and ended up having a superior physique when compared to the poor group.

Habitch and coworkers (1974) carried out a study on preschool children. They wanted to find out whether genetic differences in height and weight are important enough to warrant establishment of local height and weight standard. They studied well nourished children from both developed and developing countries falling into various ethnic groups.

They found that children from the various ethnic groups and from various socio-economic strata generally grew uniformly in length and weight, during the first six months. Thereafter the growth of children from developing countries lag behind that of children from developed countries. The difference was interpreted as arising from difference in socio-economic levels. To clarify this further, it was found that children from one of the developing countries (Colombia) but from higher socio-economic strata compared well with those of children from developed countries.

This goes to show the importance of adequate nutrition on physical growth even when one considers relation between nutrition and economic status and ethnic differences in stature at preschool age.

Malnutrition also affects the mucous membrane of the gastrointerstinal tract. The membrane become extremely small and this effect results in reduced enzyme activity. The most affected

are the sugar splitting enzymes especially lactase. Lactase are responsible for digestion of lactose, the milk carbohydrate. They are greatly reduced during period of acute malnutrition.

In general deficiency of vitamins are related to severe degree of generalised malnutrition. Lack of vitamin D & A are more evident than the other vitamins. Lack of vitamin D causes retardation of bone development while lack of vitamin A affects the eyes. Lack of thiamine would result in beriberi, lack of niacin would result in pellagra, vitamin C in scurvy, riboflavin would result in failure of growth and also to lesions of the skin and eyes. Lack of folic acid may cause anaemia.

Mineral deficiency in general retards cell formation. Deficiency of iron interferes with formation of blood cells. Calcium deficiency retards skeletal growth while iodine deficiency affects functioning of the thyroid. Iodine deficiency results in failure in both physical and mental growth (Jackson 1966).

Nutrition and Infection

The relationship that exists between nutritional status and infection is of great importance. It should therefore, be taken into consideration whenever the nutritional status of a community is being dealt with.

The relationship between malnutrition and infection is synergistic as has been found by Scrimshaw (1968), Bennett and Stanfield (1972) and Latham (1975). Malnutrition reduces the body's resistance to infection, while infection aggravates or causes malnutrition.

Infection affects nutrition through anorexia causing reduced food intake, raised nutrient requirement and reduced food tolerance. Mata and co-workers (1967) found that children with the greatest weight gain exprienced fewer days of illness. He did this by correlating days of illness with weight-gain. Parkin (1974) found that the consequence of infections in general was loss of weight and impaired physical growth.

The clinical consequence of an infection depends on the state of nutritional inadequacy at the time the infection is acquired. An infection may have no serious consequence in a well-nourished individual, but can set off a total chain of fatal events in children who are malnourished. Malnutrition reduces the body's resistance to infections as it limits the formation of antibodies in response to antigenic stimulus. As found by Gordon (1976) it also reduces the number of phagocytes, as well as their capacity to act. This definitely results in reduced immunity to infections. Wittman and co-workers (1967) found that the incidence of gastro-enteritis was highest in underweight children whereby 59% of all the patients in the lowest weight group had diarrhoea while only 16% of the normal weight children had diarrhoea. In addition, they also found that the initial response to treatment was poorest in the low weight children, who also showed a great tendency to severe recurrent episodes of diarrhoea. They found that all the children under 75% weight for age had a high incidence of diarrhoea regardless of economic status.

The consequence of infection is that malnourished individuals suffer more severe infections episodes than their well - nourished counterparts (FFH Study I963 ; Cravioto and Delicardie I976). This has an economic implication in that total duration of sickness is increased, which makes treatment more expensive, and capacity to produce goods is reduced.

People's attitude towards food during infection affects nutrient intake. There is a universal tendency to change normal diet of a patient to a liquid diet. This results in higher (though not adquate) intake of carbohydrate at the expense of other foods that are good sources of protein and vitamins.

Gastrointerstinal Parasitic Infection

There is a high rate of gastrointestinal parasitic infection in the world, with ascaris being the most prevalent parasite. Stoll (I947) estimated that 25% of the world population has this infestation. Here in Kenya, Stephenson and coworkers (I979) found that 3I% of the children in Machakos District showed evidence of having at least one parasitic infection, 8.8% had two and 0.5% had 3 infections. Of all the children's Stools they examined, they observed the ova of ascaris lumbricoides in 27% of the children, 6.7% hookworm, I.8% trichuris trichiura, 0.3% schistosoma mansoni, while I4% had a combination of E.Coli and E. Histolytica.

Parasitic infection has adverse effect on nutritional status. It is known that intestinal parasites result in depletion of scanty supply of nutrients. Large amounts of nutrients are required to be shared between the child and the parasite (FFH Study 1963). Although the role of intestinal parasites in human nutrition is inadequately studied much is known about ascaris and hookworm.

Recently, Latham and the World Bank Staff (1977) carried out a study in Machakos District. They wanted to determine the negative effects of ascaris infection on growth, as well as find out beneficial effects of deworming, on growth. They had two groups of children, the control group consisting of those who had no ascaris during study period and the study group of those who were infested. The study was divided into two periods the period before and the period after deworming. A summary of their findings is given. There was no difference between the groups in weight-for-age, Height-for-age, arm circumference-for-age and skinfold thickness using t-test. Ascaris group after deworming showed a significant growth spurt when compared to the control group. Acutely malnourished ascaris infected children gained 3.0% of their body weight in the period after deworming while the control children gained only 0.5%. It was concluded that deworming resulted in significant improvement in weight-for-age. Changes in height-for-age did not differ significantly between the groups either before or after deworming. Changes in arm-circumference, were not significantly different. In the period before deworming ascaris infected children lost significant

amounts of fat store when compared to control group. This was interpreted as a direct effect of ascaris infection. There was a significant gain in skinfold after deworming.

They also found that ascaris infection caused potbellies. Nine clinical signs of malnutrition were lost by different children after deworming. Due to high metabolic rate of ascaris children with light infections lost 3% of ingested calories to ascaris, while those with heavy infection lost up to 25% of the ingested calories. Not only do children lose nutrients due to the competition between their needs and the needs of ascaris, but ascaris reduce absorption of protein. Tripathy and co-workers (1971) found that nitrogen retention was impaired in children with a high parasite load. They also noted that there was improved nitrogen absorption after deworming.

Tripathy and co-workers (1972) found that absorption of protein and fat improved after deworming. They found abnormal jejunal biopsies in infected children. The abnormalities reverted to normal after deworning. Venkatachalan (1953) had found that roundworm affects absorption of vitamin A.

Hookworm is known to cause intestinal blood loss resulting found in considerable loss of iron. In fact hookworm is regarded as a major cause of iron deficiency anaemia. Martinez and co-workers (1967) estimated that 350 hookworms in the intestine cause daily loss of 10 ml. of blood or 2 mg. of iron.

Girdia Lamblia has been known to reduce absorption of vitamin A in children (Katsampes et al 1944). The nutritional significance of this parasite has been little studied.

Food Habits and Nutrition

Food habits play an important role in determining the nutriture of man, for food preferences and methods of food preparation are culturally determined. McCance (1972) and Land (1974) found that, foods consumed in a community are determined by beliefs and taboos surrounding particular food items.

Bennett (1975) found that the customs and food practices that have the worst effects on nutritional status of man are those that restrict intake of certain foods, especially foods of the animal origin.

People with special nutrient requirements such as pregnant and lactating women, and children are most likely to be affected by the restrictions. For example, Kershaw (1973) revealed that in the past, cow's milk was not consumed by Kikuyu women and children. The Kikuyu children therefore were primarily dependent on breastmilk, legumes and cereals for protein.

Infact the usual children's foods were millet porridges and bananas, while older children had beans in addition.

These practices are changing as found in recent studies by Hoorweg and Niemeyer (I978). They found that Kikuyu women prefer foods of high nutritional value. These foods include meat, milk, eggs, beans and peas. Next in preference were foods of low nutritional value, such as plantain and irish potatoes. For these people now, their problem is not food restriction but food availability.

Some beliefs associated with illness interfere with intake of protein foods. Forster (I966) found that in Guatemala people fed their children not to make them healthy but because they were healthy. The consequence of this belief was that certain foods believed to cause illness were withdrawn from the child's diet whenever the child became sick. The foods withdrawn include meat and milk. Another common practice is replacing solid foods with liquid diet during illness. This may reduce nutrient intake.

Some of the food habits being abondoned today were favourable to nutritional status. Such are the habits that encouraged the consumption of protein foods such as insects, animal blood and wild fruits. Some of the food preparation practices enhanced their nutritive value, such as spouting of legumes prior to cooking. Another good practice was souring of milk

before consumption. Though this does not enhance nutritive value, the souring process reduces the number of pathogenic organism (Latham I965).

Food is not valued for its nutrient content only. It has been offered as a gesture of friendhsip. In other cases it is regarded as a symbol of security while meal times are regarded as social events. It is therefore very important for people introducing nutrition programmes to understand the food habits of the people they are dealing with for the success of the programmes as was observed by Ramalingaswam (I974). Forster (I966) found that food was a symbol of security whereby strange foods and food from strangers symbolished insecurity.

The findings of a study carried out in Machakos by Steenbergen and coworkers (I978) are quoted to give an idea of feeding habits of a group of Kenyan people. Babies were found to be dependent on breastmilk in the first four months of life. Mothers introduced other foods into the babies diet from I-4 months. The first of these foods to be introduced was cows milk. Later cereal porridges, plantain and potatoes were introduced.

The most common breakfast dish was porridge prepared from maize-flour and rarely from millet or sorghum. Millet

and sorghum are more nutritious than maize. Tea was offered when sugar and/or milk were available. The most common lunch and/or supper dish was a mixture of maize and beans, or ugali eaten with a mixture of tomatoes, onion and fat. Sometimes the following foods were added to the tomato mixture; irish potatoes, green vegetables, fresh pulses or meat.

