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SIERRA LEONE

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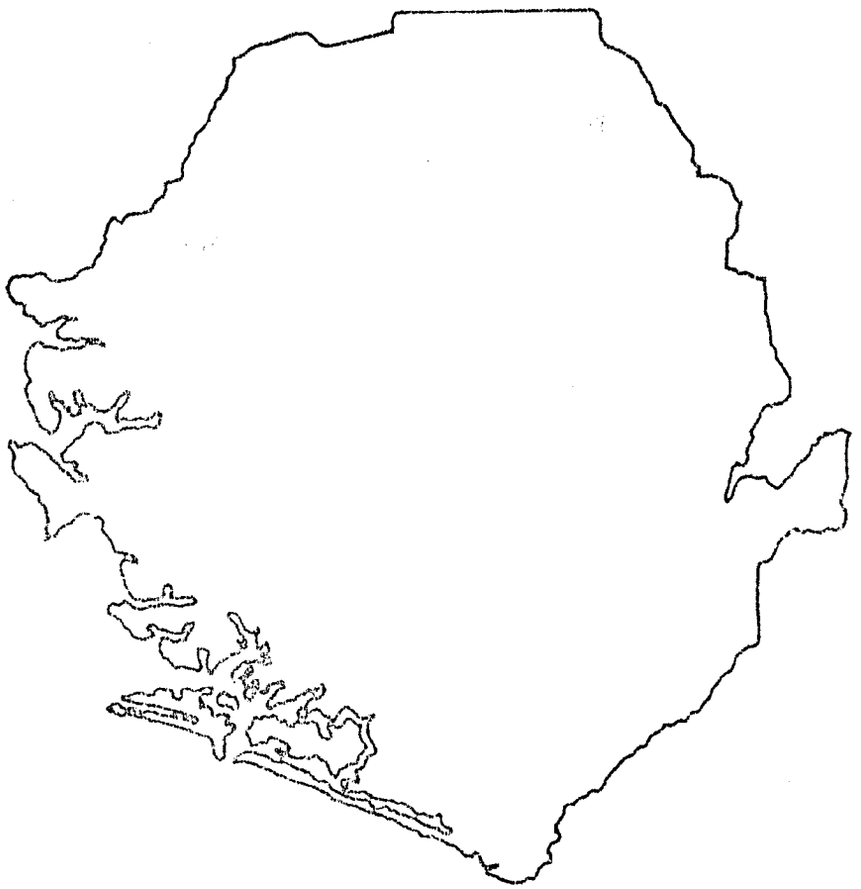

Office of Nutrition
Development Support Bureau
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Washington, D.C. 20523

SIERRA LEONE

NATIONAL NUTRITION SURVEY

Undertaken By

The Government of Sierra Leone

FINAL REPORT

OCTOBER 1978

With the Assistance of the

UCLA Nutrition Assessment Unit

Division of Population, Family and International Health

School of Public Health

University of California

Los Angeles, California, U.S.A.

In Cooperation With

The United States Agency for International Development

PREFACE

The Government of Sierra Leone has made a commitment to better the country's health status. To help with that commitment, the Ministry of Health recognized the need for a statistically valid assessment of Sierra Leone's nutritional status. Following a request of the Government of Sierra Leone to the United States Agency for International Development (AID), the Nutrition Assessment Unit of the University of California at Los Angeles (UCLA) was contracted to provide technical and administrative support for a National Nutritional Survey from November, 1977, to March, 1978.

The Survey was made possible through the combined efforts of the Ministry of Health, AID, UCLA, and the Leprosy Control Programme. A list of participating organizations (and survey personnel) appears in Appendix IV.

Many thanks go to all those who were involved in the Survey. The determined efforts of the Survey members under difficult circumstances facilitated the Survey's smooth operation. Special thanks go to the thousands of children and mothers who were cooperative throughout the exercise. Appreciation is also extended to all of those Sierra Leoneans whose warmth and hospitality contributed in no small measure towards the Survey's success.

TABLE OF CONTENTS

TABLES

TABLES (CONTINUED)

TABLES (CONTINUED)

FIGURES

APPENDICES

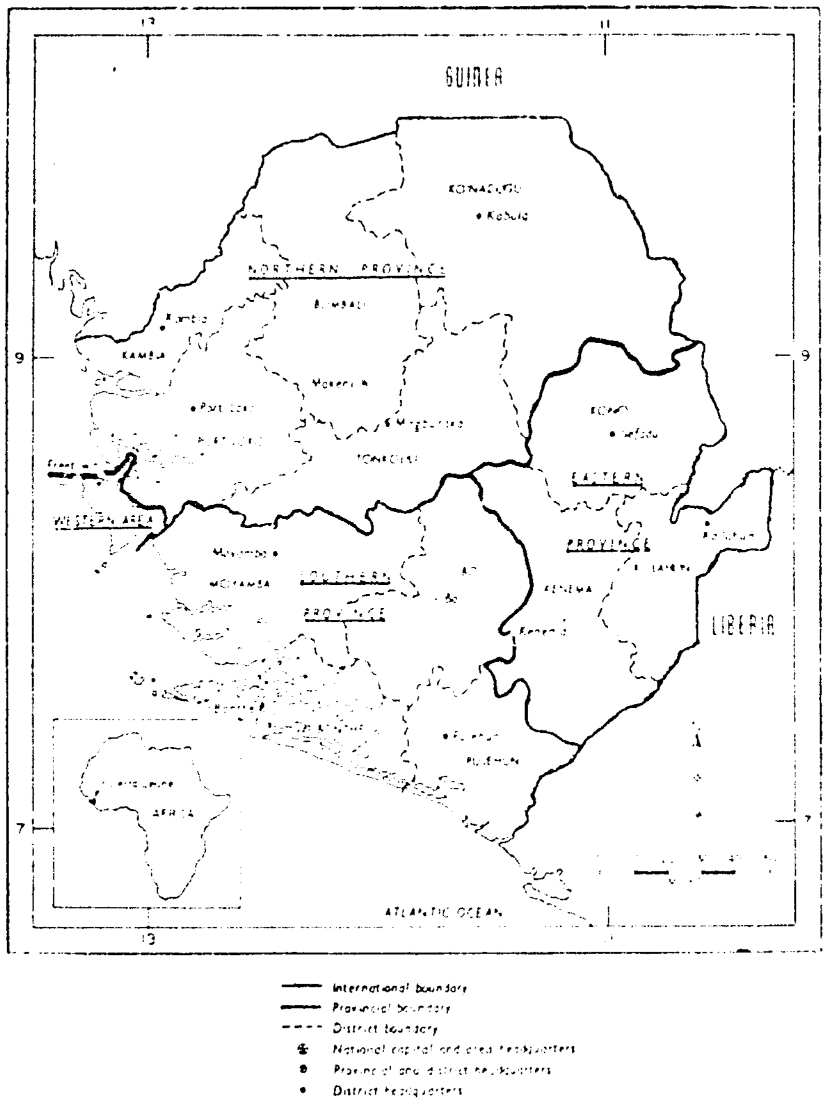


Figure 1. Republic of Sierra Leone

SUMMARY

The purpose of the Sierra Leone National Nutrition Survey was to provide an estimate of nutritional status of young children and their mothers in Sierra Leone, to compare nutritional status between selected areas, and to provide information about certain associations with nutritional status such as diet, socio-economic, health and demographic factors.

Anthropometry (body measurement), clinical signs and haemoglobin assessment provided a description of nutritional status. Interviews with the mother or her substitute were conducted to assess information on household and family characteristics, child health and diet. Laboratory tests were done to determine the presence of malaria parasites in the blood and intestinal parasites in stools. Thin blood films were made to study cell morphology and haemoglobin electrophoresis was done to study sickle cell anaemia.

The survey sample for Sierra Leone was based on the provisional results of the 1974 Population Census. The sample comprised 4880 children aged 3-59 months (0-59 months in Freetown), 3724 mothers and 1965 households. A multistage, cluster sampling technique was used, based on population proportionality. A cluster consisted of 30 children randomly sampled from 163 sites, each within an enumeration area.

Statistically valid descriptions of undernutrition prevalence rates were obtained for Freetown and each province. In addition, Sierra Leone, apart from Freetown, was described by urban and rural groupings. Each area or grouping consisted of at least 30 sites with each site containing 30 sampled children.

All national results were derived from weighting (appropriate statistical adjustment) all the province and Freetown results according to population proportionality. Thus prevalence estimates for children under five years (excluding 0-2 months) were based on the total number of these children in Sierra Leone (approximately 470,000) in a total population of 2.7 million.

The findings of the survey are briefly summarized as follows:

1. ANTHROPOMETRIC EXAMINATION OF CHILDREN UNDER FIVE YEARS OF AGE (excluding 0-2 months)

Chronic Undernutrition (or Chronic Protein-Calorie Malnutrition)

A child measuring less than 90% of the expected height for a reference child of the same age is classified as being chronically undernourished. The proportion of children classified in this way gives an estimate of the prevalence of chronic undernutrition in any population.

Chronic undernutriton in young children reflects recurrent episodes, or a prolonged period, of nutritional deficiency of calories and/or protein available to the body tissues. This nutritional deficiency usually has an onset at least six months prior to the time of examination. The deficiency is usually the result of poor diet and/or health with particular reference to acute infections and diarrheal disease.

In Sierra Leone 24.2% of the young children are chronically undernourished, affecting a total of about 111,000 children in the whole country. The prevalence is lowest in infants, increases after 12 months of age and reaches a plateau from 21 to 59 months. Using the same criteria, only 2.1% of those children belonging to the Special Group of relatively high socio-economic status are chronically undernourished. The difference between

the national prevalence rate (24.2%) and that of the Special Group (2.1%) represents the potential improvement that eventually might be obtained with a better nutritional environment.

The prevalence rates for chronic undernutrition are least in Freetown (10.3%) and lower in urban (17.4%) compared with rural Sierra Leone (26.6%). The rates are very similar in each province, ranging from 23.7% to 25.8%. The actual numbers of children affected are highest in the North (45,000--representing 41% of the 111,000 with chronic undernutrition in the whole country).

Certain factors associated with chronic undernutrition were revealed by the survey. The prevalence of undernutrition in the Sierra Leone Sample was found to be significantly greater when:

- a household's source of water was a river rather that a tap or well;
- a household head was a male;
- a household head was a farmer;
- a child's mother could not read English;
- someone other than the mother was primarily responsible for the child's care and feeding;
- the mother spent comparatively less money at the market;
- a child was not born in a hospital or clinic;
- a child aged 18-23 months was still breast-feeding;
- a child aged 3-11 months was receiving no other milk

These associations must not be regarded as causal. In addition, they may be explained by other factors. For example, chronic undernutrition may be higher in children aged 18-23 months still being breast fed because either they are not receiving food other than milk or are more likely to live in rural areas where services are poorer.

With due caution, however, associations may be used as guidelines in determining some of the factors leading to undernutrition.

Some of the associations (child's birthplace, source of water) indicate the roles that health services and poor environment have in influencing nutritional status. Likewise, other characteristics associated with poor health indicate that cultural and socio-economic conditions are also influential. Taken together these and other associations indicate that poverty, ignorance and disease interact with diet and other factors in a child's environment to determine his nutritional status.

Acute Undernutrition (or Acute Protein-Calorie Malnutrition)

A child measuring less than 80% of the expected weight for a reference child of the same height is classified as being acutely undernourished. The proportion of children classified in this way gives an estimate of the prevalence of acute undernutrition in any population.

Acute undernutrition in young children reflects a recent period of nutritional deficiency of protein and/or calories available to the body tissues with a usual onset no more than a few weeks prior to the time of examination. The prevalence of acute undernutrition is expected to be far less than that for chronic undernutrition. In a cross-sectional survey a child is examined at one time only. Thus the acute episode evidenced by cumulative episodes resulting in chronic malnutrition will be apparent through reduced growth in height.

In Sierra Leone, 3.0% of the young children are acutely undernourished. This prevalence is low throughout all areas of the country, but it reaches a peak of 9.3% at 12-14 months. Only 0.6% of the Special Group are acutely undernourished.

This result indicates that there was no famine nor near-famine situation in any area described at the time of the survey. It is highly probable that conditions at the time of the survey were relatively favourable, and that adverse seasonal influences

on nutrition occurring at other times of the year (such as during the rainy season) would not be reflected in the acute undernutrition rates seen in this survey.

The only significant associations found with acute undernutrition concern the 3-11 month old children outside Freetown, who are less likely to be acutely undernourished when being breast-fed. They are also less likely to be undernourished when having supplemental milk as well as breast milk.

Underweight (Protein-Calorie Malnutrition of Unspecified Duration)

A child measuring less than 80% of the expected weight for a reference child of the same age is classified as being underweight. The proportion of children classified in this way gives an estimate of the prevalence of underweight in any population.

Underweight-for-age in young children reflects a nutritional deficiency of protein and/or calories available to the body tissues, but the onset and duration is not know. Because the bony skeleton contributes greatly to the weight of a child, the prevalence of underweight might be similar to that of chronic undernutrition, especially when the prevalence of acute undernutrition (low weight-for-height) is relatively low.

In Sierra Leone 30.5% of the young children are underweight, far more than in the Special Group (5.1%). The prevalence of underweight is lowest in children aged 3-5 months, increases rapidly after six months and reaches a peak throughout the second year of life, reducing slightly after this.

The underweight prevalence is least in Freetown (18.3%) and less in urban (29.3%) compared with rural Sierra Leone (32.4%). The East (26.0%) has the lowest prevalence rate of the provinces.

The factors associated with underweight tend to be similar to those associated with chronic undernutrition; however, certain additional associations are also shown. The most striking of these is that in Freetown the prevalence of underweight is six

times higher in bottle-fed infants than in breast-fed infants.

Arm Circumference

Mid-upper arm circumference is determined by bone size, muscle and fat. As bone size is relatively unchanging, thin arms (which are a key clinical sign of undernutrition) reflect muscle and fat bulk.

The arm circumference-for-age and arm circumference-for-height indices were used on this survey to confirm the results of the other measures of undernutrition, such as underweight (low weight-for-age) and acute undernutrition (low weight-for-height). It should be noted however, that the arm and weight indices do not measure exactly the same aspects of undernutrition.

The arm indices showed similar trends to those of weight in comparing undernutrition based both on age and area distribution. In addition, the correlation coefficient ("r" value) of arm circumference-for-age with weight-for-age was 0.75 and arm circumference-for-height with weight-for-height was 0.80. These values vary slightly depending on the age group considered.

Arm circumference results from the survey may be used as a basis for future surveys and surveillance, particularly if adequate equipment for weight and/or height are unavailable or too costly.

2. NUTRITIONAL STATUS AND MORTALITY

Mortality information was obtained concerning each of the surveyed families. The derived mortality rates are approximations for the under-five's death rates, and are similar for each province, ranging from 31.4% to 33.3%. The rate in Freetown is much lower (20.0%). Rural(33.3%)/urban(27.3%) differences are also seen.

Correlation coefficients, relating the mean undernutrition prevalence rates and the mean mortality rates for each site, were obtained to investigate the relationship between nutritional status and retrospective mortality rates. The results indicate that for all of Sierra Leone more deaths are likely to occur in those families that have an undernourished child under five years (determined by being either chronically undernourished, underweight, or by showing arm wasting) than in those families without an undernourished child.

3. OEDEMA IN YOUNG CHILDREN

The proportion of children with oedema is low (0.2%), which is consistent with the low prevalence of acute undernutrition. Oedema identifies only a certain type of severe undernutrition florid kwashiorkor.

4. ANTHROPOMETRIC EXAMINATION OF MOTHERS

Maternal nutritional status is more difficult to define using anthropometric measures than is the status of young children.

In Sierra Leone, 8.2% of mothers are short (i.e. height less than 150 cm or 4 ft. 11 in.). The distribution of short statured mothers is similar throughout the country.

In view of the large number of different tribal groups in Sierra Leone maternal stature is used to consider the genetic component of stature in children. This genetic component has some influence in that 30% of the young children of short mothers (under 150 cm or 4'11") are chronically undernourished, compared with 19% of those with mothers who are not short (over 150 cm). However, the evidence indicates that the environmental factors associated with chronic undernutrition in young children (including diet and poor health) are much more important than genetics in determining a child's stature. This evidence

included:

1. The vast majority (84% of children classed as chronically undernourished have mothers who were not short).

2. Children of individual tribal groups have a much lower prevalence of chronic undernutrition in Freetown compared with outside Freetown (e.g. in one tribal group the prevalence in Freetown is 1.2 and outside Freetown was 27.3).

3. The difference in maternal height between Freetown and the rest of the country is very small compared with the differences in chronic undernutrition.

4. The correlation coefficient between the stature of mothers and the percentage height-for-age of their children is small (0.20).

It should also be noted that maternal stature might also reflect nutrition-related environmental factors which influenced growth in her childhood.

Low Measures of Arm Circumference and Fatfold

In Sierra Leone, 6.1 of the mothers have evidence of arm wasting (arm circumference less than 23 cm.) and 35.5 have evidence of fat wasting (fatfold less than 7.5 mm.). Throughout the country, mothers show a similar prevalence of arm wasting; however, approximately twice the prevalence rate of undernutrition (arm wasting) is found in pregnant mothers. Fat wasting is more prevalent in the Southern Province (29.7) and in rural (28.0) compared with urban (20.0) areas. This might suggest that a higher proportion of Southern and rural mothers are undernourished compared with the rest of the country. Inadequate diets may be the basis, but it should be noted that other factors, such as activity, also influence maternal arm measures. A much larger proportion of mothers with large arms (over 29 cm circumference) are seen in Freetown (22.9) and the urban areas (20.6%) compared with the rural areas (12.3%), and this could indicate higher calorie reserves.

5. DIETARY INVESTIGATIONS

Dietary information pertaining to milk availability and the onset of other food was collected on all children 30 months or younger. More detailed information was collected from a dietary subsample of 1380 children and their families selected from throughout the country. A 24-hour dietary recall method was used to gather the subsample information. Analysis compared the dietary patterns of families to that of their children in one of four age groups (3-6,6-11, 12-17 and 18-30 months) and for each area of the country. The dietary investigations were only concerned with the types of foods eaten, not the quantity.

INFANT FEEDING AND WEANING

Breastfeeding is widely practiced throughout Sierra Leone: 95% of the rural children in the 12-17 month group are still breast feeding. In the urban areas and Freetown the rates drop to 82% and 79%. Non-breast milk is used extensively in Freetown (approximately 80%, 3-11 months), less so in the urban areas (40.5%) and least in rural areas (12.3%). Children frequently received both breast and non-breast milk.

The findings indicate that breast feeding is prolonged, which should be encouraged as a beneficial practice. However, breast milk alone is only sufficient to meet a child's nutritional needs until about the sixth month. At that time other foods are needed to provide the necessary nutrients required to maintain normal growth. In addition, it is important to note the necessity of obtaining an adequate diet for the lactating mother in order to ensure an adequate maternal nutritional status.

FOOD CONSUMPTION

Very few children 3-5 months receive any food with their milk other than a cereal pap, and since a child over 17 months

old usually receives the same types of foods as his family, the critical periods to watch are the 6-11 month and 12-17 month groups.

The following is a brief summary of food group consumption:

Staples (Cereals, tubers)

Cereals were the major staples throughout the country, being consumed by 99% of the families. Tubers/cassava were eaten by over 30% of the families, except those in the Northern Provinces (15%). A high proportion of children also received these foods. At 6-11 months, 80% of the children outside Freetown were receiving a cereal staple.

Protein-Rich Foods (Apart from Milk)

Vegetable proteins (beans, seeds or nuts) were eaten by the least proportion of families in the Southern Province (53%) and by just under 80% of the remaining families in the country. Over 97% of all families in the country consumed at least one type of animal protein (mainly fish). However, far fewer children, particularly those under 12 months, received any protein rich foods apart from milk. Of the children aged 6-11 months, only 24% consumed a food rich in vegetable protein, and 30% consumed any animal protein. Of children aged 12-17 months, 51% consumed vegetable protein and 72% consumed animal protein.

Dark Green Leafy Vegetables (DGLV's)

The proportion of families eating DGLV's ranged from 51% to 75%. The proportion of children 6-11 months eating these ranged from 13% to 30%. In the 12-17 month group the percentage of children receiving DGLV's rose, but the child/family deficits were still considerable.

Fruits

Fruits were eaten most commonly by families in Freetown and the Eastern Province. Children aged 6-11 months received about 50% less than their families, and those aged 12-17 months received 25% less.

Oils and Sugar

A high proporiton of all families consumed oil in their diet. Fifty percent and 70% of children aged 6-11 and 12-17 months, respectively, also consumed oil.

Sugar was not widely consumed except in Fretown.

Discussion

A child's intake of food is dependent upon two factors:

1. Is the food available within the family?
2. If available, is it distributed to the child?

These results point to a widespread problem of food distribution within families. Only about a third of the children aged 6-11 months receive any vegetable or animal protein or any DGLV's when their families consume these foods. The proportion rises to about 70% for the children aged 12-17 months. Sifnificant improvement in the diets of children under 18 months old could be realised by a more favourable distribution of food within families.

There are also problems with the availability of food for the families. For example, vegetable protein and fruits are not widely consumed in the South; neither are DGLV's nor fruits in the North. In addition, the quantity of food available to a family or child is another important consideration, but is one that was not investigated in this survey.

In general then, whether a child over 17 months eats a particular food or not is dependent upon whether the family eats that

food. However, for a child under 17 months, his intake is determined not only by the availability to the family but also by the distribution within the family.

The development of a strong nutrition education program is needed to teach mothers about healthful infant feeding and weaning practices. The promotion of breast feeding and the utilisation of local foods for weaning, which are easily grown and obtainable, should be paramount objectives of the program.

6. ANAEMIA IN YOUNG CHILDREN AND PREGNANT MOTHERS

Anaemia, as defined by WHO based on a low haemoglobin value, (<10 Gm% for children 6-23 months and <11Gm% for those 24-59 months) was present in 58.1% of children aged 6-59 in Sierra Leone. The prevalence rates were higher in children aged 24-59 months (65.8%) compared with those aged 6-23 months (48.4%). Anaemia prevalence was lowest in the Special Group (33.3%) and Freetown (25.7%). There was little or no difference between the provinces. Sixty-five pregnant mothers had their haemoglobin levels determined, and 30.7% were diagnosed as anaemic (Haemoglobin below 11Gm%).

An anaemic blood picture was found in 51.5% of Sierra Leonean children. Such a picture was very rarely found (3.7%) in Freetown children and was most common in the Southern Province (76.6%) and least common in the North (46.5%). The usual types of anaemia found were hypochromic and microcytic, and hypochromic and normocytic. Macrocytosis was less common, but occurred in a significant percentage (10%). Of all cases with anaemia, 73% were classed as mild, 26% as moderate and 1% as severe. Low haemoglobin levels and a hypochromic blood picture were shown to be closely associated with poor nutritional status.

7. MALARIA IN YOUNG CHILDREN

Thick blood films from 1953 children were examined for the presence of malaria parasites. Almost one third of all children aged 3-59 months in Sierra Leone had malaria parasites in their blood. The rates were highest from one to four years (33.2% - 42.0%), although the presence of parasites was also common in infants.

The prevalence rate in Freetown was strikingly lower than anywhere else in the country (4.0% - Freetown; 20.6% - urban; and 36.2% rural). Malaria is often a very important cause of anaemia.

8. INTESTINAL PARASITES IN YOUNG CHILDREN

Stool samples of 899 children aged 3-59 months from throughout the country were examined for intestinal parasites. Hookworm infestation was found to increase with age from 0.0% in children aged 3-11 months to a high of 10.6% in children 48-59 months. The incidence of hookworms in stool samples was lowest in Freetown (0.7%), followed by the urban (2.1%) and the rural areas (6.9%). Hookworm may also be an important contributing factor in producing anaemia.

Roundworm infestations which may produce a significant nutritional drain on a child, were also frequently seen. The prevalence of ascaris in stools reached a plateau of about 26% from 36-59 months. An interesting result is that the highest prevalence rate was seen in Freetown (25.4% vs. 18.8% for total Sierra Leone). This was also true for the semiquantitative examination.

Other intestinal parasites, apart from Trichuris, were relatively uncommon.

CONCLUSIONS

The results suggest the following:

- Almost one-fourth of all Sierra Leonean children up to five years of age have sufficiently poor growth to indicate a long term lack of calories and/or protein available to the body tissues (chronic undernutrition). Almost one-third of the children are underweight.

- All types of undernutrition become more prevalent during the second year of life.

- Nutritional problems are much more severe in the rural areas of the country.

- Child mortality rates are higher in those families that have an undernourished child.

- Maternal undernutrition, as defined by arm wasting, is about 6.0% throughout the country, however, it is almost twice that high in pregnant women.

- Almost 60% of all children in Sierra Leone are anaemic as defined by low haemoglobin. The rate in Freetown is less than half that.

- Poor diets, resulting in iron and, at times, folate deficiencies, are a major cause of anaemia.

- Malaria is endemic throughout the country, except in Freetown, and is another major factor contributing to anaemia. Hookworm infestation may also contribute.

- Ascaris (roundworm) infestation is common throughout the country (18.8%).

- Full breastfeeding is widely practiced throughout the country for the first year (over 90%; 80% in Freetown).

- Non-breast milk is frequently given to children in Freetown and the urban areas.

- Less than 25% of all children aged 6-11 months received vegetable protein; less than 30% received animal protein; 21% received DGLV's and only 15% received fruit (the quantity of food or the combination of foods eaten together are not known).

- At 12-17 months 51% of the children received vegetable protein; 69% animal protein; 46% DGLV's and 24% fruit.

- Families frequently ate these foods but they were often not given to the children. For example, with regards to vegetable and animal protein and DGLV's only 33% of the children aged 6-11 months and 72% aged 12-17 months received these foods when they were available (eaten by the family).

- The variety of food groups consumed in a daily diet was greatest in Freetown, followed by the Eastern Province.

- Fewer families consumed vegetable proteins and oils compared with the other food groups.

- Improvement in a child's diet may be realised by the combination of an improved intra-family distribution of existing foods and, in some areas, by increased availability of certain foods.

RECOMMENDATIONS

The following recommendations were formulated in Freetown in September, 1978, by the Ministry of Health Nutrition Unit, a Nutrition Planning Consultant from AID and the UCLA Unit representatives. These are presented to suggest initial approaches and methods that the Government of Sierra Leone might consider in order to improve the nation's nutritional status and health.

It is recommended:

A. That activities (government and non-government) to improve nutrition be coordinated.

An existing mechanism for coordiration is the Council for Health Education and Nutrition, which was set up in 1969 by Cabinet action.

The functions of the Council are:

1. Coordination of health education and nutrition activities within the various ministries and agencies of the government.
2. Review of Health Education and Nutrition Projects.
3. Applied Nutrition Research.
4. Training projects.
5. Policy recommendations for improving nutrition through Ministries of Health, Agriculture, Education, Social Welfare and other agencies.

In order to carry out an expanded role in policy and programme coordination, the Council would require:

1. A permanent technical and administrative staff, with appropriate office and facilities;

2. The necessary technical and management support to carry out coordination and review of policies and programmes;

3. Regular contact with policy makers, possibly through a newsletter as well as the periodic meetings of the Council.

B. That an important area of future program activity be in nutrition education.

1. An effective way to reach large number of people at relatively low cost is through mass media, such as radio. An example is the use of short (60 second) radio message, broadcast frequently, to encourage mothers to enrich home produced baby and weaning foods. Such programmes should be designed after careful study, including evaluation of past efforts of this type.

2. Another area of need for nutrition education involves specific attention to the rural population. These people can be reached through village level workers: health, social welfare, and agriculture agents in government programmes; and also through village level non-government programmes.

3. Increased attention to nutrition education in the schools and teaching institutions is desirable.

4. The provision of in-service training in nutrition, and its relationship to the responsibility of professional, and administrative personnel in various sections, is an important area of nutrition education.

5. Curricula from all areas of nutrition training should be reviewed to assure that they are appropriate.

C. That agricultural policies and programmes be assessed to assure that they are consistent with the nutritional needs of the population, and that where appropriate nutritional components be added to agricultural projects to help meet these needs.

D. That efforts within the health sector which address nutritional needs be strengthened, particularly the nutritional activities within: (1) the M.C.H. programme; (2) the health education programme; (3) the Nutrition Unit of the Ministry of Health; and (4) the Primary Health Care project.

E. That a nutrition surveillance system be developed, in co-operation with existing government and non-government data collection systems, to consist of periodic reporting of selected nutrition indicators, including anthropometric measures and nutrition-related morbidity and mortality data.

PARTICIPATING ORGANIZATIONS

The following Sierra Leonean Ministries and agencies were involved in the Survey.

The Ministry of Health, particularly the:

- Nutrition Unit;
- Leprosy Control Programme;
- Endemic Disease Control Unit; and the
- National School of Nursing

The Central Statistics Office

The Ministry of Information and Broadcasting

The Ministry of Agriculture and Natural Resources

1. BACKGROUND INFORMATION

1.1 GENERAL INTRODUCTION

The Republic of Sierra Leone is situated on the West Coast of Africa. It is bounded on the North West and the North East by the Republic of Guinea, on the South East by Liberia, and on the South West by the Atlantic Ocean (Figure 1). The land area of Sierra Leone covers roughly 28,000 square miles (1) and it is divided into four administrative regions, the Northern, the Eastern and the Southern Provinces and the Western area. Freetown is the capital city. The population of Sierra Leone is 2.7 million (1974 Population Census, provisional results), and about 75% of the people live under a pattern of shifting agriculture (2). The per capita income is about Le 178 (Le 1 = $1 U.S.) (3). Diamond mining is carried out in the Eastern and Southern provinces and serves as an important source of foreign exchange. Children aged 0-59 months represent 17.4% of the population (1).

Climate

Sierra Leone has a tropical climate. There are two distinct seasons, the dry season starting from November to April and a rainy season lasting from May to October with a peak in July and August.

Education

In 1971, 26% of the children aged 5-14 years were in primary school and 13% of the children aged 15-19 years were in secondary school (4).

There are several teacher training colleges and two universities. About 20% of the population is literate (5).

Agriculture

Rice cultivation is the major crop activity; other crops grown

include cassava, maize, beniseed (sesame), cow peas, millet, citrus fruit, ground nuts, broad beans, and sweet potatoes. Cash crops include palm kernels, coffee, and cocoa (2, 4).

Fish and Livestock

Fish is the most important source of animal protein in Sierra Leone (2). The ocean fleet is estimated to number 3,500 canoes and 17 licensed trawlers. The catch includes shrimp, sardines and tuna; oyster culture is being developed. Fresh water fishing is done inland, mostly by women (2, 5). Other animal protein is expensive and often unevenly distributed throughout the country. The cattle industry is based in the Northern province, primarily in the Koinadugu District (2). This industry's development has been slow. However, to remedy the situation, a project is being undertaken at Teko Veterinary Section (Ministry of Agriculture) with assistance from UNDP. The project concerns the crossing of improved Kenyan Sahiwal cattle with the local Ndama breed. Pigs are concentrated in the Western Area and the Southern Province. Poultry is fairly evenly distributed throughout Sierra Leone.

1.2 HEALTH

Malaria, gastrointestinal diseases, anaemia, pneumonia, tuberculosis, schistosomiasis, neonatal tetanus and childhood infectious diseases, such as measles, which are exacerbated by diet deficiencies and poor sanitation, are serious health problems throughout the country (5).

The government operates 23 hospitals, 30 health centres, 37 maternal and child health centres, and 109 other treatment centres and dispensaries (1). These facilities are unevenly distributed throughout the country. They are also often understaffed and not well supplied. Mission groups and other private sources also operate several hospitals and health centres.

Life expectancy is estimated at 41.9 years for males and 45.1 years for females. The infant mortality rate for the Western area is 130.3 per 1000 live births. Some of the leading causes of death in children aged 1-4 years in the Western area for 1975/76 were: (1)

Measles	21.2%*
Enteritis and other diarrheal disease	13.6%*
Avitaminoses and other nutritional deficiency	9.4%*
Malaria	4.3%
Anaemia	9.2%*

* Nutritionally related diseases gives a total of 53.3%

The statistics for 1969/75 show that about 24% of all registered deaths in the Western area occurred during the first year of life (1).

The main nutritional diseases found in Sierra Leone are protein-calorie malnutrition (PCM) in children, anaemia in children and pregnant women, and goitre, which is endemic in certain areas (4).

In order to help meet the need for a nutritionally adequate and affordable weaning food, the Ministry of Social Welfare produces "Bennimix" (2). This is a locally produced "Triple Mix" made from parboiled rice, black-eyed beans, benniseed (sesame) and sugar. It sells for Le 0.50/lb. and the demand for it far exceeds its supply.

Nutrition Activities

1. Among its other responsibilities The Nutrition Unit of the Ministry of Health conducts research in nutrition related to the appraisal of nutritional status of given communities, teaches nutrition to nursing and public health students, and plans desirable nutrition programmes.

2. Nutrition education is carried out in all Maternal and Child Health clinics. Food demonstrations, using locally available food, are done in some of the clinics.

3. Catholic Relief Services supports Maternal and Child Health (MCH) activities by providing USAID supplementary food to clinics.

4. CARE is working on a nutrition education program primarily for the rural area.

5. The Christian Health Association of Sierra Leone carries out nutrition education in each of its hospitals.

6. Nutrition forms part of the Health Education and Home Economics syllabi for primary and secondary schools.

1.3 PREVIOUS NUTRITIONAL STUDIES

In a national survey conducted in 1964 by the Ministry of Health, D.M. Blankhart reported a mortality rate between 23-44% among 1450 children aged 0-3 years. Nineteen villages were surveyed from March to May. The mortality rate of children was less than 20% among mothers who had 1-3 children and 40% or more for mothers with 7 or more children (7). The prevalence of specific types of malnutrition was:

Kwashiorkor	1.2%
Under-weight and muscle wasting	5.7%
Nutritional dwarfing	40.0%

In 1965 Miss P. Thompson-Clewry of the Home Economics Department, Njala University, conducted a survey of food habits, infant feeding practices, and living conditions among families of social welfare voluntary leaders. The survey revealed that two meals were prepared each day, one in the morning and one in the

evening. Babies were breastfed for the first 18-24 months. When weaned, the infants were fed on a starchy gruel, then eventually shared the family's meal which included very little fish or meat and sometimes none at all.

2. GOALS AND OBJECTIVES

The overall goal of the Sierra Leone National Nutrition Survey was to provide baseline information about the nutritional status of young children and their mothers which can be used in determining policy and priorities for the planning and administration of applied nutrition activities.

The specific objectives of the survey were to:

1. Provide an estimate of the nutritional status of young children and their mothers throughout Sierra Leone and from this derive an indication of the general nutritional status of the entire population.

2. Compare the nutritional status in selected areas so that program priorities can be determined.

3. Provide information about associations between nutritional status and other factors, such as diet, socio-economic status and other demographic information.

4. Provide training for local personnel to enable them to carry out future surveys.

This report considers:

1. Prevalence of acute and chronic undernutrition (protein-calorie malnutrition) in children aged 3-59 months and their mothers.

2. Prevalence of anaemia in children and pregnant mothers.

3. Prevalence of malaria parasites in children.

4. Prevalence of intestinal parasites in children.

5. Prevalence of abnormal haemoglobin in children, as a guide to the problem of sickle cell disease.

6. Duration of breast feeding and age weaning foods introduced.

7. Types of foods eaten by children and their families.

8. Association of nutritional deficiencies with socio-economic, demographic, and health characteristics of household and families.

3. SURVEY DESIGN

A valid estimate of the prevalence of malnutrition requires:

1. A well defined universe.
2. A sample which is statistically reliable and representative of this universe.
3. An objective, quantifiable definition of malnutrition (see "Indices of Malnutrition.")

3.1 SURVEY UNIVERSE

The universe included the entire population of Sierra Leone (2.7 million) based on the provisional results of the 1974 Population Census (9). Table 1.

The Republic of Sierra Leone has three provinces: North, East, and South and one area, West. The Western area is predominantly Freetown, the capital of the Republic.

The Ministry of Health required a separate description of each province and Freetown as well as the whole nation. A further description was planned for the rural areas of each province and the urban areas (excluding Freetown) for the nation. "Rural" is defined by the Central Statistics Office, Freetown, as any locality with less than 2000 inhabitants and "urban" as any locality with greater than 200 population. It should be noted that throughout the report, urban areas refer only to those urban localities outside Freetown.

There was no prior data which suggested special problem geographic areas of malnutrition in Sierra Leone. However, the results of the Liberia National Nutrition Survey conducted in 1976 (10) indicated that the rural areas had a higher prevalence of children with undernutrition than in the urban areas in that country. It was anticipated that this would also be found in Sierra Leone.

The sample was selected to describe the following provinces, areas, or groupings:

1. North Province - rural (34 sites)
2. North Province - total (42 sites)
3. East Province - rural (32 sites)
4. East Province - total (48 sites)
5. South Province - rural (31 sites)
6. South Province - total (38 sites)
7. Freetown (33 sites)
8. Rural areas of Provinces (98 sites) - includes 1 in Western area
9. Urban areas of Provinces (32 sites) - includes 1 in Western area
10. Total country excluding Freetown (130 sites)
11. Total country including Freetown (163 sites)

Each site contained 30 sampled children aged 3-59 months except for Freetown where the age range was 0-59 months.

Special Group

A Special Group of children, assumed to be well nourished, was also measured. Results for this group will provide a basis for comparison with the rest of Sierra Leone.

A total of 361 children, aged 0 to 59 months, from various urban areas including Freetown, served as the Special Group.

The following criteria determined the children in this group:

1. The children were to be in good health, and with ready access to health and other facilities.
2. Parents were educated and in the better socio-economic groups.
3. The ages of the children were correct.

The children were selected from Government-assisted and private nurseries and nursery schools, and paediatricians' clinics. In

addition, teams visited the homes of 40 children.

Measurements done on this special group were height, weight, arm circumference, triceps fatfold and haemoglobin estimation. The age information was obtained from the parents or from verifiable records in the clinic, nursery or nursery school.

3.2 SAMPLING METHODS

In consultation with the Central Statistics Office, Freetown, it was decided that this survey take a subsample of sites already enumerated and visited by the Bureau's 1967/1977 Household Expenditure Survey (HES). In the HES, the total population of Sierra Leone was stratified by province capital, urban, mining and rural (Table 1).

Mining areas are adjacent to diamond mines. Most are in the Eastern Province. Their total population accounts for 41.8% of all urban areas in the country.

The Household Expenditure Survey identified 15 strata in Sierra Leone with a total of 432 Enumeration Areas (sites) selected (Table 2). An Enumeration Area (EA) is a single geographic area delineated by the Population Census. Its population is usually from 500 to 1500

Each site was contained in an EA. Thus an EA was the primary sampling unit and the complete list of EAs for the stratum, the sampling frame. The population of all the EAs in a stratum were progressively cumulated. A random starting number and a fixed sampling interval, based on the number of sites required, was used. This systematic sampling method delineated the EAs (sites) to be selected.