Consumption of vegetables varied with season. Vegetables were eaten more often during the rainy season than during the dry season as they were more available.

Infant Feeding

Breastmilk is the natural food for a new born baby. Where mothers spend most of their time with their babies, breast-feeding is usually done on demand. Flores and coworkers (1966) and Steenbergen and coworkers (1978) found that semi solid foods were introduced into child's diet as soon as they were accepted. Morley (1979) said that it has been noted that children may be receiving insufficient energy intake even before the age of three months. Gosh (1979) found that growth rate slowed down from the age of four months for those children who were dependent on breastmilk for nutrients. He found that growth stopped at the age of six months indicating that the child was not getting enough nutrients to sustain growth.

It has been noted that breastfeeding in developing countries

is on the decline (Dwyer 1975; Paulo and co-workers 1975). Abandoning of breastfeeding as observed by Morley and Woodland (1979) is encouraged by advertising and promotional practices of baby milk and infant formula by manufactures.

Dwyer (1975) found that Brazialian women rejected breast-feeding because they thought breastmilk is weak, and therefore did not accept its value. Paulo and co-workers (1975) suspected that oversweetness of artificial milk and easier suckling of the bottle made infants reject the breast. They were of the opinion that ignorance of correct nursing practices could have resulted in children preferring the bottle.

Blankhart (1974) carried out a survey in Kenyatta and Mathare estates in Nairobi. His findings indicated that exclusive breastfeeding for the first six months did not result in cases of underweight. Central Bureau of Statistics (Kenya) (1977) revealed that children weaned between six and twelve months of age had most satisfactory growth while wasting was observed in children who were still on the breast after the age of eighteen months.

Steenbergen (1976 and 1977) found that the breast-feeding pattern of Kamba children was as follows: all the children from birth to the age of twelve months were breastfed; between the age of thirteen to seventeen months 89% of the children in this age group were breastfeeding, while between the age of eighteen to twenty-three months only thirty-seven percent were breastfeeding.

She found that cow's milk was the first supplementary food to be added to children's diet. It was introduced into the diet between the ages of one and four months. Cow's milk was gradually being replaced by thin porridges between the age of four and five months, given at a frequency of two to three times a day. Porridge remained a major weaning dish until the age of two years. Ugali with milk or with a tomato stew was being given to three-quarters of the children towards the end of first year of life. A mixture of whole maize with peas or pigeon peas was eaten by only a few children under two years, as it was generally regarded unsuitable for children at this age.

Nutrient Source

A review from various studies done in Kenya is given to give an idea of sources of nutrients.

Bohdah and Gibbs (I968) carried out a study involving eight major tribes in Kenya. They found that cereals were the principle source of calories providing 79.6% of the calories consumed in Kenya. The I979-83 Development plan for Kenya indicated that cereals and primarily maize account for 60% of the calorie consumption in this country. Steenbergen and Co-workers (I978a) found that foods furnished calories in the following proportions, protein 9% carbohydrate 43% and

fat 48% for the age group 0-6 months. Protein supplied I0%, carbohydrate 63% and fat 27% of the calories for the age group 7-I8 months. For the age group I9-36 months, I2% of the calories were derived from protein, 76% from carbohydrate and I2% from fat.

Rutishauser (I975) found that energy intakes for Ugandan children fell below accepted requirement from the third month of life. She noted that energy intakes hardly increased at all in the ages between seven and thirty months. A decrease in energy intake was noted at the ages when children stopped breastfeeding despite the increase in intake of cereals. The food eaten was therefore not enough to make up for the energy breastmilk had been supplying.

The frequency of feeding may affect the amount of intake. It would be reasonable to expect the ones with more frequent intakes to have a higher nutrient intake. Nevertheless Rutishauser (I975) found little difference in energey intake of children receiving two and three meals in second year of life. Nutrient intake ofcourse would depend on both the size of the portion as well as the child's appetite.

As found by Bohdah, Gibbs and Simmons (I968) the protein available to most people in Kenya was of low biological value. For example, they found that the ratio of animal protein to vegetable protein in central province was I.7 : 98.3 percent.

However, in Nyanza they found that due to high consumption of fish, animal protein represented a quarter of the total protein. They found that 42 percent of the families under study had no animal protein whatsoever. Cereals provided fifty percent of the protein, legumes provided twenty-eight percent, fruits and vegetables provided eleven percent, while roots and tubers provided five percent. Animal protein represented only six percent of the protein consumed by these families.

For the same families Bohdah, Gibbs and Simmons (1968) found that 37.0 percent derived their iron from cereals, found that the average iron intake per person per day on average was 17 mg. and that 16.6 percent of the families had iron intake that was below the daily intake recommended by FAO (see page 51 foot note). Iron intake was found to be very low between age of one and three months, intake then rose to 50% of RDA by end of first year. The rise in intake was attributed to consumption of cereals.

They found that calcium was primarily derived from fruits and vegetables while milk provided only six percent, and that 87.7% of the families they studied had calcium intakes below recommended dietary intake. Vitamin A was mainly drived from fruits and vegetables. Steenbergen (1977) in her studies amongst the Akamba people found that all the families she studied had intakes of vitamin A that were below RDA.

Bohdah, Gibbs and Simmons (1968) found that thiamine was derived from cereals. Steenbergen (1977) found that intake of thiamine was 1-4 mg. and that 33.3% of the families were below RDA. Niacin was also found to be derived mainly from cereals with a daily intake of 9.7 mg: 63% of the families were below RDA as found by Steenbergen. She also found that the average daily intake of vitamin C was 130 mg. and that only 13% of the families were below RDA. Bohdah, Gibbs and Simmons (1968) had found that the main sources of vitamin C were fruits and vegetables.

Nutritional Assessment

Nutritional assessment can be done by means of direct and indirect methods. Indirect method would involve the use of a variety of vital statistics, such as age-specific mortality rates, morbidity and cause specific mortality and nutritionally relevant diseases. This method is found to be unsuitable for many surveys for, on one hand it would be impossible to collect accurate information and on the other, the information would be suggestive but not specifically indicative of the plane of nutrition in the community.

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1. The RDA used by Bohdah, Gibbs and Simmons were:
   a) FAO Manual of Food Consumption Surveys.
   b) FAO Report No. 15 on Calorie Requirement.
2. Van Steenbergen used Handbook on Human Nutritional Requirement FAO/WHO Rome 1974.

For the purpose of this survey, direct methods of assessing nutritional status were utilised. For more accurate results and conclusions a combination of methods had to be used, as there is no one single method which can be used. This limitation results from the gradual developmental nature of nutritional deficiencies, which goes through stages. The three main stages are:

1) Depletion of nutrient body stores

2) Growth retardation

3) Development of Clinical signs of malnutrition.

It was not possible to use all the methods available, a few methods were therefore selected on the basis of their feasibility, availability of funds and laboratory facilities.

Biochemical Tests

These tests are very useful in assessing suboptimal nutritional status where physical symptology is not recognisible, for example where nutrient levels of blood and urine are extremely low while the subject shows no other signs of deficiency.

The principle behind these tests is the fact that variations in quantity and composition (quality) of the diet are reflected by changes in the concentration of chemical substances in tissues and body fluids or by the appearance

or disappearance of specific metabolites (Arroyave 1960). The tests are of two types, those which measure changes that directly reflect the supply of nutrient, and those which detect biochemical changes reflecting metabolic alterations subsequent to nutritional effects.

These tests are however limited by the fact that, the degree to which changes can be measured by existing techniques are limited. Again, the extent to which changes can be clearly separated from the influence of genetic, environmental and physiological factors is not known.

Use of biochemical tests in this survey was limited to haemoglobin and haematrocrit estimates.

Anthropometric Measurements

Anthropometry is concerned with the measurement of physical dimensions and the gross composition of the human body at different age levels. The assumption in this case is that on average children or people at certain ages are expected to be of certain body size.

It can therefore be a useful measure of nutritional status since nutrition influencies physical dimensions and body size more than any other factor particularly in the period of early childhood when growth is most rapid. Morley and Woodland (1979) compared weight records of African and English children.

They concluded that the position of a child on weight chart depends more on his genetic background than on his nutritional state. However, they also recognise the fact that genetic differences could be considerably reduced if children receive sufficient food and medical care.

Anthropometry as an assessment method is limited as it is difficult to define community standards mainly for two reasons:

(a) Body proportions vary in different individuals and groups, with genetic and climatic factors.

(b) Height and weight level rise with improved nutrition and disease control.

The standards of reference available are based on European records. Since most developing countries do not have their own standards, they depend on other peoples standards which may not be appropriate for them. Apart from that, anthropometric figures need to be revised for every new generation otherwise they become absolete due to Secular trend (Tanner 1962).

Weight

Weight assessment in developing countries is mainly concerned with determining degree of underweight resulting from varying levels of PEM. This measure gives information on short term effects of malnutrition.

Weight is limited as a measure of growth by:

(I) Certain pathological circumstances, such as Oedema, ascaris infestation and organ enlargment. These circumstances elevate the weight of children for example, oedema fluid will have its weight recorded together with the childs weight as there is no way of determining its weight. This is the same case with ascaris load, where it is not possible to determine the weight of the child exclusively without the weight of ascaris.

(2) Weight also varies on an individual depending on time of the day it is recorded. Munsen (I964) obtained nude weights of children just before they went to bed and as soon as they arose. (There was no food intake nor emptying of bowels between the two recordings). He found that an average of weight loss of 0.4 kg. occured during the night with individual variations ranging from 0.2 to 0.7 kg. This led to the conclusion that children gain weight after the evening meal. They lost weight during the night attaining minimum weight in the morning after waking up.

For accurate assessment of growth by use of weight, accurate scales should be used. Correct reading and recording

should be done if reliable information is to be collected.

Height

Two types of heights can be recorded, vertical height and recumbent length. Falkner (1958) demonstrated that stature horizontal is superior to stature vertical, for example he found that stature horizontal exceed stature vertical by I.I cm. for a one year old child. It is therefore important to decide from the beginning whether vertical height or recumbent length is to be used due to these differences. Recumbent length is most suitable for preschool children whose vertical height is difficult or impossible to record accurately. It would be difficult to give preschool children instructions on how to stand for accurate measuring, this method would be impossible with the babies.

Apart from the usual limitations of using height values that may result from incorrect technique or recording, Falkner (1958) found that height is also limited by the fact that human beings at all ages beyond two years are 2.0 cm taller when they assume erect position in the morning than when they return to recumbent position at night. This implies that individuals attain different height at different times of the day. The greatest reduction in height occurs during the first hour after getting out of bed, than in any succeeding hour. At six to twelve months, the average decrease in body length is 0.8 cm.

after sitting for one hour. It is therefore very difficult to obtain uniform measurements and consequently standard figures ;taking such problems into consideration. Due to limitation of weight and stature values as measures of nutritional assessment, other measures were introduced. These include arm, head and chest circumferences and skinfolds thicknesses.

Morley & Woodland (I979) have identified arm circumference as an excellent indicator of nutritional status, which has the advantage of operational simplicity. Arm circumference is particularly useful in situations where a rapid method of identifying malnourished children is needed.

The value of arm circumference derives from the fact that it changes very little with age. It is a useful measure as it is very sensitive to dietary changes. To use this measure, children are fitted into different nutritional zones according to their arm circumference values. Those children who are below I2.5 cm. are considered malnourished, those whose values are between I2.5 cm and I3.5 cm. are considered to be of suboptimal nutritional status, while those above 13.5 cm. are considered as enjoying good nutritional status.

Though head circumference is mainly related to brain size, scalp's soft tissues, the skull and the brain size

vary with nutritional status. Head circumference is affected by PEM especially in the second and third year of life. Head circumference can be used as an indicator of nutritional status by comparing values with standards of reference that are available. Also, the chest/head circumference ratio is valuable in detecting PEM.

Chest circumference can be used as a community indicator of PEM. Between the ages of six months and five years, a chest/head circumference ratio of less than one may be due to failure t develop or to wasting of the muscle and fat of the chest wall. The head/chest circumference ratio is not very useful before the age of six months as the difference between them is very smal

By use of skinfolds, subcutaneous fat can be assessed which reflects calorie reserves. It should be noted that there is considerable variation in fat distribution with age. Sex differences occur throughout life whereby skinfolds for females are greater than for males right from birth. It is desirable to have local standards due to differences occuring in different climatic regions. Where local standards are not available, general standards of reference available can be used (Jelliffe 1966).

Deficiency Clinical Signs

Clinical method of assessing nutritional status is based on recognition of certain physical signs believed to be related

to nutrition inadequacy. Clinical signs are recognised only after the subjects have been on inadequate diet for a long time. Use of this procedure decreases with improvement of nutrition level, becoming less useful where mild malnutriton is concerned. The following need to be examined as they are affected by inadequate nutrition, eyes, skin, hair, parotid and thyroid glands, epithelial tissue. Jelliffe (1966) gives a good description of clinical assessment as well as the limitations involved in this method.

Dietary Survey This involves weighing of foods eaten, to determine the amount of nutrient consumption by using food tables. This method of nutritional assessment can be used singly but it has its limitations also. Though nutrient content may be calculated for all the foods eaten, it is not right to assume that if nutrient level of food consumed is adequate, then the individual is getting sufficient nutrients due to the following reasons:

(I) The nutrients ingested might not be available to the body, for example, there may be absorption defects resulting from presence of pathological conditions. There may be nutrient wastage where infections such as diarrhoea, vomiting and intestinal parasites are present.

(2) Preparation and cooking method affect some of the foods such as:-

soaking of foods and discarding of cooking water effect the content of water-soluble vitamins. Exposure of milk to sunlight destroys riboflavin .

Schaefer (1960) noted that dietary studies are especially useful where population subsist for long periods on dietary intakes which are marginal in protective nutrients and where deficiency is not clinically obvious. Reh (1962) gives a good guide on administration of dietary survey.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

Objectives of the Study

The aim of the study was to determine the nutritional status of children under five years, living in a suburban area. Also to describe feeding practices and the prevailing soio-economic and environmental conditions.

The specific objectives were:

I. To determine the nutritional status through
   (a) Anthropometry
   (b) Clinical signs of malnutrition and state of the body
   (c) Biochemical state of the body
   (d) Nutrient Intake

2. To determine demographic, socio-economic and environmental characteristics.

3. To determine feeding practices such as breastfeeding pattern, food source, food preparation and feeding methods.

4. To determine type and rate of infection including gastro-intestinal parasitic infestation.

A description of the equipment and of the pilot study are given in chapter I.

Research Design The field survey was carried out between the months of August 1978 and April 1979. The study was of semi-longitudinal type as suggested by Goldstein.
The aim was to include all the children aged between 0-36 months, living in Kangemi satellite and trenchip (sample -area). Assessment of physical growth was done for a period of six months. This limited the age of children to 42 months by end of the survey.

The period from birth to age of four years has been described as the critical period of growth. Not only is physical growth rapid but maximum growth of the brain occurs during this period. This again is the period that children are most susceptible to diseases and other infections. The investigation was so designed as to assess the child during this important period.

Method

The lay out of data collection was as follows:

1. Anthropometric measurements were done and recorded every six weeks for all the children below one year. Reason being that physical growth is quite rapid in the first year, and growth after six weeks would be measureable. By the time a child is in his second year, growth is not as rapid and the difference in

growth after a period of six weeks would be small. For this reason, all the children above one year were measured every twelve weeks.

2. Pattern of recording clinical signs was similar to that of athropometry, that is after every 6 weeks for children below one year and every 12 weeks above age of one year.

3. The age at which the fontanelle closed was also recorded.

4. Single blood and stool samples were collected. From blood, haemoglobin and haematocrit levels were determined using cyanmethaemoglobin and microhaematocrit method. Stools were examined for presence of gastro-intestinal parasites using Ritchie's (concentrated) method.

5. Information was also collected on feeding practices such as, breastfeeding patterns, and qualitative food intakes using a questionnaire while quantitative food intakes were determined using weighed food method.

6. Data on socio-economic and environmental factors was collected by means of a questionnaire. The questionnaire was administered during the whole duration of fieldwork.

Sampling Frame

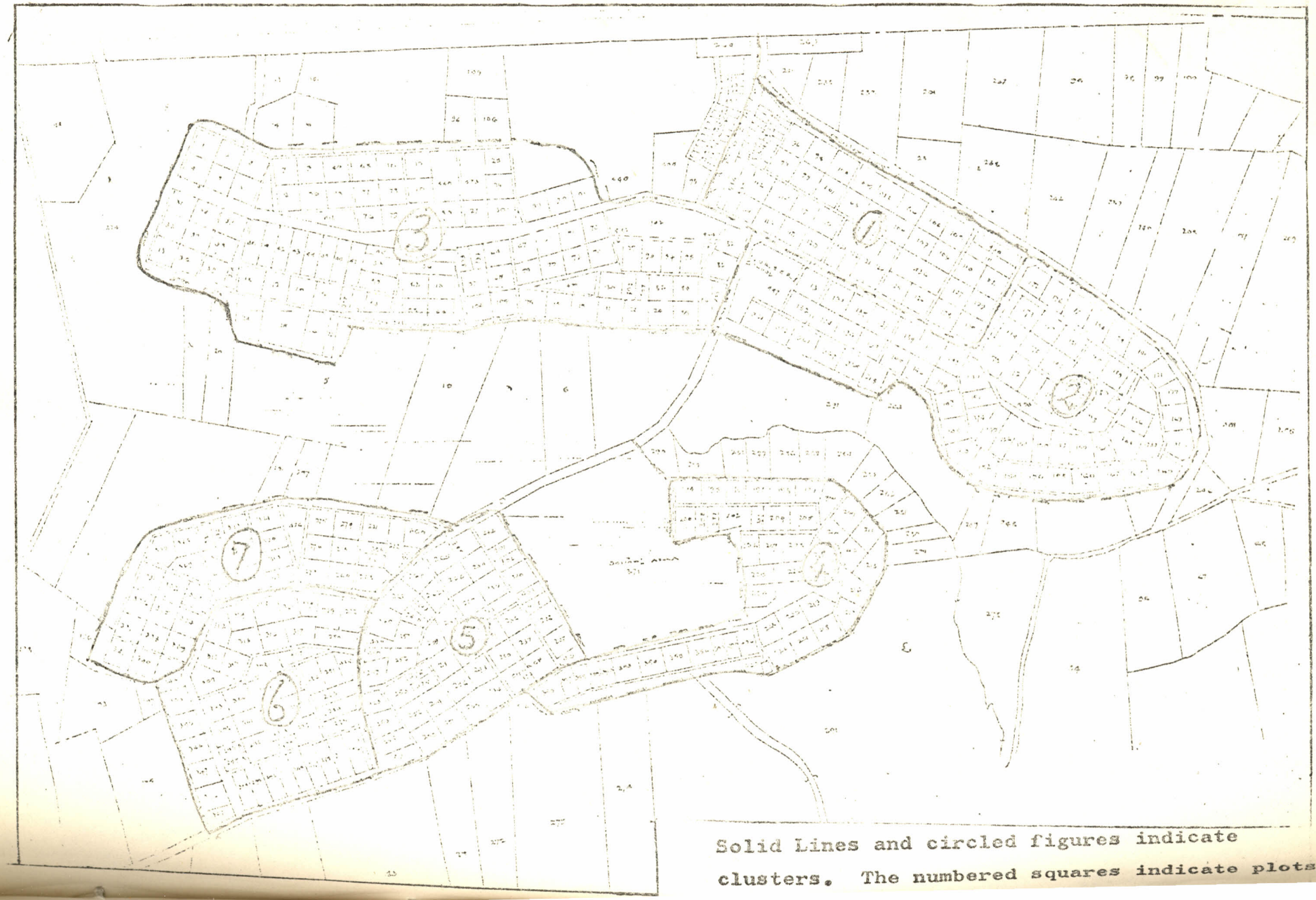
A map of Kangemi showing all the plots in the survey area was used as a sampling frame. The plots in the township and satellite were numbered, from 001-241 for the satellite and 001-422 for the township. It was then decided that the area would be divided into seven clusters, four from the township and three from the satellite. Using the table of random numbers 7 plots were selected to be used as cluster starting points. With the help of the map, cluster boundaries were easily plotted (see map 1 p. 64a) using roads as the boundaries.