For this nutrition survey, a random subsample within each strata was selected from the EAs chosed for the Household Expenditure Survey. The number of EAs selected (Table 3) was based

Table 1

POPULATION DISTRIBUTION - SIERRA LEONE

PROVINCE	URBAN Pop	URBAN %	RURAL Pop	RURAL %	TOTAL Pop	TOTAL %	%
North	127,120	5.2	916,424	37.4	1,043,544	42.6	38.3
East	254,039	10.4	517,858	21.1	771,897	31.5	28.3
South	95,612	3.9	500,479	20.4	596,091	24.3	21.9
Western Area Non-Freetown	13,034	0.5	27,169	1.1	40,203	1.6	1.5
TOTAL (excl. Freetown)	489,805	20.0	1,961,930	80.0	2,451,735	100.0	90.0
Freetown	---		---		272,589	---	10.0
GRAND TOTAL					2,724,324	---	100.0

Table 2

HOUSEHOLD EXPENDITURE SURVEY STRATA
WITH NUMBER OF SITES SELECTED

PROVINCE	PROVINCE CAPITAL	URBAN	MINING	RURAL	FREETOWN	TOTAL
North	24	33	3	72	---	132
East	24	30	30	48	---	132
South	24	21	3	36	---	84
Western Area (excl. Freetown)	---	6	---	6	---	12
					72	72
TOTAL	72	90	36	162	72	432

Table 3

NUMBER OF SITES SELECTED
FOR NATIONAL NUTRITION SURVEY

PROVINCE	PROVINCE CAPITAL	URBAN	MINING	RURAL	FREETOWN	TOTAL
North	2	5	1	34	---	42
East	2	4	10	32	---	48
South	3	3	1	31	---	38
Western Area (excl. Freetown)	---	1	---	1	---	2
					33	33
TOTAL	7	13	12	98	33	163
			32			

Numbers underlined refer to the strata formed in the Nutrition Survey sample for a complete description.

Table 4

POPULATION DISTRIBUTION - SIERRA LEONE
URBAN AREAS (EXCLUDING FREETOWN)

PROVINCE	PROVINCE CAPITAL		URBAN		MINING		TOTAL	
	Pop	%	Pop	%	Pop	%	Pop	%
North	25,580	5.2	79,709	16.3	21,831	4.5	127,120	26.0
East	29,502	6.0	56,747	11.6	167,790	34.2	254,039	51.8
South	39,427	8.1	41,229	8.4	14,956	3.0	95,612	19.5
Western Area	---		13,034	2.7	---		13,034	2.7
TOTAL	94,509	19.3	190,719	39.0	204,577	41.7	489,805	100.0

on population proportionality and the total number required for sufficient precision estimates (see Appendices I and II). It should be noted that from the ten strata in the Household Survey under province capital, urban and mining, a single stratum for urban areas was formed for the Nutrition Survey (Table 4).

4. METHODOLOGY

The field phase of the survey was carried out by ten two-man teams, five laboratory technicians, and five supervisors, plus support staff. All teams traveled throughout the country and visited 163 sample sites. Laboratory technicians rotated among the teams to collect blood and stool samples; they worked in 82 sites. Within a site the teams visited selected families in their homes to conduct the interviews, take anthropometric measurements, and collect samples. Appendix IV contains a description of the logistics and a list of the personnel.

Form I was completed on every child in the survey (N=4890). Anthropometric measurements of all the children and their mothers were recorded. In addition, Form I contained information on demographic, dietary, and health characteristics relevant to the nutritional status of the child and household.

Form II gathered more detailed dietary information on the child and family, and was completed in 1380 cases. This subsample was selected from every second child up to 30 months of age.

The laboratory subsample was selected from approximately every second site in the main sample, i.e., a total of 82 sites. Blood was collected for haemoglobin determination, thin and thick blood films, and for haemoglobin electrophoresis to identify sickle cell trait and disease. Stool samples were also collected. The survey forms and detailed explanations of the procedures and equipment are found in Appendix V.

The core of this report will describe the prevalence of protein-calorie malnutrition and anaemia in Sierra Leone. This description will be based on anthropometric measurements, haemoglobin determinations, and the clinical signs of oedema. The other information gathered on the survey will attempt to identify factors that may be associated with PCM.

4.1 SURVEY ITEMS DESCRIBING THE PREVALENCE OF MALNUTRITION

The survey of 1965 households randomly sampled from the entire country included the following items to indicate the prevalence of protein-calorie malnutrition and anaemia.

Anthropometry

Weight, height or length (for children unable to stand), and arm circumference were measured on all 4890 children under five years of age.

Height and arm circumference on 2965 mothers were measured. Triceps fatfold was measured on 3738 children and 2253 mothers.

Haemoglobin Determination

Capillary blood was collected from a one in four subsample of the children, and from approximately one-half of all pregnant mothers. It was obtained by a finger prick and collected in Unopettes containing Drabkins' solution. A total of 1006 haemoglobin tests were done in the child subsample, 298 in the special group and 65 from pregnant mothers.

The cyanomethaemoglobin method was used to determine haemoglobin levels. Approximately one-half of the readings were done by a technician in the field staging areas using a Fisher Haemophotometer. A total of 742 readings from the latter part of the survey and most of the special group were completed at the Haemotology Laboratory, University Center for the Health Sciences (CUSS), Yaounde, Cameroon. Verification of the field haemoglobin values was also done at CUSS and at the University of California, Los Angeles, School of Public Health.

Oedema

Every child was examined for clinical evidence of kwashiorkor. This was determined by testing for the presence of bilateral pedal oedema by applying firm thumb pressure on the dorsum of the feet and observing whether pitting occurred.

4.2 OTHER SURVEY ITEMS

The following items were used to provide information relating to nutritional status:

Household and Family Information

The following information was obtained about the household:

- Household size - defined as those who regularly eat meals together from a common source.
- Occupation and sex of household head.
- The source of water and the distance it is from the house.

The following information was obtained about the child:

- Child's age - determined by one or more of the following: birth record, clinic record, parent declaration, or calendar of events.
- Child's birth order - according to live births.
- Milk teeth count - used to verify ages that were suspected of being grossly incorrect.
- Child care - the primary person currently caring for the child during the day.
- Child's place of birth - hospital, clinic, or home.

The following information was obtained about the mother:

- Tribe
- Ability to read English
- Currently pregnant or lactating
- Total number of live births
- Number of children alive today

The following information was obtained about the father:

- Presence or permanent absence of the father
- Contribution of child support by the father
- Number of wives

Dietary Information

A Qualitative Dietary Recall was used to gather information on

every second child 30 months or younger and his family. The Simplified Dietary Survey Metnodology developed by the Committe on International Nutrition Programs, National Academy of Sciences, USA, was followed. This is a 24-hour qualitative dietary recall method, which also compares the food actually given to a child with the food that is available to it by virtue of being consumed by the family.

Information was also obtained concerning:

Breast Feeding - for children 30 months or less

Prevalence and frequency of breastfeeding

Mother employed outside of the home (subsample only)

Other Milk Availability

Prevalence and frequency of other milk given

Prevalence of bottle feeding

Cost of powdered milk per week (subsample)

Food Availability

Prevalence and frequency (subsample) of children receiving food other than milk

Frequency of meals prepared for the family (subsample)

Laboratory Tests

Thick blood films to determine the prevalence of malaria parasites were made on approximately one-half of the children. Stool samples to test for intestinal parasites were also collected from most of these same children. These samples were read in the field at the staging areas by a Laboratory Superintendent from Connaught Hospital, Freetown. Results were verified by the pathologists at Connaught Hospital.

Thin blood films were made from the same children and mothers who had their haemoglobin levels determined. These films were read in Freetown by the laboratory staff at Connaught Hospital. Pathologists verified a 1:15 sample of all films.

Haemoglobin electrophoresis was also done on this subsample. These tests were conducted in the Haemotology Laboratory, University

Center for the Health Sciences (CUSS), Yaounde, Cameroon.

4.3 DATA PREPARATION AND ANALYSIS

At the completion of the survey at each sample site, the forms were checked for clarity and completeness by team members and supervisors. In the staging areas the forms were reviewed and edited by senior survey personnel.

The forms were coded and keypunched by the Central Statistics Office, Freetown. A tape was made for data analysis on an IBM 30 computer at the Health Sciences Computing Facility, UCLA. Copies of the survey forms and the punched data cards remained in Sierra Leone.

The core system of FORTRAN subroutines for anthropometric analysis was obtained from the Center for Disease Control in Atlanta, Georgia, USA and included in the basic program structure at UCLA. The subroutines including reference standards were used for all height-for-age, weight-for-age, and weight-for-height indices, as well as arm circumference and fatfold indices.

5. INDICES OF MALNUTRITION

5.1 ANTHROPOMETRIC INDICES FOR PROTEIN-CALORIE MALNUTRITION IN CHILDREN

The focus of this survey was to identify the extent of malnutrition in young children by the use of anthropometry. The nutritional condition resulting from a deficiency in protein and/or calories utilized by the body, is called protein-calorie malnutrition (PCM) (11). Children with PCM have a low weight or height for their age and thus, anthropometric measurements can be used to indicate the presence and severity of undernutrition. In this report the diagnosis and classification of PCM (or undernutrition) is based on anthropometry following the recommendations of WHO (12).

Anthropometry is used because it is a quantifiable, objective, rapid, and relatively simple method of nutritional assessment when compared with other methods, such as biochemical and clinical. The methodology used for this survey has been field tested recently in several countries throughout the world and has anthropometry as the key measure for undernutrition (10, 13, 14).

Reference Values

An "optimal" weight or height is represented by the median values in a population where there is little or no PCM. Such a well-nourished population, also called a reference or elite group, can consist of children from industrialised areas of the world or from the best nourished group of African children (15). Unlike adults, young children with different ethnic origins but similar socio-economic backgrounds, have similar body measures (16).

Reference data for height and weight for this survey were derived from large, representative studies recently completed in the U.S.A. This was recommended by the National Academy of Sciences (NAS) Committee on Nutrition Advisory to the Center for Disease Control, U.S.A., in 1974 and reported recently in the Bulletin of the World Health Organ-

isation (17). The reference populations included children up to 24 months from middle to upper socio-economic status families and those aged 2-6 years from a nation-wide study in the U.S.A. (18, 19). The median values (50th percentile) in each group were taken as the 100% reference point (median reference). For example, if the height of a thousand children of the same age in good health were measured, the height of the 500th-ranked child (50th percentile) would be used as the median reference. The median values for height and weight of the reference population are described and tabulated in Appendix VIII.

Index Levels for Protein-Calorie Malnutrition

The reference median values for body measures are used to represent a level of normal growth. The further a child's body measure (such as weight and height) is below this reference median level, the greater is the likelihood of PCM. Also the further below the reference median the measure is the more severe the PCM is likely to be.

A certain percentage of the reference value is selected as a point below which a child is diagnosed as being undernourished. The basis of this selection is discussed later in this section.

5.2 SPECIFIC ANTHROPOMETRIC INDICES AND THEIR INTERPRETATION FOR CHILDREN

The three major indices presented in this report are weight-for-height, height-for-age and weight-for-age.

Weight-for-Height

Weight is the sum total of all body tissues, whereas the height of a child measures only the body skeleton. During an acute period of nutritional deficiency, there is a reduction of muscle and fat. This results in weight reduction, but height is not affected. The relationship between weight and height alters,

so that the weight-for-height ratio is reduced. After a recovery period when weight is restored, the weight-for-height ratio returns to "normal" (20, 21).

In this survey weight-for-height is used to gain knowledge about acute PCM (also termed acute undernutrition or recent body wasting). This is based on the principle that a child of a certain height has an expected "normal" weight (20, 21). This index is independent of precise age so it is particularly useful when exact ages are difficult to determine (22). A child weighing less than 80% of the reference weight-for-height will be classed as being acutely undernourished. Acute undernutrition is a nutritional deficiency of recent onset of usually a few weeks to a few months. The highest prevalence occurs in times of famine or seasonal food shortages (23).

Height-for-Age

As a result of frequent episodes or a prolonged period of undernutrition, the height or length of a child will fail to increase in the normal way. Short stature can be the end result, which may be considered an indication of chronic PCM (also termed chronic undernutrition or stunting). Thus, the proportion of short children in a population gives an estimate of the prevalence of chronic undernutrition. Chronic PCM usually has a prior onset of at least six months. The highest prevalence occurs with a long-term deficit of food (calories and/or protein), often combined with persistent or recurrent ill health (12).

In this survey the height-for-age index compares the height of the child with that expected for a normal or reference child of the same age. This index, unlike weight-for-height, requires a precise estimate of age, particularly for very young children. A child measuring less than 90% of his expected height-for-age will be classed as chronically undernourished.

Weight-for-Age

The weight of an individual measured repeatedly over a period of time, can indicate the onset and duration of protein-calorie malnutrition (24). In a single prevalence weight measurement of a population, however, the weight-for-age index does not distinguish between acute protein-calorie malnutrition (recent body wasting) and the chronic form (stunting). For example, using the weight-for-age index alone, it is not possible to determine whether a child with low weight-for-age is tall with body wasting or short and well-proportioned. Combinations of the weight-for-height and height-for-age indices overcome this problem.

Combined Weight-for-Height and Height-for-Age

The weight-for-height index estimates acute undernutrition (wasting) and height-for-age estimates chronic undernutrition (stunting). Because these two indices represent different aspects of the child's nutritional history, the presence or absence of wasting or stunting may be linked for each individual child in order to more accurately assess nutritional status (20, 21). For each child, one of four possible categories can be described: normal, wasting, stunting, wasting and stunting (Table 5). For example, a child with a low weight-for-height and a low height-for-age would be diagnosed as being concurrently acutely and chronically undernourished.

Table 5: COMBINED WEIGHT-FOR-HEIGHT AND HEIGHT-FOR-AGE INDICES

Nutritional Status	Nutritional Index	
	Weight for Height*	Height for Age**
Normal	Normal	Normal
Wasting (acute undernutrition)	Low	Normal
Stunting (chronic undernutrition)	Normal	Low
Both Wasting and Stunting (combined acute and chronic undernutrition)	Low	Low

*Weight-for-Height:

Normal: 80% or more than reference median weight-for-height.

Low (wasting): Less than 80% of reference median weight-for-height.

**Height-for-Age:

Normal: 90% or more than reference median height-for-age.

Low (stunting): Less than 90% of reference median height-for-age.

Other Anthropometric Indices

These include measurements of arm circumference and triceps fatfold. They may be considered of secondary importance to the major indices based on weight and height measurements, and the interpretation of results from these measures is different from that of weight-for-height and weight-for-age.

A key clinical sign for undernutrition is thin limbs (12). Arm circumference quantifies arm bulk and hence is a more direct indication of muscle and fat content of the body than weight measurements alone. There is good correlation between mid-upper arm circumference and weight indices (25).

Arm circumference in well-nourished children increases rapidly during the first year of life. It does not change significantly between 1-5 years of age, and therefore, it is a useful screening tool for protein-calorie malnutrition when precise age is not known (22). Arm circumference-for-age was used on this survey because ages were carefully determined for other measures and children under one year were included. Arm circumference-for-height was also used, and like weight-for-height, it is independent of precise age.

Arm circumference results from the survey can be used as a basis for nutritional assessment for future surveys and surveillance, particularly when adequate equipment is unavailable for height and weight measurement.

The triceps fatfold is the only measure used on this survey to quantify body fat. It is an indirect index for total body calorie storage. Subcutaneous fatfold measures correlate well with overall body fat (26). Fatfold is difficult to measure reliably, therefore results should be interpreted cautiously.

Interpretation of Children's Indices

Indices are based on internationally available reference median values. A list of these sources and the actual values are presented in Appendix VIII. These reference values do not constitute a specific "standard" of ideal nutrition, but simply represent the results from populations with reasonable health and nutrition backgrounds (27). No reference information is available for Sierra Leone, thus outside sources are required.

For each index value, a single value was predetermined below which a child was classed as being undernourished. This value, or cut-off point, is based on a percentage of the reference median according to age (or height). In general, this cut-off point corresponds to the first to third percentile level of the reference distribution. This means that any result below the cut-off point is equivalent to the lowest 1% - 3% of the reference population.

Experience in Africa indicates that the cut-off points selected for this survey are suitable for estimating the presence of undernutrition in young children. Such studies include weight-for-age (28), weight-for-height (29), height-for-age (10), arm circumference-for-height (30), and fatfold-for-age (31). The cut-off points according to the percentage of medians and percentiles, with their interpretations are listed in Table 6 .

Table 6: ANTHROPOMETRIC INDICES IN YOUNG CHILDREN

CUT-OFF POINT
REFERENCE VALUE

INDEX	% MEDIAN	PERCENTILE*	INTERPRETATION**
Height-for-Age	90%	1st	Chronic Undernutrition (PCM)
Weight-for-Height	80%	3-5th	Acute Undernutrition (PCM) - mod/severe
Weight-for-Age	80%	3rd	Combination Acute/ Chronic Undernutrition
Arm Circumference-for-Age	82.5%	3rd	Arm Soft Tissue Wasting
Fatfold-for-Age	60%	3rd	Fat Wasting - Low Calorie Reserve

*In the reference population this is the approximate percentile, due to some variation according to age.

**Interpretation of a value below the cut-off point percent median of reference; for example, a child with under 90% of the reference median for height-for-age is classed as having chronic PCM.

Throughout the report percentage prevalence rates for undernutrition are presented. A prevalence rate for a particular index is the proportion of children who fall below the cut-off point compared with the total number of children sampled, expressed as a percentage.

The selection of a single cut-off point for a description of undernutrition allows comparisons between areas of the country and selected groups. It also permits investigation of associated factors, such as occupation of household head, associated with PCM in children.

The values above the cut-off point are interpreted as "normal" in the sense that the risk of undernutrition is less than for the

values below. Obviously, those above the cut-off point represent a broad spectrum from borderline undernutrition to normal to over-nutrition.

It should be noted that distributions of index values according to percentage ranges of the reference median are also included in this report. For example, the 90-95 % of median reference height-for-age quantifies those children who are at-risk for chronic PCM. This estimates the number who may fall below the cut-off point of 90% if unfavorable environmental changes occur which commonly result in worsening of nutritional status.

5.3 OEDEMA

Children

Kwashiorkor was diagnosed by the presence of bilateral pedal oedema. Oedema was determined by the occurrence of pitting as a result of thumb pressure on the dorsum of the feet. Kwashiorkor is a much more severe form of acute undernutrition than the levels described by anthropometry in this report.

5.4 HAEMOGLOBIN

The presence of anaemia was determined according to the WHO references for haemoglobin levels. The reference levels were placed at 11.0 gm/100 ml for pregnant women and children aged 24-60 months and at 10.0 gm./100 ml for children aged 6-23 months.

6. SURVEY RESULTS AND ANALYSIS

6.1 AGE AND SEX DISTRIBUTION OF SAMPLE

Age of Child

With the exception of the Special Group, the age distribution was similar throughout all areas of the country. Table 7 gives the age distribution of the sample by strata.

Table 7: AGE DISTRIBUTION OF SAMPLE

Months	Rural	Urban	Freetown	Sierra Leone	Special
0-2	0.1	0.5	3.7	0.5	2.8
3-5	7.3	6.8	5.5	7.1	4.7
6-11	16.4	14.3	14.5	15.8	6.1
12-23	23.4	27.1	23.7	24.1	8.6
24-35	20.8	19.9	22.7	20.8	11.6
36-47	19.5	17.3	17.0	18.8	38.5
48-59	12.4	14.3	13.0	12.8	27.7
Total	2937	954	989	4882	361

Children 0-2 months were included only in the samples for Freetown and the special group.

Generally, the number of children was consistently less in the 48-59 month group; however, in the Special Group the number of children increased sharply after 35 months. This increase is due to the fact that most of the children in the Special Group were selected from nurseries and nursery schools.

The generally decreasing numbers of children found in the older age group might be explained by the following:

1. Actual demographic patterns.
2. Fewer numbers of older children available for interview.
3. Exclusion of older children due to difficulties with age determination.

No data on the age distribution by year are available for children under five years of age in Sierra Leone.

Sex of Child

As shown in Table 8 , the sex distribution was essentially equal throughout the country.

Table 8: SEX DISTRIBUTION OF SAMPLE

	Rural	Urban	Freetown	Sierra Leone
Male	50.2	49.2	50.0	49.9
Female	49.8	50.8	50.0	50.1

Determination of Children's Ages

Most of the children's ages were determined by using a calendar of local events; this was often combined with parental declaration as to the child's age. Birth records were used to determine the ages of only 14.4 of the children; the rate was over 20 in Freetown and the urban areas. Clinic records were most useful in Freetown and the urban areas and also in the South Province.

All of the above methods are considered reliable, but in the absence of a written record and when dealing with a forgetful or suspicious mother, age determination can become quite tedious and difficult. The importance of accurate age determination was stressed throughout the survey, and no systematic bias was discovered in any of the teams' methods of age assessment.

Table 9: SOURCE OF BIRTH INFORMATION

AREA	Percentage of ages determined by: Birth Record	Clinic Record	Calendar	Stated
South	9.8	23.5	84.1	59.0
East	16.0	11.7	83.9	70.5
North	10.5	10.7	85.1	76.2
Rural	10.3	10.9	87.2	70.6
Urban	20.1	28.1	74.3	64.1
Freetown	21.1	36.4	69.4	75.5
Sierra Leone	14.4	19.4	81.1	70.4

6.2 NUTRITIONAL STATUS OF CHILDREN IN SIERRA LEONE

Prevalence of Undernutrition (Protein-Calorie Malnutrition)

Table 10 lists the prevalence rates of various types of undernutrition in children under five years old in Sierra Leone. The methods for deriving these rates are discussed in Section 5, "Indices of Malnutrition."

Table 10: PREVALANCE OF UNDERNUTRITION IN SIERRA LEONE

Type of Undernutrition	% of Children With Undernutrition: Sierra Leone	Special Group
Chronic Undernutrition	24.2	2.1
Acute Undernutrition	3.0	0.3
Underweight	30.5	4.0

Undernutrition is a serious problem in Sierra Leone. Approximately one child out of every four (24.2.) is chronically undernourished (height-for-age less than 90. of reference median). These children are failing to reach their full growth potential, which is indicative of long standing nutritional problems. The prevalence rate of 3.0 for acute undernutrition (weight-for-height less than 80) shows that at the time of the survey, undernutrition of recent onset contributed significantly less to the problem than did chronic undernutrition. The rate of 30.5 for underweight children reflects both conditions of acute and chronic undernutrition, and confirms the extent of the problem.

The significance of these results can be seen by comparing them with those of the Special Group. For both acute and chronic undernutrition, Sierra Leone as a whole has a prevalence rate ten times greater than that of the Special Group. This implies that, given a more favourable environment in which to develop, Siera Leonean children could improve their nutritional status to approximate that of the Special Group.

The low rates for acute undernutrition most probably are explained by the fact that this survey was conducted during January, February, and March. This was the dry season, and also the end of harvest time, so food was plentiful. An annual "hungry season" occurs just before the new harvest. Prevalence rates for acute undernutrition, reflecting recent food intake, would be expected to be higher at that time of year.

It should be noted that by defininition, acute undernutrition is of shorter duration than chronic undernutrition. Typically, an acutely undernourished child either improves or dies within a relatively short period of time; whereas, a chronically undernourished child may remain in that condition for months or years. Therefore, at most any given time, a normal population is likely to have less acutely undernourished children than chronically undernourished.

Concurrent Acute and Chronic Undernutrition

Classifying children into one of four categories helps to quantify the extent of the undernutrition problem. Table 11 gives the results of such a c'assification.

TABLE 11: CONCURRENT ACUTE AND CHRONIC UNDERNUTRITION

	Percentage of Children			
	Wasted & Stunted	Wasted	Stunted	Normal
Sierra Leone	1.1	1.9	22.2	74.9

Based on anthropometric indices as defined in Chapter 5, children are classified as being eitner normal, stunted, wasted or stunted and wasted.

In Sierra Leone, 1.1 of the children under five years old are concurrently stunted wit wasted muscles and these should be considered as needing immediate attention. In terms of numbers affected, stunting (affecting 22 of the children and arising from chronic undernutrition) is by far the most severe problem. However, those few children (3.0) with wasting muscles are individually in a more critical situation.

6.3 NUTRITIONAL STATUS OF CHILDREN BY AGE

Results of the anthropometric indices are presented by age for the whole country. This is done to indicate whether the prevalence of undernutrition is related to age groups within the total range of children up to five years old. The percentages are weighted figures based on the population proportion according to each area.

Chronic Undernutrition

Table 12 shows the pattern of chronic undernutrition by age in Sierra Leone. The prevalence rate is lowest at 3-5 months (10.6%) and tends to increase steadily to a high of 31.6% at 21-23 months.

After 24 months the rate reaches a plateau and remains high through 59 months.

Table 12: CHRONIC UNDERNUTRITION* IN SIERRA LEONE BY AGE

Age in Months	% Chronically Undernourished
3-5	10.6
6-8	14.1
9-11	14.3
12-14	21.3
15-17	16.5
18-20	21.2
21-23	31.6
24-29	24.8
30-35	29.9
36-47	28.1
48-59	30.5
	Average 24.2

*Height-for-age <90%

Acute Undernutrition

The prevalence rate is low at 3-5 month (2.2%), peaks at 12-14 months (9.3%) and then decreases. The lowest rates occur after the latter half of the third year. By the fourth year the rate is very low (0.3%).

Table 13: ACUTE UNDERNUTRITION* IN SIERRA LEONE BY AGE

Age in Months	% Acutely Undernourished
3-5	2.2
6-8	3.6
9-11	6.0
12-14	9.3
15-17	4.8
18-20	4.6
21-23	3.9
24-29	2.8
30-35	1.7
36-47	1.3
48-59	0.3
Average	3.0

*Weight-for-height <80%

Underweight

The proportion of underweight children in Sierra Leone is lowest at 3-5 months, increases rapidly during the rest of the first year and remains at a high level throughout the second year. After 24 months decreases and remains at about 25%.

Table 14: UNDERWEIGHT* IN SIERRA LEONE BY AGE

Age in Months	% Underweight
3-5	13.8
6-8	27.3
9-11	37.5
12-14	42.0
15-17	38.5
18-20	38.4
21-23	41.5
24-29	27.4
30-35	26.2
36-47	23.5
48-59	28.2
Average	30.5

*Weight-for-age <80%

Discussion

Chronic undernutrition appears to become a problem early in Sierra Leone. By five months of age, 10.6% of the children are less than 90% of their expected height-for-age. This figure, however, must be viewed with caution. It appears inordinantly high, especially when one considers the high rate (almost 95%) of full breastfeeding in this age group. In order to explain this, factors other than the infant's diet and health must be considered.

At the age of 3-5 months a child's size is often still a reflection of intrauterine or prenatal nutritional status (31).

Accordingly, small (or chronically undernourished) infants, less than six months old, frequently are the result of maternal malnutrition. Also, infants younger than six months who were born prematurely are likely to be classed as chronically malnourished. The rate of 13.8% for underweight children, 3-5 months, also suggests that premature (or low weight-for-age) babies were in the sample. Again, poor maternal nutrition is often a factor in premature birth. After six months prenatal conditions are less significant to a child's growth than are the post-natal conditions.

The steady rise in the prevalence of chronic undernutrition and underweight children from 6-23 months is a common pattern in developing countries (32), and is probably due to similar circumstances. Typically, by six months, a child's nutritional needs have increased to the point that breastfeeding alone is no longer sufficient to meet them. Often, neither the right foods nor enough food is given to a child to make up the deficit. In addition, breastfeeding, itself, begins to decline, which further aggravates the situation. Also, after 6 months a child becomes exposed to a more adverse environment. This includes poor sanitation, with subsequent diarrheal conditions, other infections and, periodically, a more inadequate diet.

All of these factors may lead to episodes of acute undernutrition, characterised by body wasting, or they may work to retard normal linear growth (stunting). Their effect on the prevalence of acute undernutrition is demonstrated by the peak seen at 12-14 months in Table 13 . Episodes of acute undernutrition are critical times for children; they tend to either improve or die within a matter of weeks or a few months. As such, the same type of cumulative effect as may be seen in chronic undernutrition is not evident in acute undernutrition. However, repeated episodes may result in chronic undernutrition.

Figure 2 shows the prevalence of each type of undernutrition

Figure 2: UNDERNUTRITION IN SIERRA LEONE BY AGE

according to age in Sierra Leone. From the graph it is clear that age is an important factor associated with undernutrition. The first two years of life are a critical period in which the prevalence of undernutrition, as defined by each of the indices, peaks and, in the case of chronic undernutrition often determines the levels seen throughout the remaining age groups. These years are most important and should be considered a target group for any remedial programme.

6.4 NUTRITIONAL STATUS BY AREA

In order to determine the extent of undernutrition within the nation, the sample included separate descriptions for each province and urban/rural division. The prevalence rates listed are estimates, which in general become more precise the larger the sample size. A sample size of 900 is required for a description to ensure an adequate level of precision (see Survey Design).

There are sufficient sample sizes for each of the Provinces and Freetown to be compared with one another. The urban and rural strata may also be compared with each other and with Freetown. Note that "urban" refers to those urban areas excluding Freetown. The mean result for Sierra Leone was computed by weighting the results of the areas according to population proportionality. The results of the Special Group are given separately and not figured in the country's average.

All tables describe the percentage prevalence of the anthropometric index according to the cut-off point listed.

Chronic Undernutrition

Table 15: CHRONIC UNDERNUTRITION* BY AREA

Area	% Chronically Undernourished
South	25.8
East	23.7
North	24.9
Rural	26.6
Urban	17.4
Freetown	10.3
Sierra Leone	24.2
Special	1.7

*Height-for-age < 90%

There are significant differences ($P < 0.05$) between Freetown and the rest of Sierra Leone, and also between the urban and rural areas of the country. There are no statistical differences among the Provinces; however, there are significant differences when each is compared with Freetown. The Provinces average approximately 25% chronically undernourished while the rate for Freetown is 10.4%

The prevalence rate in Freetown is also significantly lower than that found in either the urban or the rural strata. The results also show that the urban areas of the country are much better nourished than the rural areas. In the rural areas 26.6% of the children are chronically undernourished, as compared with 17.4% of the urban children.

The differences between the Special Group and the rest of the country are striking. The Special has a prevalence rate of 1.7% compared with an overall rate of 24.2% for Sierra Leone. Even in Freetown chronic undernutrition is five times more frequent than in the Special Group.

Acute Undernutrition

Table 16: ACUTE UNDERNUTRITION* BY AREA

Area	% Acutely Undernourished
South	4.1
East	1.9
North	3.5
Rural	3.2
Urban	3.2
Freetown	1.6
Sierra Leone	3.0
Special	0.6

*Weight-for-height < 80%

The differences in the prevalence rates for acute undernutrition throughout the country are not as marked as they are for chronic undernutrition. There is no difference in the rates for the urban and rural areas of the country. Again, Freetown does have a lower prevalence of acute undernutrition, but the differences, although significant, are not great. The Special Group shows the lowest rate - 0.6%.

The same holds true for the Provinces. Freetown and the Eastern Province indicate significantly lower prevalence rates than the Southern or Northern Provinces, but the differences may not be useful in planning and policy making.

Underweight

Table 17: UNDERWEIGHT CHILDREN BY AREA

Area	% Underweight
South	33.4
East	26.0
North	32.7
Rural	32.4
Urban	24.3
Freetown	18.3
Sierra Leone	30.5
Special	5.1

*Weight-for-age < 80%

The urban areas of the country have a significantly lower prevalence rate for underweight children than do the rural areas (24.3% vs. 32.4%). The Freetown rate of 18.3% is much lower, but is still high compared to that of the Special Group (5.1%). Of the Provinces, the East with a

rate of 26.0% has the lowest prevalence of underweight children.

Concurrent Acute and Chronic Undernutrition

Freetown and the urban areas have a larger proportion of normal children compared with the rural areas. The most noticeable difference is in the prevalence rate for stunting. Concurrent acute and chronic undernutrition is least in Freetown and the Eastern Province. These concurrent rates should be viewed with caution as the number of children included are small.

TABLE 18: CONCURRENT ACUTE AND CHRONIC UNDERNUTRITION BY AREA

	Percentage of Children			
AREA	Wasted & Stunted	Wasted	Stunted	Normal
South	1.6	2.5	25.8	70.1
East	0.6	1.4	25.5	72.5
North	1.1	2.3	24.6	72.0
Rural	1.1	2.1	25.5	71.3
Urban	1.4	1.6	16.0	81.1
Freetown	0.3	1.3	10.1	88.3
Sierra Leone	1.1	1.9	22.2	74.9

Discussion

Certain generalizations can be drawn from the above information:

1. Undernutrition, particularily chronic undernutrition and underweight, is a problem throughout Sierra Leone.
2. The prevalence rates of undernutrition are greater in the rural areas of the country.
3. Freetown has the lowest prevalence rates.

4. The prevalence rates in the provinces tend to be similar but are lowest in the East.

Taking the prevalence rates and translating them into numbers of children affected gives a clearer view of the situation. The following formula was used to calculate the numbers of undernourished children -

P x 17.4 x U = Number of undernourished children/area; when:

P = Total population of county, province or state.
17.4 = % of population younger than 5 years.
U = % prevalence rate of undernutrition/area.

(These figures are only approximations and the provincial and strata totals may not equal the total Sierra Leone figures due to differences in weighting and rounding the numbers.) Figures 3, 4, and 5 compare the prevalence rates and the approximate numbers of children affected by each type of undernutrition in each area.

Figure 3: ACUTE UNDERNUTRITION

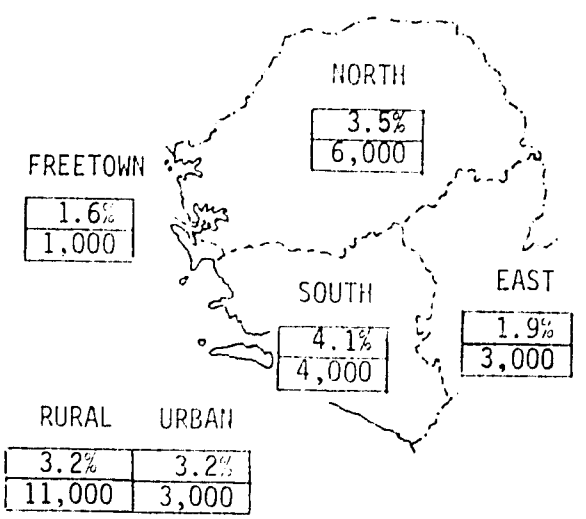


Figure 4: CHRONIC UNDERNUTRITION

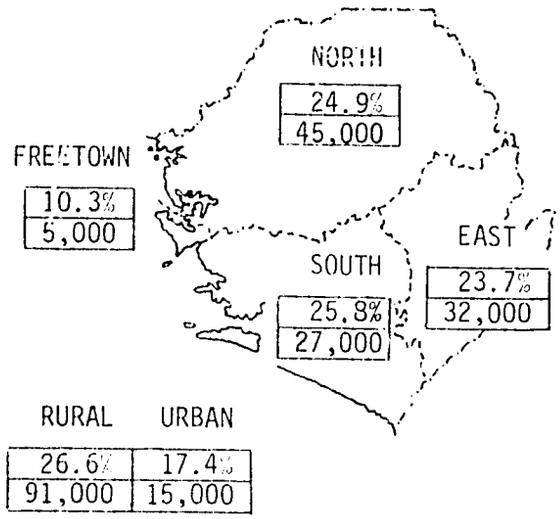
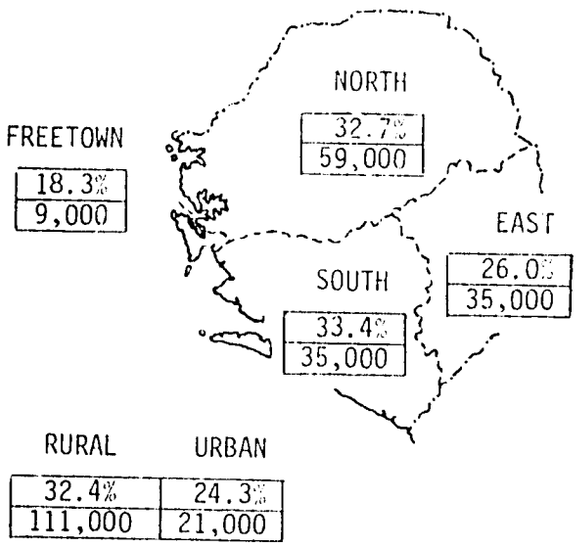


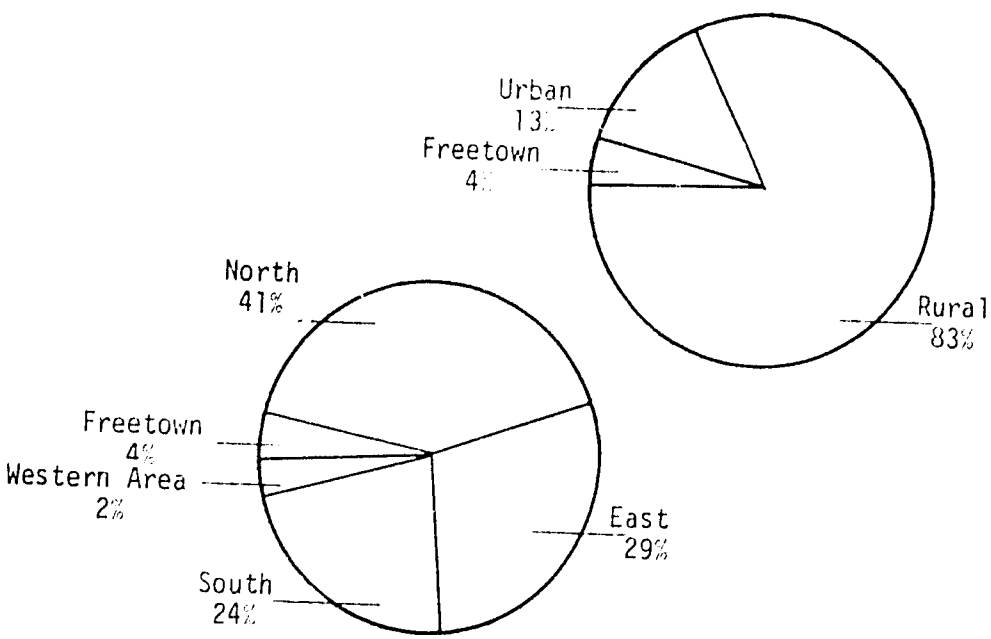
Figure 5: UNDERWEIGHT



Figures 6, and 7 also illustrate where the problems of undernutrition are found in the country. The percentage figures represent each area's contribution in terms of numbers of children affected. For example, according to Figure 6 , 83 of all chronically undernourished children in Sierra Leone are living in the rural areas of the country. The urban areas and Freetown contribute 13% and 4% respectively.

Figure 6 shows that 41% of all chronically undernourished children live in the Northern Province, 24% live in the South and 29% live in the East. These percentages are most revealing when one compares the similar prevalence rates of chronic undernutrition found in each of the provinces.