All the households in each cluster were visited. For each household visited, enquiries were made as to whether there were children aged 0-36 months. Only children in this age group were going to be included in the sruvey. So only those mothers with children in this group were given the details of the study. The mothers were then asked whether they were willing to participate. Those who agreed to participate were registered. Each household enumarated was numbered for the purpose of identification. Enumaration of the households was done by moving from door to door until all the households in each plot had been visited before moving to the next plot. A subsequent visit was made to those households whose owners were not in during the first visit.

Sampling Technique and Sample

In preparation for sampling a tour of Kangemi was done. The aim of the tour was to determine whether the living conditions

Map 1. Kangemi Township and Satellite



Solid Lines and circled figures indicate clusters. The numbered squares indicate plots.

in the three sub-divisions of Kangemi were similar. The farmland was found different from township and satellite. For this reason it was exluded from the survey area.

For sampling purposes clusters were used. The survey area was divided into seven clusters. Roads were used as cluster boundaries. Each cluster consisted of a sequence of households, consisting of not less than 200 people. The clusters were then numbered. Cluster one, two and three were in the satellite, while cluster four, five, six and seven were in the township. The township had four clusters as it was larger, had more houses and a higher population than the satellite. (A lot of the plots in the satellite had commercial buildings such as bars and shops .

Each household in every cluster was visited. All the children in these clusters who were aged between 0-36 months were registered, only if their mothers were willing to participate.

Sample Size

The size of the sample was not predetermined. As many children as the mothers were willing to participate were registered. A total of 250 children were registered during the first two visits but only 240 were available for the first measurement. Any children born, in the registered families later were also included bringing the total sample to 255 children of whom 144 were males and 111 were females.

The mothers involved were those who were permanent or semi-permanent residents of Kangemi. Semi-permanent members were those who had been in Kangemi for a period of at least three months and were going to remain there for the next six months.

A subsample was used for the dietary survey where a quarter of the children in the main sample were to be included.

Description of methods of nutritional assessment, procedures of anthropometry, determing of nutritional deficiency signs and recording of teeth eruption was done as recommended by Jelliffe (1966).

Deviation from his recommendation occured only during measuring of arm circumference. He recommended that the tape measure overlaps, so that reading starts from the mark of 10 cm, and then one substracts 10 from the reading. To avoid errors that may occur due to subtracting, arm circumference was measured without overlapping the tape (see picture 6b p. 70).

Dietary survey was carried out as suggested by Reh (1962) through home visits. Information on socio-economic status was also collected during home visits. (See Appendix) By home visits it is meant that the survey team visited the homes of the participants. The questionnaire and recording of information was done then.

It had been planned that the anthropometric measurements would be administered at the clinic using appointment system

as suggested by Moore and coworkers (1954). This meant that a certain number of mothers would be requested to report at a central place and measurement taken. The central places are referred to as clinics. Three clinics were being operated for the purpose of measurements at:

I. Kangemi Social Hall for cluster 1,2 and 3.

2. Kangemi Primary School for cluster 4 and 5.

3. Sub-chief's camp for cluster 6 and 7.

Mothers living in cluster 4-7 were allowed to choose the clinic which was most convenient to them.

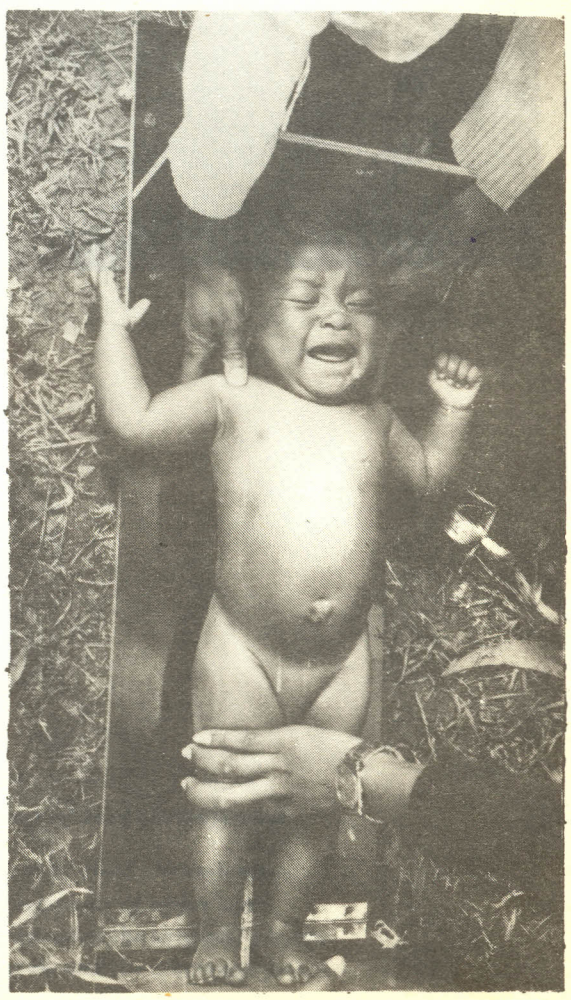
Appointment Card

Appointment cards were designed and given to mothers. Dates of clinic days were written on the cards together with some of the children's details (see page 72)

Not all the mothers given appointments came to the clinics for example, only 49.2% and 14.6% of the expected children turned up for first and second clinics respectively. All the other mothers were seen at home. It was decided that the rest of the measurements would be done at home by means of home visits.