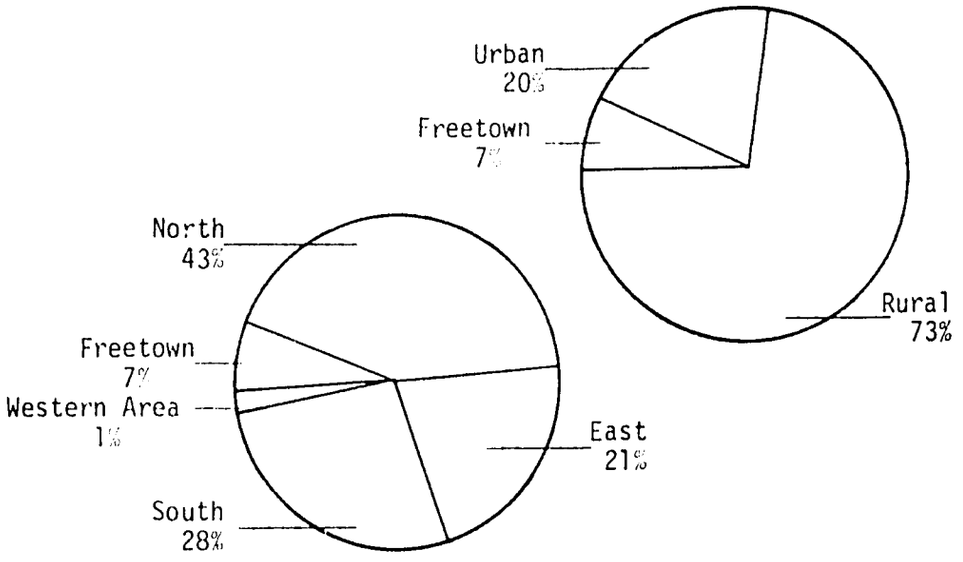
Figure 6: PROPORTION OF CHRONIC UNDERNUTRITION BY AREA



Similarly, Figure 7 shows the proportions for acute undernutrition. Even though the prevalence rates of acute undernutrition are the same for the urban and rural strata (3.2%), 73% of the acutely undernourished children live in the rural areas. Thirty percent live in the urban areas.

Again, most of the acutely undernourished children (43%) live in the Northern Province, and the least (7%) live in Freetown.

Figure 7: PROPORTION OF ACUTE UNDERNUTRITION BY AREA



These figures help to visualize the extent of the problem and they emphasize the differences between areas of the country. It becomes apparent that the magnitude of the problem is greater outside of Freetown, and even greater yet outside of the other urban areas. In order to effectively improve nutritional status in Sierra Leone the emphasis of nutrition intervention programmes will need to be directed toward the provinces and in particular the more rural areas.

6.5 FREQUENCY DISTRIBUTION OF ANTHROPOMETRIC INDICES ACCORDING TO AREA

In addition to knowing how many children are classed as malnourished by failing to reach a single cut-off point of the reference median, it is also useful to know where the remaining children fall in relation to the reference median. Milder and more severe types of malnutrition are also recognized (e.g., under 85 of weight-for-height of the reference value or below 60 of weight-for-age of the reference value) and should be considered in nutrition planning.

TABLE 19: FREQUENCY DISTRIBUTIONS OF ANTHROPOMETRIC INDICES ACCORDING TO REFERENCE MEDIANS

Percentage of Reference Median	Percentage Frequency Distributions		
	Height for Age	Weight for Height	Weight for Age
<60	]	]	1.7
60- 69.9	-0.6	-3.0	6.6
70- 74.9			8.2
75- 79.9			14.0
80- 84.9	4.1	4.5	16.0
85- 89.9	19.5	12.0	16.1
90- 94.9	38.1	18.5	22.8
95- 99.9	27.0	20.4	
100-104.9	8.3	29.2	]-10.1
105-109.9	]-2.3	]-12.4	]- 4.6
110+			

These results show that 4.5% of the children are in the 80-84.9% range which is just above the cut-off for acute undernutrition; 38.1% are just above the chronically undernourished category; and 16.1% are just above the 80% of the weight-for-age reference median cut-off. These may be considered as borderline groups. It is likely that the factors leading to poor nutritional status are only marginally better for these groups than for the frankly undernourished groups. Any change for the worse in the nutritional environment of the country could have a marked effect on these children.

On the other hand, those children falling just below the cut-off points might also be classified as borderline. They form another relatively large group, but one whose nutritional status may be significantly bettered by moderate improvements in their environment. More complete tables of the frequency distributions are given in Appendix III.

6.6 OEDEMA

Only ten children in the total sample, 0.2%, had bilateral pitting oedema of the lower legs, a clinical sign of kwashiorkor. It is possible that other cases of oedema were overlooked, but even so, the percentage would still be very low.

This percentage rate is consistent with the relatively low incidence of acute undernutrition found throughout the country. It should also be noted that this sign is very insensitive in detecting the prevalence of acute undernutrition as it identifies only a certain type of severe protein-calorie malnutrition, florid kwashiorkor.

Table 20: OEDEMA

AREA	PERCENTAGE
South	0.2
East	0.2
North	0.1
Rural	0.2
Urban	0.0
Freetown	0.4
Sierra Leone	0.2

6.7 OTHER ANTHROPOMETRIC MEASURES

Table 21: LOW* ARM CIRCUMFERENCE-FOR-AGE MEASURE BY AGE

Age in Months	Percentage
<3	2.3
3-5	8.2
6-8	21.9
9-11	25.9
12-14	24.6
15-17	23.3
18-20	21.1
21-23	22.3
24-29	13.1
30-35	8.0
36-47	4.7
	Average 14.7

*Arm circumference-for-age <82.5% reference median

After five months the prevalence rate for thin arm circumference-for-age increases sharply and remains at a high level (about 23%) throughout the second year of life. From 24-59 months the rate steadily decreases.

Table 22: LOW* ARM CIRCUMFERENCE-FOR-HEIGHT MEASURE BY AGE

Age in Months	Percentage
<3	2.3
3-5	2.7
6-8	4.4
9-11	6.9
12-14	7.7
15-17	6.7
18-20	8.5
21-23	7.3
24-29	3.5
30-35	2.0
36-47	2.0
48-59	1.4
	Average 4.3

*Arm circumference-for-height < 82.5% reference median

The prevalence of low circumferences-for-height is much lower than that shown by low arm circumference-for-age; however, the age distribution is similar. The greatest percentage of thin arms-for-height is seen between 9-23 months.

Table 23: LOW* FATFOLD -FOR-AGE MEASURE BY AGE

Age in Months	Percentage
<3	16.2
3-5	23.1
6-8	48.7
9-11	58.8
12-14	56.3
15-17	56.7
18-20	50.4
21-23	49.3
24-29	28.9
30-35	15.5
36-47	13.3
48-59	10.4
	Average 31.1

*Fatfold-by-age <60' reference median

The prevalence pattern of low fatfold-for-age corresponds closely with that of arm circumference-for-age.

Discussion

Arm circumference is determined by bone size, muscle tissue and fat. As bone size is relatively unchanging, thin arms, (which are a key clinical sign of undernutrition) are more a reflection of changes in muscle tissue and fat.

Arm circumference-for-height is a similar index to weight-for-height, in that it relates a soft tissue measure to a skeletal measure (height). In addition both indices are independent of age and may also be used as indicators of recent nutritional status (29).

The low prevalence of thin arms-for-height corresponds to the weight-for-height index and indicates that acute undernutrition was less of a problem at the time of the survey than was either chronic undernutrition or underweight.

Arm circumference-for-age measurements usually correlate well with weight-for-age measurements (25). The age distribution pattern of undernutrition determined by low arm measures (arm wasting) is similiar to that for underweight (Tables 21-23). Up to six months of age the prevalence rate of thin arms is relatively low; however, from six months through the critical second year, the prevalence rates are significantly higher. The prevalence of low fatfold measures increases sharply at the same time. This would indicate that the low arm measures are caused in part by low fat stores which indicate a low caloric body reserve and reflect an inadequate caloric intake.

The pattern of undernutrition throughout the country as determined arm wasting also corresponds with the general pattern determined by the other indices (Table 24). Low fatfold measures were uniform throughout the country.

Table 24: PREVALENCE OF LOW ARM MEASURES BY AREA

	Percentage of Children with Low Arm Measures		
AREA	AC/Age	AC/Height	Fatfold/Age
South	19.2	6.4	32.1
East	12.1	2.9	29.1
North	16.8	4.5	30.9
Rural	16.4	4.8	30.6
Urban	12.1	3.5	33.9
Freetown	7.0	2.5	34.0
Sierra Leone	14.7	4.3	31.1
Special Group	0.0	0.0	22.4

6.8 MATERNAL ANTHROPOMETRIC MEASURES

The following indices and their cut-off points listed below are used in the evaluation of nutritional status of mothers.

Table 25: ANTHROPOMETRIC MEASURES FOR MOTHERS

	Cut-Off Point	Significance
Height	less than 150 cm	Short
Arm Circumference	less than 23 cm	Undernutrition
Fatfold (triceps)	less than 7.5 mm	Low calorie reserve

Height

A maternal stature of less than five feet may be considered sufficiently short to be associated, at least to some degree, with short stature in the woman's child. Maternal height alone is less useful than that of both parents, but is acceptable when only the mother is available. Correlation between the height of mother and child could suggest important genetic factors and/or the effect of the environment on growth (33). Although it may reflect her nutritional status as a child, the nutritional significance of short stature in women is not nearly as clear as that for young children. The choice of the cut-off point for maternal height of five feet, a level used in parts of Africa, has an added value in obstetric interpretations, in that such a shorter woman is decidedly at risk for obstructed labor due to a small pelvis (34).

Arm Circumference

An arm circumference of 23 cm corresponds to 80% of the reference value for adult women and has been used to provide an estimate of undernutrition in other countries (35, 10, 13).

Triceps Fatfold Thickness

The triceps fatfold cut-off point of 7.5 mm is the value for the third to fifth percentile value for adult Black women in the U.S.A. (36). This value is approximately 40% of the reference median triceps fatfold. A value below this does not necessarily mean undernutrition, but does suggest a lack of caloric reserve and low fat stores in the body.

RESULTS AND ANALYSIS

Height

Throughout the country, 8.2% of all mothers surveyed were found to be shorter than 150 cm; similar results were found for each area in Freetown and the Northern Province. No urban/rural differences were seen.

Table 26: FREQUENCY DISTRIBUTION OF MATERNAL HEIGHTS

	% of Mothers Within Ranges		
	Height ranges in cm		
AREA	-150	150-165	166+
South	8.9	84.3	6.8
East	8.1	85.3	6.6
North	8.2	82.6	9.2
Rural	8.7	83.7	7.5
Urban	7.2	85.4	7.4
Freetown	7.1	82.4	10.5
Sierra Leone	8.2	83.9	7.9

Arm Circumference

The figure of 6.1% for undernourished mothers (AC < 23 cm) in Sierra Leone reflects similar situations in each area of the country. However, differences were seen in the proportions of mothers with arm circumferences of 29 cm or greater. Freetown and the urban areas have more mothers with large arms.

Table 27: FREQUENCY DISTRIBUTION OF MATERNAL ARM CIRCUMFERENCES

	% of Mothers Within Ranges		
	Arm circumference ranges in cm		
AREA	-23	23-28.9	29+
South	6.7	78.5	14.8
East	6.1	79.1	14.8
North	5.9	80.8	13.3
Rural	6.0	81.7	12.3
Urban	6.6	72.8	20.6
Freetown	5.8	71.3	22.9
Sierra Leone	6.1	78.7	15.2

Triceps Fatfold

Throughout Sierra Leone 17.2% of all mothers had a triceps fatfold thickness below 7.5 mm. Taking into account the difficulties involved in obtaining precise fatfold measures, the prevalence of low measures was similar for each area of the country. Only 0.9% of the mothers surveyed had a triceps fatfold of over 25 mm, which is an indication of obesity.

Table 28: FREQUENCY DISTRIBUTION OF MATERNAL FATFOLDS

	% of Mothers Within Ranges		
	Fatfold ranges in mm		
AREA	<7.5	7.5-24.9	25+
South	19.8	80.2	0.0
East	14.3	84.5	1.2
North	16.9	83.0	1.0
Rural	17.9	81.4	0.7
Urban	13.8	85.1	1.0
Freetown	18.0	79.3	2.3
Sierra Leone	17.2	81.8	0.9

Another interesting result can be seen by comparing the percentages of pregnant and non-pregnant mothers whose arm circumferences fall below 23 cm (Table 29). The numbers in the sample are small, but they do indicate a definite trend. Overall, almost twice as many pregnant women are classed as undernourished as are non-pregnant women. This is seen in all areas of the country. Proportionally more pregnant mothers also had low fatfold measures when compared with non-pregnant mothers (20.8% vs. 16.6%). It would appear that this should be investigated further and should also include lactating mothers.

Pregnancy and especially lactation create a tremendous nutritional drain on a woman. If her pregnancies are repeated and closely spaced, the drain is greatly compounded, and it then becomes very difficult for a woman to replenish her own body store of nutrients. A concurrent first step in trying to improve the nutritional status of children is to insure that their mothers are healthy and well nourished.

Table 29: PREGNANT AND NON-PREGNANT MOTHERS WITH ARM WASTING

AREA	Percentage of mothers with arm circumference below 23 cm	
	Pregnant	Non-Pregnant
South	11.5	6.1
East	12.9	5.3
North	11.1	5.3
Rural	10.9	5.5
Urban	13.7	5.6
Freetown	8.6	5.4
Sierra Leone	11.0	5.5

6.9 MORTALITY

Mortality information was obtained indirectly, based on two questions to the mother:

1. How many babies altogether were born alive by you?
2. How many of these children were alive today?

The difference in the two answers indicate the total number of deaths. Interviewers were then instructed to cross-check with the mother regarding the number who died.

Mortality rates (MR) were compiled from the following formula:

$$MR = \frac{B-A}{B}$$

where B = children born alive, A = children alive today.

This estimate of mortality rate is used as an indicator of the mortality rate for under fives. This based on the assumption that 90% of all children (i.e. the vast majority)die before the age of five. Results for Freetown from the Medical Statistics Office have shown this to be the case (reference 1). Thus, the mortality rates presented here should closely approximate those for the under fives.

The method of questioning was used so that a more consistent answer would be given than if more complex information was sought. The same method was used throughout the survey, hence valid comparisons between areas are possible.

It should be noted that the age of death was not requested as it was considered that the answers might be unreliable.

Table 30: MORTALITY RATES BY AREA

AREA	Live Births	Deaths	Mortality/ 1000
South	3562	1188	333.5
East	4373	1402	320.6
North	3822	1200	314.0
Rural	9206	3063	332.7
Urban	2665	727	272.8
Freetown	2314	462	199.7
Sierra Leone	14,185	4252	304.8*

* weighted

Results

Mortality rates for each province appeared similar. Rates were lower in urban compared with rural and lowest of all in Freetown.

As an approximation, it would appear that about 30% of children who are born alive, die before they reach their fifth birthday.

Association of Mortality Rates with Undernutrition

As the nature of the survey was cross-sectional, the object was to determine whether the nutritional status of the index child was related to retrospective mortality of children in the same families. The mean mortality rate and the mean undernutrition rate for each site were plotted and a scattergram with a regression line obtained (e.g. Figure 8). Each number in the graph represents two variables - the prevalence of chronic undernutrition (Ht/Age<90%) and the mortality rate per 1000 live births for the particular site. One circled example indicates prevalence of 48% chronic undernutrition and a mortality rate of 120 per 900 live births in one site. A number greater than one, e.g. the circled "4" in the graph, indicates that the same results occurred in four sites.

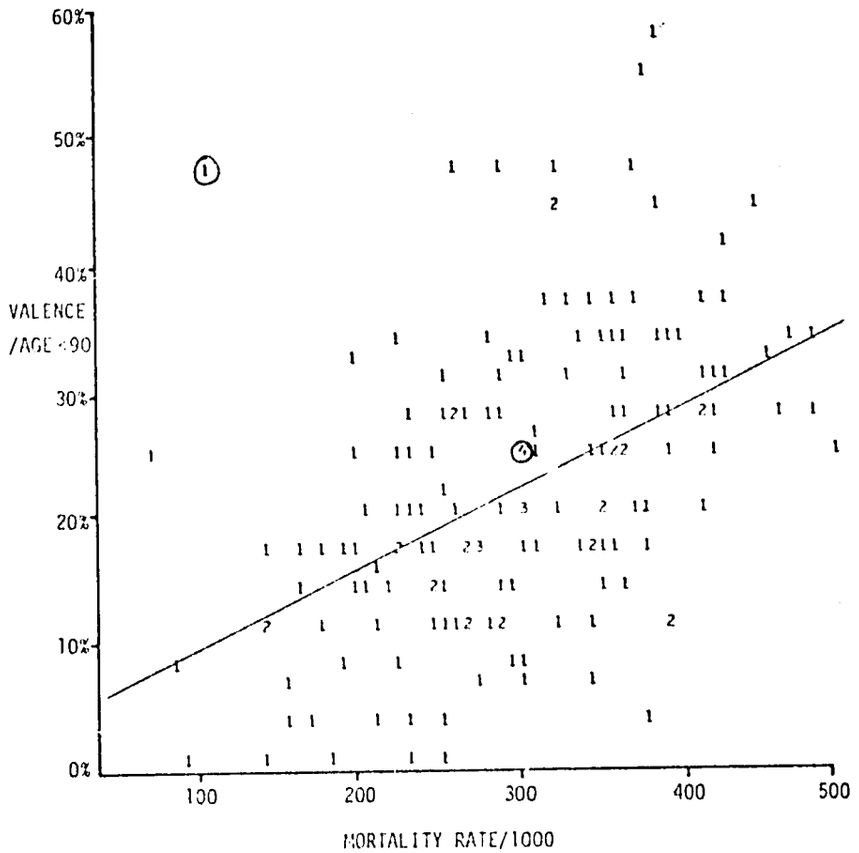
Table 31: MORTALITY AND UNDERNUTRITION CORRELATION COEFFICIENTS BY AREA

AREA	N	Type of Undernutrition: Acute Undernutrition	Chronic Undernutrition	Underweight	Arm Wasting
South	38	.02	.35	.42	.38
East	48	.13	.47	.24	.41
North	42	.06	.02	.12	.12
Freetown	33	-.33	.08	-.06	-.03
Sierra Leone	163	.13	.47	.40	.44

N = number of sites

The correlation coefficients were positive for chronic undernutrition, underweight and arm wasting prevalence in the South and East (but not the North) province, and for Sierra Leone. This shows a significant statistical association between anthropometry and mortality. In other words, in these areas the more undernutrition in a site, the more deaths per 100 children there are likely to be.

Figure 8: CORRELATION OF CHRONIC UNDERNUTRITION AND MORTALITY



N=163 Sites

Correlation=.467

	Mean	Std Dev	Regression Line	Res MS
X	290.4	87.4	X=3.5Y + 215.1	5.9
Y	21.5	11.6	Y=.06X + 3.4	10.6

6.10 HOUSEHOLD AND FAMILY CHARACTERISTICS RELATED TO HEALTH

Information concerning the following household and family characteristics was collected. This was done in order to partially describe different nutritional environments, and to investigate possible associates with nutritional status. This information is reported according to: Household Characteristics, Maternal Characteristics, and Paternal Characteristics.

Person Interviewed

Mothers of the index children were assumed to be the most reliable source of information and were present and interviewed in over 82% of the cases. The distribution of person interviewed is similar for each area of the country.

Table 32: PERSON INTERVIEWED

AREA	Percentage Following Persons Were Interviewed: Mother	Father	Grand-mother	Other
South	82.2	4.7	6.9	6.1
East	84.9	5.4	5.0	4.7
North	80.7	6.7	8.0	4.5
Rural	81.5	6.4	7.0	5.0
Urban	86.2	3.3	5.2	5.2
Freetown	82.6	3.0	6.9	7.4
Sierra Leone	82.7	5.1	6.7	5.5

HOUSEHOLD CHARACTERISTICS

Household Size

Throughout the country most of the sample came from households of between 5 and 7 members. Generally, smaller households were found in Freetown and the urban areas, and in the South. Larger households were found more frequently in the North.

Table 33: HOUSEHOLD SIZE

Percentage of Households

AREA	Size Ranges				
	2-4	5-7	8-10	11-15	16+
South	23.1	35.5	21.3	12.1	8.2
East	18.1	32.2	21.4	15.6	12.5
North	13.3	28.6	25.2	20.9	12.0
Rural	16.8	33.6	22.7	16.5	10.3
Urban	22.1	28.0	21.7	14.9	13.3
Freetown	25.2	35.6	21.1	13.5	4.5
Sierra Leone	19.5	33.0	22.2	15.6	9.7

Sex of Household Heads

By far the greatest number of households were headed by males. Most of those households headed by females were found in Freetown.

Table 34: SEX OF HOUSEHOLD HEADS

AREA	Percentage Male
South	95.0
East	97.2
North	95.1
Rural	96.5
Urban	93.2
Freetown	89.5
Sierra Leone	94.5

Occupation of Household Heads

The occupations of the household heads were coded according to the CSO's Census Occupation Codes. These were then combined to form the more distinct socio-economic groups listed in Table 35.

Overall, farming was the most frequent occupation, being carried out by 53.9% of the household heads. In the rural areas over 80% of the household heads were farmers, in the urban areas only 24%, and in Freetown only 1.1%. Among the provinces the North had the greatest proportion of farmers.

Table 35: OCCUPATION OF HOUSEHOLD HEAD

	Percentage of Occupation Groups				
	Groups*				
AREA	(1)	(2)	(3)	(4)	(5)
South	6.5	10.7	68.1	11.2	3.5
East	4.7	16.0	60.2	15.6	3.4
North	3.9	9.1	76.0	7.5	3.4
Rural	4.0	6.6	80.2	6.8	2.3
Urban	8.1	31.2	24.1	28.5	7.8
Freetown	8.2	36.1	1.1	43.5	11.1
Sierra Leone	5.6	17.1	53.9	18.2	5.1

*Group: (1) Professionals, Administrators
(2) Clerical, Sales, Services
(3) Farmers
(4) Production/Laborer
(5) Unemployed/Unclassified

Source of Water and Distance Away

Almost 60% of all households surveyed received their water from a tap or well, the majority of which were shared with other households. In the rural areas, 60% of the households got their water from a river or stream.

In the North almost 65% of the households got their water from a river or stream. This is a considerably higher figure than that found in the other provinces.

Generally, most households (58.6%) had easy access to their water supply. Difficult access (i.e. more than 30 minutes away) was rare in all areas of the country; however, this could change during the later dry season as water may become more scarce.

Table 36: SOURCE OF WATER

	Percentage of households getting water from:			
	Tap/Well			
ARE*	Own	Share	River	Other
South	6.2	46.0	45.6	2.2
East	8.1	51.7	39.6	0.6
North	3.5	31.5	64.7	0.2
Rural	2.3	36.2	60.2	1.2
Urban	19.9	68.9	11.2	0.0
Freetown	34.9	62.1	2.9	0.0
Sierra Leone	12.1	47.5	39.7	0.7

Table 37: DISTANCE FROM SOURCE OF WATER

AREA	Percentage of Households Separated from their water by: 0-5 min.	5-30 min.	30+ min.
South	60.2	39.5	0.0
East	51.8	44.8	3.4
North	57.5	41.6	0.9
Rural	54.4	43.9	1.6
Urban	63.5	35.3	1.2
Freetown	67.1	31.5	1.4
Sierra Leone	58.6	39.9	1.5

CHILD CHARACTERISTICS

Child's Birthplace

Almost 70% of the children surveyed in Freetown, and almost 50% of the urban children, were born in a hospital or clinic.

The rate dropped to 11.9% in the rural areas. Among the provinces the lowest rate was in the North.

Table 38: CHILD'S BIRTHPLACE

AREA	Percentage Born In A Hospital or Clinic
South	20.6
East	26.4
North	14.0
Rural	11.9
Urban	49.6
Freetown	69.5
Sierra Leone	31.0

Birth Order

The greatest number of children surveyed were the first born in their families. In all areas the percentage of children surveyed decreased as birth order increased. Generally, more children of a higher birth order (equal to or greater ıan nine) were seen in rural areas; more first-born children were seen in Freetown and the urban areas.

TABLE 39: BIRTH ORDER

Birth Order	Percentage of Children			
	Rural	Urban	Freetown	Sierra Leone
1	17.0	23.7	29.9	20.8
2	16.1	18.0	18.4	16.9
3	14.0	11.8	12.8	13.3
4	11.4	12.1	11.5	11.5
5	10.3	9.2	8.8	9.8
6	8.0	7.9	6.2	7.6
7	7.2	6.9	3.5	6.4
8	5.2	5.7	4.0	5.1
9	4.0	2.0	2.2	3.2
10	3.3	1.4	1.1	2.5
11 +	3.6	1.4	1.4	2.7
Total	100.0	100.0	100.0	100.0

Child Care

Throughout the country, mothers were overwhelmingly cited as the person who usually cares for the child throughout the day. This rate decreased somewhat in Freetown.

TABLE 40: PRIMARY CHILD CARE

AREA	Percentage of children cared for by: Mother	Father	Grand-mother	Other
South	98.8	0.1	0.6	0.4
East	98.0	0.3	0.7	0.9
North	98.4	0.5	1.0	0.1
Rural	98.6	0.3	0.7	0.3
Urban	97.5	0.1	1.1	1.1
Freetown	91.5	1.1	4.6	2.7
Sierra Leone	97.0	0.5	1.5	0.9

MATERNAL CHARACTERISTICS

Mother's Tribe

The tribal mix of survey mothers is quite varied but is similar to the actual tribal distribution seen in Sierra Leone as reported in the 1963 Population Census (37).

TABLE 41: MOTHER'S TRIBE

AREA	Percentage of Mothers Belonging to Tribe Mende	Temne	Limba	Creole	Other
South	74.0	10.0	0.8	0.1	15.0
East	44.7	8.2	2.4	0.2	44.4
North	1.2	54.6	12.6	0.0	31.6
Rural	42.8	22.3	5.3	0.1	29.4
Urban	26.3	29.6	5.8	0.3	38.0
Freetown	8.6	30.7	21.8	7.5	31.4
Sierra Leone	33.0	25.4	8.5	1.6	31.5

Mother Pregnant

The pregnancy rates were similar in each of the provinces. Higher rates were seen in Freetown and the urban areas than in the rural areas.

TABLE 42: MOTHER PREGNANT

AREA	Percentage Pregnant
South	11.2
East	10.2
North	9.6
Rural	9.7
Urban	12.2
Freetown	13.1
Sierra Leone	10.8

Mother Reads English

Illiteracy was very high throughout the country. Overall only 7.7% of the mothers could read English. The literacy rate of mothers is lowest in the rural areas but jumps dramatically to 25.1% in Freetown.

TABLE 43: MOTHERS WHO READ ENGLISH

AREA	Percentage Literate
South	4.9
East	3.6
North	2.0
Rural	1.9
Urban	8.6
Freetown	25.1
Sierra Leone	7.7

PATERNAL CHARACTERISTICS

Father Permanently Absent

Throughout the country 16.4% of the survey children's fathers were permanently absent. Permanently absent is defined as having been away from home for a period of at least six months. Deceased fathers are in this category. The proportion of absent fathers is about equal throughout the country.

TABLE 44: FATHER ABSENT

AREA	Percentage Absent
South	18.1
East	14.4
North	15.6
Freetown	18.2
Sierra Leone	16.4

Father Contributing

Almost 10% of all the survey fathers do not contribute to support their children. The highest proportion of fathers not contributing is in Freetown (12.1%) and the lowest proportion is in the East.

TABLE 45: FATHER CONTRIBUTES

AREA	Percentage Not Contributing
South	10.0
East	6.6
North	10.6
Freetown	12.1
Sierra Leone	9.5

Table 46 combines these results in order to see how they relate. Overall 9.0% of the fathers are absent from the household but still contribute to support their children. This is to say that over 50% of all absent fathers still contribute to their children's welfare. Another interesting result is the percentage of fathers who live in their households but fail to support their children. This figure reaches 5.3% in Freetown.

TABLE 46: STATUS OF FATHER

AREA	Percentage of Fathers			
	Absent Contributing	Absent Not Contributing	Present Contributing	Present Not Contributing
South	9.7	8.4	80.3	1.6
East	9.0	5.4	84.4	1.2
North	6.3	9.3	83.0	1.3
Freetown	11.4	6.8	76.5	5.3
Sierra Leone	9.0	7.4	81.5	2.1

Number of Wives

Polygamy is more widely practiced in the Northern and Eastern Provinces than in the South and Freetown. In Freetown almost 67% of the fathers had just one wife and only 7.8% had three or more.

TABLE 47: NUMBER OF WIVES

AREA	N	Percentage of children whose fathers have the following number of wives 1	2	3+
South	1198	48.8	26.7	22.3
East	1468	38.4	30.9	29.3
North	1227	32.8	32.6	31.7
Freetown	989	66.9	22.2	7.8
Sierra Leone	4882	45.3	28.5	23.8

Discussion

The various characteristics described may be used as indicators of demographic and socio-economic patterns and also is a rough indication of the availability of some health services. There is some overlap as to what each of the characteristics reflect, but below are the basic groupings.

Demographic Indicators

Household Size
Sex Household Head
Tribe
Mother Pregnant
Birth Order
Child Care

Socio-Economic Indicators

Occupation Household Head
Father Status
Number of Wives
Mother Reads English

Health Indicators

Birth Place
Source of Water
Clinic Record

The most noticeable trend running through the various characteristics is the difference between Freetown, the urban areas, and the rural areas. These differences were evident in each characteristic described.

The social structure of households appears to vary according to the degree of urbanisation of an area. This is to be expected since life styles in towns and cities differ dramatically from the more agrarian rural life styles. The highest degree of urbanisation in Sierra Leone is achieved in Freetown, and this is also reflected by many of the indicators.

Generally, when compared to the more rural areas, the urbanised areas are characterized by smaller households, smaller familes (determined by birth order), slightly more female household heads, more educated mothers, and more mothers who leave the daytime care of their children to someone else (possibly while they go to work). In addition the occupations of the household head shift dramatically away from farming as they enter into the more monied economy. Health services are also improved (as indicated by the availability of water and the increased access to hospitals and clinics) in the urban areas.

The nutritional significance of these differences is not always clear. For example, compared to a rural family, an urban family might be characterised by being of smaller size and by having a larger income (both the mother and father employed). This might appear to be an ideal situation - relatively few persons to feed and income from two sources - but things could be much different. In addition to all the other expenses encountered by living in a city, a larger proportion of this family's income will need to go towards food since they do no farming. With the mother away from home during the day, she may not be able to adequately care for and feed (breastfeed) her young children, and they become less well nourished than their rural counterparts.

The Northern province, compared to the South and East, had cer-

tain features which might be considered detrimental to the health and nutrition status of the young child. These included a lesser access to health care (e.g., lower proportion of children with a clinic or birth record or born in a hospital); lower proportion of households using a well, although there was the same access to any form of water (as shown by distance water away) and a slightly less literacy rate (e.g. Mother Reads English). It should be noted that the proportion of rural to total population in the North (87.8%) was higher than the East (67.0%) but similar to the South (84.0%).

Factors in the North which may or may not influence nutritional status included a greater proportion with larger households, more polygamous families and a higher percentage of farmers than the other provinces.

7. ASSOCIATIONS OF UNDERNUTRITION WITH REL FAMILY AND CHILD CHARACTERISTICS

In this chapter, relevant household, family and child characteristics (e.g. household size or sex of child) are checked for associations with the percentage of sampled children who were found to have undernutrition, defined by anthropometry (see Indices of Malnutrition - Chapter 5).

The following variables (characteristics) were investigated for the whole country:

HOUSEHOLD CHARACTERISTICS

1. Household Size (Freetown/Rest of Country)
2. Household Head Occupation (Freetown/Rest of Country)
3. Sex of Household Head
4. Number of wives (By Province, Freetown)
5. Father absent, present, contributing, not contributing
6. Household Food Money Part Week (Freetown/Rest of Country)

CHILD CHARACTERISTICS

1. Number of children under 5 years per family
2. Birth Order
3. Person Caring for Child
4. Birth Place of Child (by age)
5. Sex of Child (by age)
6. Age Determination (by age)
   a. Birth Record
   b. Clinic Record
   c. Calendar of Events
   d. Stated Age
7. Source of Milk (by age and by Freetown/Rest of Country)
   a. Breast
   b. Other Milk
   c. Bottle

8. Food Other than Milk (by age and by Freetown/Rest of Country)

MATERNAL CHARACTERISTICS

1. Person (Mother) Interviewed
2. Tribe of Mother (Freetown and each Province)
3. Mother Reads English (Freetown/Rest of Country)
4. Mother pregnant

HEALTH FACTORS

1. Source of Water (Freetown/Rest of Country)
2. Distance away from water (Freetown/Rest of Country)
3. Mortality in children

For each variable the following descriptions of undernutrition were included:

Chronic Undernutrition: Under 90% of reference height for age (H/A < 90%).

Underweight: Under 80% of reference weight for age (W/A < 80%).

Arm Wasting: Under 82.5% of reference arm circumference for age (AC/A < 82.5%).

Acute Undernutrition: Under 80% of reference weight for height (W/H < 80%) was generally not included. No significant differences were found, mainly because of the low sample sizes for acutely undernourished children.

The sample size (N) is included for each variable.

Only associations which show a statistically significant difference (P value equal or less than 0.05) in the percentages of undernutrition for each variable are included in the tables. The probability value (P) more precisely determines the significance of differences from the chi-square test by considering the proportions of children who have and do not have undernutrition for the particular variable. Only the percentages who

have undernutrition are included in the tables, for the purpose of brevity.

The P value result indicates whether a difference is statistically significant, while the percentage results shows the magnitude of the difference for each variable.

To illustrate, Table 48 shows the percentage of undernutrition, according to whether the mother was able to read English or not. In the provinces there was a significantly greater percentage of children under five years of age with chronic undernutrition (23.5%) belonging to mothers who could not read English, compared with children whose mothers were able to read (14.3%). In other words, there were about 9% more children with chronic undernutrition belonging to those mothers who could not read English. Differences of similar order of magnitude were also shows for underweight and thin arms. No difference was found for Freetown, apart from thin arms. The complete table is as follows:

TABLE 48

(Expanded from Table 52, Section 3)

CHILDREN CHRONICALLY UNDERNOURISHED

NUMBER

		Yes	No	Total
Mother Reads English	Yes	18	108	126
	No	741	2412	3153
	Total	759	2520	

PERCENTAGE

		Yes	No	Total
Mother Reads English	Yes	14.3	85.7	100.0%
	No	23.5	76.5	100.0%
	Total	23.1	76.9	100.0%

It must be noted that an important or significant association of any variable with nutritional status does not necessarily indicate a causal relationship. On the other hand, an association could exist, but may not be found with this particular sample.

The choice for cut-off points for particular variables (e.g. household size 2-5, 6-10, 11+) was based on the results describing these variables in Chapter 6, with sample/size sufficient for an association description. The same consideration was given to describing some variables only by total country and others by provinces. Age groupings were included where relevant to the child's nutritional status. For example, both the child's source of milk or food, and nutritional status might vary considerably according to the age of the child.

7.1 HOUSEHOLD CHARACTERISTICS

1. Household Size

The association of nutritional status with household size was inconclusive. However, in Freetown chronic undernutrition was more prevalent in large (11+) households.

2. Occupation of Household Head

Children from a farming household are more likely to be undernourished, according to all three indices, than are children from non-farming households. Most of the farmers in Sierra Leone practice shifting agriculture on a subsistance basis and tend toward relatively monotonous diets. Agricultural and nutritional programmes targeted at improving the production and diets of the small farmer could be most beneficial.

3. Sex of Household Head

Throughout Sierra Leone chronic undernutrition is more

likely to be a problem in a household headed by a male. This could indicate that benefits might be realized if some portion of a nutrition education programme were also aimed at men.

4. Number of Wives

There are somewhat conflicting associations between nutritional status and the number of wives the child's father has. In general for all of Sierra Leone, a child is more likely to be undernourished if the father has more than one wife.

5. Father Contribution

No important difference found.

6. Money Spent on Food

Outside of Freetown, a significant trend appears that links nutritional status with the amount of money that a child's mother (caretaker) spent the last time she went to the market. According to each index, nutritional status improved with increased expenditure. A larger sample size would have probably picked up this same association in Freetown. This may be viewed as a socio-economic indicator and it re-emphasises the close tie that nutrition and health status have with income.

TABLE 49

PERCENTAGE UNDERNUTRITION ACCORDING TO HOUSEHOLD CHARACTERISTICS

HOUSEHOLD CHARACTERISTICS		Sample Size	Chronic H/A 90%	Under-Weight W/A 80%	Arm Wasting AC/A 82.5%
1. Household Size - Freetown					
	1-4	196	11.7%		
	5-10	531	7.0%		
	11+	245	15.9%		
2. Occupation of Household Head - Provinces					
	Farmers	2546	27.4%	32.5%	16.5%
	Rest	1334	18.6%	25.6%	13.1%
3. Sex of Household Head - Total Country					
	Male	4564	22.0%		
	Female	256	15.2%		
4. Number of Wives					
East	1	565		21.4%	9.4%
	2+	868		28.9%	13.7%
North	1 or 2	835	26.5%		
	3	413	20.6%		
TOTAL COUNTRY	1	2268		25.5%	
	2+	2580		29.5%	
5. Money Spent on Food					
Provinces	-1 Le	499	30.3%	36.2%	19.4%
	1-2.5 Le	1189	21.6%	27.2%	14.1%
	2.5 Le+	485	19.2%	24.3%	11.5%
TOTAL COUNTRY	-1 Le	551	27.8%	34.8%	18.1%
	1-2.5 Le	1764	18.2%	24.5%	11.8%
	2.5 Le	768	15.6%	20.6%	9.6%

7.2 CHILD CHARACTERISTICS

1. Number of Children Under Five Years per Family

   No important differences found.

2. Birth order of child

   No important differences found.

3 Person Caring for Child

   Chronic undernutrition was more prevalent when someone other than the mother cared for the child. The opposite was found with regards to arm wasting.

4. Birthplace of Child

   In the provinces, undernutrition prevalence was consistently greater when the child was born outside a hospital or clinic. No differences were found for Freetown. Birthplace may be viewed as an indicator of health service availability and as an indicator of socio-economic status. Poorer families and those far removed from a hospital or clinic are not very likely to have their children born in a hospital or clinic. These same characteristics may also have a negative influence on nutritional status.

5. Sex of Child

   No difference found according to sex of child.

6. Age Determination Methods

   Children aged 12-59 in the provinces, who had a birth record or clinic record, tended to have less undernutrition prevalence. Conversely, where the calendar of events method was used, children were more likely to be undernourished. This may also be viewed as a socio-economic status and health indicator, as birth records and clinic

records indicate that the family has had access to medical care. Also, more highly educated people tend to keep better records.

7. Source of Milk

In the provinces, children aged 3-11 months who were not breast-fed were far more likely to be acutely undernourished and more likely to have arm wasting. Conversely, those aged 18-23 months who were still breast fed were more likely to have chronic undernutrition and be underweight*. Children aged 3-11 months in the provinces who had another source of milk (other than the breast) were less likely to be undernourished. Bottle fed children in Freetown were far more likely to be underweight.