Picture 1

Picture 2

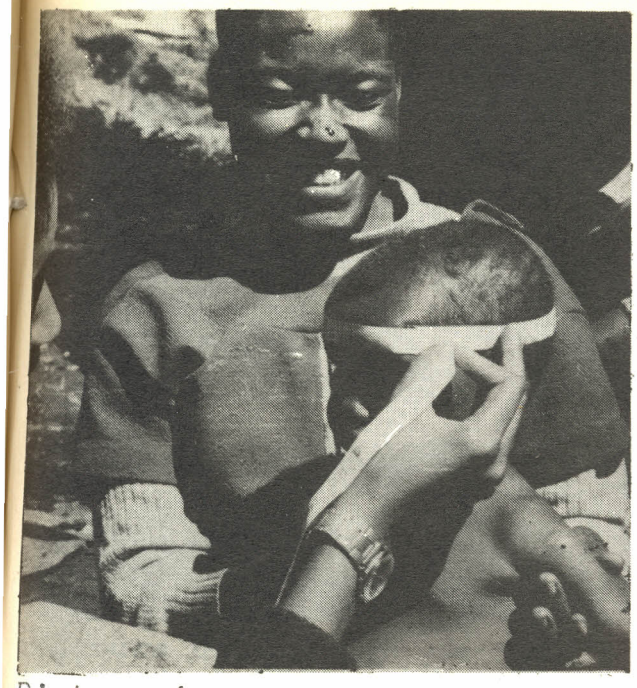


Picture 3

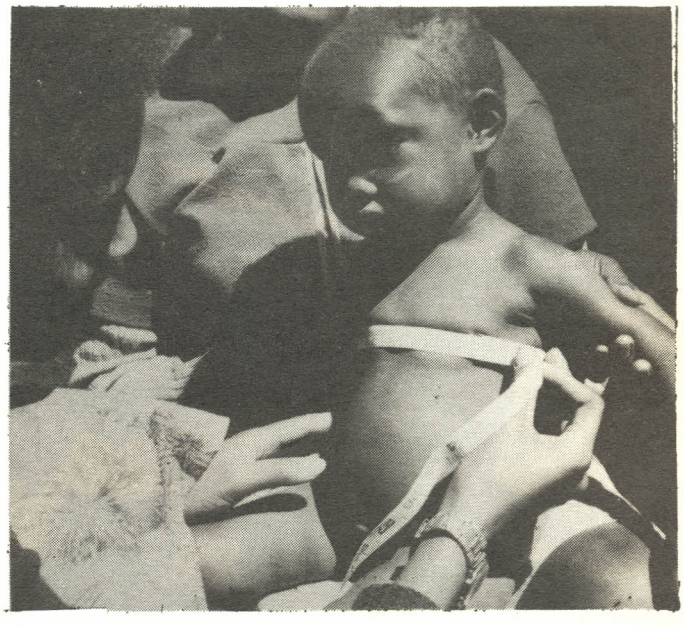
1 *Weighing an infant (using a basket)*

2 *Weighing an older child (using a pant)*

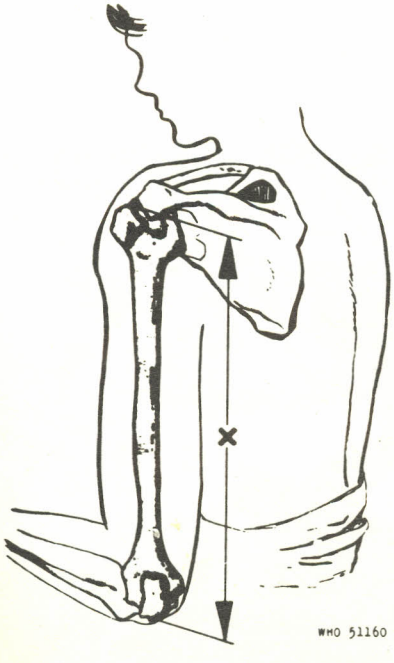
3 *Length measurement of a child*



Picture 4



Picture 5



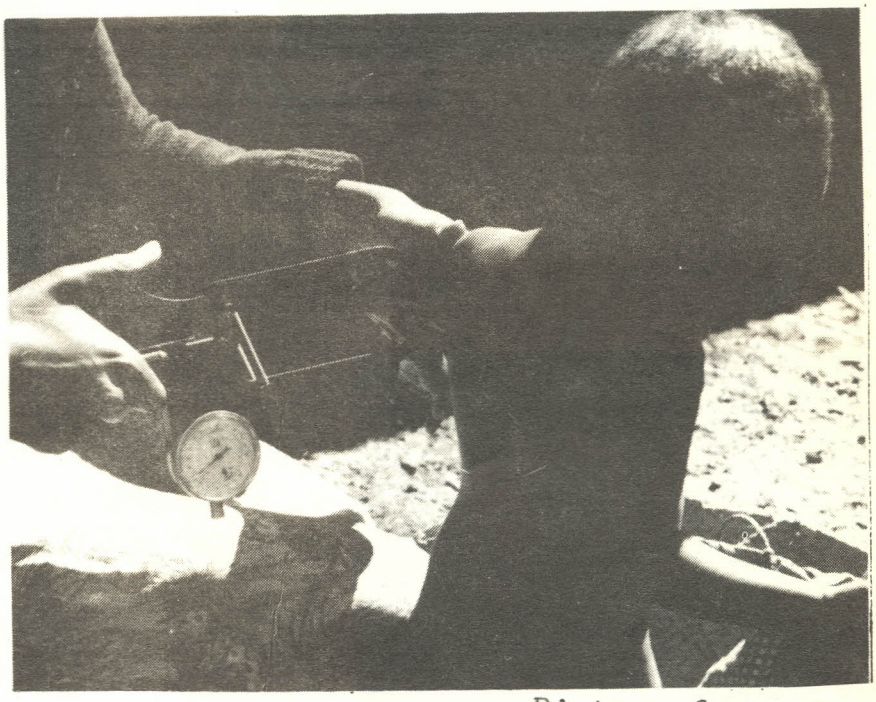
Picture 6a

4 *Measurement of head circumference*

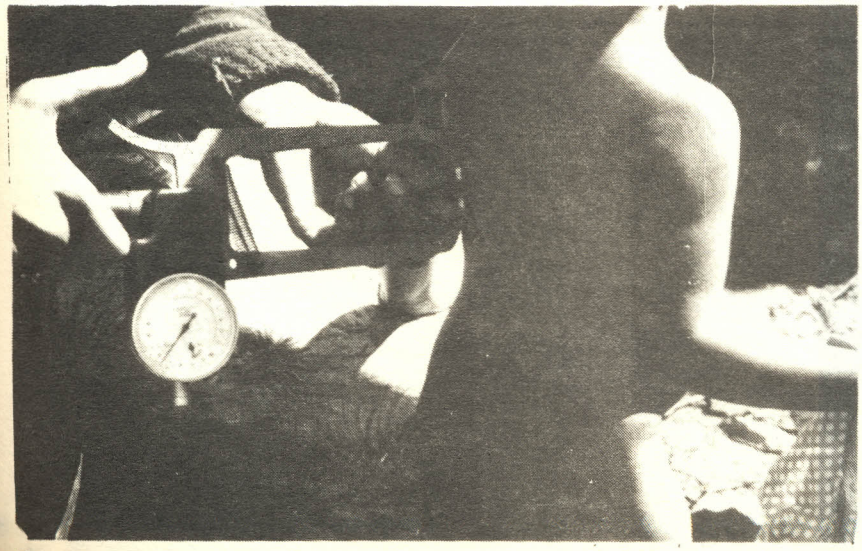
5 *Measurement of chest circumference*

6a *Assessing midpoint of upper arm (Halfway between the acromial process of the scapula and the olecranon process*

Picture 6b



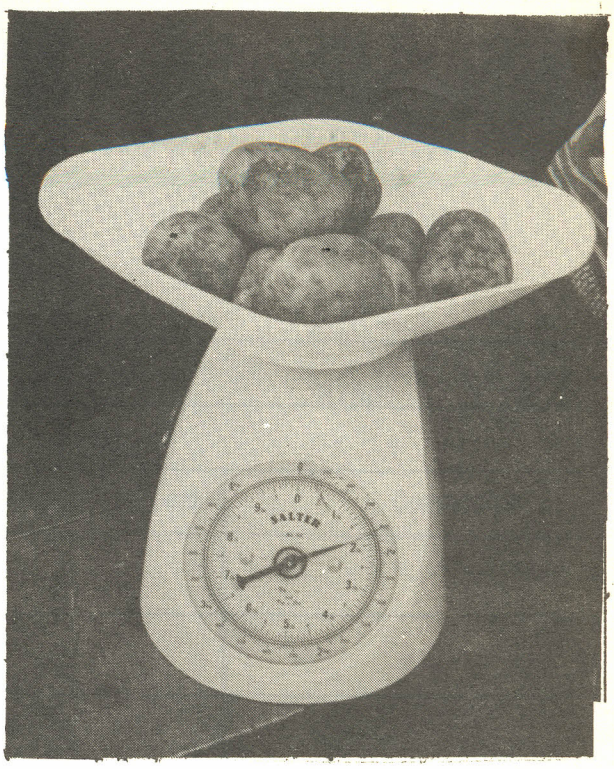
Picture 6c



Picture 7

6b *Measurement of arm circumference*

Picture 8a



Picture 8b

Picture 8c

8 a *Determining weight of a saucepan*
b *Weighing potatoes*
c *Weighing cooked food*

APPOINTMENT CARD

Name Child: P/NO H/NO				
Name Mother: P/NO				
Date	Meas.	WT. KG.	Length HT cm	Comments
	Ist			
	2nd			
	3rd			
	4th			
	5th			
PLACE:				

The dates of the appointments were written on the card. The mothers were verbally reminded of the date of the next clinic three to seven days before the clinic day.

CHAPTER 4

ANALYSIS AND RESULTS

INTRODUCTION

A total of 171 households were enumerated for the purpose of this study. However the number of households used in the analysis of data differs because information from certain households was either unavailable or was considered unreliable.

SOCIOECONOMIC FACTORS

Household Size

The average household size was 5.4 people, Mullick (1979) found an average household size of 4.4 persons. The difference between Mullick's figure and that found by the author, may have been due to the sample size, or the nature of sample. In this survey only those households which had children below 36 months were registered, and the minimum number registered per household was three.

Table 4.1.1 The Distribution of Households According to the Number of People Per Household

Number of People	Number HH	Percentage
3-5	94	56.6
6-8	52	31.4
9-11	17	10.2
12-14	-	-
15-17	1	0.6
18	2	1.2
Total	160	100

In table 4.1.1 it is shown that more than half the households had 3-5 persons. This indicates that most households had 1-3 children. Only 1.8% of the households had more than 11 persons.

Household Heads and Mothers of Sample Children

Table 4.1.2 Household Heads Grouped According to Age

Age years	Number	Percentage
20	14	9.3
20-29	53	35.1
30-39	62	41.1
40+	22	14.5
Total	151	100.0

As indicated on table 4.1.2, 76.2% of the household heads were aged between 20-39 years. Information on household heads was not available for 20 households.

The population of Kangemi is dominated by young adults who have immigrated to Nairobi in search of jobs.

Sex of the Household Heads

Out of 171 household heads, 18.3% were females, the rest, 81.7% were males. The baseline survey of 1973 indicated that only 9% of the households were headed by females. The difference between baseline survey findings and this survey suggest an increase in female migration to urban areas probably in search of jobs or may be households with husband and wife moved out and therefore women heads have become more.

Mullick's (1979) finding indicated that 15% of the heads were females. The difference between her finding and the finding of this survey may be due to different methods of- (see p. 73) sampling. Every household in this case had a woman unlike in Mullick's survey, and this would explain the higher proportion of women as heads of households.

Marital Status of Household Heads

The majority of the household heads (79.8%) were married ; 14.3% were unmarried; 3.6% were separated or divorced, while 2.4% were widowed. All the heads who are under the category of unmarried were mothers living on their own, as there were no unmarried male heads in the sample group.

Mothers of Sample Children

Age of Mothers

Table 4.1.3 Mothers of Sample Children Grouped According to Age

Age Years	Number	Percentage
15-19	14	10.1
20-24	45	32.6
25-29	43	31.2
30-34	24	17.4
35-39	11	8.0
40+	1	0.7
Total	138	100.0

Table 4.1.3 indicates that the majority of mothers (73.9 %) were aged 15-29 years.

Pregnancy, Miscarriages and Deaths

Table 4.1.4 Number of Pregnancies per Mother

No. Preg.	Mothers	Percent
1-3	74	43.3
4-6	68	39.8
7-9	22	12.9
10-12	7	4.0
TOTAL	171	100.0

As findings presented in table 4.1.4 indicate, 56.7% of the mothers had had at least six pregnancies. This could be considered as a high rate of pregnancy since the majority of mothers (73.9%) were aged 15-29 years and therefore still fertile. They could be expected to give birth to more children. The incidence of miscarriages was as follows: 12.3% of the mothers agreed that they had miscarriages and 87.7% had none. The reported number of miscarriages per mother ranged between 1-2, where 9.4% of them had one miscarriage and 2.9% had two miscarriages. Mothers reported to have lost chidren through death as follows: 11.7% had lost one child, 2.3% two children, 0.6% three children and another 0.6% four children. The rest of the mothers (84.8%) had not lost any.