Breast feeding is the natural way to feed young children and should be strongly advocated within the country. Breast-feeding also provides the perfect complement of nutrients to the child and it eliminates the danger stemming from unsanitary feeding bottles. Breast milk alone usually cannot provide sufficient protein, calories and other nutrients for a child over six months of age, and these children must also receive nutrients from other sources.

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* It is assumed that other factors were involved, i.e. these children may not have received adequate total food and/or they were more likely to live in rural areas, where services were poorer.

TABLE 50

PERCENTAGE UNDERNUTRITION ACCORDING TO CHILD CHARACTERISTICS

CHILD CHARACTERISTICS		Sample Size	Chronic H/A 90%	Under-Weight W/A 80%	Arm Wasting AC/A 82.5%
3. Child Care					
Total Country	Mother	4053	20.6%		14.3%
	Other	794	26.7%		9.9%
4. Birth Place					
Provinces					
3-11	Clinic	280	7.1%	16.5%	10.4%
	Home	462	13.8%	27.3%	20.9%
	Other	279	13.3%	31.2%	26.2%
12-23	Clinic	374	13.9%	32.5%	17.4%
	Home	476	23.9%	40.0%	26.2%
	Other	235	24.0%	45.1%	25.5%
24-59	Clinic	807	16.7%	19.1%	4.5%
	Home	1058	30.6%	26.4%	7.9%
	Other	552	31.7%	29.1%	10.3%
TOTAL	Clinic	1483	14.0%	21.7%	8.7%
	Home	1998	25.1%	29.8%	15.3%
	Other	1071	25.6%	33.0%	17.8%
6. Methods of Age Determination					
a. Birth Record - Provinces					
3-11	Yes	135			
	No	945			
12-59	Yes	560	18.6%	24.1%	9.3%
	No	3173	25.6%	29.4%	12.6%
b. Clinical Record - Provinces					
3-11	Yes	202			
	No	881			
12-59	Yes	717	19.0%		
	No	3006	25.8%		
c. Calendar of Events - Provinces					
3-11	Yes	894		26.6%	
	No	186		18.3%	
12-59	Yes	3016	25.9%	29.9%	12.9%
	No	716	18.7%	23.4%	8.9%

TABLE 51

PERCENTAGE UNDERNUTRITION ACCORDING TO SOURCES OF MILK

7. Sources of Milk		Sample Size	Acute W/H 80%	Chronic H/A 90%	U'Wt W/A 80%	Arm Wastg. AC/A 82.5%
a. Breast Fed						
Provinces						
3-11 m	Yes	803	4.0%			20.9%
	No	65	10.8%			32.3%
12-17 m	Yes	382				
	No	89				
18-23 m	Yes	233		33.0%	46.3%	
	No	210		21.9%	35.2%	
b. Other Milk						
Provinces						
3-11 m	Yes	163	1.8%	7.4%	19.0%	14.6%
	No	705	4.8%	14.8%	30.2%	23.3%
12-17 m	Yes	32				
	No	434				
18-23 M	Yes	14				
	No	427				
c. Bottle Fed						
Freetown						
3-11	Yes	90			18.9%	
	No	64			3.1%	

7.3 MATERNAL CHARACTERISTICS

1. Tribe of Mother

Differences in the nutritional status of children of different tribes were seen. However, when the nutritional status of children from the same tribe but in different areas of the country were compared, significant differences were also seen. For example, 27.3% of the Mende children in the South Province were chronically undernourished, but only 1.2% of those in Freetown were. Likewise, 23.8% of the Temne children in the North were chronically undernourished, compared with 7.5% in Freetown. These large differences seen between areas emphasise the importance of environment, as opposed to genetics, in determining nutritional status.

2. Mother Reads English

Throughout the country undernutrition of each type was from two to three times more prevalent in children whose mothers could not read English. This is an important nutritional link with socio-economic status and education. It also implies that a nutrition education programme should be primarily geared towards the illiterate mother.

3. Mother Pregnant

Children whose mothers were pregnant were less likely to be chronically undernourished. It is doubtful that this is nutritionally significant.

TABLE 52

PERCENTAGE UNDERNUTRITION ACCORDING TO MATERNAL CHARACTERISTICS

MATERNAL CHARACTERISTICS		Sample Size	Chronic H/A 90%	Under-Weight W/A 80%	Arm Wasting AC/A 82.5%
2. Tribe of Mother					
Total Country-	Mende	1587	25.9%*	32.1%*	17.0%*
	Temne	1242	18.4%	25.2%	12.3%
	Creole	88	13.6%*	22.1%	5.7%*
	Limba	431	17.4%	23.8%	10.7%
	Unknown	1439	21.3%	22.1%	12.7%
Mende	South	863	27.3%	36.0%	20.1%
	East	651	27.3%	30.3%	13.5%
	Freetown	81	1.2%*	6.2%*	6.2%*
Temne	South	103	18.4%	23.3%	12.5%
	East	123	14.6%	12.2%*	6.5%*
	North	696	23.8%*	31.9%*	14.8%*
	Freetown	295	7.5%*	15.7%	8.8%
3. Mother Reads English					
Provinces	Yes	126	14.3%	20.8%	7.9%
	No	3153	23.5%	30.2%	16.4%
Freetown	Yes	199			3.0%
	No	614			8.1%
TOTAL COUNTRY	Yes	325	10.1%	16.7%	4.9%
	No	3767	21.4%	28.4%	15.1%
4. Mother Pregnant - Total Country					
	Yes	412	19.9%		
	No	3678	26.2%		

*Significantly different from rest.

7.4 HEALTH FACTORS

1. Water Source

Throughout the country and according to each index, children who received their water from a river were more likely to be undernourished than those who received their water from a tap or well. Also, children whose household shared a tap or well with another household were more likely to be undernourished than those who had a private tap or well. A source of good water is essential for good health.

2. Distance Away from Water

No important differences found.

3. Mortality in Children

Generally, families with an undernourished child, according to each index, are more likely to have more total deaths of children than when the child under four is not undernourished. This is discussed more fully in Section 6.9.

TABLE 53

PERCENTAGE UNDERNUTRITION ACCORDING TO HEALTH CHARACTERISTICS

HEALTH CHARACTERISTICS	Sample Size	Chronic H/A 90%	Under-Weight W/A 80%	Arm Wasting AC/A 82.5%
1. Water Source				
Provinces				
Tap/Well	1992	21.1%	26.6%	13.2%
River	1858	28.0%	34.1%	17.8%
Total Country				
Own Tap/Well	647	13.4%	21.1%	17.8%
Shared Tap/Well	1847	18.9%	24.6%	12.1%
River	1377	27.5%	33.8%	17.6%

8. LABORATORY INVESTIGATIONS

8.1 ANAEMIA IN CHILDREN (HAEMOGLOBIN DETERMINATION)

The presence of anaemia was determined according to the WHO references for haemoglobin levels (38). The reference levels were placed at 11.0 gm/100 ml for children aged 24-60 months and at 10.0 gm/100 ml for children aged 6-23 months. Any value below these levels was classed as anaemia.

TABLE 54: PREVALENCE OF ANAEMIA (LOW HAEMOGLOBIN) IN CHILDREN BY AREA AND AGE

Area	Percentage with Anaemia					
	6-23 months		24-59 months		6-59 months	
	N	%	N	%	N	%
South	95	52.6	101	69.3	196	61.2
East	128	45.4	166	59.6	294	53.5
North	110	54.5	116	74.2	226	64.6
Rural	285	50.9	353	67.4	638	60.0
Urban	40	35.0	61	59.0	101	49.5
Freetown	88	19.2	110	30.9	198	25.7
Sierra Leone	413	48.4	524	65.8	937	58.1
Special Group	47	19.2	231	38.6	278	33.3

Results

Anaemia was present in 58.1% of children aged 6-59 months throughout Sierra Leone. There was a slightly higher anaemia rate in children aged 24-59 months (65.8%) compared with those aged 6-23 months (48.4%).

Anaemia prevalence was far less in the Special Group for both age groups than in all areas outside Freetown. In fact, the results for the Special Group approximated those for Freetown. The Eastern Province had the lowest prevalence of anaemia among the provinces and the rate was less in the rural compared with the urban areas.

Comparing results within the country requires caution, because of the relatively low sample sizes. For example, with urban areas (N=101) the actual range for anaemia prevalence might be as much as ± 10% (i.e., 39-59%).

Discussion

Throughout the world anaemia is one of the foremost public health problems, and its effects are widespread and varied. Most notably the oxygen carrying capacity of the blood is lowered accompanied by a decrease in maximal work output. Several other mechanisms and biochemical pathways are also effected and may lead to cellular and subcellular abnormality, subnormal mental performance and growth retardation (39). Anaemia was found in this survey to be positively correlated with undernutrition (see Appendix VI).

Dietary deficiency in iron and/or folic acid, malaria and intestinal (e.g. hookworm) parasitism and recurrent infections are common causes of anaemia in children in developing countries. All these factors, apart from infections, were investigated in this survey.

THIN BLOOD FILM

A thin blood film was prepared from the same children who had their haemoglobin levels determined. A total of 812 thin films were examined; this number excluded 43 films which were unsatisfactory and not read.

Results

An anaemic blood picture was found in 51.5% of Sierra Leonean children aged 6-59 months. It is of interest that the prevalence of anaemia based on haemoglobin levels (58.1%) was very similar.

TABLE 55: PREVALENCE OF ANAEMIA (THIN BLOOD FILM) BY AGE

Age	N	Percentage Anaemic
3-5	57	47.4
6-23	320	57.5
24-59	435	47.1
Total	812	51.2

An anaemic picture was exceedingly rare in Freetown. From the blood picture results it might appear that anaemia was highest in the South and least in the North. More complete tables of the thin film results by age and area can be found in Appendix II.

TABLE 56: PREVALENCE OF ANAEMIA (THIN BLOOD FILM) BY AREA

AREA	Percentage Anaemic
South	72.1
East	57.2
North	42.7
Rural	70.6
Urban	55.9
Freetown	3.4
Sierra Leone	51.2

Discussion

Of all cases with anaemia assesed by the blood picture, 73% were classed as mild, 26% as moderate and 1% as severe.

The type of anaemia was checked on the thin film to provide some clues as to possible aetiology. Of all anaemias, microcytes

were predominant in 41%, normocytes in 49%, and microcytes in 10%; of all anaemias, hypochromia was present in almost all instances and hyperchromia was rare.

That hypochromia was the most common finding, being present in 58.3% of all blood film, suggests iron deficiency is the major factor in anaemia. Chronic iron deficiency, based on the proportion of microcytes, was also found to be fairly common. Macrocytosis was found as the predominant feature in 5.3% of films. It is probably much more common as a secondary feature. This result suggests that folate deficiency is important but not nearly as important as iron deficiency.

MALARIA PARASITES

Thick blood films from 1953 children were examined for the presence of malaria parasites. Table 57 shows the prevalence rates in each area of the country. The most striking results are the low prevalences found in Freetown (4%) compared to the rest of the country, and the rural/urban differences (36.2% and 20.6%). The South also shows considerably lower prevalence rates than do the other provinces.

TABLE 57: PREVALENCE OF MALARIA PARASITES BY AREA

AREA	Sample Size	Percentage Positive
South	441	20.6
East	594	41.6
North	535	39.3
Rural	1406	36.2
Urban	194	20.6
Freetown	353	4.0
Sierra Leone	1953	30.1
SL Excluding Freetown	1601	33.1

Table 58 shows the prevalence rates of malaria by age. The Freetown results were excluded because they were so dissimilar. The results show an increasing incidence of malaria with age, peaking in the fourth year of life followed by a slight drop.

TABLE 58: PREVALENCE OF MALARIAL PARASITES BY AGE

Age in Months	Sample Size	Percentage Positive
3-5	117	15.4
6-11	246	28.0
12-23	374	33.2
24-35	315	38.4
36-47	326	42.0
48-59	222	36.0
TOTAL	1601	34.3

Discussion

The diagnosis of malaria was made on thick films alone. Thin films were not used so that the type of malaria was not known. It is probable that the prevalence rates for malaria on the basis of the thick film results were underestimated. The quality of the stained smear in many instances made identification of the parasites difficult. Of the 2006 smears prepared, 53 (2.5%) had to be discarded because they were unsatisfactory. Six technicians read the films, making standardization difficult. A cross check of a 1:15 sample by a senior technician confirmed the underestimates of malaria prevalence rates.

The presence of parasites does not necessarily mean that the child is clinically infected. Another point to consider was that if a child was recently treated for the condition with anti-malarials, there may be no parasites to be found.

Parasite loads often change quickly in areas where malaria is

endemic and a cross-sectional survey will only indicate the situation at one time. During the rainy season, for example, the prevalence rates would be expected to be higher.

Notwithstanding, almost 1/3 of all children aged 3-59 months in Sierra Leone had evidence of malaria parasitism, as shown by the thick film. Although the rates were highest from 1 to 4 years, an important proportion of infants from 3-11 months (24.0%) had parasites.

The lower prevalence of malaria in Freetown compared with the rest of the country is in agreement with prior studies by the Ministry of Health (40). Mosquitoes are easier to control in Freetown than in the more rural areas. In addition, prevention and treatment with antimalarial drugs are more readily available in Freetown.

This may also explain the difference between the urban (20.6%) and rural (36.2%) parasite rates.

It is not clear why the parasite rate was less in the South (20.6%) compared with the other two provinces (39.3% and 41.6%).

Malaria is an important factor in causing anaemia, both in adults and young children. The difference in malaria parasite rates for Freetown and the rest of Sierra Leone would explain to some extent the lesser prevalence of anaemia in Freetown.

8.2 INTESTINAL PARASITES

PREVALENCE BY AREA

Stool samples were collected from a total of 899 children. The number and the distribution of samples collected by area and age are seen in Appendix VI. The major results are given below and are given as the percent positive based solely on the subsamples.

TABLE 59: PREVALENCE OF INTESTINAL PARASITES BY AREA

AREA	Sample Size	Percentage of children with parasites		
		Hookworm	Ascaris	Trichuris
South	241	10.0	23.7	2.9
East	253	2.4	15.7	2.0
North	254	7.1	14.2	3.9
Rural	665	6.9	18.3	3.2
Urban	96	2.1	12.5	5.2
Freetown	138	0.7	25.4	7.2
Sierra Leone	899	5.4	18.8	4.0

Hookworm

Freetown and the urban areas show consequently lower incidences of hookworm infestation (0.7% and 2.1%) than do the rural areas (6.9%) The Eastern Province also shows a very low incidence (2.4%).

Ascaris lumbricoides

Ascaris infestation is much more common in Sierra Leone than is hookworm. The most interesting finding is the high prevalence rate seen in Freetown (25.4%). The Southern Province also has a high incidence (23.7%).

Trichuris tricharia

The incidence of Trichuris is uniformly low throughout the country. However, once again Freetown has the highest prevalence rate (7.2%).

PREVALENCE BY AGE

Table 60 shows the age distribution of children with intestinal parasties.

TABLE 60: PREVALENCE OF INTESTINAL PARASITES BY AGE

AGE in Months	Sample Size	Percentage of children with parasites		
		Hookworm	Ascaris	Trichuris
3-11	188	0.0	4.8	0.0
12-23	207	4.3	17.9	2.4
24-35	185	7.0	21.6	3.2
36-47	187	7.0	26.2	8.6
48-59	132	10.6	25.8	6.8
3-59	899	5.4	18.8	4.0

Hookworm

Hookworm was not found to be a problem during the first year of life. From 12-59 months the trend is an increasing prevalence with age.

Ascaris

The prevalence of Ascaris in the stools also increases with age. A plateau of about 25% is reached at the end of the third year and continues through 59 months.

Trichuris

No trichuris infestation was seen from 3-11 months. The prevalence rate remains low through the third year, and reaches a plateau at approximately 7% from 36-59 months.

Discussion

The collection of stools from young children was done on a convenience basis. Where a technician was present (i.e. every second site) stool cups were left with the index children selected for that site. When feasible, the cups were distributed at the beginning of the day or the night before to those children likely to be selected in the sample. The cup and fingernail of the selected child was marked with the same lacquer color to avoid confusion in households. Each child selected in the same household had a unique

identifying color applied. Later that day, or on the following day, the specimen was examined and collected, if produced. Technicians were instructed to cross-examine the mother, or the person caring for that child, to make sure the specimen was produced by the same child. This was then transferred to 10mm plastic and sealed containers and preserved in 10% formal saline.

All specimens were read by the same technician from the Connaught Hospital, Freetown. A total of 899 were read; these comprised 37% of the total possible number that could have been obtained if every child in the sites had "produced."

It must be noted that no concentration tests were done, so that the presence of parasites done by the smear method would miss many children who had parasites in lesser amounts.

Since only one technician read the stool results it is more likely that the prevalence rates for various areas of the country can be compared with greater confidence than, for example, the thick film results where six technicians did the readings.

From the results it would appear that hookworm is likely to be an important cause of anaemia in certain children from the first year of life, in rural areas and in the Southern and Northern provinces. It is difficult to interpret the relative importance of hookworm and malaria infestation with regard to the prevalence of anaemia although it would appear that malaria is more common.

Ascaris infestation was common in children from 1-4 years throughout all areas of Sierra Leone. It is unclear why its prevalence was equally as common in Freetown. Overcrowding and poor hygiene habits of young children may contribute. Other intestinal parasites, apart from Trichuris, were relatively uncommon. However, a semiquantitative method based on the number of parasites seen in the microscope field was used to approximately determine parasite loads. In general, it appeared from the results that hookworm loads tended to be lighter when compared with Ascaris loads. Most of the

positive hookworm samples were either scanty or 1+; whereas, about one-half of the positive Ascaris smears were 2+ or more.

8.3 ANAEMIA IN PREGNANT WOMEN

Anaemia in pregnant women is defined as a haemoglobin level below 11 gm/100 ml whole blood (WHO).

Results

Table 61: DISTRIBUTION OF HAEMOGLOBIN LEVELS IN PREGNANT WOMEN

	Percentage of Women					
	GM%					
	<9.0	9.0-9.9	10.0-10.9	11.0-11.9	12.0-12.9	13.0+
Sierra Leone	3.0	6.2	21.5	29.2	24.6	15.4

Haemoglobin determination was done on 65 pregnant women from throughout the country. Anaemia was diagnosed in 30.8%. The high percentage of mothers in 11.0 - 11.9 range (29.2%) indicates a large group with borderline anaemia. Depending on the future disease and nutrition picture of each individual, there is a large percentage of mothers who could potentially slide toward haemoglobin levels below 11.0 grams. The mean haemoglobin level was 11.6 gm %.

Discussion

Anaemia during pregnancy is associated with an increased risk of maternal and fetal morbidity and mortality. As the pregnancy advances toward term, the fetus maintains an ever increasing drain on the mother's blood. The net result is a decreasing concentration of haemoglobin in the mother's blood, and a consequent decrease in the volume of oxygen her blood delivers to the fetus and to her own body organs. Reduced oxygen supply has numerous deleterious effects on both mother and child, including increased risk of premature delivery, low birthweight, placental hypertrophy, and

reduced estriol excretion (39).

8.4 MEASLES

A total of 1127 blood specimens were collected on filter paper from throughout Sierra Leone. These specimens were then sent to the Center for Disease Control (CDC) in Atlanta, Georgia, USA, to be tested for the presence of measles antibodies. However, 767 of the specimens did not have a sufficient quantity of blood in order to run measles tests for HI on them (small pockets where blood did not soak the filter paper made them unusable).

TABLE 62: PREVALENCE OF MEASLES BY AREA

AREA	N	Percentage With Measles
South	125	31%
East	101	14%
North	197	29%
Freetown	37	19%
Sierra Leone		24.4%

The tests for measles antibodies were conducted on only the 360 sufficiently collected blood specimens, of which 88 (24.4%) were positive and 272 (75.6%) were negative. The prevalence rates are higher in the Southern and Northern Provinces, but due to small sample size, caution must be used when comparing results from one area to another.

Discussion

Field observations suggest that measles, of all the common communicable diseases of childhood, imposes an unusually severe nutritional stress. It may in fact, precipitate kwashiorkor in malnourished children more frequently than any other infectious disease (41, 41, 43, 44).

The diarrhea and fever of measles frequently interact in undernourished children to produce a condition of impaired intestinal absorption during a time of greatly increased metabolic activity. This is an example of the malnutrition-infection cycle common to many diseases. Undernutrition leaves an individual more susceptible to infections, which often worsens the undernutrition, which in turn leads to more frequent and more severe infection.

Treating only an infection or disease will not break the cycle. The only way to do that is to improve the nutritional status of the susceptible groups.

8.5 HAEMOGLOBIN ELECTROPHORESIS (Sickle Cell Test)

The blood of 302 children aged 6-59 months sampled from Sierra Leone, excluding Freetown, was tested for haemoglobin genotype. Few children (0.3%) showed sickle cell-disease. Sickle cell traits were found in 23.2%. A "rapid" haemoglobin genotype (AA+) occurred in 34.8% of children. This has no apparent clinical significance.

It is known that sickle cell-disease is an important cause of severe anaemia, but is a relatively uncommon cause of anaemia in general.

9. DIETARY INVESTIGATION

9.1 INFANT FEEDING AND WEANING

In order to gain a better understanding of the nutritional influences on a child, it is necessary to have an understanding of certain feeding practices. Foremost among these are the practices of breast-feeding, artificial feeding and weaning.

Duration of Breast-Feeding

Table 63: PERCENTAGE OF CHILDREN FULLY BREAST FED

Area	Age in Months 3-5	6-11	12-23	24-30	3-30
South	91.9	91.4	63.6	16.0	66.1
East	92.6	90.9	69.2	20.1	68.9
North	98.6	93.6	69.9	12.0	67.0
Rural	96.2	91.9	71.0	16.0	68.7
Urban	90.3	91.9	57.7	10.4	60.7
Freetown	81.1	79.3	47.1	3.5	51.6
Sierra Leone	93.8	90.6	65.8	13.8	65.3

Almost 90% of all children in the country are fully breast-fed throughout their first year of life (full breast-feeding, as used here, is defined as breast-feeding a child five or more times a day). The differences in the prevalence rates of the provinces are not great, and the rates for the urban and rural strata are also similar. However, in Freetown the prevalence of breast-feeding is more than 10% less than the rest of the country.

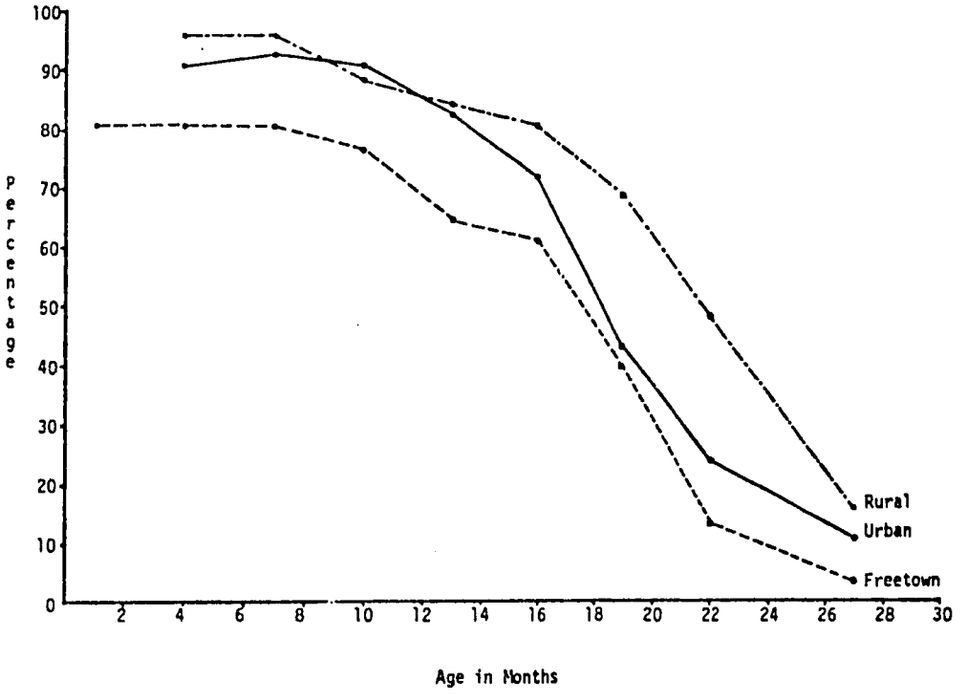
After one year the child feeding patterns shift considerably. From 12-23 months full breast-feeding is much more common in the rural areas of the country than in the urban areas (71.0% vs. 57.5%). Breast-feeding is similarly practiced in each of the Provinces in this age group

but is again lower in Freetown.

The rates in the 24-30 month age group indicate the prevalence of prolonged breast feeding. This practice is most common in the Eastern province, where 20.1% of the children are still fully breast-fed after 24 months, and least common in Freetown (3.5%). The rural areas also show a greater amount of prolonged breast-feeding than do the urban areas.

The patterns of breast-feeding in the urban and rural areas and Freetown can also be seen from the graph below.

Figure 9 PERCENTAGE OF CHILDREN FULLY BREAST-FED BY AGE



Non-Breast Milk

Table 64: PERCENTAGE OF CHILDREN RECEIVING NON-BREAST MILK

Area	Age in Months				3-30
	3-5	6-11	12-23	24-30	
South	28.0	16.6	4.3	0.0	9.7
East	24.4	21.2	5.7	0.0	11.8
North	21.5	5.7	4.5	0.6	6.1
Rural	17.3	9.8	3.5	0.3	6.3
Urban	56.4	32.6	9.2	0.0	18.9
Freetown	81.5	78.6	38.7	8.3	47.7
Sierra Leone	31.4	21.9	8.3	1.2	13.5

As could be expected, more children in Freetown and the other urban areas receive non-breast milk than do rural children. From 3-5 months, 81.5% of the children in Freetown and 56.4% of the children in the urban strata receive non-breast milk; 17.3% of the rural children receive it. From 24-30 months, non-breast milk is virtually not consumed anywhere except in Freetown.

It is interesting to compare the percentage of children in Freetown and the urban areas that are fully breast-fed with those that receive non-breast milk. Especially in those children less than a year old, there is considerable overlap between the two groups, so one type of feeding does not necessarily preclude the other.

Bottle-Feeding

Table 65 shows the prevalence of bottle feeding throughout the country. The pattern seen is quite similar to that seen for children receiving non-breast milk. Bottle-feeding is widely practiced in Freetown from 3-11 months and in the urban areas from 3-5 months.

TABLE 65: PERCENTAGE OF CHILDREN BOTTLE FED

Area	Age in Months 3-5	6-11	12-23	24-30	3-30
South	18.9	8.1	1.8	0.0	5.2
East	18.9	9.1	3.6	0.7	6.4
North	10.7	3.1	3.1	0.0	3.4
Rural	8.2	4.1	1.5	0.0	2.8
Urban	43.5	18.4	6.4	0.9	12.4
Freetown	61.1	41.3	16.0	4.6	25.2
Sierra Leone	20.7	10.8	4.2	0.8	7.2

Age Onset of Food

Throughout the country, 58% of all children are receiving food at 3-5 months. Fewer children in Freetown and the North Province receive food at this age. At 6-11 months almost 85% of all children were receiving food.

TABLE 66: PERCENTAGE OF CHILDREN RECEIVING FOOD

AREA	Age in Months 3-5	6-11	12-17	18-30
South	60.0	89.0	93.6	99.2
East	60.8	82.9	97.5	100.0
North	51.0	75.5	92.2	98.1
Rural	60.0	85.5	94.3	98.9
Urban	56.1	77.1	94.0	100.0
Freetown	47.4	83.6	94.6	99.1
Sierra Leone	58.0	83.8	94.3	99.1

Discussion

The results indicate that the practice of breast-feeding is still common throughout the country, but has decreased significantly in Freetown where bottle feeding of children is the most widely practiced. They also show that children in the critical 6-11 month age group, particularly in the North, frequently do not receive any supplemental foods along with breast milk.

Breastfeeding is the optimal mode of infant feeding and is usually sufficient to meet a child's nutritional need until about the sixth month. After that time, other foods, in addition to breast milk, are needed to provide the necessary nutrients required to maintain normal growth. By six months of age, all children should be receiving other foods, but breast-feeding should be continued conjunctively as long as possible.

Bottle feeding is often a dangerous practice for several reasons. An unsanitary feeding bottle filled with over-diluted milk (in order to make the expensive formula last longer), capped with a dirty nipple is a common sight in developing countries which often leads to the recurrent cycle of undernutrition and infection. The associations discussed in Chapter 7.2 show that bottle feeding dramatically increases the incidence of undernutrition.

The development of a strong nutrition education program is needed to teach mothers about more beneficial infant feeding and weaning practices. The promotion of breastfeeding and the utilisation of local foods for weaning which are easily grown and obtainable should be paramount objectives of the program.

9.2 QUALITATIVE DIETARY RECALL

INTRODUCTION

All dietary methodology used was based on the recommendations by the National Academy of Sciences, U.S.A., modified to Sierra Leonean needs (45). This methodology assumes that consumption information based on the types of foods eaten throughout a country would be feasible and valid and provide useful data for nutrition policies and programmes.

The index child's consumption of 24 different foods was assessed using a modified 24-hour recall method. The child's caretaker was asked to name all the foods the child ate the day before the interview, starting from the time the child first awoke. After checking the responses with the list in Form II, a further questioning took place which obtained the respondent's diet and that of the rest of the family. In the same way comments were made when modification of the food listed was ingested (e.g., pap or type of commercial weaning food).

Information was not collected about the method of preparation, frequency nor quantity of intake. It was not known if the foods reportedly eaten were consumed together or separately, nor were any time intervals assessed between consumption of foods (i.e. whether given together or not).

Sample Size

The diet subsample included every second child from 3 up to 30 months of age in the main sample. A total of 1380 dietary listings were analysed, each containing information concerning the child and the family. The average number of children with dietary information per site was 12. The child dietary patterns are described for each of the provinces, Freetown and for the urban and rural strata. The descriptions are in four age groups: 3-5, 6-11, 12-17, and 18-30 months.

This breakdown produces small sample sizes in certain areas and

ages, particularly in the 3-5 month group where the average sample size for the provinces and Freetown is 39. Two basic assumptions regarding the acceptance of these low sample sizes are: 1. qualitatively the diet of a young child or family varies little within a site; and 2. there is no bias in the method of subsample selection.

The distribution by area and age group of the child is shown below.

TABLE 67
AGE DISTRIBUTION OF DIETARY SUBSAMPLE BY AREA

		Percentage of Children Age In Months			
AREA	N	3-5	6-11	12-17	18-30
South	331	11.2	28.1	19.0	41.7
East	403	12.7	26.1	19.6	41.7
North	382	12.8	25.7	20.2	41.4
Rural	838	11.9	27.1	18.7	42.2
Urban	294	13.9	23.8	22.8	39.5
Freetown	248	7.7	24.6	22.6	45.2
Sierra Leone	1380	11.8	26.3	19.8	42.0

Food Groups

The results are presented first by food groups and area of the country. The food groups are then cumulated into a scoring system for each area. The individual foods eaten by children and families, in each area of the country, along with the intra-family distribution are given in Appendix VII.

To simplify the presentation of the results, foods with similar nutrient values are grouped together (Table 68). The results are presented by food group and indicate whether at least one of the foods in that particular group was eaten the day before.

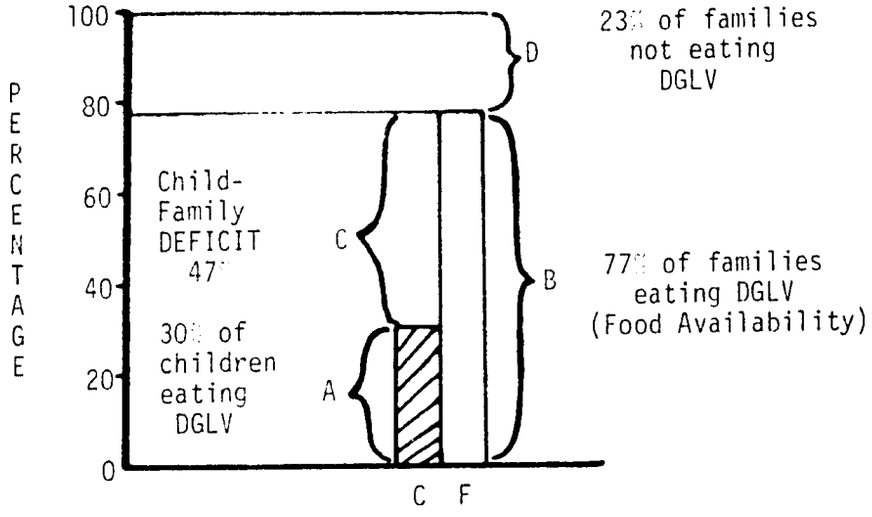
TABLE 68: FOODS AND THEIR GROUPS

INDIVIDUAL FOODS	GROUPS
FooFoo/Cassava Gari Yam/Sweet Potato Plantain	TUBERS, ROOTS, STARCHY FRUIT
Rice Wheat/Bread Millet/Sorghum Maize	CEREALS
Legumes/Beans Benniseed/Groundnuts/Kanya	VEGETABLE PROTEIN
Fish Beef/Other Meat Chicken Eggs	ANIMAL PROTEIN
Dark Green Leafy Vegetables	DGLV
Fruits	FRUITS
Palm oil Other oil Margarine	OILS
Sugar/Sweets	SUGAR/SWEETS

In figures 10-23, the histograms indicate the percentages of children and families in each province consuming food from the different groups on the day before the interview. The histograms are devrived from the tables at the end of this chapter and present the results in two ways. Figures 10-17 indicate for a particular food group what proportion of families and children consume that food in each area of the country. Figures 18-23 indicate for a particular area of the country what proportion of the families and children consume food from the individual food groups. In both cases the results are grouped according to the ages of the children. In this presentation "family food" is defined as that food, and may be

considered as an index of food availability for the child, since any food eaten by the family is also potentially food for the child.

The first two columns from the second row of Figure 14 are reproduced below, and show 30% of the sample children aged 6-11 months in Southern Province had atleast one DGLV (A) compared with 77% of their corresponding families (B). In other words, over three quarters of all families had at least one food from the DGLV group, while less than half of their children aged 6-11 months had any.



A - Proportion of children eating DGLV (30%).

B - Proportion of families eating DGLV (77%). (Food Available)

C - (B minus A) Proportion of children not eating DGLV when available to family (Child - Family difference or deficit 77% - 30% = 47%)

D - Proportion of families not eating DGLV (Food unavailable = 100% - 77% = 23%).

The difference (C) between the family column and that of the child (shaded column) indicates the proportion of children who did not receive that food when it was available (eaten) in the family.

The terms "food availability" and "child-family deficit" or "deficit" are used in this report based on the above explanations. In this example, improvement solely in the intra-family distribution of DGLV's with regards to the young child would reduce this deficit and enable more children to receive DGLV's. This child-family deficit is one possible explanation when a certain proportion of children do not receive a particular food or group. In other situations it may be related to food unavailability with or without a deficit.

PROPORTION OF CHILDREN AND FAMILIES CONSUMING FOOD GROUPS

Table 69 shows the percentages of families in each area of the country who consumed foods from the food groups listed.

TABLE 69: FAMILY CONSUMPTION OF FOOD GROUPS

AREA	Percentage of Families Consuming Food Group							
	Tuber	Cereals	Veg. Pro.	Ani. Pro.	DGLV	Fruit	Oil	Sugar
South	35	99	53	98	75	22	95	7
East	29	100	71	98	58	43	87	24
North	15	99	80	96	51	18	78	11
Rural	27	99	64	97	58	24	86	8
Urban	22	100	83	98	68	41	88	32
Freetown	34	100	86	98	70	58	77	68

These are quoted in the histogram descriptions and are the average figures for each area. They do not relate to the child age groups.

The child/family deficits and child/family ratios are based on the actual numbers of cases in each age group.

Tubers, Roots, Starchy Fruit

Foods in the tuber group were most commonly consumed by families in the Southern Province (35%) and Freetown (34%). In the East 29% of the families ate at least one food from the group while in the North the rate dropped to 15%. The urban-rural difference was not great (22% vs. 27%).

Very few children 3-5 months received any of the tubers and the

rate increased only slightly in the 6-11 months group. On the average about 20% of the 12-17 months group are eating food from this group, but by this time, and certainly in the ages 18-30 months, their qualitative consumption is approaching that of the families.

Cereals

A cereal staple was consumed by almost every family throughout the country. Cereals were also commonly consumed by children in each area of the country. Over 50% of all children aged 3-5 months, with the exception of those in Freetown, received cereals; 26% of those in Freetown did. By 6-11 months, considerably more children were receiving cereals: 83% of the rural children; 70% of the urban; and 64% of them in Freetown. Among the provinces, fewer children in the North (72%) received any cereals.

After 12 months over 90% of all children were receiving cereals; however, the rate in Freetown was again the lowest.

Vegetable Protein

The consumption patterns of foods with a high vegetable protein content varied throughout the country. These were most commonly eaten by the families in Freetown (86%), followed by those in the urban areas (83%). Only 64% of the rural families ate any legumes, seeds or nuts. Considerable differences were also seen in the results for the provinces. The family rates ranged from 53% in the South to 80% in the North.

Very few children 3-5 months anywhere in the country received any of the vegetable protein group. From 6-11 months the children receiving these foods ranged from 13% in Freetown to 29% in the North. What is striking are the large child/family deficits seen in each area. Children in this age group received these foods on average over 40% fewer times than did their parents. The largest deficits are seen in Freetown (75%) and the urban areas (61%).

The deficits in the 12-17 month group average just over 20%. In the South, East and North the children received food from this group 38%, 52% and 58% of the time respectively. From 18-30 months the children received almost the same foods and the families, but still in the South less than 50% of the children were receiving any high protein vegetable food. Nowhere were more than 70% of the children receiving any of these foods.

Animal Protein

Throughout the country almost every family (97%) had some animal protein in their diet. This is based on the wide consumption of fish (Appendix VIII) and produces a very high index of availability for the children.

The consumption patterns of animal protein for children are similar for each area of the country, but, as would be expected, there are definite age differences.

Very few children aged 3-5 months received any of these foods. Approximately 30% of the children aged 6-11 months (20% in Freetown) received animal protein. This means that in the 6-11 month age group approximately 70% of the families who had fish, meat, poultry or eggs to eat did not feed any of these foods to their children.

In the 12-17 month group approximately 67% of the children throughout the country received animal protein; and the figure is over 90% for the 18-30 month group.

Dark Green Leafy Vegetables

The consumption of DGLV's varied throughout the country. In the North only 51% of the families consumed DGLV's; 58% did in the East and 75% in the South. Seventy percent of the families in Freetown, 68% in the urban areas, and 58% in the rural areas consumed DGLV's.

The children's consumption patterns again showed significant age differences. Virtually no children aged 3-5 months (only 2% in the Eastern Province) received DGLV's. Thirty percent of the children aged 6-11 months in the South, 18% in the East and 20% in the North received DGLV's.

There were no urban/rural differences (21% vs. 22%) but only 13% of the Freetown children received any DGLV's. The largest child/family deficits were seen in Freetown (60%), the Southern Province and the urban areas (45% each).