Marital Status of Mothers

The majority of mothers (75.4%) were married; 20.5% were unmarried, 3.5% were separated or divorced and only 0.6%

were widowed. The fact that three-quarters of the mothers were married suggested that most of the people who immigrated into Kangemi were accompanied by their families.

Education

Five categories of levels of education were used based on the stages when schooling is usually discontinued. These categories were further subdivided into completed and not completed. Completed referred to those who stayed until the end of that level and did an examination. Not completed referred to those who dropped out before completing.

Sitting examinations leads to acquiring of certificates which are important (in present day Kenya) in procurring of employment and in advancing ones academic aspirations and eventually in determining socio-economic status. Those under the category of none are those who have never attended a formal school.

Table 4.1.5 Education Levels as Completed or not Completed by Heads of Households and Mothers

Level of Education	Household Heads		Mothers	
	Number	Percent	Number	Percent
None	28	17.9	48	28.9
Std 1-4	14	9.0	16	9.6
Std 5-8 complete	47	30.1	42	25.3
" not complete	18	11.5	28	16.9
Form 1-2 complete	4	2.6	3	1.9
" not complete	19	12.2	13	7.8
Form 3-4 complete	25	16.0	15	9.0
" not complete	1	0.6	1	0.6
Total	156	100.0	166	100.0

The finding as presented in table 4.1.5 indicates that nearly 30% of the mothers never went to school as compared to 17.9%. It also indicates that 31.4% of the heads attended secondary school as compared to 19.2% of the mothers. This may suggest that educating males was more favoured than educating females.

The mothers were then asked to state their source of knowledge on feeding of the children. None of the mothers claimed to have received nutrition education from formal schools. The majority (80%) said they learnt from the child welfare clinics. For the rest (20%) some learnt from the radio, others from husbands and others from reading. This shows how little formal schools effect change in nutrition behaviour especially at primary level which the majority of people attend.

Technical Training for both Heads and Mothers

As revealed by the study the majority of both the household heads and mothers had no technical training.

Many of the heads (70.5%) had no technical training; 9% had less than one year of training; 6.4% had one year training while 9.6% had two or more years of training.

As for the mothers, 82.6% had no technical training, 8.4% had less than one year training, 6.6% had one year of training while 2.4% had two or more years of training.

The fact that one has been trained or not trained influences occupational status, job opportunities as well as income levels for most people.

Occupation

Table 4.1.6 Occupation of Household Heads

Occupation Type	No.	%	
Professionals e.g. doctors, businessmen	15	9.5	
Less professionals e.g. teachers, shopkeepers	11	7.0	
Skilled workers e.g. clerks	81	51.9	
Partly skilled e.g. machine operators	22	14.2	*83.4
Unskilled e.g. porters, labourers	27	17.3	
	156	100.00	

The classification used in table 4.1.6 is based on one suggested by Barker (1976), whereby classification was devised based on a grading of occupations according to their levels of skill.

The findings of the survey with regard to occupation correspond to the findings on technical training, where lack of training and low academic levels lead to acquisition of jobs that do not require prior training, and skill is acquired on job. People of low academic levels and in such occupation brackets where, 83.4% of the heads fit, are not likely to be earning high salaries. This fact is later revealed after estimating the household income.

It was found that 30.7% of the heads were self-employed, 16.0% were government employees, 52.1% were employed by private

companies and institutions, while 1.2% were unemployed. Mullick (1979) found an employment rate of 46%. The difference in these findings is due to sampling.

Mothers' Occupation

The mothers were put into three categories: employed, unemployed and housewives. The term unemployed referred to those who had no specific occupation and were not housewives. The majority (68.3%) of the mothers were housewives, 28.1% were employed, 3.6% were unemployed. The mothers falling into the category of unemployed were unmarried mothers who were still living with their parents.

INCOME

The household heads were asked to give an estimate of the total household income per month. The estimates given were pooled contributions of the household members.

It was estimated that 42.0% of the households were earning between 100-600 K.shs. (18.3% had a maximum income of 200 K.shs.), 30.0% had an income of upto 1200 K.shs. and 28.0% earned over 1200 K.shs. Three heads (1.8%) reported that they were earning upto 3000 K.shs. per month.

The mothers were specifically asked to state how much they contributed to household income per month in cash. The majority (71.6%) did not contribute but 28.4% contributed. Of these who contributed, 20.5% contributed upto K.shs 400, 4.2% contributed between K.shs. 401-900 while 3.7% contributed above K.shs. 900.
It should be noted that 18.3% of the mothers were also household heads. Therefore only 9.8% of the mothers were giving additional contribution (since

they were not household heads).

The heads were again asked to state the number of the different sources of income that they had.

It was found that 72.5% of the households had only one source of income, 16.9% had two, while 10.5% did not state the number.

It can then be assumed that the majority of the people were either dependent on monthly salaries or for those who were self-employed they most likely had only one business.

Expenditure and Savings

The heads of households were asked to estimate their monthly expenditure. About a third (32.7%) were spending a maximum of K.Sh. 500 per month, 37.6% were spending K.Sh. 1000 the rest d (29.7%) were spending upto K.Sh. 2000.

The proportion of those who spent more than K.Sh. 2000 may seem higher than those who earned it according to income findings. This is because the intervals used for income are different from those used for expenditure.

Findings on incomes indicated that incomes were low. This definitely would influence the type of goods and services purchased by these people. It influencies types of food to be eaten, housing and other facilities. The people were barely managing, living from day to day . It was not then surprising

to find that the majority (60.0%) could not save and only 40% claimed to be saving. Out of the 40% who could save, 27% claimed monthly savings of upto K.Sh. 200 while 13.0% claimed to be saving upto K.Sh. 400.

ENVIRONMENT

Housing - There was a total of 171 houses.

Walls

The majority of the houses (69.6%) had walls made of timber, 28.1% had mud walls, and 2.3% had stone walls. Half of the houses (50.3%) had been properly partitioned with solid walls, one of these 26.9% had timber walls, 22.2% mud walls and 1.2% we stone walls. The rest of the houses (49.7%) were single roomed dwellings. For the purpose of providing privacy in those single roomed dwellings, 44.4% of the rooms were partitioned with cloth curtains, 0.6% with cardboard, while 4.7% were not partitioned at all.

Roofs

Most of the houses (95.9%)) had corrugated iron sheet roofs and 4.1% had flattened tin roofs.

Floors

Out of 171 houses, 67.3% had concrete floors and 32.7% earthen floors. The houses were poorly ventilated and were crowded. (See p. 21).

Sanitary Conditions and Practices

Pit-latrines were used as a method of excreta disposal in 97.7% of the household, and flush toilets in 2.3% of the households. Mothers were asked how they took care of children's

excreta disposal as not all preschool chidren can use pit latrines. The results are shown in table no 4.1.7.

Table 4.1.7 Method of Disposing Children's Excreta

Excreta Disposal	No. of Households	%
Mother removes it	74	43.3
Child given a paper	35	20.5
Child goes anywhere	25	14.6
Child goes to the toilet	4	2.3
Child using napkins	33	19.3
Total	171	100.0

The methods used in table 4.7.1 are as follows:

Mother removes it - Refers to a situation where the mother removed the excreta only if she happened to be aware of it.

Child given paper - Refers to a situation where a mother gave a child a piece of paper to defecate on, then removed it.

Child goes anywhere - Refers to a situation where nobody bothered about where a child defecated or what happened to it.

Child using napkings - The mother washed the napkins after use.

An observation of the condition of the latrines was made. It was found that 51.8% of the pit latrines were clean and 48.2% were not clean.

Some were in a very bad condition; either they were full or the floors were collapsing or both, and therefore were not safe to be used. The pit latrines had timber walls either concrete floor slab or earthen floors. The majority of pit-latrines were shared between the members of several households. (see p. 87 pic. 13)

An observation of the compounds was also made. There were very few compounds (11.5%) which had stagnant water. In 17.3% of the compounds presence of excreta was observed. It was suspected that this percentage would have been higher if excreta was not eaten by dogs and chicken. It should be noted that mothers who were not concerned with the disposal of their children's excreta stated that it was eaten by chicken or dogs.

Since all the houses were not self contained, household members were asked to state where they bathed. Heads of 93.3% of the household said that the landlords had provided them with small rooms adjacent to the latrines. The members of the remaining 6.7% households said they bathed in the house. Washing of clothes was done outside the house (see p. 86 pic. 10 and p. 87 pic. 11).

Refuse Disposal

For most households refuse was usually left scattered indiscriminately round the houses, but a few people burnt theirs. The city council had not made any arrangement for refuse collection and disposal in this area (see p. 87 pic. 12)

Water Supply

Out of 171 households 95.2% had piped water, 4.8% got their water from the river. One of the households getting water from the river also used rain water whenever it was available.

Cooking Fuel

Charcoal was the main fuel used for cooking purposes. It was solely used in 42.1% of the households and in another 46.8% households, it was used in combination with paraffin. In 11.1% of the households paraffin or gas were used.

Lighting

For lighting purposes, 76.6% of the households were using hurricane lamps, 15.8% were using electricity and 7.6% were using tin containers with paraffin and a wick.

Picture 9

Picture 10

9 *A mother with her five children*

10 *A mud house in suburban Nairobi*

Picture 11

Picture 12

Picture 13

11 *One of the compounds in the study area*

12 *Indiscriminate refuse disposal*

13 *Pit-latrine.*

ILLNESSES

Information collected on illnesses was analysed to show their frequency according to age and sex, and also to give an indication of the most prevalent illnesses in preschool children living in Kangemi. A test was also done to determine whether there were significant differences between males and females on frequency of illnesses.

Table 4.2.1 Frequency Distribution of Illnesses According to Age and Sex

Age	MALES			FEMALES			SEXES COMBINED		
	No. of Obsrv.	No. times illness Obsrv.	%	No. of Obsrv.	No. times illness Obsrv.	%	No. of Obser.	No. times illness Obsrv.	%
1-6	58	25	43.1	59	31	52.5	117	56	47.8
7-12	76	26	34.2	60	31	51.7	136	57	41.9
13-18	61	35	57.4	56	16	28.6	117	51	43.6
19-24	39	24	61.5	41	18	43.9	80	42	52.5
25-30	49	21	42.9	51	24	47.1	100	45	45.0
31-36	40	15	37.5	30	12	40.0	70	27	38.6
37-42	23	11	47.8	13	7	53.8	36	18	50.0
Total	346	157	45.3	310	139	44.7	656	296	45.1

Findings as presented in table 4.2.1 indicate that males were prone to illnesses during the second year of life. A test was done to determine whether differences in various age groups were significant. According to X^2 test the differences were significant at 5% level.

$$X^2 = 12.9 \quad P < 0.05, \quad DF = 6$$

The females were more vulnerable to illnesses during the first and after third year of life. However the differences for various age groups according to X^2 tests were not significant.

$$X^2 = 9.36 \quad P > 0.05 \quad DF = 6$$

However for both sexes combined illnesses were commonest in the age period 19-24 months and 37-42 months. Using X^2 test significance difference was found between males and females in age period 7-12 and 13-18 months. In age period 7-12 months females were more affected than males at 5% level.

$$X^2 = 4.19 \quad P < 0.05 \quad DF = 1$$

In age period 13-18 months males were more affected than females at 1% level.

$$X^2 = 9.85 \quad P < 0.01 \quad DF = 1$$

Prevalent Types of Illnesses

Of all the different illnesses recorded, 70% were colds, 15% diarrhoea, 7.1% fever, 3.6% vomiting, 2.9% pneumonia and 1.4% stomach pains.

Diarrhoea and vomiting became less frequent after the first seven months of life. Colds persisted throughout upto the age of 42 months but with the number of cases decreasing with age.

Gastrointestinal Parasite Infection

Analysis was done to show prevalence of gastrointestinal parasites and types of parasites according to age and sex.

Table 4.2.2 Gastrointestinal Parasite Infection According to Age and Sex

Age Months	Ascaris		E. Coli		G. Lambia		C. Mesnili		H. Nana		T. Trichura		E Hartmani		Hookworm		I. Butsch.		Total
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
1-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-12	1	-	-	1	-	2	-	1	2	-	-	-	1	-	-	-	-	-	8
13-18	2	2	1	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	7
19-24	6	3	1	2	2	1	1	2	2	-	-	1	-	-	-	-	-	-	21
25-30	6	6	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	14
31-36	2	2	-	-	-	-	-	1	1	1	-	2	-	-	-	-	-	1	10
37-42	1	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	4
Total	18	15	2	3	2	3	2	4	6	1	1	4	1	0	1	0	0	1	64

Stools of 166 children were examined for presence of gastro-intestinal parasites, Stools of 51 (30.7%) children were infected. Of the children infected 11.8% were in their first year of life, 45.1% were in their second year, 38% in third year and 5.1% in fourth year. Of those 51 infected children, 76.5% had one type of infestation, 19.7% had two, 1.9% had three types and another 1.9% had five types. **Ascaris infestation was the commonest, out of the 51 infestation stools 64.7% had ascaris ova.**

ASSESSMENT OF NUTRITIONAL STATUS

The measures used in assessment of nutritional status were clinical signs, anthropometry, haemoglobin and haematrocrit levels.

Clinical Signs of Malnutrition

Data was analysed to give the total number of children with signs and those without. This was done by going through the data collected during the different observations done on each child and recording those who had signs and those who did not have. The results are presented in table 4.3.1.

Table 4.3.1 Prevalence of Defficiency signs in Males and Females

	Males		Females		Total
	n	%	n	%	
Thin hair	44	55.0	36	45.0	80
Sparse hair	46	54.1	39	45.0	85
Hair dyspigmentation	62	53.0	55	47.0	117
Conjuctiva Xerosis	1	100	-	-	1
Skin xerosis	38	48.7	40	51.3	78
Follicular hyperkeratosis	5	33.3	10	66.7	15
Muscular wasting	42	54.5	35	45.3	77
Potbelly	64	60.3	42	39.6	106
Moonface	14	70.0	6	30.0	20

A total of 254 children, 143 males and 111 females were examined for clinical signs of malnutrition. It was found that 91 (35.8%) had no clinical signs at all (during the whole survey period) while 164 (64.2%) had at least one sign. Of those 91 who did not have clinical signs 57.1% were males and 42.9% were females.

A Chi squared test was carried out to determine whether there was a significant difference in prevalence of clinical signs between males and females at 5% level. There was no significant difference

χ^2

Table 4.3.2 Distribution of Clinical Signs of Malnutriton According to Age (Sexes Combined)

Age in Months	1-6		7-12		13-18		19-24		25-30		31-36		37-42	
Total no. observ.	119		123		103		81		105		73		37	
Sign	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Thin Hair	6	5.0	25	20.3	16	15.5	7	8.6	13	12.3	5	6.8	3	8.1
Sparse Hair	7	5.9	29	23.6	17	16.5	7	11.1	13	11.4	5	9.6	3	10.8
H. Dyspigm.	3	2.5	29	23.6	9	27.2	12	26.7	12	26.7	7	15.1	4	10.8
M. Wasting	5	4.2	18	14.6	5	4.9	13	16.0	20	19.0	13	17.8	13	35.1
Potbelly	4	3.4	16	13.0	10	9.7	19	23.5	34	32.4	21	28.8	20	37.8
Moonface	-	0.0	4	3.3	4	3.9	4	4.9	9	8.6	2	2.7	4	10.8
Conjunc. Xerosis	-	0.0	-	0.0	-	0.0	-	0.0	1	0.9	-	0.0	-	0.0
Skin Xerosis	-	0.0	7	5.7	7	6.8	11	13.6	30	28.6	13	17.8	10	27.0
F. Hyperkeratosis	1	0.8	3	2.4	-	0.0	-	0.0	7	6.7	1	1.4	2	5.4
Impetigo & Scabies	4	3.4	8	6.5	4	3.9	7	8.6	7	6.7	7	9.6	2	5.4

Findings on clinical signs as presented on table 4.3.2 show that hair signs, muscular wasting and potbelly were very common. The proportion of children with signs during the first six months of life was less than 6%. From the seventh month the proportion of cases generally increased.

The highest rate of hair signs was recorded at age 7-18 months, with rate of hair dyspigmentation remaining common upto age of 30 months. Muscular wasting and potbelly were common at 7-12 months, then the rate dropped to rise again from the age of 19 months onwards; with the highest rate occuring at 37-42 months. Skin xerosis became common after the age of 18 months. Conjuctival xerosis was almost absent while follicular hyperkeratosis and moonface were rarely observed. It is most probable that skin xerosis was more as a result of weather, rather than deficiency. Impetigo and scabies are not directly related to malnutrition but are indicative of conditions suitable for malnutrition.

Table 4.3.3 Percentage Distribution of Number of Clinical Signs by Age Groups, Sexes Combined

Age in Months	Number of Signs					
	0	1	2	3	4	5
1-6	86.6	5.9	5.9	0.0	0.8	0.8
7-12	59.3	9.8	8.1	13.0	4.1	6.5
13-18	68.0	10.7	3.9	9.7	4.9	2.9
19-24	46.9	23.5	12.3	9.9	4.9	2.5
25-30	35.2	23.1	16.7	12.0	2.8	7.4
31-36	49.3	21.9	15.1	5.5	2.7	5.5
37-42	43.2	18.9	18.9	8.1	5.4	5.5
Total	58.5	15.0	10.5	8.4	3.4	4.2

The findings are presented in table 4.3.3 indicated that prevalence of clinical signs was not so common in the first 18

months of life. Over 50% of the children in the group had no signs, while from the age of 19 months the proportion of those with was over 50%.

The proportion of children in age period 1-18 months with more than one sign generally remained below that of the older children though there was a higher prevalence of 3 signs in age period 7-12 months than in other months. Four signs seemed to be on the higher rating at 7-24 months and at 37-42 months. But generally for all age groups, the proportion of those with 3 signs tended to remain below 10% while proportion with 2 signs after 18 months on average was 15%.