In the 12-17 month group just 39% of the children in the North were eating DGLV's; however, they also had the lowest deficit (40%) of any area. In the South and in Freetown, 53% of the children were given DGLV's to eat but that still leaves deficits of almost 30% and 20% respectively. The largest deficit is seen in the urban areas (33%).

In the 18-30 group the children's consumption patterns approach that of their families. They range from 67% in the South to 47% in the North.

Fruits

Except in Freetown, fruits were not widely reported as being eaten anywhere in the country. Fifty-eight percent of the families in Freetown, 43% in the East, 22% in the South and 18% in the North had any fresh fruit in their diets. Over 40% of the urban families, compared to 21% of the rural families, consumed fruit.

Less than 10% of the children aged 3-5 months received any fruit. In those aged 6-11 months the percentages ranged from 31% in Freetown to 7% in the North. A deficit of 25% was seen in the urban areas. In the 12-17 and the 18-30 month groups the deficits are generally small and the child consumption approximates that of the families.

Oils

Oils (usually palm oil) were also widely consumed throughout the country. Approximately 95% of the families in Freetown and the South Province had at least one of the oil group in their diet; 87% of those in the Eastern Province and 78% of those in the North also consumed oil.

In comparison to most other foods, oils were often introduced into children's diets at an early age. Almost 15% of all rural children aged 3-5 months were receiving oil, and by 6-11 months, 48% of these children were receiving oil.

Sugar/Sweets

In Freetown 68% of the families interviewed consumed sugar. This figure dropped sharply to 32% in the urban areas and 8% in the rural areas. In the East 24% of the families used sugar.

Except in the 3-5 month group and in Freetown, the qualitative consumption of sugar by children was close to that of their families.

SUMMARY

In general, very few children aged 3-5 months received any of the food groups listed. The exceptions to this are those children who receive cereals. This is usually in the form of a rice pap and is often combined with oil. Also, after 17 months almost all children receive the same foods as their families. The critical age groups then become 6-11 months and 12-17 months. These ages are also shown to be the most critical anthropometrically and the remainder of this chapter will deal primarily with these age groups.

Staples (Cereals, tubers)

Cereals were the major staples throughout the country, being

consumed by 99% of the families. Tubers/cassava were eaten by over 30% of the families except those in the Northern Provinces (15%). A high proportion of children also received these foods. At 6-11 months 80% of the children outside Freetown were receiving a cereal staple.

Protein-Rich Foods

Vegetable proteins were eaten by the least proportion of families in the Southern Province (53%) and by just under 80% of the remaining families in the country. Over 97% of all families in the country consumed animal protein (mainly fish). However, far fewer children (up to 70% fewer), particularly those under 12 months, received any high protein foods.

Dark Green Leafy Vegetables

The proportion of families eating DGLV's ranged from 51% to 75%. The proportion of children 6-11 months eating these ranged from 13% to 30%. In the 12-17 month group the percentages of children receiving DGLV's rose but the child/family deficits were still considerable.

Fruits

Fruits were eaten most commonly by families in Freetown and the Eastern Province. Children aged 6-11 months received about 50% less than their families, and those aged 12-17 months received 25% less.

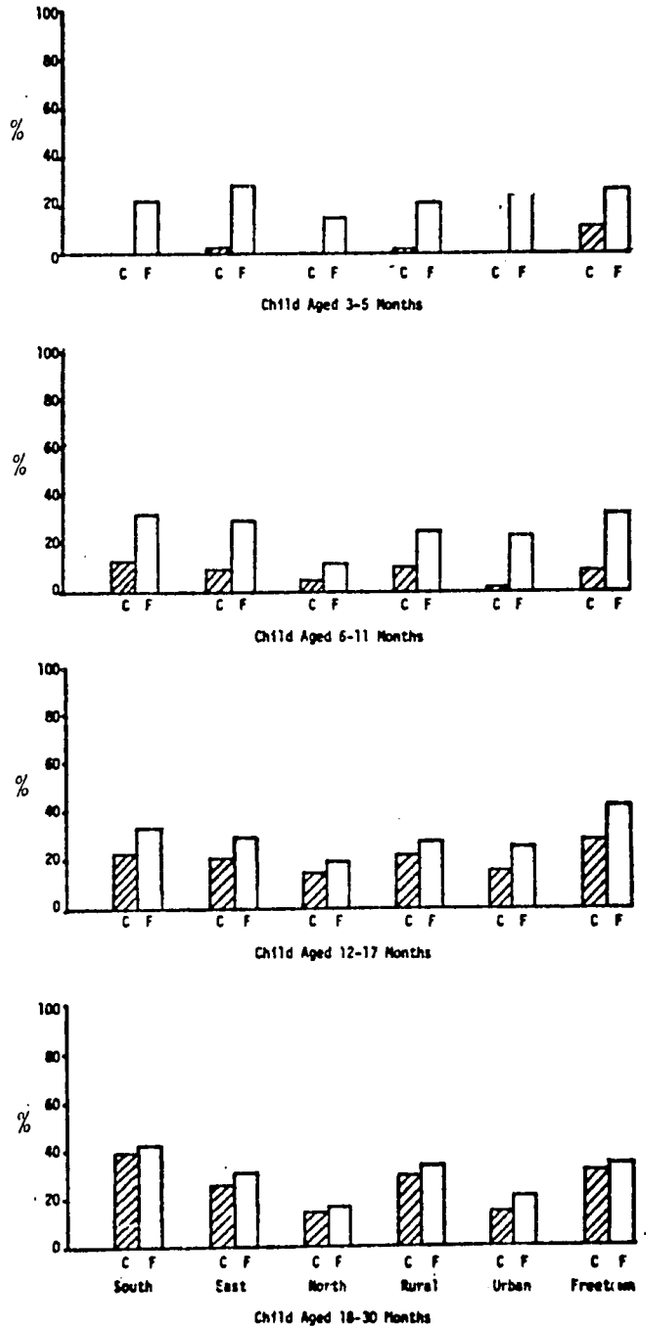
Oils and Sugar

A high proportion of all families consumed oil in their diet. Fifty percent and 75% of children aged 6-11 and 12-17 months respectively also consumed oil.

Sugar was not widely consumed except in Freetown.

FIGURE 10

TUBERS, ROOTS, AND STARCHY FRUITS

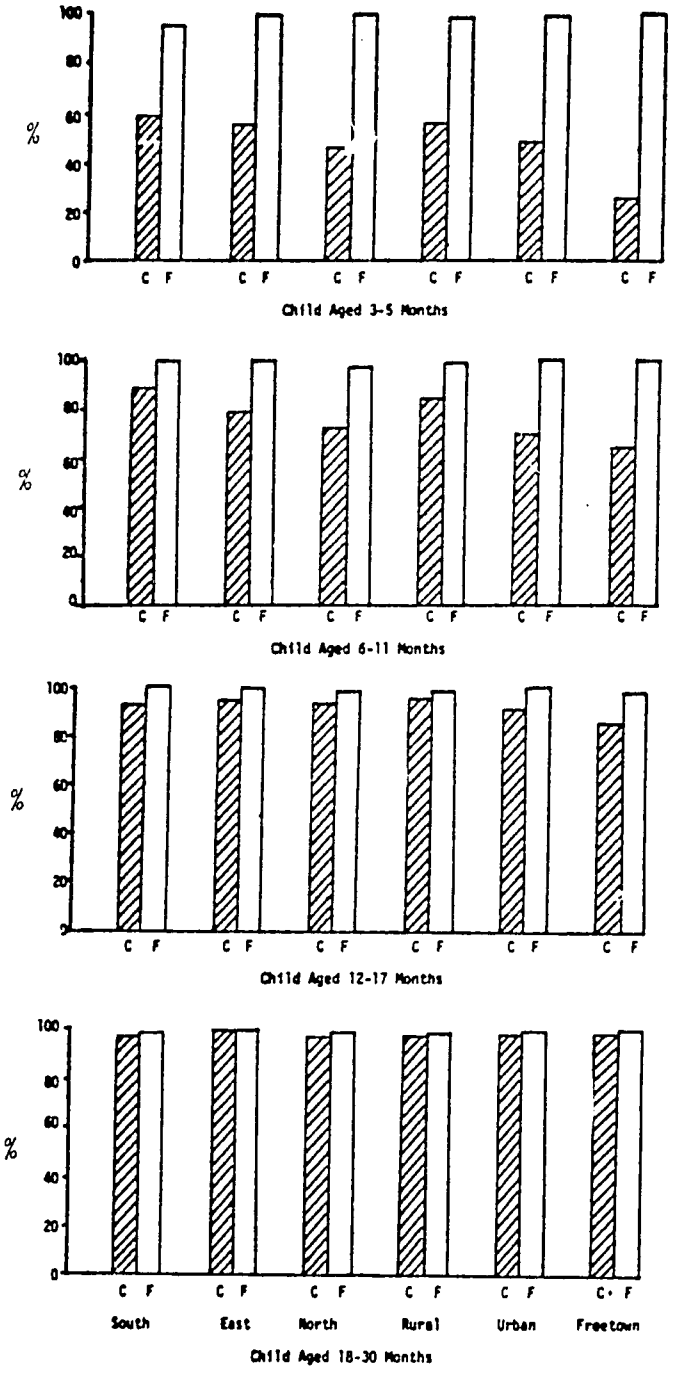


C=Child
F=Family

Note: The percentage figures indicate only what proportion of families and children received food from each group

FIGURE 11

CEREALS



C=Child
F=Family

FIGURE 12

VEGETABLE PROTEINS

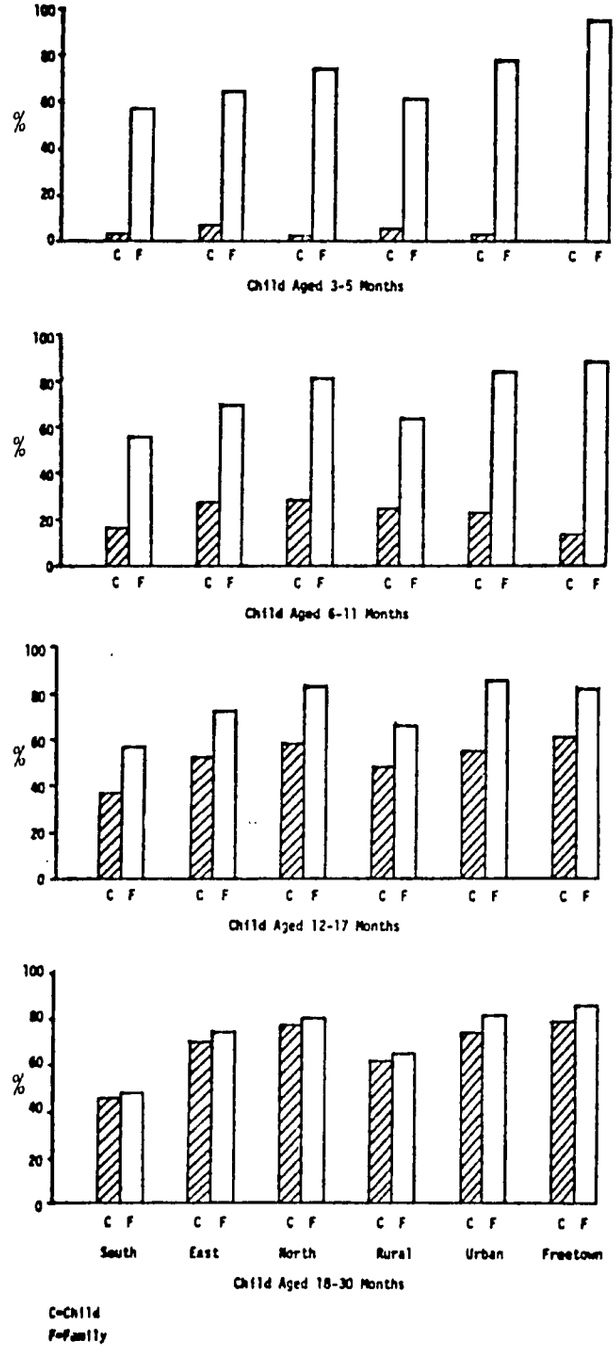
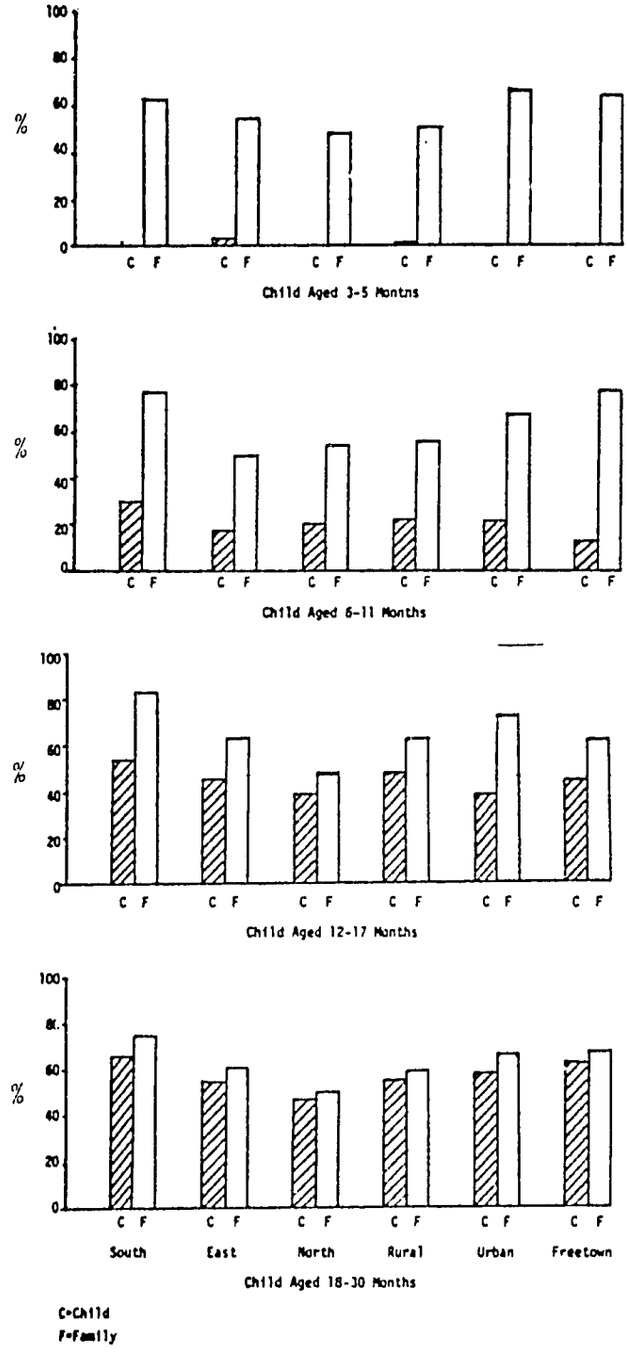


FIGURE .13

ANIMAL PROTEINS

FIGURE 14

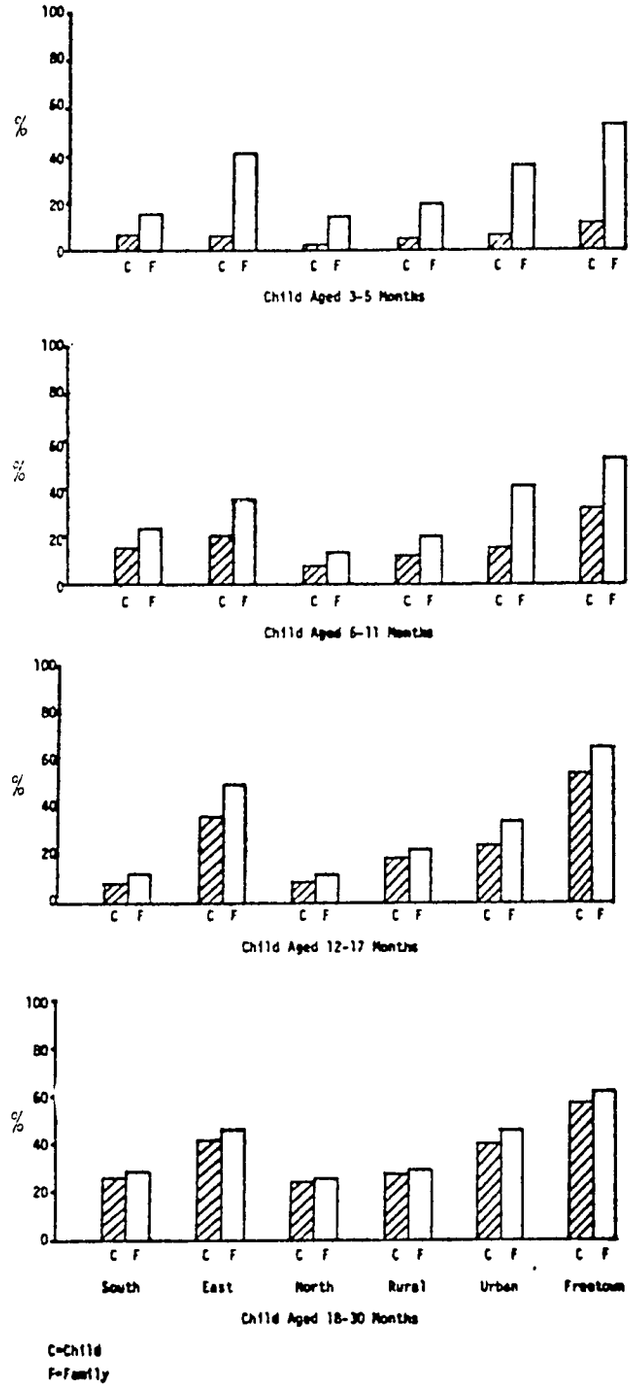
DARK GREEN LEAFY VEGETABLES



C=Child
F=Family

FIGURE 15

FRUITS



C=Child
F=Family

FIGURE 16
OILS

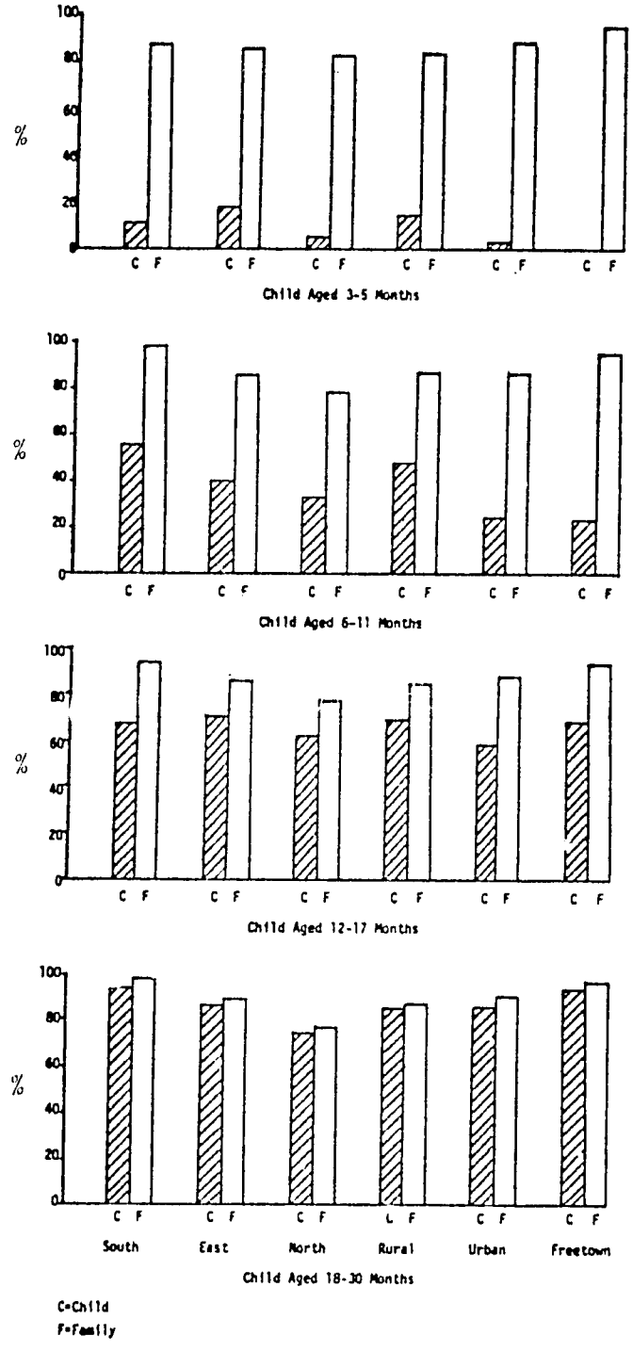
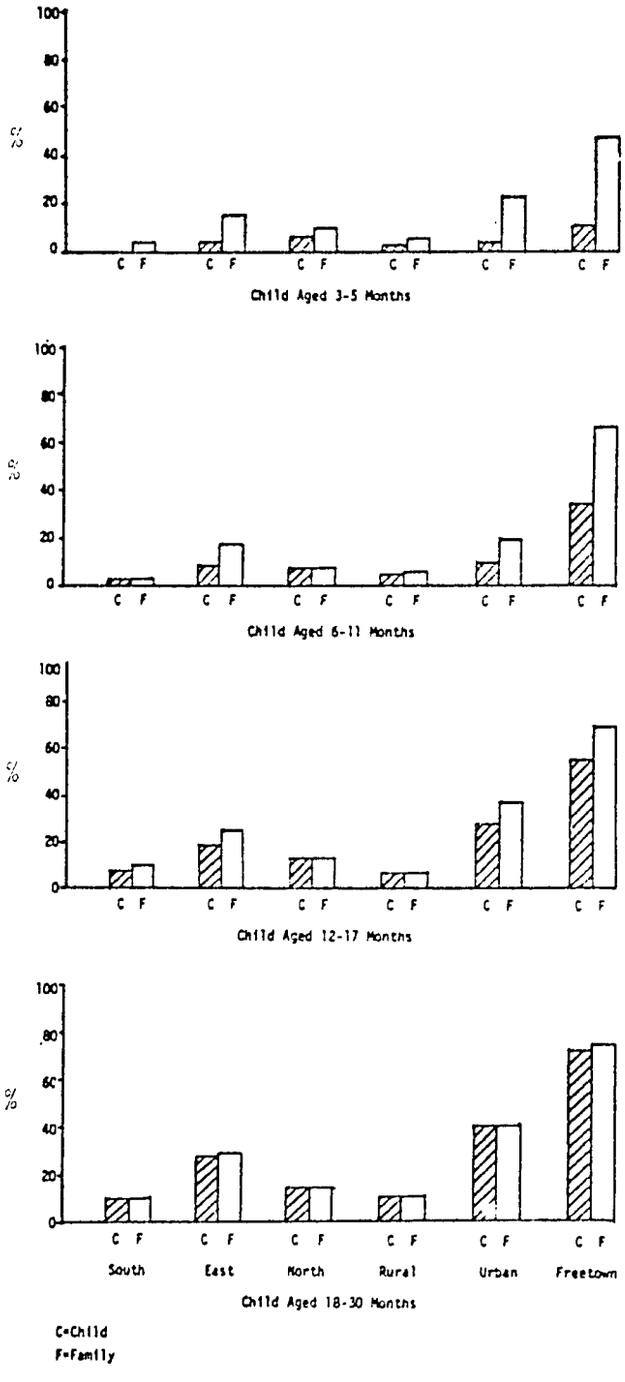


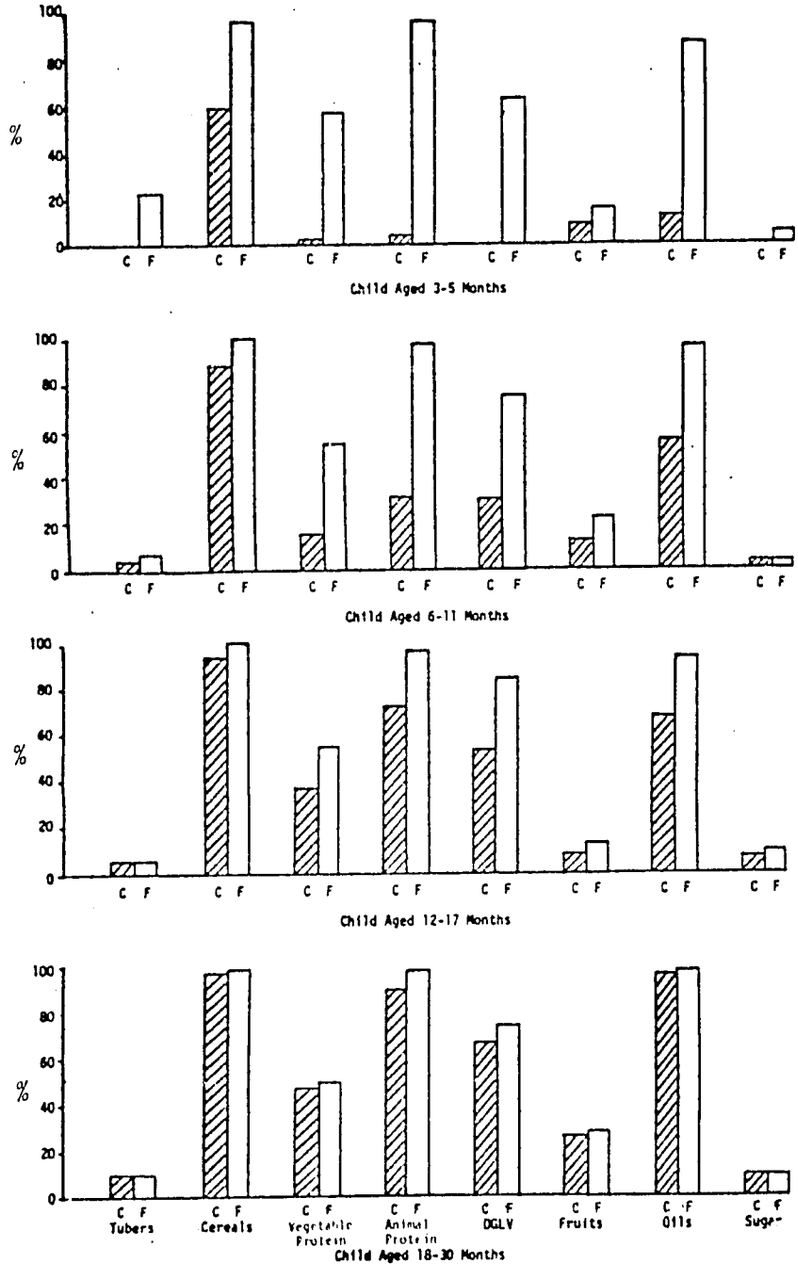
FIGURE 17
SUGAR/SWEETS



C=Child
F=Family

FIGURE 18

SOUTHERN PROVINCE

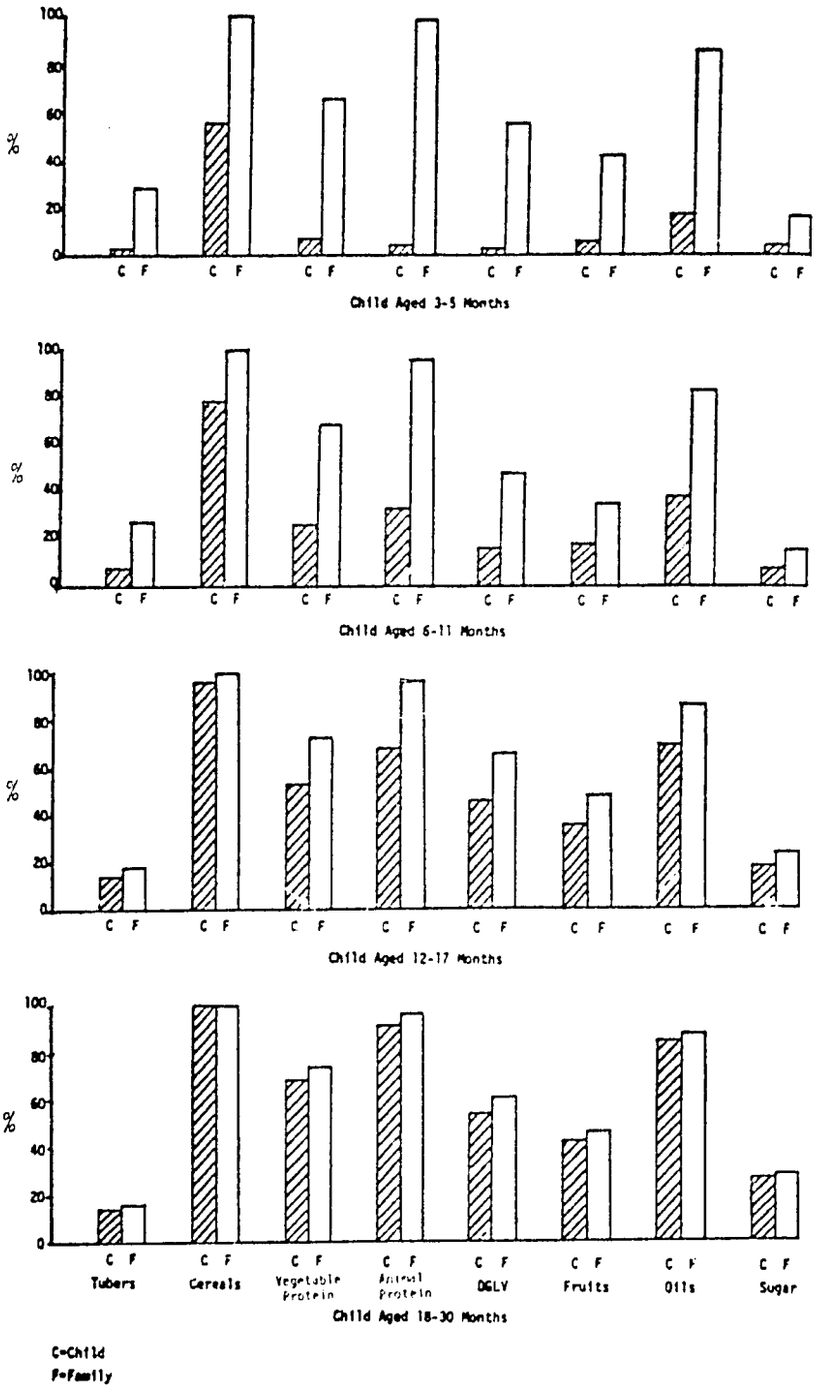


C=Child

F=Family

FIGURE 19

EASTERN PROVINCE



C=Child
F=Family

FIGURE 20

NORTHERN PROVINCE

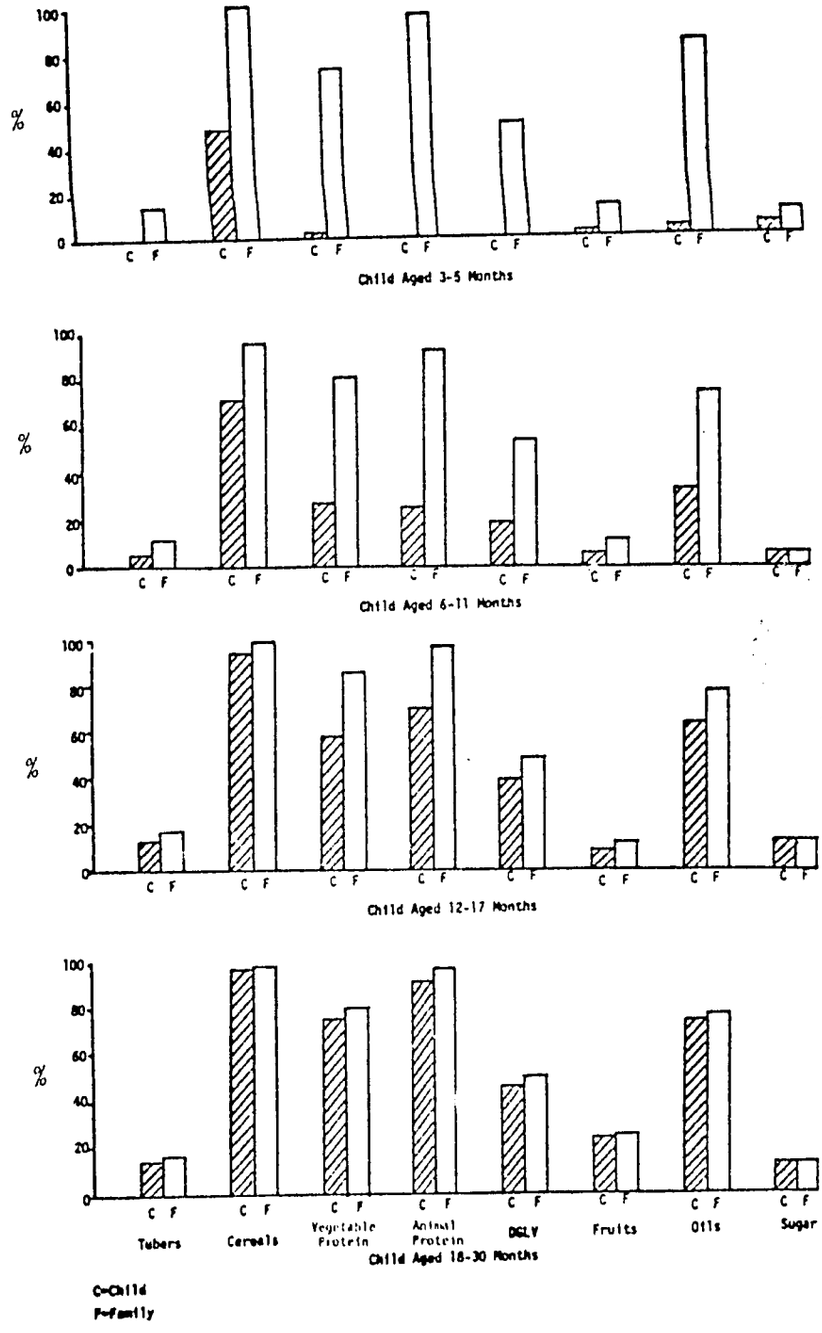


FIGURE 21

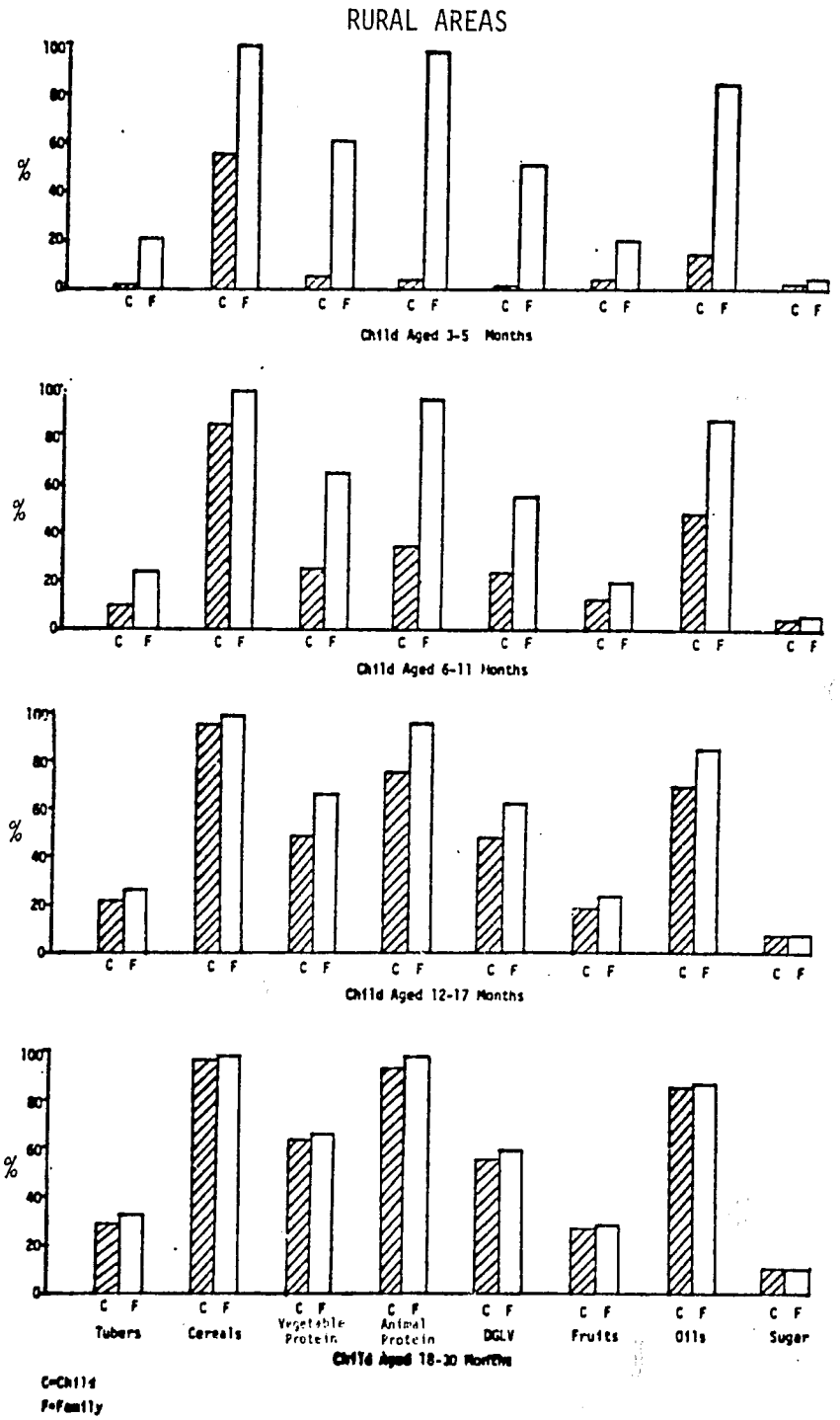

RURAL AREAS
%
100
80
60
40
20
0
C F
Child Aged 3-5 Months
Child Aged 6-11 Months
Child Aged 12-17 Months
Child Aged 18-30 Months
Tubers
Cereals
Vegetable Protein
Animal Protein
DGLV
Fruits
Oils
Sugar
C=Child
F=Family

FIGURE 22

URBAN AREAS

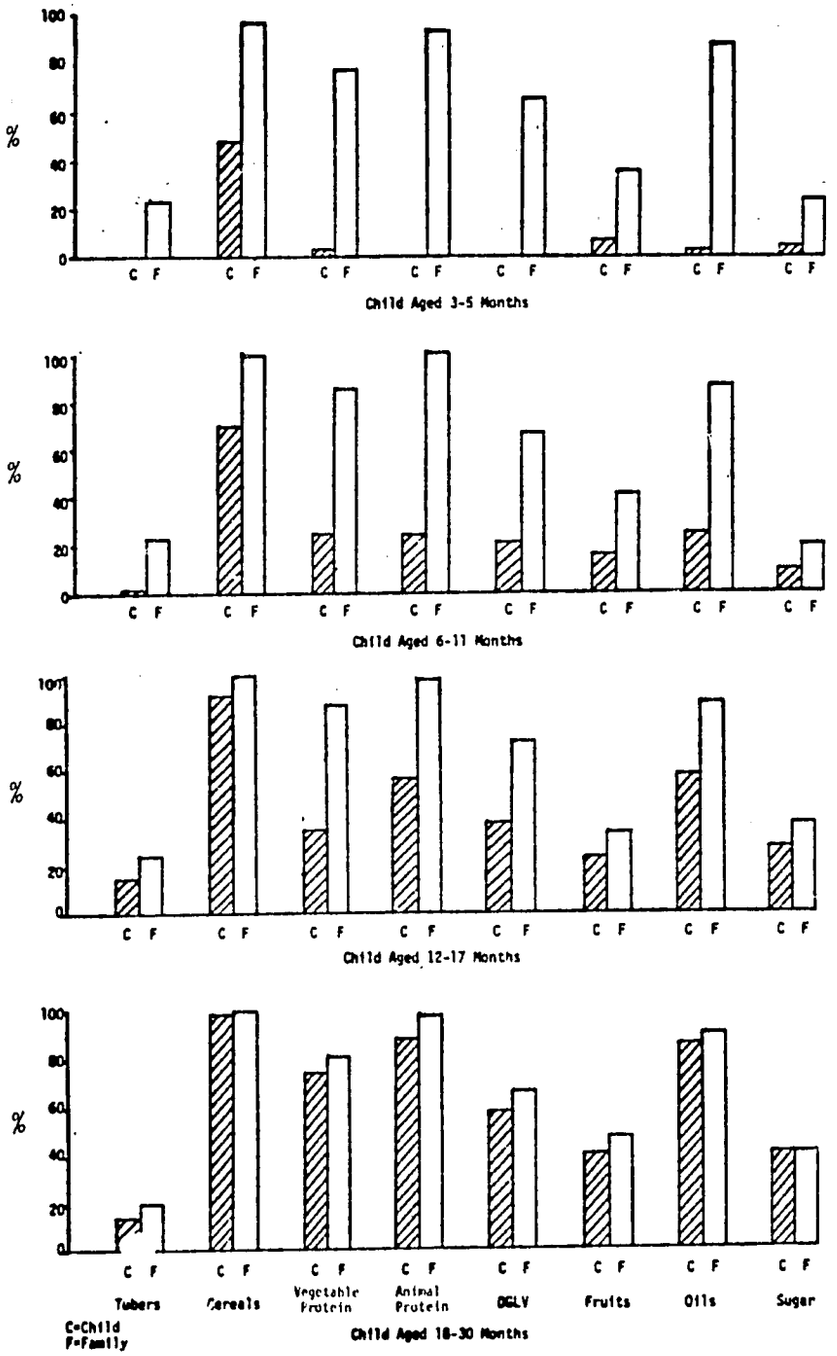
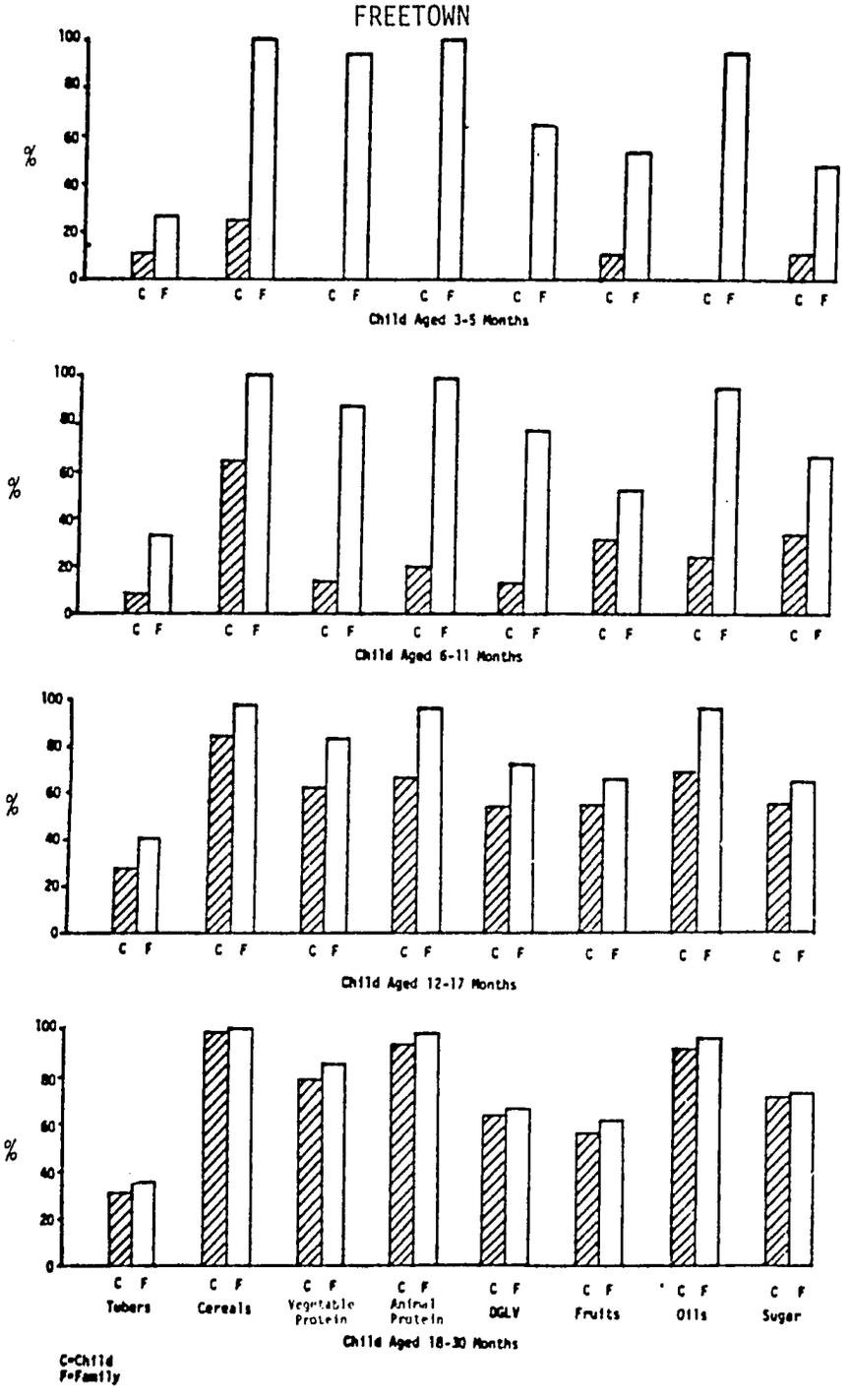


FIGURE 23

FREETOWN



DISCUSSION

The determination of an adequate diet for a group (as well as an individual) by qualitative methods is somewhat arbitrary. Ideally every family should be having a daily mixed diet consisting of a staple (cereal preferably), other vegetable protein, animal protein, DGLV, fruits and oils. However, the questions arise not when one tries to determine the ideal, but when one tries to evaluate what is adequate or inadequate.

To assess the diets of children and families in the given areas, the 60% level was chosen as the cut-off point. This is to say that if a food group was consumed in less than 60% of the cases involved, then it was not considered as being widely consumed. This may or may not be nutritionally significant depending on what happens with the other food groups. The most notable example is the tubers. Their low consumption is usually more than offset by the high consumption of the cereal staples.

The following food groups are listed along with the area in which the consumption by families (and the availability to the child) was relatively low. The percentage of families eating the particular foods are included. (see also Table 69, page 107).

Tuber -- all areas - 35%, lowest in the North (15%)
Vegetable Protein -- South (53%)
DGLV -- North (51%), East (58%)
Fruit -- All areas, lowest in North (18%) and South (22%)
Sugar/Sweets -- All areas except Freetown (Sugar does not appear to be a major source of calories)

The following tables show the percentage of children in each

province who received a food from that group.

TABLE 70: CHILD CONSUMPTION OF FOOD GROUPS

Child 6-11 months	Percentage of Children Receiving Food From Group							
AREA	Tubers	Cereals	Veg. Pro.	Ani. Pro.	DGLV	Fruit	Oil	Sweets
South	13	89	17	31	30	14	56	2
East	9	79	28	34	18	30	40	9
North	4	72	27	27	20	7	32	7
Rural	10	83	25	33	22	12	48	5
Urban	1	70	23	23	21	17	24	10
Freetown	9	64	20	20	13	31	23	33
Child 12-17 months								
South	22	92	38	72	53	9	68	8
East	20	95	52	66	46	37	70	19
North	14	93	58	68	39	9	62	13
Rural	21	95	48	73	48	19	69	7
Urban	16	91	55	57	38	23	58	38
Freetown	28	84	61	66	53	54	68	53

With the exception of cereals, no food group was consumed by over 60% of the children aged 6-11 months. In the 12-17 month tubers, DGLV and fruits were consumed by less than 60% of the children. Vegetable proteins were also consumed by less than 60% except in Freetown. Cereals, animal protein and oils were consumed by more than 60% of all children in each province.

The second and third six months of a child's life are nutritionally critical periods. After the first six months, breast milk alone is no longer sufficient to sustain normal growth and develop-

ment. At that time, new foods must be introduced into the child's diet, and in order to insure that all the nutrients are being consumed, as great a variety of foods as possible should be given. From the dietary results presented, it is obvious that many children under 18 months, especially those 6-12 months, are receiving an inadequate diet.

A child's intake of food is dependent upon two factors:

1) Food availability -- based on family intake
2) Food distribution -- determined by which and how much of the family's foods are given to the child.

If a food is not usually in a family's diet - because it is either not grown or too expensive or is a taboo - then it is not likely to be given to the child. It is unavailable, and no improvement in the child's intake is likely to occur until it becomes available to the family. On the other hand, if a family's intake of a food is high and the child's intake is low, then a change in the intra-family distribution could make a considerable improvement in the child's intake. Often to increase a child's intake of a food, improvements in both the availability and distribution of the food are required.

Intra-family distribution of food may be evaluated by the child-family differences, or deficits (see page 106), in the rates of intake, or by use of child-family distribution ratio (D.R.).

The results for the deficit for all food groups have been presented (see histograms). A low deficit generally indicates that the children received the food almost as often as their families, a high deficit that children infrequently had the food compared with their families.

A further concept describing the degree of distribution within the family is the child/family distribution ratio (D.R.), which may be expressed as a percentage.

D.R. = $^{A}/_{B}$ x 100 (see page 106), where A and B are the same described in the prior formula.

The distribution ratio complements the child-family deficit. While the deficit is the absolute percentage difference between the percentage of children receiving a food compared with the family receiving, the ratio is the proportion of these child/family results. The higher the ratio results the more children received that food when their families had it. Table 71 presents the average distribution ratio throughout Sierra Leone for each food group by child age. A more complete table of the distribution ratios is in Appendix VII.

TABLE 71

CHILD/FAMILY DISTRIBUTION RATIOS FOR FOOD GROUPS BY AGE - SIERRA LEONE

Age	Distribution Ratios as a Percentage						
	Tuber	Cereal	Veg. Pro.	Ani. Pro.	DGLV	Fruit	Oils
6-11 months	35	77	33	30	35	56	44
12-17 months	71	93	70	71	73	76	77

Cereals are the most widely shared foods in both age groups. Fruits are the foods most widely shared with 6-11 month old children (56% country-wide) followed by the oils (44%). The distribution rates for the other food groups average between 30-35%.

These figures rise sharply to between 70-77% for the 12-17 month groups. These clearly show that much can be done, especially in the 6-17 month group, to increase the children's food intake by improving the distribution within the families.

9.3 DIETARY VARIETY INDEX

The variety of a diet may be indicated by the number of food groups represented in that diet. If all the foods eaten are from one or two groups, the variety is poor. If, on the other hand, one or more foods from several groups are consumed, then the variety is quite good. Based on this, a variety index can be established that scores one point for each food group represented in a diet. A monotonous diet will receive a low score and a varied diet a high one.

Each of the food groups listed below are represented in the scoring system. A score from 0 to 11 is possible. The average number of food groups consumed by the subjects in an area is expressed as the mean score. In the tables showing the distributions of the variety index scores in each area of the country, the mode score (representing the number of food groups most frequently consumed in that area) is underlined.

This qualitative assessment method cannot be used to determine the nutrient content of a diet. Its usefulness is based on the assumption that a more varied diet is more likely to provide all the required nutrients than is a less varied diet.

FOOD GROUPS USED IN DIETARY SCORES

Tuber, Roots and Starchy Fruit	Commercial Weaning Food
Cereals	Dark Green Leafy Vegetables
Vegetable Protein (Beans, Seeds, Nuts)	Fruit
Animal Protein	Oils
Breast Milk	Sugars/Sweets
Other Milk	

VARIETY SCORES - FAMILIES

The mean score and the distribution of the variety index scores for families in each area of the country is given in Table 72.

TABLE 72: VARIETY SCORES - FAMILIES

AREA	N	Percentage of families consuming foods from the following number of groups							Mean Score
		1	2	3	4	5	6	7+	
South	330	0.3	0.6	5.8	33.3	42.4	13.9	3.7	4.7
East	403	0.0	0.7	10.9	26.5	31.3	18.9	11.7	4.9
North	381	0.5	1.3	18.9	36.2	32.3	8.4	2.4	4.3
Rural	837	0.4	1.2	14.2	35.0	34.3	12.1	2.8	4.5
Urban	293	0.0	0.0	5.5	22.5	37.2	19.1	15.7	5.2
Freetown	248	0.4	0.4	3.2	10.1	21.8	33.1	31.0	5.9

The most varied diets are consumed in Freetown. Almost 65% of the families interviewed in Freetown consumed diets representing six or more food groups. In the rural areas, less than 15% of the families consumed food from that number of groups. The least varied diets were consumed in the Northern Province.

VARIETY SCORES - CHILDREN

Based on the mean scores, children in the North in both age groups had the least variety in their diets. Children in Freetown had by far the most. In each area, the mean dietary scores of the children aged 12-17 months is similar to that of the families.

TABLE 73: VARIETY SCORES - CHILDREN

AREA	Percentage of children consuming foods from the following number of groups							Mean Score
	1	2	3	4	5	6	7+	
6-11 months								
South	5.4	23.7	31.2	6.4	14.0	11.8	7.5	3.4
East	12.4	20.0	24.8	11.4	12.4	12.4	6.6	3.6
North	22.5	30.6	12.2	6.1	15.3	11.2	2.1	3.0
Rural	13.7	21.6	23.8	7.9	16.7	11.0	5.3	3.5
Urban	14.3	34.2	18.5	8.6	4.3	14.2	5.9	3.5
Freetown	6.6	24.6	21.3	22.9	4.9	4.9	14.8	3.8
12-17 months								
South	7.9	15.9	3.2	12.7	19.0	30.2	11.1	4.6
East	2.5	6.4	13.9	6.3	19.0	32.9	19.0	5.1
North	7.5	10.4	6.5	14.3	33.7	19.5	7.8	4.4
Rural	5.1	9.6	5.7	12.7	28.7	28.0	10.2	4.6
Urban	7.5	11.9	13.4	7.5	16.4	23.9	19.4	4.7
Freetown	3.6	1.8	7.3	9.1	7.3	21.8	49.1	6.1

DISCUSSION

Both the mean and mode scores for the families and older children suggest that dietary variety was greatest in Freetown, followed by the urban areas, and least in the rural areas. This correlates with the same general ranks of areas by nutritional status, with Freetown having the least prevalence of undernutrition and the rural area the highest.

Though these results tend to indicate the usefulness of comparing dietary patterns of different groups, there are several limitations in attempting to relate these variety scores to an individual's nutritional status. This is particularly true for a young child. For example, nothing is more nutritious than a diet of breast milk - nor less varied.

Only in the age group 12-17 months was a positive association found between variety scores and nutritional status i.e. children with a high variety score tended to have a lower prevalence rate of undernutrition (Table 74). No consistent relationship was found in the age groups 3-5, 6-11, and 18-30 months of diet scores with the prevalence rates for acute undernutrition (under 80% weight-for-height), chronic undernutrition (under 90% height-for-age), underweight (under 80% weight-for-age) and arm wasting (under 82.5% arm circumference-for-age).

TABLE 74 DIETARY VARIETY AND NUTRITIONAL STATUS (12-17 Months)

		Percentage of Children Undernourished			
Variety Score	Sample Size	Acute W/H<80%	Chronic H/A<90%	Underweight W/A < 80%	Arm Wasting AC/A<82.5%
1-2	39	17.5	25.6	46.1	25.0
3-4	52	13.5	26.9	34.6	27.4
5	59	10.0	20.3	51.7	26.7
6	72	5.6	12.5	43.1	27.8
7+	55	5.4	9.1	23.6	12.7
TOTAL	277	9.6	18.0	39.9	24.1

These results do not mean that the importance of dietary variety is restricted to the 12-17 month group, as other factors must also be considered. These include such things as the quantity of foods eaten, as well as non-dietary factors such as health which also affect nutritional status.

When a milder degree of acute undernutrition was considered (under 85% weight-for-height) a positive association was found for all ages (Table 75). The variety scores were categorized in each age group to take into account sample sizes.

TABLE 75 PERCENTAGE MILD ACUTE UNDERNUTRITION ACCORDING TO VARIETY SCORES

Age Group Months	Variety Score	Sample Size	% Mild Acute Undernutrition
3-5	1-2	118	5.1
	3+	39	0.0
6-11	1-2	133	14.3
	3+	223	7.6
12-17	1-4	91	22.0
	5+	186	15.1
18-30	1-5	306	10.1
	6+	267	6.4

*<85% weight-for-height

The fact that such associations were found with recent, rather than chronic undernutrition in all age groups, suggests that the variety scores probably relate to more recent, as opposed to long term, events.

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

SOUTHERN PROVINCE

Child Aged 3-5 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Food Groups				
Tubers	0	22	22	0
Cereals	59	95	95	62
Vegetable Protein	3	57	57	5
Animal Protein	5	97	97	5
Breast Milk	100	-	-	-
Other Milk	33	3	33	100
Commercial Weaning	5	0	5	100
Dark Green Leafy Veg.	0	62	62	0
Fruits	8	11	16	50
Oils	11	87	87	13
Sugar/Sweets	0	3	3	0
Child Aged 6-11 Months				
Food Groups				
Tubers	13	31	32	41
Cereals	89	98	100	89
Vegetable Protein	17	55	56	30
Animal Protein	31	99	99	31
Breast Milk	98	-	-	-
Other Milk	13	0	13	100
Commercial Weaning	2	0	2	100
Dark Green Leafy Veg.	30	77	77	39
Fruits	14	19	23	61
Oils	56	97	98	57
Sugar/Sweets	2	0	2	100

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

SOUTHERN PROVINCE

Child Aged 12-17 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Food Groups				
Tubers	22	29	32	69
Cereals	92	100	100	92
Vegetable Protein	38	54	57	67
Animal Protein	72	95	97	74
Breast Milk	87	-	-	-
Other Milk	8	5	10	80
Commercial Weaning	0	0	0	-
Dark Green Leafy Veg.	53	81	83	64
Fruits	9	6	12	75
Oils	68	93	93	73
Sugar/Sweets	8	7	10	80
Child Aged 18-30 Months				
Food Groups				
Tubers	39	39	42	93
Cereals	98	97	99	99
Vegetable Protein	46	49	49	94
Animal Protein	90	99	99	90
Breast Milk	33	-	-	-
Other Milk	5	3	5	100
Commercial Weaning	1	0	1	100
Dark Green Leafy Veg.	67	74	74	91
Fruits	26	20	28	93
Oils	93	97	97	96
Sugar/Sweets	10	6	10	100

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

EASTERN PROVINCE

Child Aged 3-5 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Food Groups				
Tubers	2	27	29	7
Cereals	55	98	100	55
Vegetable Protein	8	61	63	13
Animal Protein	4	98	98	4
Breast Milk	100	-	-	-
Other Milk	22	6	24	92
Commercial Weaning	6	0	6	100
Dark Green Leafy Veg.	2	55	55	4
Fruits	6	39	41	15
Oils	18	85	85	21
Sugar/Sweets	3	15	16	19
Child Aged 6-11 Months				
Food Groups				
Tubers	9	28	29	31
Cereals	79	100	100	79
Vegetable Protein	28	69	70	40
Animal Protein	34	97	97	35
Breast Milk	98	-	-	-
Other Milk	20	9	23	87
Commercial Weaning	4	0	4	100
Dark Green Leafy Veg.	18	50	50	36
Fruits	20	29	37	54
Oils	40	82	85	47
Sugar/Sweets	9	15	18	60

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

EASTERN PROVINCE

Child Aged 12-17 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Food Groups				
Tubers	20	24	28	71
Cereals	95	99	100	95
Vegetable Protein	52	69	72	72
Animal Protein	66	95	95	69
Breast Milk	91	-	-	-
Other Milk	10	7	11	91
Commercial Weaning	4	0	4	100
Dark Green Leafy Veg.	46	63	66	70
Fruits	37	41	49	76
Oils	70	82	86	81
Sugar/Sweets	19	20	25	76
Child Aged 18-30 Months				
Tubers	25	26	30	83
Cereals	100	99	100	100
Vegetable Protein	70	73	74	95
Animal Protein	93	97	98	95
Breast Milk	44	-	-	-
Other Milk	12	10	12	100
Commercial Weaning	0	0	0	-
Dark Green Leafy Veg.	56	61	61	92
Fruits	42	32	46	91
Oils	86	87	89	97
Sugar/Sweets	28	20	29	97

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

NORTHERN PROVINCE

Child Aged 3-5 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Food Groups				
Tubers	0	14	14	0
Cereals	47	100	100	47
Vegetable Protein	2	71	73	3
Animal Protein	0	94	94	0
Breast Milk	100	-	-	-
Other Milk	12	0	12	100
Commercial Weaning	4	2	6	67
Dark Green Leafy Veg.	0	49	49	0
Fruits	2	12	14	14
Oils	4	82	82	5
Sugar/Sweets	6	4	10	60
Child Aged 6-11 Months				
Food Groups				
Tubers	4	11	11	36
Cereals	72	98	98	73
Vegetable Protein	29	80	81	36
Animal Protein	27	95	96	28
Breast Milk	100	-	-	-
Other Milk	5	0	5	100
Commercial Weaning	1	0	1	100
Dark Green Leafy Veg.	20	53	54	37
Fruits	7	11	13	54
Oils	32	78	79	41
Sugar/Sweets	7	0	7	100

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

NORTHERN PROVINCE

Child Aged 12-17 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio (%)
Food Groups				
Tubers	14	18	19	74
Cereals	93	99	99	94
Vegetable Protein	58	82	83	70
Animal Protein	68	97	97	70
Breast Milk	94	-	-	-
Other Milk	2	0	2	100
Commercial Weaning	0	0	0	-
Dark Green Leafy Veg.	39	48	48	81
Fruits	9	11	12	75
Oils	62	77	78	79
Sugar/Sweets	12	6	12	100
Child Aged 18-30 Months				
Food Groups				
Tubers	14	15	16	87
Cereals	97	98	99	98
Vegetable Protein	77	80	80	96
Animal Protein	91	97	97	94
Breast Milk	40	-	-	-
Other Milk	4	1	4	100
Commercial Weaning	0	1	1	0
Dark Green Leafy Veg.	47	49	50	94
Fruits	24	17	25	96
Oils	74	77	77	96
Sugar/Sweets	13	5	13	100

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

RURAL

Child Aged 3-5 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio(%) (4)
Food Groups				
Tubers	1	20	21	5
Cereals	56	98	99	57
Vegetable Protein	5	60	61	8
Animal Protein	4	98	98	4
Breast Milk	100	-	-	-
Other Milk	16	1	16	100
Commercial Weaning	4	0	4	100
Dark Green Leafy Veg.	1	51	51	2
Fruits	4	18	20	20
Oils	14	83	83	17
Sugar/Sweets	3	2	5	60
Child Aged 6-11 Months				
Food Groups				
Tubers	10	24	24	42
Cereals	83	98	99	84
Vegetable Protein	25	64	64	39
Animal Protein	33	96	96	34
Breast Milk	99	-	-	-
Other Milk	8	0	8	100
Commercial Weaning	1	0	1	00
Dark Green Leafy Veg.	22	56	56	39
Fruits	12	16	20	60
Oils	48	84	87	55
Sugar/Sweets	5	2	6	83

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

RURAL

Child Aged 12-17 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio(%) (4)
Food Groups				
Tubers	21	25	27	78
Cereals	95	99	99	96
Vegetable Protein	48	65	66	73
Animal Protein	73	94	95	77
Breast Milk	95	-	-	-
Other Milk	5	2	5	100
Commercial Weaning	0	0	0	-
Dark Green Leafy Veg.	48	61	62	77
Fruits	19	17	23	83
Oils	69	83	84	82
Sugar/Sweets	7	4	7	100
Child Aged 18-30 Months				
Food Groups				
Tubers	29	29	32	90
Cereals	98	98	99	99
Vegetable Protein	62	64	64	97
Animal Protein	93	98	98	95
Breast Milk	43	-	-	-
Other Milk	3	2	3	100
Commercial Weaning	0	0	0	-
Dark Green Leafy Veg.	55	59	59	93
Fruits	28	19	29	97
Oils	84	87	86	98
Sugar/Sweets	10	5	10	100

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

URBAN

Child Aged 3-5 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio(%) (4)
Food Groups				
Tubers	0	24	24	0
Cereals	49	98	98	50
Vegetable Protein	2	76	78	3
Animal Protein	0	93	93	0
Breast Milk	100	-	-	-
Other Milk	34	10	39	87
Commercial Weaning	7	2	9	78
Dark Green Leafy Veg.	0	66	66	0
Fruits	7	31	36	19
Oils	2	88	88	2
Sugar/Sweets	4	22	24	17
Child Aged 6-11 Months				
Food Groups				
Tubers	1	21	22	5
Cereals	70	100	100	70
Vegetable Protein	23	81	84	27
Animal Protein	23	100	100	23
Breast Milk	97	-	-	-
Other Milk	29	12	32	91
Commercial Weaning	7	0	7	100
Dark Green Leafy Veg.	21	68	68	31
Fruits	17	35	41	41
Oils	24	87	87	28
Sugar/Sweets	10	16	20	50

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

URBAN

Child Aged 12-17 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio(%) (4)
Food Groups				
Tubers	16	19	25	64
Cereals	91	100	100	91
Vegetable Protein	55	80	86	64
Animal Protein	57	99	99	58
Breast Milk	82	-	-	-
Other Milk	14	10	17	82
Commercial Weaning	4	0	4	100
Dark Green Leafy Veg.	38	70	71	54
Fruits	23	26	33	70
Oils	58	85	88	66
Sugar/Sweets	28	28	37	76
Child Aged 18-30 Months				
Food Groups				
Tubers	15	18	20	75
Cereals	99	98	100	99
Vegetable Protein	73	81	81	90
Animal Protein	88	98	98	90
Breast Milk	28	-	-	-
Other Milk	20	14	20	100
Commercial Weaning	2	0	2	100
Dark Green Leafy Veg.	58	66	66	88
Fruits	40	34	46	87
Oils	85	89	90	94
Sugar/Sweets	40	27	40	100

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

FREETOWN

Child Aged 3-5 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio(%) (4)
Food Groups				
Tubers	11	16	27	42
Cereals	26	100	100	26
Vegetable Protein	0	95	95	0
Animal Protein	0	100	100	0
Breast Milk	95	-	-	-
Other Milk	68	26	73	93
Commercial Weaning	5	0	5	100
Dark Green Leafy Veg.	0	63	63	0
Fruits	11	42	53	21
Oils	0	95	95	0
Sugar/Sweets	11	48	48	23
Child Aged 6-11 Months				
Food Groups				
Tubers	9	25	32	28
Cereals	64	98	100	64
Vegetable Protein	13	88	88	15
Animal Protein	20	99	99	20
Breast Milk	92	-	-	-
Other Milk	59	25	59	100
Commercial Weaning	21	0	21	100
Dark Green Leafy Veg.	13	77	77	17
Fruits	31	36	52	60
Oils	23	95	95	24
Sugar/Sweets	33	54	67	49

PERCENTAGE FREQUENCY INTAKE OF FOOD GROUPS

FREETOWN

Child Aged 12-17 Months	Percentage of times eaten by: Child (1)	Rest of Family (2)	Child &/or Family (3)	Child/ Family Ratio(%) (4)
Food Groups				
Tubers	28	36	41	68
Cereals	84	94	98	86
Vegetable Protein	61	82	82	74
Animal Protein	66	94	96	69
Breast Milk	79	-	-	-
Other Milk	29	22	40	72
Commercial Weaning	23	0	23	100
Dark Green Leafy Veg.	53	69	71	76
Fruits	54	36	65	83
Oils	68	93	93	73
Sugar/Sweets	53	46	68	78
Child Aged 18-30 Months				
Food Groups				
Tubers	31	24	34	91
Cereals	99	100	100	99
Vegetable Protein	79	83	85	93
Animal Protein	93	98	98	95
Breast Milk	16	-	-	-
Other Milk	41	34	42	98
Commercial Weaning	11	1	11	100
Dark Green Leafy Veg.	62	64	67	93
Fruits	57	38	61	93
Oils	92	95	90	85
Sugar/Sweets	71	58	73	97

APPENDICES

APPENDIX I. SURVEY DESIGN

A. Survey Sample Size

The method of determining sample size presented here very closely follows the method used by the Center for Disease Control, Atlanta, Georgia.

Some of the key factors which determine sample size include:

1. Available financial, personnel and physical resources.
2. Constraints such as time and logistical problems affecting the survey in the field, particularly transport.
3. Nature of the sample distribution assumed applicable.
4. The extent and depth of information desired.
5. Precision desired for statistical estimates and the confidence level to be associated with them.

Considering the effect of these factors on the survey, 30 sampling units would allow an estimation of the portion of the population in an area having a characteristic provided the characteristic is not rare (less than 5%) or very sporadic in its distribution.

To determine the appropriate survey sample size for a geographic area, the following equation can be used if the sampling distribution of the estimated prevalence is approximately Gaussian (46).

$$n = \frac{K Z^2}{D^2} (p) (1 - p)$$

Z = normal deviate for confidence level desired (1.96 for 95% confidence and 1.64 for 90% confidence).

p = proportion of population having the attribute measured. This is determined by educated guess.

D = deviation from "p" due to sampling with confidence level chosen. The confidence limits for "p" would be $p \pm D$.

K = adjustment for "clustering effect."

Past experience with the Liberia National Nutrition Survey data regarding the proportion of children up to five years of age under the 90% reference median height for age has shown that K = 2 should allow for the clustering effect. The "Z" score is generally chosen for 95% confidence (Z = 1.96).

While the value of D can be predetermined, it depends on the value of p and may or may not be acceptable; for example, 50% ± 5% might be considered acceptable, but 10% ± 5% might not.

The value of p yielding the largest n is .5, so if a number of different attributes are to be measured for the universe, it is usally safest to assume p = .5. After fixing K, Z and p; n and D are the only values not determined.

By determining maximum deviation tolerable (D) equal to 4.6%, n can be solved for as follows:

$$K = 2 \text{ (cluster effect)}$$
$$Z = 1.96 \text{ (95\% confidence)}$$
$$p = .5 \text{ (50\%)}$$
$$D = .046 \text{ (4.6\%)}$$
$$n = \frac{2\,(1.96)^2}{(.046)^2}\,(.5)\,(.5)$$
$$n = 900$$

Thirty children were drawn using a random start technique within each selected unit. A total sample of 900 children (30 sample units x 30 children) with proportions having a characteristic varying as follows would have the following approximate precisions:

% Having Characteristics	95% Confidence Limits
50.0%	± 4.6%
20.0% (80.0%)	± 3.7%
10.0% (90.0%)	± 2.8%

Predetermination of sample size does not predetermine precision of survey estimation. Some variables will have greater precision than predicted and others will have less. The precision estimates are in Appendix II.

B. Sample Selection

I. First Stage

(a) The universe sampled was the whole population of Sierra Leone, as defined by the 1974 Population Census. Samples were drawn from each province and the Western Area by urban, mining and rural strata.

(b) A random start and a fixed interval method for population proportional sampling was done for each stratum, using the Enumeration Area EA lists from the census. The Household Expenditure Survey selected their sites in this manner:

(1) The populations of all EAs for the stratum were progressively cumulated.

(2) The stratum total population was divided by the predetermined number of sample sites to obtain a sampling interval.

e.g. Total population of Northern Province Rural Areas = 1,043,544
Number of sites to be selected = 72
Sampling interval = $\frac{1,043,544}{72}$ = 14,494

(3) A random number was selected, within the range of the sampling interval (e.g. for North rural, a number from 1 to 14,494). This number identified the first Enumeration Area (or site) sampled.

(4) The sampling interval was added consecutively to the starting number to identify further EAs as sites until all sites were selected, up to the end of the cumulative total population.

(5) Other strata of the country (North Province capital, etc.) were sampled in the same way to select sites.

II. Subsample for Nutrition Survey

The list of EAs selected by the Household Survey for each strata was numbered from one to the last EA. Simple random sampling without replacement was done to select from these EAs a subsample for the Nutrition Survey. Subsampling ceased when the desired number of sites was reached.

III. Second Stage

In order to sample the children within the selected EAs, household head lists, recently compiled by the Household Survey, were used. That survey had numbered the households with chalk and noted on the list the precise location of each household. In Freetown and Provincial Capitals a street number for each household was also noted.

Note on the list was made of the total number of households with more than one member. All single member households were excluded from the lists, bearing in mind that it would be impossible for such a household to contain both a child under 5 years of age and a responsible adult. For each list in the sites for Freetown and the urban areas of Sierra Leone, two random numbers were selected (without replacement of the first) in order to choose the starting households for clusters of 15 children each. Once the first number (household) was selected, the second number could not fall within a predetermined range of households around that first household. This was to prevent overlapping of clusters.

Teams were instructed to visit the first selected household and continue down the list until 15 children were measured. Thence

they proceeded to the second starting household for the remaining 14 children. Any children encountered from new households not listed were included in the cluster. When the end of the list was reached before 15 children were measured, teams continued moving in the same direction, and selected the nearest remaining children within the EA. Maps with clearly marked EA boundaries were supplied to each team.

The same general procedure was followed for the rural areas of the country with some modification. Instead of two clusters of 15 children each, only one cluster of 30 was selected. This was based on constraints of time and resources; it would have been more difficult to reach two clusters, instead of one, among often widely separated households and villages in the rural areas.

Other modifications were also based on these same constraints. For example, if the initial village in a site contained 30 households, but only four appeared on the household list, a team would then begin at the selected random start and follow on down the list. However, upon completing the four households, instead of moving on to the next village listed, the team would continue sampling in that same village by selecting children from the nearest remaining households. If after visiting all the households in the first village they were still short of the required thirty children, they would then continue on down the list for the next village.

At times, the order in which villages within a site appeared on the household lists was not consistent with their geographical proximity. For example, village (1) and village (3) on the list may have been separated by only a mile; however, village (2) might have been on the same path, but could have been another six miles away. In a case like this, the teams would move in the direction of village (2), but sample from the nearest households encountered.

C. List of Survey Sites

The sites visited during the Survey are listed below by their Enumeration Area (EA) number. Information concerning the individual EA's may be obtained from the Central Statistic Office, Freetown.

Site Number	EA Number	Site Number	EA Number	Site Number	EA Number
1	3101-03	26	3107-22	51	0204-03
2	3101-05	27	3107-24	52	0205-12
3	3101-08	28	3107-30	53	0207-04
4	3101-14	29	3108-13	54	0209-05
5	3101-20	30	3108-26	55	0302-03
6	3101-26	31	3108-29	56	0302-11
7	3102-01	32	3108-33	57	0303-05
8	3102-05	33	3108-39	58	0304-03
9	3102-10	34	3203-09	59	0304-04
10	3103-02	35	3203-07	60	0304-19
11	3103-11	36	0102-12	61	0305-12
12	3103-19	37	0104-07	62	0306-17
13	3103-2	38	0104-21	63	0308-15
14	3103-22	39	0105-02	64	0310-05
15	3103-32	40	0105-21	65	0311-12
16	3104-06	41	0106-04	66	0312-03
17	3104-12	42	0107-15	67	0313-07
18	3104-18	43	0108-19	68	0402-01
19	3105-05	44	0108-30	69	0403-02
20	3105-15	45	0108-41	70	0404-12
21	3106-04	46	0109-03	71	0407-02
22	3106-16	47	0113-01	72	0408-03
23	3106-19	48	0114-01	73	0410-10
24	3107-11	49	0114-16	74	1102-01
25	3107-19	50	0202-06	75	1102-12

Site Number	EA Number
76	1106-10
77	1106-15
78	1109-02
79	1111-04
80	1111-10
81	1112-03
82	1201-04
83	1201-12
84	1204-01
85	1204-09
86	1205-03
87	1206-02
88	1208-06
89	1208-22
90	1208-37
91	1208-42
92	1212-09
93	1212-22
94	1212-36
95	1212-48
96	1214-09
97	1214-14
98	1215-08
99	1215-14
100	1216-07
101	1301-06
102	1303-01
103	1304-19
104	1305-15
105	1306-16
106	1307-04
107	1306-13
108	1308-06
109	1309-02
110	1309-35
111	1309-42
112	1310-12
113	1310-18
114	1311-04
115	1311-15
116	1311-25
117	1311-34
118	1312-12
119	1313-09
120	1313-15
121	1313-17
122	2101-24
123	2102-10
124	2102-11
125	2103-12
126	2106-05
127	2108-08
128	2108-18
129	2109-11
130	2110-09
131	2111-06
132	2112-15
133	2113-02
134	2202-05
135	2203-17
136	2205-01
137	2205-11
138	2206-28
139	2207-06
140	2304-07
141	2307-03
142	2307-10
143	2309-18
144	2311-02
145	2402-09
146	2404-04
147	2404-15
148	2406-22
149	2406-25
150	2407-08
151	2407-26
152	2407-42
153	2409-05
154	2501-05
155	2504-06
156	2504-17
157	2504-15
158	2506-05
159	2509-07
160	2510-07
161	2511-04
162	2511-15
163	2511-42

APPENDIX II PREVALENCE ESTIMATES AND PRECISIONS

Estimates of Mean Prevalence Rates With Confidence Intervals

Prevalence results from this sample survey are estimates of the true prevalence rates. The mean prevalence rate plus or minus a given value show the interval for which there is 95% confidence that the true prevalence rate will fall within the total range. This interval is derived from the standard error of mean values for each group of thirty children who are measured in a selected enumeration area or site.

The statistical formula for computing the 95% confidence interval for the true prevalence rate of a stratum or ecological area is based on a calculation of the standard error:

$$\text{Standard Error (S.E.)} = \frac{s_h}{\sqrt{n_h}}$$

(NOTE: The confidence interval includes $\pm$ 2 S.E.)

$$\text{where } s_h = \sqrt{\frac{\Sigma(x - \bar{x}_h)^2}{n_h - 1}}$$

s_h = Standard deviation of mean values of prevalence rates for groups of thirty children from selected enumeration areas.

and (1) n_h = Number of enumeration areas (sites) in the hth stratum.

(2) Σ = Summation is meant to be over the sites within s stratum

(3) x = Prevalence rate determined from thirty children within a site.

(4) $\bar{x}_h$ = The mean prevalence rate for the sum of all EAs in a stratum.

(5) h = Stratum number.

This estimate is based on a probability proportion sample chosen with replacement. Our sample was selected without replacement, so this is a conservative estimate of the Standard Error (Cochran,Sampling Techniques, Second Edition, Section 11.9, p.308).