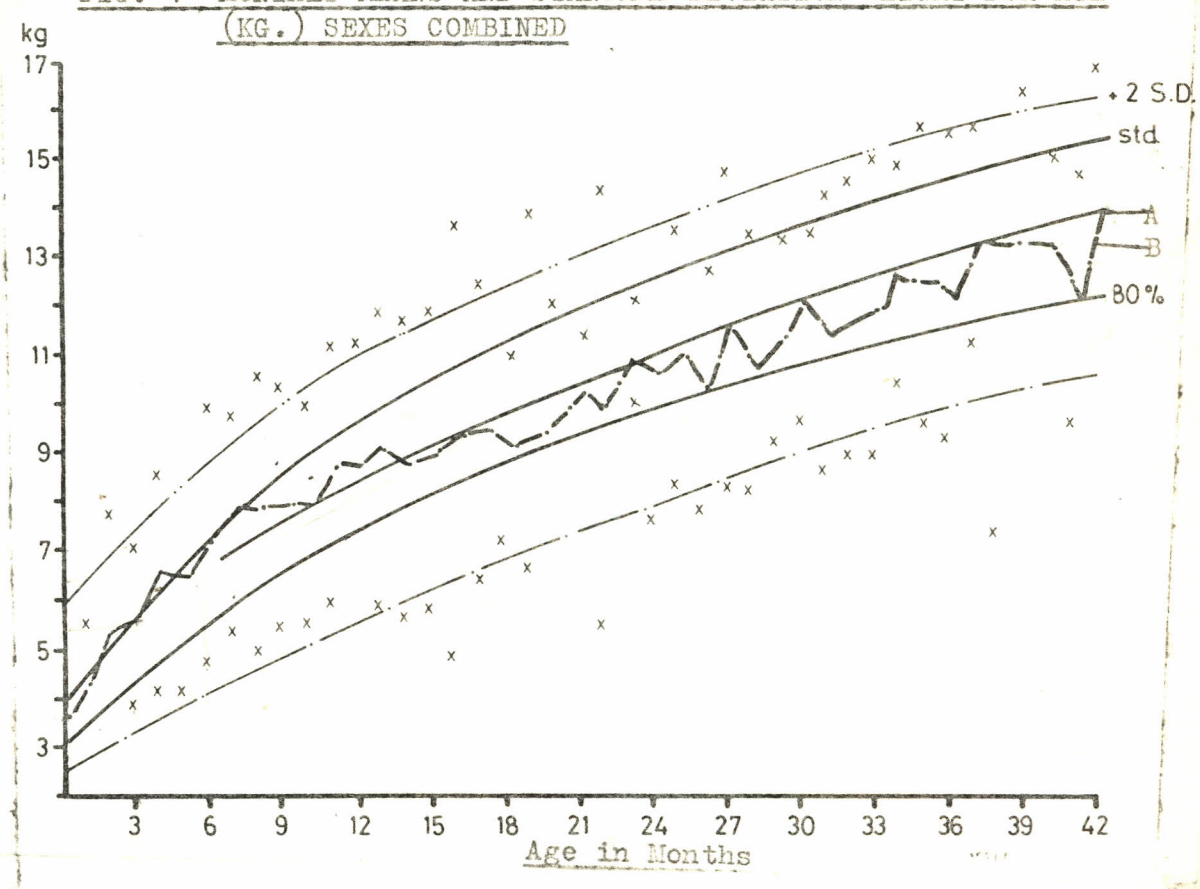
ANTHROPOMETRY

Weight, height, arm, head and chest circumferences as well as subscapular and triceps skinfolds were the anthropometric measures used in assessing nutritional status.

Apart from giving the children's means, standard deviation and growth rates, they were also classified according to their level of nutritional status.

Weight

FIG. 1 MONTHLY MEANS AND STANDARD DEVIATION WEIGHT-FOR-AGE (KG.) SEXES COMBINED



X Standard Deviation Points

A Constructed Childrens Means

B Actual Childrens Means

Std & 80% limits refer to Havard Limits

The Means and Standard Deviations presented in figure 1 were for sexes combined after determining that the difference between males and females were not significant according to student t'test at 5% level. As indicated by the weight curve,

children were above standard upto the age of three months. The curve then dropped and the lowest mean was recorded at 42 months which was 78% of standard. High standard deviations indicated that there were great variations in children within same month of age. The outliers as indicated on figure 1 affect the means. The steep upward direction of the curve indicating rapid growth started levelling from the age of nine months indicating slowed growth.

FIGURE 2 WEIGHT-FOR-AGE AS PERCENTAGE OF HARVARD STANDARD

Figure 2 shows the mean weights for children as percentage of standard and gives a general picture of nutritional status. Upto the fifth month children had means that exceeded standard. The curve drops rapidly upto about 10 months then they stabilised lying generally between 90% and 80% of standard. The mean weight at 22 and at 41-42 months was below 80% of standard. The curve was at the lowest at these three ages.

Weight-for-Age

Table 4.4.1 Nutritional Status of Children According to Weight-for-Age

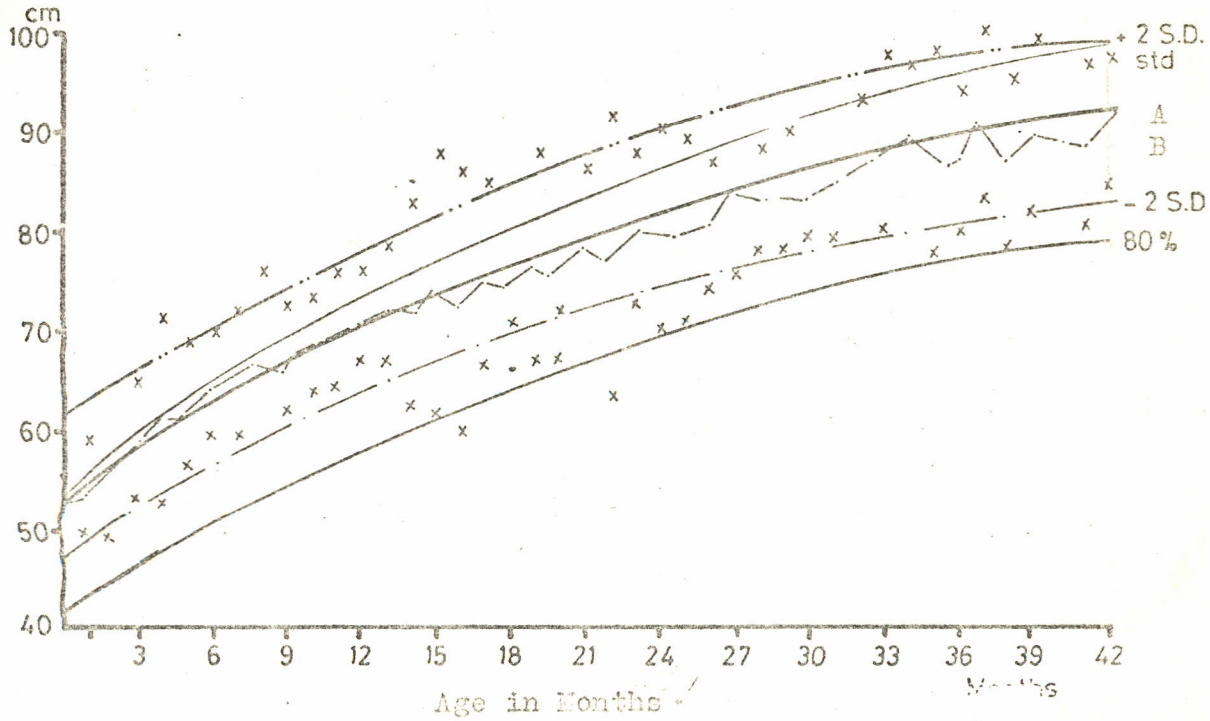
Grade	Severe PEM	Moderate PEM	Mild PEM	Normal		Total
Age in Months	60	60-74	75-89	90-100	100	
1-6	-	6	19	22	17	64
7-12	-	5	16	11	6	38
13-18	2	4	23	14	3	46
19-24	-	7	13	10	3	33
25-30	-	2	21	16	1	40
31-36	-	2	14	8	-	24
37-41	-	2	5	3	-	10
Total	2	28	111	84	30	255
Percentage	0.8	11.0	43.5	32.9	11.8	100

The classification used in table 4.4.1 is as suggested by Waterlow (WHO 1976). According to the findings of this study 55.3% of children were malnourished, the rest 44.7% had normal growth. Considering age period, 44.1% of the children in their first year of life were malnourished, 60.8% in the second year and 60.9% in the third year. Of those children who were malnourished, 32.6% were aged 1-12 months, 34.8% were aged 13-24 months, 27.7% were aged 25-36 months, and 4.9% were aged 37-42 months.

Kangemi children were most vulnerable to malnutrition in their second year of life, those severely malnourished were also in second year of life.

Height

FIGURE 3 MONTHLY MEANS AND STANDARD DEVIATION LENGTH-FOR-AGE (cm)
SEXES COMBINED



X Standard Deviation Points
A Constructed Children's Mean
B Actual Children's Mean
Std & 80% limit refer to Havard Limits

The figures for monthly means and ± 2 S.D. are presented in graph form (figure 3), for sexes combined, after determining that the difference in means between males and females was not siginifica according to student 't' test, at 5% level. The standard deviations are the deviations from the children's means.

As the curve indicates, children grew well in height in the first year and the curve remained closer to standard curve. Growth was not as satisfactory beginning the second year when the direction of the curve started to drop.

The standard deviations indicate that there were no great height variations in children within the same month of age. In general the nutritional status of the children as judged by height-for-age was satisfactory.

FIGURE4 HEIGHT- FOR-AGE AS PERCENTAGE OF HARVARD STANDARD

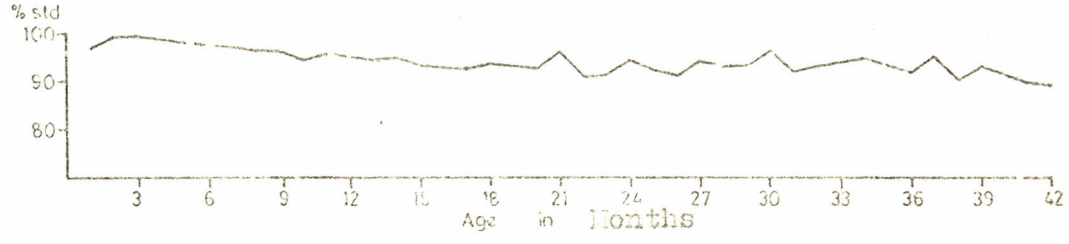


Figure 4 is given to make the illustration clearer. The mean height for one month children was 97% of standard then reached 100% at two months, from then on nutritional status deceased steadily with age reaching 90% of standard by age of 41 months.