The standard error of prevalence rates for combinations of strata such as for the whole of Sierra Leone is estimated by:

$$SE^2(\bar{x}_{st}) = \sum_{h=1}^{L} \frac{N_h^2}{N^2} \frac{s^2_h}{n_h}$$

where L is the number of strata

N_h is the population of the hth stratum

N is the total population of the L strata $N = \sum_{1}^{L} N_h$

s^2_h is the variance of the prevalence rates of the n_h sites.

$$\bar{X}_{st} = \sum_{1}^{L} \frac{N_h}{N} \bar{x}_h$$

The 95% confidence interval for the true prevalence for the population of Sierra Leonean children is

$$\bar{x}_{st} \quad +/- \ 2.0 \ S.E. \ (\bar{x}_{st}).$$

In table 15, page 38, for example, 25.8% of the children in the Southern Province were estimated to have chronic undernutrition. Based on the sample, the true prevalence rate was 25.8 +/- 3.9% i.e. 21.9% to 29.7% This range (21.9% to 29.7%) is the 95% confidence interval of the true prevalence rates for this measure.

Comparisons of Prevalence Estimates Between Areas

Statistically significant differences of prevalence estimates of nutritional status comparing certain parts of Sierra Leone are examined in this section. The formula for determining a 95% confidence interval for the difference is:

$$\mathcal{L}_1 = (\bar{x}_a - \bar{x}_b) - 2\sqrt{SE_a^2 + SE_b^2} \quad \text{and}$$

$$\mathcal{L}_2 = (\bar{x}_a - \bar{x}_b) + 2\sqrt{SE_a^2 + SE_b^2}$$

where:

$\bar{x}_a$ = the mean prevalence rate for area "a"
$\bar{x}_b$ = the mean prevalence rate for area "b"
SE_a^2 = the standard error of mean prevalence estimate for "a"
SE_b^2 = the standard error of mean prevalence estimate for "b"

If the range from the lower to the upper limit does not include zero, then the difference between the mean prevalence rates ($\bar{x}_a$ and $\bar{x}_b$) is statistically different from zero at the 0.05 level.

Table 17, page 40 compares the prevalence estimates between provinces. For example, there was no statistical difference between the North and South with regards to the prevalence of underweight. In this example,

$$\ell_1 = (32.7 - 33.4) - 2\sqrt{(1.55)^2 + (1.95)^2}$$

$$= -0.7 - 5.0 = -5.7$$

and $$\ell_2 = -0.7 + 5.0 = +4.3$$

The range -5.7 to 4.3 includes zero, therefore the difference between the mean prevalence rates (32.7 and 33.4%) is <u>not</u> statistically different from zero at the 0.05 level. In this example, the mean difference in rates was 0.7, but the range was -5.7 to +4.3.

An example showing a statistically significant difference from zero was the difference between the underweight prevalence for the South (33.4%) and East (26.0%) of 7.4%. The range of this difference at the 95% confidence interval using the ℓ_1 and ℓ_2 formula above, was 7.4 +/- 4.8; i.e. 12.2 to 2.6%, a relatively large difference.

In summary, allowance must be made for the sample variability of the estimate of the true difference in prevalence rates. Accordingly, the data are given as intervals rather than single point

estimates. In effect, we are 95% confident that the intervals presented (estimate +/- 2 S.E.) will contain the true prevalence difference.

UNDERNUTRITION PREVALENCE
ESTIMATES AND PRECISIONS

Area	% Chronic Undernutrition H/A<90%	2SE	Range	% Underweight W/A<80%	2SE	Range
South	25.8	3.9	21.8-29.6	33.4	3.9	29.5-37.3
East	23.7	2.8	20.8-26.4	26.0	2.8	23.2-28.8
North	24.9	3.4	21.5-28.3	32.7	3.1	29.6-35.8
Rural	26.6	2.2	19.1-23.5	32.4	2.1	30.4-34.6
Urban	17.4	3.1	14.2-20.4	24.3	3.7	20.5-27.9
Freetown	10.3	2.3	7.9-12.5	18.3	2.8	15.5-21.1
Sierra Leone	24.2	1.7	17.8-21.2	30.5	1.7	27.8-31.2

Area	% Acute Undernutrition W/H<80%	2SE	Range	% Acute (Mild) Undernutrition W/H<85%	2SE	Range
South	4.1	1.2	2.9-5.3	8.6	1.8	6.8-10.2
East	1.9	0.8	1.1-2.7	6.0	1.5	4.5-7.5
North	3.5	1.4	2.2-5.0	8.3	1.8	6.5-10.1
Rural	3.2	0.9	2.3-4.1	7.8	1.2	6.6-9.0
Urban	3.2	1.1	2.0-4.2	7.2	1.9	5.3-9.1
Freetown	1.6	0.8	0.8-2.4	5.5	1.8	3.7-7.3
Sierra Leone	3.0	0.7	2.3-3.7	7.5	0.9	6.6-8.4

UNDERNUTRITION PREVALENCE
ESTIMATES AND PRECISIONS

	% Low Arm Circumference/Age			% Low Fatfold/Age		
Area	AC/A<82.5%	2SE	Range	FF/A<60%	2SE	Range
South	19.2	2.6	16.6-21.8	42.8	8.1	34.7-50.9
East	12.0	2.0	10.0-14.0	36.5	5.0	31.5-41.5
North	16.1	2.7	13.4-18.8	40.6	6.3	34.3-46.9
Rural	16.4	1.7	14.7-18.1	40.3	4.3	36.0-44.6
Urban	12.0	2.9	9.1-14.9	40.2	7.5	32.7-47.7
Freetown	6.8	1.5	5.3-8.3	36.5	5.2	31.3-41.7
Sierra Leone	14.6	1.4	13.2-16.0	39.9	4.3	35.6-44.2

APPENDIX III PERCENTAGE FREQUENCY DISTRIBUTIONS OF ANTHROPOMETRIC INDICES

A. WEIGHT-FOR-HEIGHT: PERCENTAGE FREQUENCY DISTRIBUTIONS ACCORDING TO REFERENCE MEDIAN

	Percentages of Reference Median							
	<80	80-84.9	85-89.9	90-94.9	95-99.9	100-104.9	≥105	N
Rural	3.2	4.7	12.1	18.6	20.0	29.0	12.4	921
Urban	2.9	3.4	9.8	19.3	22.8	29.4	11.3	900
Freetown	1.6	3.8	11.8	17.8	21.8	30.6	12.6	968
Sierra Leone	3.0	4.5	12.0	18.5	20.4	29.2	12.4	4839
Special Group	0.3	3.0	8.1	20.1	21.0	35.7	11.7	357

B. HEIGHT-FOR-AGE: PERCENTAGE FREQUENCY DISTRIBUTIONS ACCORDING TO REFERENCE MEDIAN

	Percentages of Reference Median							
	<80	80-84.9	85-89.9	90-94.9	95-99.9	100-104.9	≥105	N
Rural	0.7	4.6	21.2	38.0	25.5	7.6	2.3	2928
Urban	0.2	1.9	15.3	40.2	29.1	11.1	2.1	952
Freetown	0.1	1.3	8.8	28.1	36.9	12.5	2.2	977
Sierra Leone	0.6	4.1	19.5	38.1	27.0	8.3	2.3	4857
Special Group	0.0	0.0	2.1	9.2	46.7	32.4	9.5	360

C. WEIGHT FOR AGE: PERCENTAGE FREQUENCY DISTRIBUTIONS ACCORDING TO REFERENCE MEDIAN

	Percentages of Reference Median									
	<60	60-69.9	70-74.9	75-79.9	80-84.9	85-89.9	90-99.9	100-109.9	≥ 110	N
Rural	1.9	7.3	8.8	14.6	16.1	15.7	21.5	9.7	4.4	>926
Urban	1.0	5.2	5.2	11.7	16.1	16.9	27.6	10.9	5.3	951
Freetown	0.6	2.1	5.0	10.2	15.1	18.3	30.3	12.1	6.3	973
Sierra Leone	1.7	6.6	8.2	14.0	16.0	16.1	22.8	10.1	4.6	4850
Special Group	0.0	0.0	0.9	3.6	7.4	11.9	36.8	26.4	13.1	361

APPENDIX IV. LOGISTICS AND PERSONNEL

A. General

Survey Schedule

Nov. 23-29, 1977	Training of Senior Personnel
Nov. 30-Dec.23	Training of Survey Teams
Dec. 28-Jan.17, 1978	Field Phase - Freetown/Reference
Jan. 18-Feb. 1	- Eastern Province
Feb. 2-Feb.23	- Northern Province
Feb. 24-Mar. 4	- Southern Province
Mar. 5-Mar.10	- Reference Population
Mar. 11-Mar.21	Final Editing, coding and key-punching by CSO, lab analysis

Survey Preparation

The initial weeks in Sierra Leone were spent both preparing for the training phase of the survey and ensuring that all appropriate government agencies as well as officials in the provinces were notified of the survey commencement.

Training

A one week training session was held for the senior personnel. During this time they were familiarized with the survey forms and were given the opportunity to practice measurement techniques both in the classroom and in the field.

Survey members were trained at the National School of Nursing. The co-directors and supervisors led the training which lasted for three and a half weeks. The schedule consisted of theoretical and practical training, individual reading of the training manual, group discussions, and assignments. The method of carrying out each anthropometric measurement was thoroughly explained, and practice sessions were held under the supervision of the senior personnel.

After several practice sessions, standardization exercises were carried out to assure the precision and validity of each teams measurements. Practice sessions were then held outside the School of Nursing at a local clinic. Upon completion of the training phase, field testing was done in a village just outside Freetown.

Personnel

The following is a list of survey personnel and their duties:

1. Co-directors

   One co-director was provided by UCLA Nutrition Assessment Unit and one by the Ministry of Health. They were responsible for planning and administering the survey, training the senior personnel and team members, handling the logistics and finances in the field, and preparing the report.

2. Senior Personnel

   Three senior personnel were provided by the Ministry of Health. Their duties were as follows:

   a. Accompany and supervise teams in the field.
   b. Check and edit all forms of the teams they supervised.
   c. Assist with procurement, movement and dispersion of supplies.
   d. Assist in planning team movements in each province.
   e. Ensure that the teams survey the correct villages.
   f. Handle any problems that might arise with local officials.

3. Team Members

   Ten teams were formed consisting of a team leader and an assistant. Their duties were as follows:

   a. Be responsible for all survey equipment and forms checked out to them.
   b. Select and survey the inhabitants in each EA.
   c. Edit all forms.

4. Laboratory Supervisor

   One lab supervisor was present in order to ensure that each lab tech had the proper supplies, and to check lab forms and techniques in the field to ensure that the lab work was being done properly.

5. Laboratory Technician

   Five lab techs accompanied the teams in the field. They collected all necessary lab samples. Samples were taken in half of the sites, and the sites to be sampled within each province were selected in a random manner.

Many others participated as a part of the support team necessary to keep the survey running smoothly. These people are listed under the participating organization to which they belonged.

Transportation

Ten vehicles and two motorcycles were supplied by the Ministry of Health and the Leprosy Control Programme (LCP). These vehicles were maintained by a support team who remained in each staging area ready to repair vehicles as needed. Several sites were reached by boat or canoe when it was not feasible to reach them by road. In many instances an additional trek of several miles had to be taken in order to reach the more remote sites.

Participating Organizations

The Ministry of Health played a key role in the survey. It provided the co-director, supervisors, team members, laboratory technicians, laboratory staff to read the samples collected, and the drivers of the vehicles. In addition it provided administrative support, office and classroom space, and duplicating equipment and supplies.

The LCP was sub-contracted by UCLA to handle finances, provide a logistics officer, his assistant and a fitter, and assume responsibility for vehicle procurement and maintenance. Most in-county supplies were procured through LCP.

The Central Statistics Office provided a statistics advisor and a field supervisor. The advisor helped in selecting the sample and training the teams, and together with the field supervisor monitored the movements of teams during the field phase, in order to ensure that the correct sampling procedure was followed. This office also coded and key punched the forms.

The Ministry of Agricultural and Natural Resources provided an agricultural advisor who provided information on the production of food and market prices out in each province and the western area.

The Ministry of Information and Broadcasting made several annoucements regarding the movements of the survey teams over the radio and aired two television programmes dealing with the survey.

The A.I.D. Mission to Sierra Leone provided administrative support.

UCLA was responsible for survey administration, training of personnel, establishing a survey methodology and analyzing results. UCLA also provided anthropometric and lab equipment and reagents, a survey co-director who was in Sierra Leone for 4 months, and the UCLA Nutrition Assessment Unit director who made several preliminary visits during the planning period and spent a total of five weeks during the survey period in Sierra Leone.

The Office of Nutrition, Development Support Bureau, and the Africa Bureau of AID/Washington provided the funds to the UCLA Nutrition Assessment Unit for the planning and execution of the survey, data analysis and final report.

B. Personnel

Personnel participating in the Sierra Leone National Survey or its preparation and analysis are listed below. Unless otherwise indicated, personnel are officials of the Ministry of Health Government of Sierra Leone.

Mr. B.J. Allie	Field Supervisor, Central Statistics Office (C.S.O.)
Mr. J. Abu	Team Leader, E.D.C.U.
Dr. Aubee	Pathologist, Ministry of Health
Mr. S. Bangura	Laboratory Technician
Mrs. S. Blyden	Liason Officer - Ministry of Health
Mr. B. Browdy	Statistical Consultant, UCLA School of Public Health
Mr. M. Carew	Team Member E.D.C.U.
Mrs. G. Carrol	Survey Co-Director, Nutritionist Ministry of Health
Miss J. Chain	Statistical Preparation - UCLA Nutrition Assessment Unit
Mrs. M. Clay	Laboratory Supervisor
Mr. W.D. Clay	Survey Co-Director, UCLA Nutrition Assessment Unit
Mr. G. Coleridge-Taylor	Permanent Secretary - Ministry of Health
Mr. D. Conteh	Team Member E.D.C.U.
Mr. S. Conteh N'jai	Survey Supervisor E.D.C.U.
Dr. W. Cumberland	Bio-Statistician, UCLA School of Public Health
Dr. M. Davies	Chief Medical Officer Ministry of Health
Mr. O. De Bode	Statistical Preparation - UCLA Nutrition Assessment Unit

Mr. F. Douglas	Mechanic - Leprosy Control Programme
Mr. I.B. Dumbuya	Logistics Officer - L.C.P.
Dr. G. Gage	Principal Medical Officer - Southern Province
Mr. A. Gobba	Team Leader E.D.C.U.
Miss S. Gregory	Statistical Preparation - UCLA Nutrition Assessment Unit
Mrs. S. Harleston	Agricultural Advisor - Ministry of Agriculture and Natural Resources
Mr. R. Huddleston	USAID - Sierra Leone
Miss P. Ishihara	Typist - UCLA Nutrition Assessment Unit
Mr. A. Jalloh	Team Leader E.D.C.U.
Dr. D. Jelliffe	Principal Investigator - UCLA Nutrition Assessment Unit, UCLA School of Public Health
Mrs. P. Jelliffe	Dietary Consultant, UCLA School of Public Health
Mrs. R. Jonah	Typist - Ministry of Health
Mr. M. Joe	Team Member E.D.C.U.
Mr. O. Juana	Laboratory Technician
Mr. D. Kamara	Laboratory Supervisor
Mr. S.K. Kamara	Team Member E.D.C.U.
Mr. A.B. Kamara	Team Member E.D.C.U.
Mr. F. Kargbo-Reffel	Team Leader E.D.C.U.
Mr. A.S. Koroma	Team Member E.D.C.U.
Mr. I.W. Koroma	Team Leader E.D.C.U.
Mr. P. Koroma	Team Member E.D.C.U.
Mr. E. Lavally	Team Member E.D.C.U.
Mr. I. Luseni	Team Member E.D.C.U.

Mr. T. Macauley	Survey Supervisor, Health Education Officer
Mr. J. Mahoi	Team Member E.D.C.U.
Mr. H. Max M'carthy	Deputy Director C.S.O.
Dr. O. Mends	Pathologist - Ministry of Health
Mr. A. Moiguah	Team Leader E.D.C.U.
Mr. J. Muranah	Team Member E.D.C.U.
Mr. S. N'jai	Assistant Logistics Officer - L.C.P.
Dr. G. Poynor	Nutrition Planner - AID
Mr. K.P. Rhodes	Statistical Advisor - C.S.O.
Mr. A. Scott	Laboratory Supervisor
Mr. M. Sep[illegible]	Team Member E.D.C.U.
Father Rocco Serra	Director - Leprosy Control Programme
Mr. L.J. Sesay	Team Leader E.D.C.U.
Mr. L. Sheriff	Team Leader E.D.C.U.
Mrs. M. Sogie Thomas	Laboratory Superintendent
Mr. A. Smith	Laboratory Technician
Mr. J. Tarawallie	Team Leader E.D.C.U.
Mr. I. Thulla	Laboratory Technician
Mr. J. Thompson	Laboratory Technician
Mr. M.C. Thompson	Laboratory Superintendent
Mr. S.M. Turay	Team Leader E.D C.U.
Miss R. Wassenberg	Research Associate - UCLA Nutrition Assessment Unit
Dr. B. Williams	Deputy Chief Medical Officer Ministry of Health
Mr. T.B. Williams	Team Member E.D.C.U.

Mrs. P. Whyndam	Deputy Secretary - Ministry of Health
Mr. D. Yarjah	Survey Supervisor E.D.C.U.
Dr. A. Zerfas	Director - UCLA Nutrition Assessment Unit, UCLA School of Public Health

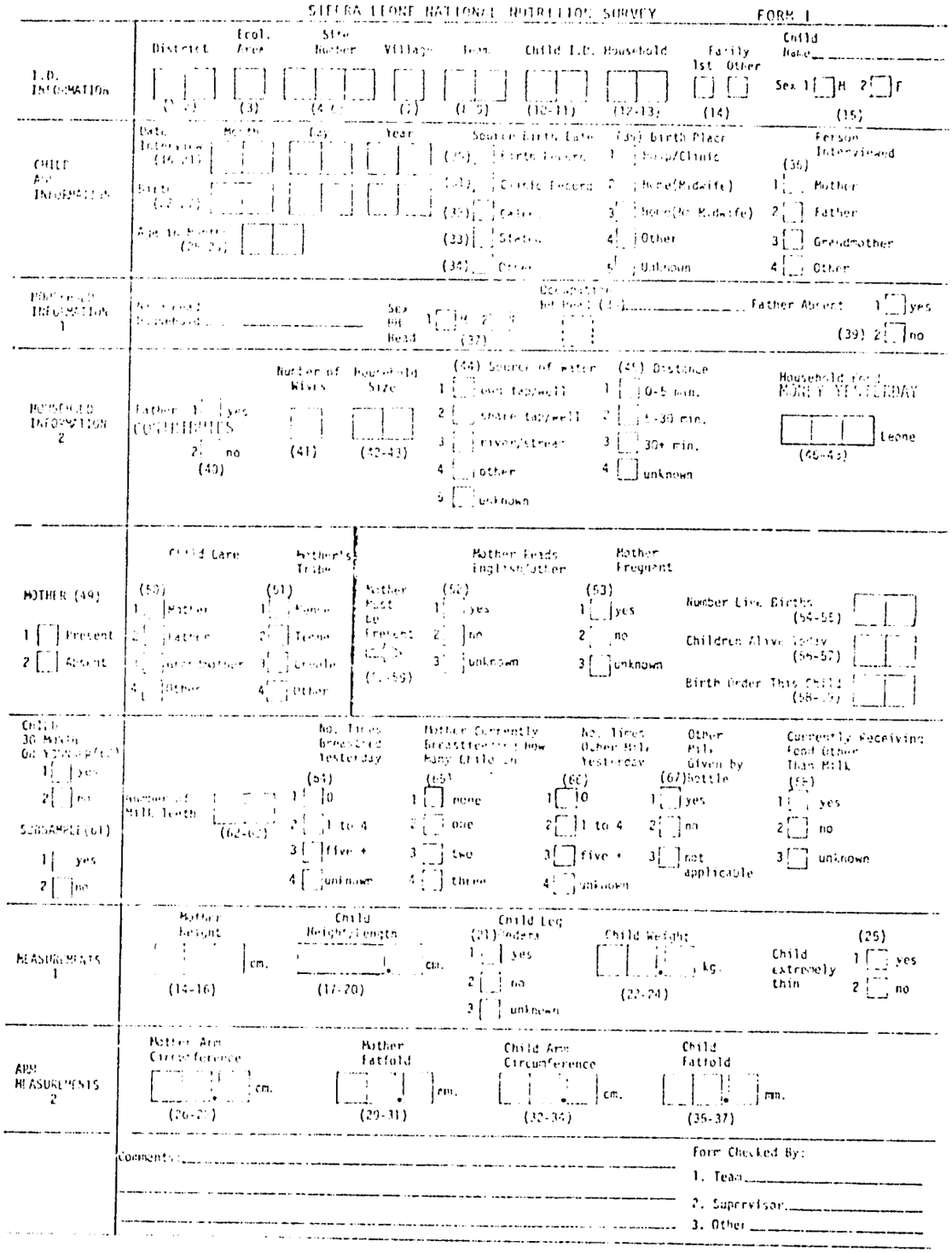
L.C.P. - Leprosy Control Programme

E.D.C.U. - Endemic Disease Control Unit

U.C.L.A. - University of California, Los Angeles

APPENDIX V. METHODOLOGY AND PROCEDURES

A. Form I



SIERRA LEONE NATIONAL NUTRITION SURVEY — FORM I

I.D. INFORMATION: District (1-2); Ecol. Area (3); Stew Number (4-6); Village (7); Team (8-9); Child I.D. Household (10-11); Family 1st Other (12-13); (14); Child Name; Sex 1 M 2 F (15)

CHILD AGE INFORMATION: Date Interview (16-21); Birth (22-27); Age in Months (28-29); Source Birth Date (30) Birth Record, (31) Card, (32) Other, (33) Status, (34) Other; (35) Birth Place 1 Hosp/Clinic, 2 Home(Midwife), 3 Home(No Midwife), 4 Other, 5 Unknown; Person Interviewed (36) 1 Mother, 2 Father, 3 Grandmother, 4 Other

HOUSEHOLD INFORMATION 1: No. in Household; Sex of Head 1 M 2 F (37); Occupation of Head (38); Father Absent 1 yes 2 no (39)

HOUSEHOLD INFORMATION 2: Father Resident 1 yes 2 no (40); Number of Wives (41); Household Size (42-43); (44) Source of water 1 own tap/well, 2 share tap/well, 3 river/stream, 4 other, 9 unknown; (45) Distance 1 0-5 min., 2 5-30 min., 3 30+ min., 4 unknown; Household cash MONEY YESTERDAY Leone (46-48)

MOTHER (49): 1 Present, 2 Absent; Child Care (50) 1 Mother, 2 Father, 3 Other Relative, 4 Other; Mother's Tribe (51) 1 Kuranko, 2 Temne, 3 Limba, 4 Other; Mother Reads English/Other (52) 1 yes, 2 no, 3 unknown; Mother Pregnant (53) 1 yes, 2 no, 3 unknown; Mother Must Go Frequent (54-59); Number Live Births (54-55); Children Alive Today (56-57); Birth Order This Child (58-59)

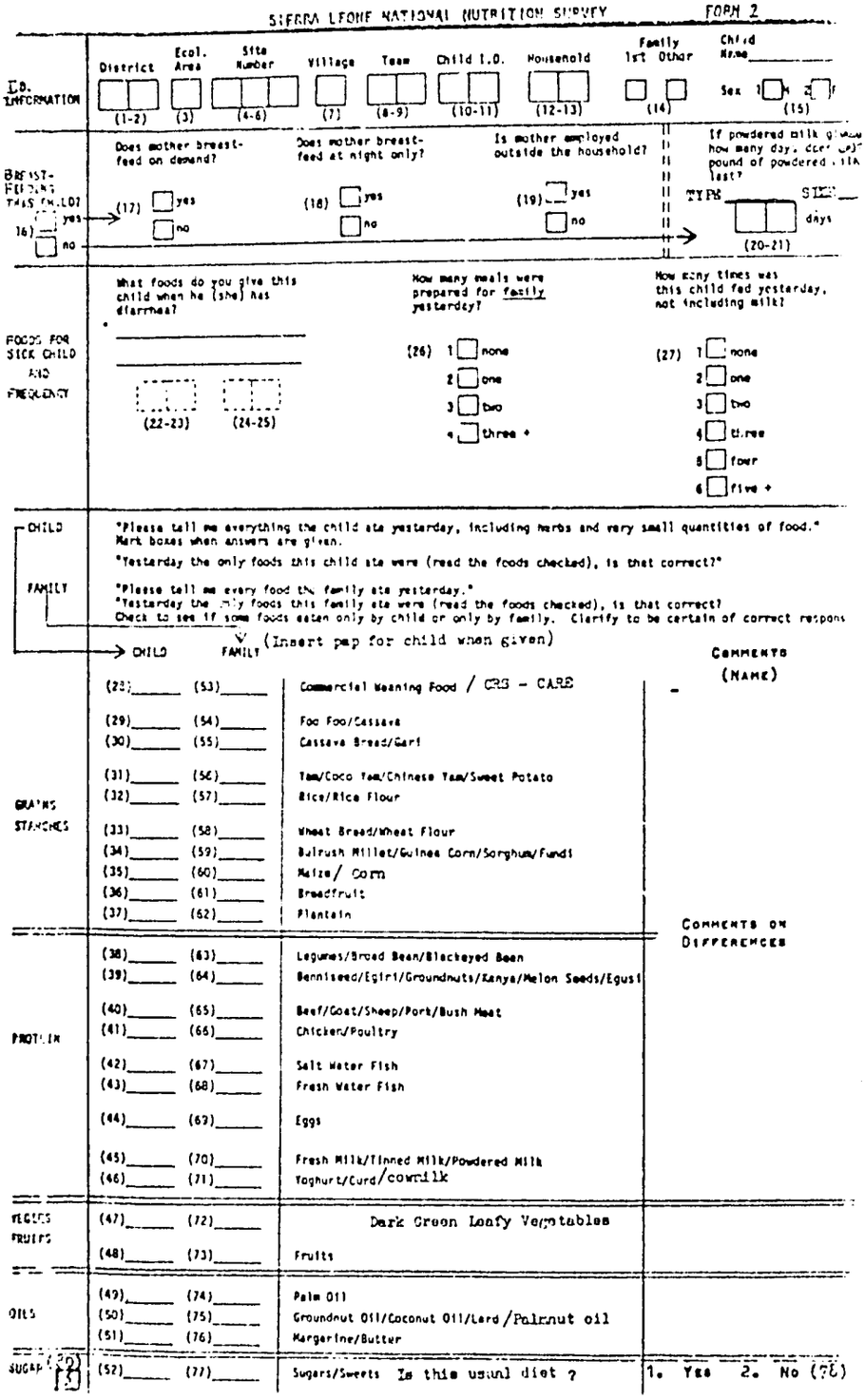
Child 30 Months Or Younger (60) 1 yes 2 no; Subsample (61) 1 yes 2 no; Number of Milk Teeth (62-63); No. Times Breastfed Yesterday (64) 1 0, 2 1 to 4, 3 five +, 4 unknown; Mother Currently Breastfeeding How Many Children (65) 1 none, 2 one, 3 two, 4 three; No. Times Other Milk Given Yesterday (66) 1 0, 2 1 to 4, 3 five +, 4 unknown; Other Milk Given by Bottle (67) 1 yes, 2 no, 3 not applicable; Currently Receiving Food Other Than Milk (68) 1 yes, 2 no, 3 unknown

MEASUREMENTS 1: Mother Height cm. (14-16); Child Height/Length cm. (17-20); Child Leg Edema (21) 1 yes, 2 no, 3 unknown; Child Weight kg. (22-24); Child extremely thin (25) 1 yes, 2 no

ARM MEASUREMENTS 2: Mother Arm Circumference cm. (26-27); Mother Fatfold mm. (29-31); Child Arm Circumference cm. (32-34); Child Fatfold mm. (35-37)

Comments: ____ Form Checked By: 1. Team ____ 2. Supervisor ____ 3. Other ____

B. Form II



SIERRA LEONE NATIONAL NUTRITION SURVEY — FORM 2

I.D. INFORMATION: District (1-2); Ecol. Area (3); Site Number (4-6); Village (7); Team (8-9); Child I.D. (10-11); Household (12-13); Family 1st Other (14); Child Name; Sex 1 M 2 F (15)

BREAST-FEEDING THIS CHILD? 16) yes / no

Does mother breast-feed on demand? (17) yes / no

Does mother breast-feed at night only? (18) yes / no

Is mother employed outside the household? (19) yes / no

If powdered milk given, how many days, does (s)he get a pound of powdered milk last? TYPE ____ SIZE ____ days (20-21)

FOODS FOR SICK CHILD AND FREQUENCY

What foods do you give this child when he (she) has diarrhea? (22-23) (24-25)

How many meals were prepared for family yesterday? (26) 1 none 2 one 3 two 4 three + 5 four 6 five +

How many times was this child fed yesterday, not including milk? (27) 1 none 2 one 3 two 4 three 5 four 6 five +

CHILD: "Please tell me everything the child ate yesterday, including herbs and very small quantities of food." Mark boxes when answers are given. "Yesterday the only foods this child ate were (read the foods checked), is that correct?"

FAMILY: "Please tell me every food the family ate yesterday." "Yesterday the family foods this family ate were (read the foods checked), is that correct? Check to see if some foods eaten only by child or only by family. Clarify to be certain of correct respons

(Insert pap for child when given)

	CHILD	FAMILY		COMMENTS (NAME)
	(28)	(53)	Commercial Weaning Food / CRS - CARE	
	(29)	(54)	Foo Foo/Cassava	
	(30)	(55)	Cassava Bread/Gari	
	(31)	(56)	Yam/Coco Yam/Chinese Yam/Sweet Potato	
GRAINS STARCHES	(32)	(57)	Rice/Rice Flour	
	(33)	(58)	Wheat Bread/Wheat Flour	
	(34)	(59)	Bullrush Millet/Guinea Corn/Sorghum/Fundi	
	(35)	(60)	Maize/ Corn	
	(36)	(61)	Breadfruit	
	(37)	(62)	Plantain	
	(38)	(63)	Legumes/Broad Bean/Blackeyed Bean	COMMENTS ON DIFFERENCES
	(39)	(64)	Benniseed/Egiri/Groundnuts/Kanya/Melon Seeds/Egusi	
	(40)	(65)	Beef/Goat/Sheep/Pork/Bush Meat	
PROTEIN	(41)	(66)	Chicken/Poultry	
	(42)	(67)	Salt Water Fish	
	(43)	(68)	Fresh Water Fish	
	(44)	(69)	Eggs	
	(45)	(70)	Fresh Milk/Tinned Milk/Powdered Milk	
	(46)	(71)	Yoghurt/Curd/cowmilk	
VEGTS FRUITS	(47)	(72)	Dark Green Leafy Vegetables	
	(48)	(73)	Fruits	
OILS	(49)	(74)	Palm Oil	
	(50)	(75)	Groundnut Oil/Coconut Oil/Lard/Palmnut oil	
	(51)	(76)	Margarine/Butter	
SUGAR (32) 15	(52)	(77)	Sugars/Sweets Is this usual diet ?	1. Yes 2. No (78)

C. Form Clarifications

Form I was the basic survey form, and was completed for each child in the main sample. It contained all the demographic and socio-economic background information and the anthropometric measurement. The following are explanations of some questions on Form I.

Childs Birthdate: This was the most important background information on the form. Great care was therefore taken in assessing the child's age.

Method of Assessment:

1. Birth record - This was the most valid document on the child's age, e.g., birth or baptismal certificate.

2. Clinic record - This was a record from a clinic which contained the child's age.

Whenever these records were not available, birth estimates were made.

3. Stated - This was marked when the date was given by the person interviewed.

4. Calendar - Calendars of events, or historical calendars, were constructed by the teams in each site visited. Important local events, likely to be remembered by the villagers such as death of a chief, harvest time, etc., were recorded along with when they occured. Age was then determined by associating the time of a child's birth to particular events. The calendars were also used to verify the ages determined by the other methods An example of a Local Events Calendar is on page 173.

Family First or Other: "1st" was marked if the child being interviewed was the first child from that family to be interviewed. The child didn't necessarily have to be the first born. "Other" was marked for all the subsequent children interviewed from that family.

Father Absent: The father was marked absent if he was permanently away from the home.

Father Contributes: "Yes" was marked if father contributed in cash or kind to support the family, irrespective of whether or not he was present.

Household Size: This was defined as all the people who regularly ate food prepared from a common source (pot).

Household Food Money Past Day: (Freetown only) The mother or guardian was asked how much she spent for food for the household yesterday or last time she went to the market.

Child Care: This referred to the person who generally feeds and cares for the child during the day.

Number of Milk Teeth: The number of milk teeth plus six approximates a child's age in months in the first two years of life. The number of teeth were counted if the child was less than 30 months old. This provided a very rough estimate of the age, for the purpose of reviewing age assessment.

Form II

Form II is the dietary sub-sample, and was completed for every second child 30 months old or younger. Parents or caretakers were asked to recall everything that the child ate and everything that the family ate on the day prior to the day of the interview. Everything the child ate was marked in the box head "Child", and that for the family, under "Family".

D. CALENDAR OF LOCAL EVENTS

DISTRICT	SITE I.D	VILLAGE	I.D.N.
12	37	01	C1

	ANNUAL	1972	1973	1974	1975	1976	1977	1978
JAN.	NEW YEAR START OF FARMING							
FEB.					[illegible]			
MAR.	ENTRANCE EXAMS. BEGINNER RAINS							
APR.	PEN ANNOUNCEMENT START OF RAINS		NATIONAL ELECTION				[illegible]	
MAY	PLANTING SEASON			DEATH OF VILLAGE HEAD			ELECTION DAY	
JUNE	HEAVY RAINS							
JULY	SCHOOLS CLOSED			NEW VILLAGE HEAD ELECTED				
AUG.	HEAVY RAIN					FASTING STARTS.	FASTING STARTS	
SEPT.	BOARDS REOPEN					FASTING ENDS.	FASTING ENDS.	
OCT.					PILGRIMAGE TO MECCA			
NOV.	RAMATTAN, RICE HARVEST		P. C. VISITS SECTION TWICE			PILGRIMAGE TO MECCA	PILGRIMAGE TO MECCA	
DEC.	X-MAS							

E. Equipment and Procedures

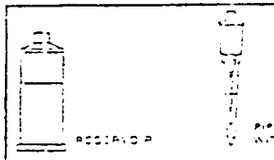
Height or length of children was measured in centimeters with a custom-made portable wooden board produced from a prototype made at UCLA. Height of mothers was measured to the nearest centimeter using an extension piece of this board. Weight of children was measured using a Salter hanging scale (25 kg. capacity). Arm circumference was measured with a Zerfas Insertion Tape. Triceps fatfold of children and mothers was measured with a Holtain-Tanner-Whitehouse caliper at the mid-posterior point of the left upper arm. The detailed procedures may be found in the Sierra Leone Nutritional Survey Training Manual.

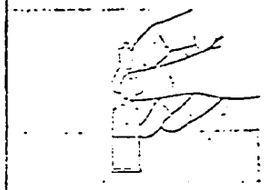
Blood samples were obtained by a finger or toe prick. All thick and thin films were prepared and stained at the end of each day by the technician in the field. The thick film was stained in Giemsa stain and the thin films were fixed in methanol and stained with Leishman's stain.

Blood for the haemoglobin determinations was collected in "Unopettes" as described on the next page. The haemoglobin electrophoresis test were also carried out on these same collected samples. The tests for measles antibodies were carried out on strips of filter paper soaked through in two spots with blood.

Stool samples were collected in covered paper cups. A portion of the sample was then taken and preserved in 10 ml formal saline.

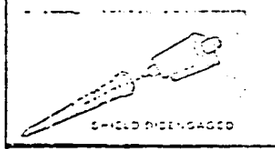
D. STEPS FOR TAKING BLOOD FOR HEMOGLOBIN USING UNOPETTES



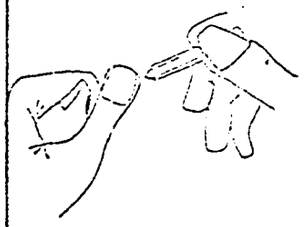


1. Take one unopette reservoir from the sealed plastic bag which has been prepared with the village ID code.

2. Grasping the reservoir in one hand, holding the pipette tubefully with the other, apply firm even pressure and push the tip of the pipette shield through the diaphragm in the neck of the reservoir. Remove the pipette with shield.

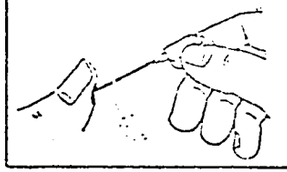


3. Disengage shield from the pipette with a twist action and leave the pipette loose in the shield (as shown) until ready to use. Place reservoir and pipette aside until ready to use.

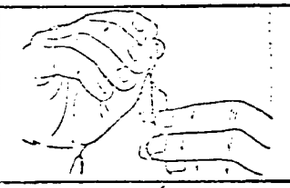


4. Clean thumb of subject's hand by rubbing with alcohol swab. Allow area to dry.

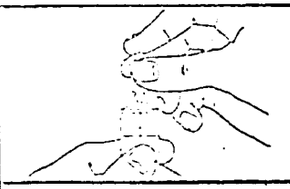
5. Hold the subject's thumb in your hand. Make a quick, but firm jab with the lance to the fleshy part of the thumb. (Be prepared for a sudden, instinctive withdrawal movement by the subject).
Using a dry gauze swab, wipe away the first two drops of blood.



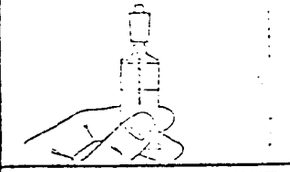
6. Allow a drop of blood to form on the thumb. Holding the pipette horizontally, touch the pipette to, but not into this drop, and allow the pipette to fill by capillary action. Wipe away excess blood from outside of the pipette, being careful not to touch the tip which would draw blood out.



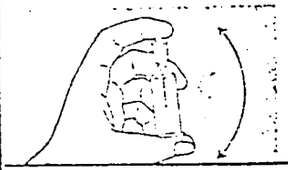
7. Loosely insert pipette into the opening of reservoir bottle.



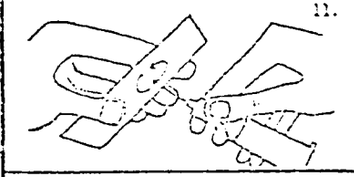
8. Gently squeeze the bottle with one hand.
With the other hand cover upper opening of pipette with your index finger. Suck pipette into reservoir.



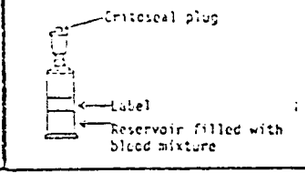
9. Release pressure on reservoir. Release finger from pipette. (Blood will then be drawn into reservoir bottle).
Squeeze the container several times. Be careful not to let reservoir liquid overflow.



10. Place your index finger over the opening of reservoir and pipette unit and invert a few times to mix.



11. Hold Critoseal upside down in one hand.
With thumb and index finger of other hand, hold reservoir and pipette unit by grasping pipette top.
Place pipette opening into Critoseal. Use twisting action to plug pipette. Remove.



12. Make sure subject's hand is wiped off and if desired, apply bandage.
Write ID of subject on unopette label. Return unopette to prenumbered plastic bag. Place bag in pack.

A. PERCENTAGE DISTRIBUTION OF HAEMOGLOBIN LEVELS ACCORDING TO AREA AND AGE

	Haemoglobin Ranges in Gm%								
	<8	8 - 8.9	9 - 9.9	10 - 10.9	11 0 11.9	12 - 12.9	>13	Sample Size	Prevalence of Anaemia
6-24 months									<10 Gm%
Freetown	1.1	7.7	11.0	26.4	29.7	14.3	9.9	10	19.8
South	11.6	14.7	26.3	26.3	12.6	6.3	2.1	95	52.6
East	10.2	12.5	22.7	27.3	13.3	7.8	6.2	128	45.4
North	14.5	20.9	19.1	25.4	16.4	2.7	0.9	110	54.5
Sierra Leone	11.0	31.5	21.5	26.4	15.7	6.5	3.8	435	52.8
Special	2.1	4.3	12.8	19.1	34.0	21.3	6.4	47	19.2
25-59 months									<11 Gm%
Freetown	0.9	5.7	8.6	14.3	29.5	20.0	21.0	105	29.5
South	9.9	9.9	22.8	26.7	20.8	8.9	0.1	101	69.3
East	6.0	12.6	17.5	23.5	22.9	12.6	4.8	166	59.6
North	7.0	15.5	27.6	24.1	14.7	10.3	0.9	116	74.2
Sierra Leone	7.0	12.0	21.2	23.7	20.5	11.5	3.8	488	63.9
Special	2.2	7.4	13.4	15.6	32.5	19.5	9.5	231	38.6

with Nutritional Status

Anaemia was found to be positively correlated with nutritional status, i.e. anaemic children were more likely to have a higher prevalence of undernutrition.

ANAEMIA AND NUTRITIONAL STATUS

Age Group	Sample Size	Percentage of Children Undernourished: Acute Mild W/H < 85%	Chronic H/A<90%	Under-weight W/A<80%	Arm Wasting AC/A<82.5%
6-23 months					
Anaemia<10Gm%	173	16.2%*	20.8%	46.2%*	37.0%*
No Anaemia≥10Gm%	228	9.6%*	16.2%	30.0%*	14.7%*
24-59 months					
Anaemia<11Gm%	304	3.3%	35.5%*	30.6%*	8.5%
No Anaemia≥11Gm%	215	3.3%	18.1%*	21.8%*	5.1%

* significant difference at P<0.05.

C. THIN FILM RESULTS BY AGE

Age in Months	Sample Size	Micro-cytic	Macro-cytic	Normo-cytic	Hypo-chromic	Hyper-chromic	Normo-chromic
3-5	57	14.0	3.5	82.5	52.6	0.0	47.4
6-23	320	24.4	7.5	68.1	68.1	1.6	30.3
24-59	435	19.5	3.9	76.6	54.0	0.9	45.1
3-59	812	21.1	5.3	74.6	58.3	1.1	40.6

D. THIN FILM RESULTS BY AREA

Area	Sample Size	Micro-cytic	Macro-cytic	Normo-cytic	Hypo-chromic	Hyper-chromic	Normo-chromic
South	222	14.0	4.5	81.5	76.6	0.9	22.5
East	243	22.2	4.1	73.7	58.8	0.8	40.4
North	199	36.7	8.5	54.8	54.3	2.0	43.7
Rural	580	22.6	6.0	71.4	62.6	1.4	36.0
Urban	85	31.8	2.4	65.8	56.5	0.0	43.5
Freetown	147	8.8	4.1	87.1	42.1	0.7	57.2
Sierra Leone	812	21.1	5.3	73.6	58.3	1.1	40.6

E. DISTRIBUTION OF COLLECTED STOOL SAMPLES BY AGE AND AREA

Number of Samples Collected

Area	Age in Months			
	3-11	12-23	24-59	TOTAL
South	61	48	132	241
East	50	56	147	253
North	46	63	145	254
Rural	142	145	378	665
Urban	16	26	54	96
Freetown	30	36	72	138
Sierra Leone	188	207	504	899

A. CHILD/FAMILY DISTRIBUTION RATIOS FOR FOOD GROUPS

Child 6-11 months

AREA	Distribution Ratios as a Percentage						
	Tuber	Cereal	Veg. Pro.	Ani. Pro.	DGLV	Fruit	Oils
South	41	89	30	31	39	61	57
East	31	79	40	35	36	54	47
North	36	73	36	28	37	54	41
Rural	42	84	39	34	39	60	55
Urban	5	70	27	23	31	41	28
Freetown	28	64	15	20	17	60	24
Sierra Leone	35	77	33	30	35	55	44

Child 12-17 months

South	69	92	67	74	64	75	23
East	71	95	72	69	76	76	81
North	74	94	70	70	81	75	79
Rural	76	96	73	77	77	83	82
Urban	64	91	64	58	54	70	66
Freetown	68	86	74	69	76	83	73
Sierra Leone	71	93	70	71	73	76	77

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

SOUTHERN PROVINCE: 3-5 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%)* (4)
Foo Foo/Cassava	0	19	19	0
Gari	0	03	03	0
Yam/Sweet Potato	0	03	03	0
Plantain	0	00	0	0
Commercial Weaning	05	0	05	100
Rice	54	95	95	57
Rice Pap				
Wheat/Bread	0	03	03	0
Millet/Sorghum	0	0	0	0
Maize	05	0	05	100
Legumes	03	22	22	14
Seeds/Nuts	03	49	49	06
Beef/Other Meat	03	14	14	21
Poultry	0	0	0	0
Saltwater Fish	03	41	60	05
Freshwater Fish	03	41	41	07
Eggs	0	0	0	0
Milk (Breast)	92			
Milk (Non-Breast)	33	03	33	100
Dark Green Leafy Veg.	0	62	62	0
Fruits	08	11	16	50
Palm Oil	11	80	80	14
Other Oils	0	5	05	0
Margarine	0	0	0	0
Sugar/Sweets	0	03	03	0

* Also termed Distribution Ratio in this report.

This equals $\frac{\text{Percentage of times food eaten by child}}{\text{Percentage of times food eaten by child \&/or Family}}$

i.e. $\frac{\text{Column (1) result}}{\text{Column (3) result}}$ in the table, expressed as a percentage

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

SOUTHERN PROVINCE: 6-11 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	10	22	23	43
Gari	02	06	06	33
Yam/Sweet Potato	0	01	01	0
Plantain	01	02	03	33
Commercial Weaning	02	0	02	100
Rice	89	98	100	89
Rice Pap				
Wheat/Bread	0	02	02	0
Millet/Sorghum	0	0	0	0
Maize	0	0	0	0
Legumes	08	22	22	36
Seeds/Nuts	11	38	39	28
Beef/Other Meat	08	18	18	44
Poultry	01	01	01	100
Saltwater Fish	17	56	56	30
Freshwater Fish	14	43	43	33
Eggs	0	0	0	0
Milk (Breast)	91			
Milk (Non-Breast)	13	0	13	100
Dark Green Leafy Veg.	30	77	77	39
Fruits	14	19	23	61
Palm Oil	54	96	98	100
Other Oils	05	02	05	100
Margarine	02	01	03	67
Sugar/Sweets	02	0	02	100

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

SOUTHERN PROVINCE: 12-17 month-old Child and Family

FOOD	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	14	20	20	70
Gari/Cassava Bread	5	7	7	71
Yam/Sweet Potato	5	5	7	71
Plantain	2	0	2	100
Commercial Weaning	0	0	0	0
Rice	92	100	100	92
Rice Pap				
Wheat/Bread	8	10	13	62
Millet/Sorghum	0	0	0	0
Maize	0	0	0	0
Legumes	17	27	30	57
Seeds/Nuts	24	34	37	65
Beef/Other Meat	14	22	22	64
Poultry	0	0	0	0
Saltwater Fish	45	60	62	73
Freshwater Fish	32	43	43	74
Eggs	0	0	0	0
Milk (Breast)	87			
Milk (Non-Breast)	8	5	10	80
Dark Green Leafy Veg.	53	81	83	64
Fruits	9	6	12	75
Palm Oil	65	90	90	72
Other Oils	18	16	18	100
Margarine	4	4	.6	67
Sugar/Sweets	8	7	10	80

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

SOUTHERN PROVINCE: 18-30 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	24	25	26	92
Gari/Cassava Bread	10	10	11	91
Yam/Sweet Potato	4	5	5	80
Plantain	1	1	1	100
Commercial Weaning	1	0	1	100
Rice	97	96	98	99
Rice Pap				
Wheat/Bread	9	5	9	100
Millet/Sorghum	0	0	0	0
Maize	1	0	1	100
Legumes	22	23	23	96
Seeds/Nuts	31	34	34	91
Beef/Other Meat	7	8	8	88
Poultry	1	2	2	50
Saltwater Fish	52	58	59	88
Freshwater Fish	42	44	44	95
Eggs	1	2	2	50
Milk (Breast)	33			
Milk (Non-Breast)	5	3	5	100
Dark Green Leafy Veg.	67	74	74	91
Fruits	26	20	28	93
Palm Oil	88	93	93	95
Other Oils	8	8	9	89
Margarine	3	2	3	100
Sugar/Sweets	10	6	10	100

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

EASTERN PROVINCE: 3-5 month-old Child and Family

FOOD	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	2	8	10	20
Gari/Cassava Bread	0	0	0	0
Yam/Sweet Potato	0	18	18	0
Plantain	0	6	6	0
Commercial Weaning	6	2	6	100
Rice	55	98	100	55
Rice Pap				
Wheat/Bread	2	14	14	14
Millet/Sorghum	2	0	2	100
Maize	0	0	0	0
Legumes	0	24	24	0
Seeds/Nuts	8	47	49	16
Beef/Other Meat	0	4	4	0
Poultry	0	4	4	0
Saltwater Fish	4	73	73	5
Freshwater Fish	0	22	22	0
Eggs	0	0	0	0
Milk (Breast)	93			
Milk (Non-Breast)	22	6	24	92
Dark Green Leafy Veg.	2	55	55	4
Fruits	6	39	41	15
Palm Oil	16	73	73	22
Other Oils	2	18	20	10
Margarine	0	8	8	0
Sugar/Sweets	4	14	16	13

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

EASTERN PROVINCE: 6-11 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	6	15	16	38
Gari	1	2	3	33
Yam/Sweet Potato	3	12	12	25
Plantain	1	2	2	50
Commercial Weaning	4	1	4	100
Rice	74	100	100	74
Rice Pap				
Wheat/Bread	5	13	13	38
Millet/Sorghum	3	0	3	100
Maize	3	0	3	100
Legumes	12	26	27	44
Seeds/Nuts	17	46	50	34
Beef/Other Meat	4	17	17	24
Poultry	1	2	2	50
Saltwater Fish	24	60	63	38
Freshwater Fish	7	29	29	24
Eggs	2	1	3	67
Milk (Breast)	91			
Milk (Non-Breast)	19	9	22	86
Dark Green Leafy Veg.	18	49	49	37
Fruits	20	29	37	54
Palm Oil	37	65	70	53
Other Oils	3	16	16	19
Margarine	1	8	8	13
Sugar/Sweets	9	15	18	50

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

EASTERN PROVINCE: 12-17 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	5	9	9	55
Gari/Cassava Bread	1	1	2	50
Yam/Sweet Potato	13	14	18	72
Plantain	7	7	8	88
Commercial Weaning	4	0	4	100
Rice	91	99	100	91
Rice Pap				
Wheat/Bread	20	24	28	71
Millet/Sorghum	0	0	0	0
Maize	1	0	1	100
Legumes	17	22	23	74
Seeds/Nuts	36	49	50	72
Beef/Other Meat	13	13	16	81
Poultry	0	0	0	0
Saltwater Fish	37	60	60	62
Freshwater Fish	24	33	33	73
Eggs	0	0	0	0
Milk (Breast)	91			
Milk (Non-Breast)	10	7	11	91
Dark Green Leafy Veg.	46	63	66	70
Fruits	37	42	50	74
Palm Oil	57	69	73	78
Other Oils	11	12	12	92
Margarine	6	10	12	55
Sugar/Sweest	19	20	25	76

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

EASTERN PROVINCE: 18-30 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	11	12	13	85
Gari/Cassava Bread	2	3	3	67
Yam/Sweet Potato	9	10	11	82
Plantain	6	5	7	86
Commercial Weaning	0	0	0	0
Rice	100	99	100	100
Rice Pap				
Wheat/Bread	28	21	29	97
Millet/Sorghum	1	1	1	100
Maize	0	0	0	0
Legumes	31	31	31	100
Seeds/Nuts	46	50	51	
Beef/Other Meat	17	19	19	90
Poultry	1	1	1	100
Saltwater Fish	53	58	59	90
Freshwater Fish	36	37	37	97
Eggs	1	0	1	100
Milk (Breast)	44			
Milk (Non-Breast)	12	10	12	100
Dark Green Leafy Veg.	56	61	61	92
Fruits	42	32	46	
Palm Oil	74	76	77	96
Other Oils	14	15	16	88
Margarine	12	11	13	92
Sugar/Sweets	28	20	39	72

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

NORTHERN PROVINCE: 3-5 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	0	10	10	0
Gari/Cassava Bread	0	4	4	0
Yam/Sweet Potato	0	0	0	0
Plantain	0	0	0	0
Commercial Weaning	4	2	6	67
Rice	35	100	100	35
Rice Pap				
Wheat/Bread	0	0	0	0
Millet/Sorghum	6	0	6	100
Maize	6	0	6	100
Legumes	0	14	14	0
Seeds/Nuts	2	67	69	3
Beef/Other Meat	0	10	10	0
Poultry	0	4	4	0
Saltwater Fish	0	53	53	0
Freshwater Fish	0	39	39	0
Eggs	0	0	0	0
Milk (Breast)	99			
Milk (Non-Breast)	12	0	12	100
Dark Green Leafy Veg.	0	49	49	0
Fruits	2	12	14	14
Palm Oil	4	73	73	5
Other Oils	0	14	14	0
Margarine	0	2	2	0
Sugar/Sweets	6	4	10	60

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

NORTHERN PROVINCE: 6-11 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	3	7	7	43
Gari/Cassava Bread	1	4	4	25
Yam/Sweet Potato	0	1	1	0
Plantain	0	0	0	0
Commercian Weaning	1	0	1	100
Rice	70	98	98	71
Rice Pap				
Wheat/Bread	2	1	2	100
Millet/Sorghum	4	0	4	100
Maize	0	0	0	0
Legumes	6	16	16	38
Seeds/Nuts	25	70	72	35
Beef/Other Meat	3	13	13	23
Poultry	0	1	1	0
Saltwater Fish	16	52	52	31
Freshwater Fish	9	36	36	25
Eggs	0	0	0	0
Milk (Breast)	94			
Milk(Non-Breast)	5	0	5	100
Dark Green Leafy Veg.	20	53	54	37
Fruits	7	11	13	54
Palm Oil	31	75	76	41
Other Oils	1	11	11	9
Margarine	0	0	0	0
Sugar/Sweets	7	0	7	100

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

NORTHERN PROVINCE: 12-17 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	4	9	9	44
Gari/Cassava Bread	6	6	6	100
Yam/Sweet Potato	2	2	3	67
Plantain	0	0	0	0
Commercial Weaning	0	0	0	0
Rice	92	98	98	94
Rice Pap				
Wheat/Bread	5	4	5	100
Millet/Sorghum	0	0	0	0
Maize	1	0	1	100
Legumes	14	20	20	70
Seeds/Nuts	52	72	73	71
Beef/Other Meat	5	9	9	56
Poultry	1	4	4	25
Saltwater Fish	51	64	64	80
Freshwater Fish	17	29	30	57
Eggs	1	2	2	50
Milk (Breast)	94			
Milk (Non-Breast)	2	1	2	100
Dark Green Leafy Veg.	39	48	48	81
Fruits	9	11	12	75
Palm Oil	61	73	74	82
Other Oils	9	12	12	75
Margarine	1	1	1	100
Sugar/Sweets	11	6	11	100

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

NORTHERN PROVINCE: 18-30 month-old Child and Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (4)
Foo Foo/Cassava	8	8	9	88
Gari/Cassava Bread	5	5	6	83
Yam/Sweet Potato	1	2	2	50
Plantain	1	0	1	100
Commercial Weaning	1	0	1	100
Rice	96	96	98	98
Rice Pap				
Wheat/Bread	13	5	13	100
Millet/Sorghum	0	0	0	0
Maize	0	0	0	0
Legumes	18	18	18	100
Seeds/Nuts	69	72	72	96
Beef/Other Meat	15	16	16	94
Poultry	3	0	3	100
Saltwater Fish	64	68	68	94
Freshwater Fish	28	28	29	97
Eggs	0	1	1	0
Milk (Breast)	40			
Milk (Non-Breast)	3	1	3	100
Dark Green Leafy Veg.	47	49	50	94
Fruits	24	17	25	96
Palm Oil	70	74	74	95
Other Oils	13	11	13	100
Margarine	1	0	1	100
Sugar/Sweets	13	5	13	100

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

RURAL AREAS: 3-5 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	1	14	15	7
Gari	0	3	3	
Yam/Sweet Potato	0	4	4	
Plantain	0	1	1	
Commercial Weaning	4	0	4	
Rice	8	57	57	14
Rice Pap	42	0	42	100
Wheat/Bread	1	0	1	
Millet/Sorghum	3	0	3	
Maize	4	0	4	
Legumes	1	16	16	6
Seeds/Nuts	5	50	50	10
Beef/Other Meat	1	10	10	10
Poultry	0	2	2	
Saltwater Fish	3	59	59	5
Freshwater Fish	1	38	38	3
Eggs	0	0	0	-
Milk (Breast)	100	-	-	-
Milk (Non-Breast)	16	0	16	100
Dark Green Leafy Veg.	1	51	51	2
Fruits	4	60	20	20
Palm Oil	13	77	77	17
Other Oil	1	13	13	8
Margarine	0	1	1	
Sugar/Sweets	3	5	5	

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

RURAL AREAS: 6-11 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	8	15	16	50
Gari	1	4	4	
Yam/Sweet Potato	1	5	5	
Plantain	0	0	0	-
Commercial Weaning	1	0	1	
Rice	44	62	62	71
Rice Pap	36	0	36	100
Wheat/Bread	1	2	2	
Millet/Sorghum	2	0	2	
Maize	1	0	1	
Legumes	9	22	22	41
Seeds/Nuts	17	45	47	36
Beef/Other Meat	5	14	14	36
Poultry	1	2	2	
Saltwater Fish	19	52	53	36
Freshwater Fish	11	38	38	29
Eggs	0	0	0	-
Milk (Breast)	99	-	-	-
Milk (Non-Breast)	7	0	7	
Dark Green Leafy Veg.	22	56	56	39
Fruits	12	15	19	63
Palm Oil	46	80	84	55
Other Oil	3	9	10	30
Margarine	0	0	0	-
Sugar/Sweets	5	0	6	

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

RURAL AREAS: 12-17 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	10	16	16	62
Gari	6	5	6	
Yam/Sweet Potato	7	6	8	
Plantain	3	2	3	
Commercial Weaning	0	0	0	-
Rice	81	85	86	94
Rice Pap	13	0	13	100
Wheat/Bread	5	6	6	
Millet/Sorghum	0	0	0	-
Maize	1	0	1	
Legumes	17	22	23	94
Seeds/Nuts	35	47	47	74
Beef/Other Meat	12	15	16	75
Poultry	1	2	2	
Saltwater Fish	45	55	56	80
Freshwater Fish	25	36	36	69
Eggs	1	2	2	
Milk (Breast)	95	-	-	-
Milk (Non-Breast)	5	2	5	
Dark Green Leafy Veg.	47	60	61	77
Fruits	19	17	23	83
Palm Oil	65	78	79	82
Other Oil	14	14	15	93
Margarine	1	1	1	
Sugar/Sweets	7	4	7	

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

RURAL AREAS: 18-30 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	15	16	17	88
Gari	7	7	8	
Yam/Sweet Potato	6	6	7	
Plantain	2	0	2	
Commercial Weaning	0	0	0	-
Rice	93	93	94	99
Rice Pap	4	0	4	
Wheat/Bread	10	0	10	100
Millet/Sorghum	0	0	0	-
Maize	0	0	0	-
Legumes	27	0	27	100
Seeds/Nuts	44	57	57	77
Beef/Other Meat	13	14	14	93
Poultry	1	0	1	
Saltwater Fish	54	57	58	93
Freshwater Fish	39	41	41	95
Eggs	0	1	1	
Milk (Breast)	43	-	-	-
Milk (Non-Breast)	3	2	3	
Dark Green Leafy Veg.	55	59	59	93
Fruits	28	19	29	97
Palm Oil	79	82	82	96
Other Oil	12	11	13	92
Margarine	1	0	1	
Sugar/Sweets	10	0	10	100

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

URBAN AREAS (EXCEPT FREETOWN): 3-5 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	0	7	7	
Gari	0	0	0	-
Yam/Sweet Potato	0	15	15	-
Plantain	0	5	5	-
Commercial Weaning	7	4	9	
Rice	2	58	58	3
Rice Pap	39	0	39	100
Wheat/Bread	2	19	19	11
Millet/Sorghum	2	0	2	
Maize	2	0	2	
Legumes	0	27	27	-
Seeds/Nuts	2	73	75	3
Beef/Other Meat	0	7	7	
Poultry	0	7	7	
Saltwater Fish	0	73	73	-
Freshwater Fish	0	17	17	-
Eggs	0	0	0	-
Milk (Breast)	100	-	-	-
Milk (Non-Breast)	34	10	39	87
Dark Green Leafy Veg.	0	66	66	-
Fruits	7	31	36	19
Palm Oil	2	73	73	3
Other Oil	0	20	20	-
Margarine	0	10	10	-
Sugar/Sweets	4	22	24	17

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

URBAN AREAS (EXCEPT FREETOWN): 6-11 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	1	14	14	7
Gari	0	4	4	
Yam/Sweet Potato	0	4	4	
Plantain	0	3	3	
Commercial Weaning	7	1	7	
Rice	26	59	59	44
Rice Pap	41	0	41	100
Wheat/Bread	7	17	18	39
Millet/Sorghum	1	0	1	
Maize	1	0	1	
Legumes	7	20	21	33
Seeds/Nuts	20	73	77	26
Beef/Other Meat	3	23	23	13
Poultry	0	0	0	-
Saltwater Fish	20	69	70	29
Freshwater Fish	4	24	24	17
Eggs	1	1	2	
Milk (Breast)	97	-	-	-
Milk (Non-Breast)	29	12	32	91
Dark Green Leafy Veg.	21	68	68	31
Fruits	17	35	41	41
Palm Oil	23	73	73	31
Other Oil	1	14	14	7
Margarine	2	11	12	17
Sugar/Sweets	10	16	20	50

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

URBAN AREAS (EXCEPT FREETOWN): 12-17 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	2	4	5	
Gari	3	6	6	
Yam/Sweet Potato	6	9	12	50
Plantain	3	4	4	
Commercial Weaning	4	0	4	
Rice	55	70	70	79
Rice Pap	30	0	30	100
Wheat/Bread	26	28	38	68
Millet/Sorghum	0	0	0	-
Maize	1	0	1	
Legumes	16	25	28	57
Seeds/Nuts	46	67	73	63
Beef/Other Meat	5	10	11	45
Poultry	0	1	1	
Saltwater Fish	43	77	77	56
Freshwater Fish	17	26	27	63
Eggs	0	0	0	-
Milk (Breast)	82	-	-	
Milk (Non-Breast)	14	10	17	82
Dark Green Leafy Veg.	38	70	71	54
Fruits	22	26	32	69
Palm Oil	49	74	77	64
Other Oil	13	13	16	81
Margarine	9	13	16	56
Sugar/Sweets	28	24	33	85

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

URBAN AREAS (EXCEPT FREETOWN): 18-30 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	9	11	12	75
Gari	4	4	5	
Yam/Sweet Potato	2	4	4	
Plantain	3	3	4	
Commercial Weaning	2	0	2	
Rice	80	80	82	98
Rice Pap	18	0	18	100
Wheat/Bread	38	24	39	97
Millet/Sorghum	1	1	1	
Maize	1	1	1	
Legumes	15	16	16	94
Seeds/Nuts	66	74	74	89
Beef/Other Meat	14	13	17	82
Poultry	4	4	4	
Saltwater Fish	67	77	77	87
Freshwater Fish	22	22	23	96
Eggs	2	0	2	
Milk (Breast)	28	-	-	-
Milk (Non-Breast)	20	14	20	100
Dark Green Leafy Veg.	58	66	66	88
Fruits	39	34	45	87
Palm Oil	70	76	77	91
Other Oil	13	15	16	81
Margarine	16	15	18	89
Sugar/Sweets	39	28	41	95

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

FREETOWN: 3-5 month-old Child & Family*

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child %/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	11	5	16	69
Gari/Cassava Bread	0	0	0	-
Yam/Sweet Potato	0	5	5	-
Plantain	0	5	5	-
Commercial Weaning	5	0	5	-
Rice	16	100	100	16
Rice Pap				
Wheat/Bread	5	47	47	10
Millet/Sorghum	0	0	0	-
Maize	5	0	5	-
Legumes	0	11	11	-
Seeds/Nuts	0	95	95	0
Beef/Other Meat	0	11	11	0
Poultry	0	0	0	-
Saltwater Fish	0	100	100	0
Freshwater Fish	0	0	0	-
Eggs	0	0	0	-
Milk(Breast)	95			
Milk(Non-Breast)	68	26	74	92
Dark Green Leafy Veg.	0	63	63	0
Fruits	11	42	53	21
Palm Oil	0	79	79	0
Other Oils	0	16	16	0
Margarine	0	40	40	0
Sugar/Sweets	11	48	48	23

* Note very small sample size (N=19)

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

FREETOWN: 6-11 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	8	13	21	62
Gari	0	8	8	
Yam/Sweet Potato	0	3	3	
Plantain	0	5	5	
Commercial Weaning	21	18	21	100
Rice	26	62	62	42
Rice Pap	36	0	36	100
Wheat/Bread	20	52	56	36
Millet/Sorghum	0	0	0	-
Maize	0	0	0	-
Legumes	5	19	21	24
Seeds/Nuts	13	82	82	16
Beef/Other Meat	2	17	17	12
Poultry	0	3	3	
Saltwater Fish	15	92	92	16
Freshwater Fish	0	5	5	
Eggs	5	7	7	
Milk (Breast)	92	-	-	-
Milk (Non-Breast)	59	25	59	100
Dark Green Leafy Veg.	13	77	78	17
Fruits	31	36	52	60
Palm Oil	15	81	81	19
Other Oil	3	26	26	12
Margarine	10	43	46	22
Sugar/Sweets	33	54	67	49

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

FREETOWN: 12-17 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	16	20	25	64
Gari	5	9	9	
Yam/Sweet Potato	12	9	14	86
Plantain	4	9	9	
Commercial Weaning	22	21	23	96
Rice	61	79	81	98
Rice Pap	16	0	16	100
Wheat/Bread	43	52	95	45
Millet/Sorghum	0	0	0	
Maize	2	0	2	
Legumes	7	12	14	50
Seeds/Nuts	59	82	82	72
Beef/Other Meat	11	16	16	69
Poultry	0	0	0	-
Saltwater Fish	64	92	94	68
Freshwater Fish	5	0	5	
Eggs	7	2	7	
Milk (Breast)	79	-	-	-
Milk (Non-Breast)	29	20	38	76
Dark Green Leafy Veg.	52	68	70	74
Fruits	54	36	65	83
Palm Oil	48	75	75	64
Other Oil	14	26	28	50
Margarine	28	34	46	61
Sugar/Sweets	53	35	67	79

PERCENTAGE FREQUENCY INTAKE OF INDIVIDUAL FOODS

FREETOWN: 18-30 month-old Child & Family

FOODS	Percentage of times eaten by: Child (1)	Family (2)	Child &/or Family (3)	Child/ Family Ratio (%) (4)
Foo Foo/Cassava	8	10	13	62
Gari	9	9	12	75
Yam/Sweet Potato	6	5	6	
Plantain	14	3	14	100
Commercial Weaning	11	0	11	100
Rice	86	87	89	97
Rice Pap	10	0	10	100
Wheat/Bread	73	62	76	96
Millet/Sorghum	1	1	2	
Maize	0	0	0	-
Legumes	21	21	23	91
Seeds/Nuts	74	78	81	91
Beef/Other Meat	13	15	17	88
Poultry	1	1	1	
Saltwater Fish	89	95	95	94
Freshwater Fish	4	4	4	
Eggs	6	5	7	
Milk (Breast)	16	-	-	-
Milk (Non-Breast)	41	34	42	98
Dark Green Leafy Veg.	62	64	67	93
Fruits	56	38	60	93
Palm Oil	71	77	80	89
Other Oil	25	25	29	86
Margarine	53	48	57	93
Sugar/Sweets	71	58	73	97

APPENDIX VIII. ANTHROPOMETRIC REFERENCE DATA

A. Anthropometric Standards for Reference Populations

Data from reference populations are used throughout the world to indicate whether a subject, usually a child, has normal anthropometric measurements such as weight or height. The reference median value is a basis of comparison between the child studied and that of the reference population.

The result is usually presented in the form of percentages (12). For example, a child's weight has a value that is a percentage of the median weight for children of the same age from the reference population. This result is expressed as a "percentage weight-for-age." In the same way, percentages of other measures can be expressed such as "percentage height-for-age." The percentage weight-for-height is the ratio of the weight of the child with that of the median weight of reference children who are the same height.

Requirements for reference data include (27):

1. A large and valid sample, representative of a well defined group.
2. Relatively recent reference data.
3. Adequate measuring techniques.

If the reference population is from an industrialized country and is characterized by reasonably adequate health and nutrition care, then it might indicate a median level of a measure near which the risk of morbidity and mortality related to undernutrition is relatively low. This is one basis for the "Road to Health" weight charts used throughout the world, where a continuing upper level of the "safe" weight range is based on a reference median.

Such a level is neither ideal nor is it necessarily a "standard" that a population would be expected to achieve with improved health and nutrition status. Within the country itself, there is usually an upper socio-economic group which can indicate to some extent the potential

growth and tissue bulk of the rest of the country. This assumes similar racial groups are compared. A perspective may thus be achieved by comparing the reference median such as from the USA, a Sierra Leone optimum and the rest of the Sierra Leone population.

No reference data are available from Sierra Leone. However, studies in West Africa, such as in Ibadan (15) show that young children of families attending the University have similar measurements of weight and height to American children. Habicht presents evidence from studies in less developed countries that the difference in growth of preschool children attributable to social class and environment is far greater than that related to ethnic factors (16). Recent results of the International Biological Program indicate that genotype differences in growth perhaps do not exist between Africans and Europeans (47), strengthening the evidence that environmental factors such as health and nutrition, are all important in growth.

Reference data for height and weight for this survey were derived from large, representative studies recently completed in the USA. This was recommended by the National Academy of Sciences (NAS) Committee on Nutrition Advisory to the Center for Disease Control, USA in 1974. The reference populations included children up to 24 months from middle to upper socio-economic status families and those aged 2-6 years from a nation-wide study in the USA and were more recently compiled by the National Center for Health Statistics, USA (18, 19).

These data are similar but not identical to that recommended by WHO using the "Boston" reference population compiled 30 years ago (12). Comparisons of results for this survey with others using the Boston references should take into account the differences.

Reference data for arm circumference and fatfold measures was derived from the Ten State Survey performed in the USA in the late 1960's and the results prepared by the Center of Disease Control, Atlanta, Georgia, USA.

Using the reference data, on what basis can an index for undernutrition be derived? For practical purposes, it should indicate a level below which an individual or population is at serious risk of ill health. Delayed mental development and reduced potential for learning also have been implicated as factors related to this low nutritional status (48).

REFERENCE ANTHROPOMETRY DATA ACCORDING TO AGE AND SEX
FOR HEIGHT AND WEIGHT

Age in Months	Height (cm)				Weight (kg)			
	Boys		Girls		Boys		Girls	
	100%	90%	100%	90%	100%	80%	100%	80%
0	50.5	45.5	49.9	44.9	3.3	2.6	3.2	2.6
1	54.6	49.1	53.5	48.1	4.3	3.4	4.0	3.2
2	58.1	52.3	56.8	51.1	5.2	4.2	4.7	3.8
3	61.1	55.0	59.5	53.6	6.0	4.8	5.4	4.3
4	63.7	57.3	62.0	55.8	6.7	5.4	6.0	4.8
5	65.9	59.3	64.1	57.7	7.3	5.8	6.7	5.4
6	67.8	61.0	65.9	59.3	7.8	6.2	7.2	5.8
7	69.5	62.6	67.6	60.8	8.3	6.6	7.7	6.2
8	71.0	63.9	69.1	62.2	8.8	7.0	8.2	6.6
9	72.3	65.1	70.4	63.4	9.2	7.4	8.6	6.9
10	73.6	66.2	71.8	64.6	9.5	7.6	8.9	7.1
11	74.9	67.4	73.1	65.8	9.9	7.9	9.2	7.4
12	76.1	68.5	74.3	66.9	10.2	8.2	9.5	7.6
13	77.2	69.5	75.5	68.0	10.4	8.4	9.8	7.8
14	78.3	70.5	76.7	69.0	10.7	8.6	10.0	8.0
15	79.4	71.5	77.8	70.0	10.9	8.7	10.2	8.2
16	80.4	72.4	78.9	71.0	11.1	8.9	10.4	8.3
17	81.4	73.3	79.9	71.9	11.3	9.0	10.6	8.5
18	82.4	74.2	80.9	72.8	11.5	9.2	10.8	8.6
19	83.3	75.0	81.9	73.7	11.7	9.4	11.0	8.8
20	84.2	75.8	82.9	74.6	11.8	9.5	11.2	9.0
21	85.1	76.6	83.8	75.4	12.0	9.6	11.4	9.1
22	86.0	77.4	84.7	76.2	12.2	9.8	11.5	9.2
23	86.8	78.1	85.6	77.0	12.4	9.9	11.7	9.4
24*	85.6	77.0	85.7	77.1	12.3	9.8	11.8	9.4
25	86.4	77.8	86.4	77.8	12.5	10.0	12.0	9.6
26	87.2	78.5	87.2	78.5	12.7	10.2	12.2	9.8
27	88.1	79.3	87.9	79.1	12.9	10.3	12.4	9.9
28	88.9	80.0	88.6	79.7	13.1	10.5	12.6	10.1
29	89.6	80.6	89.3	80.4	13.3	10.6	12.8	10.2
30	90.4	81.4	90.0	81.0	13.5	10.8	13.0	10.4
31	91.2	82.1	90.7	81.6	13.7	11.0	13.2	10.6
32	92.0	82.8	91.4	82.3	13.9	11.1	13.4	10.7
33	92.7	83.4	92.1	82.9	14.1	11.3	13.6	10.9
34	93.5	84.2	92.7	83.4	14.3	11.4	13.8	11.0
35	94.2	84.8	93.4	84.1	14.4	11.5	13.9	11.1

Age in Months	Height (cm)				Weight (kg)			
	Boys		Girls		Boys		Girls	
	100%	90%	100%	90%	100%	80%	100%	80%
36	94.9	85.4	94.1	84.7	14.6	11.7	14.1	11.3
37	95.6	86.0	94.7	85.2	14.8	11.8	14.3	11.4
38	96.3	86.7	95.4	85.9	15.0	12.0	14.4	11.5
39	97.0	87.3	96.0	86.4	15.2	12.2	14.6	11.7
40	97.7	88.0	96.7	87.0	15.3	12.2	14.8	11.8
41	98.4	88.6	97.3	87.6	15.5	12.4	14.9	11.9
42	99.1	89.2	97.9	88.1	15.7	12.6	15.1	12.1
43	99.7	89.7	98.5	88.7	15.8	12.6	15.2	12.2
44	100.4	90.4	99.2	89.3	16.0	12.8	15.4	12.3
45	101.0	90.9	99.8	89.8	16.2	13.0	15.5	12.4
46	101.7	91.5	100.4	90.4	16.4	13.1	15.7	12.5
47	102.3	92.1	101.0	90.9	16.5	13.2	15.8	12.6
48	102.9	92.6	101.6	91.4	16.7	13.4	16.0	12.8
49	103.6	93.2	102.2	92.0	16.9	13.5	16.1	12.9
50	104.2	93.8	102.7	92.4	17.0	13.6	16.2	13.0
51	104.8	94.3	103.3	93.0	17.2	13.8	16.4	13.1
52	105.4	94.9	103.9	93.5	17.4	13.9	16.5	13.2
53	106.0	95.4	104.5	94.1	17.5	14.0	16.7	13.4
54	106.6	95.9	105.0	94.5	17.7	14.2	16.8	13.4
55	107.1	96.4	105.6	95.0	17.9	14.3	17.0	13.6
56	107.7	97.0	106.2	95.6	18.0	14.4	17.1	13.7
57	108.3	97.5	106.7	96.0	18.2	14.6	17.2	13.8
58	108.8	98.0	107.3	96.6	18.3	14.6	17.4	13.9
59	109.4	98.5	107.8	97.0	18.5	14.8	17.5	14.0

Note: Reference data up to 23 months taken for length; data 24 months and above taken for height

REFERENCE ANTHROPOMETRIC DATA ACCORDING TO SEX FOR WEIGHT FOR HEIGHT AND ARM CIRCUMFERENCE FOR HEIGHT

(Combined Sexes)

Height/Length (cms)	Weight (kgs)		Arm Circ. (cms)	
	100% Ref.	80% Ref.	100% Ref.	82.5% Ref.
48			10.6	8.7
49	3.3	2.6	10.8	8.9
50	3.4	2.7	11.0	9.1
51	3.5	2.8	11.2	9.2
52	3.7	3.0	11.4	9.4
53	3.9	3.1	11.6	9.6
54	4.1	3.3	11.8	9.7
55	4.3	3.4	12.0	9.9
56	4.6	3.7	12.2	10.1
57	4.8	3.8	12.4	10.2
58	5.1	4.1	12.6	10.4
59	5.4	4.3	12.8	10.6
60	5.6	4.5	13.0	10.7
61	5.9	4.7	13.2	10.9
62	6.2	5.0	13.4	11.1
63	6.5	5.2	13.6	11.2
64	6.8	5.4	13.8	11.4
65	7.1	5.7	14.0	11.6
66	7.4	5.9	14.1	11.6
67	7.6	6.1	14.2	11.7
68	7.9	6.3	14.3	11.8
69	8.2	6.6	14.4	11.9
70	8.5	6.8	14.5	12.0
71	8.7	7.0	14.6	12.0
72	9.0	7.2	14.7	12.1
73	9.2	7.4	14.8	12.2
74	9.5	7.6	14.9	12.3

(Combined Sexes)

Height/Length (cms)	Weight (kgs)		Arm Circ. (cms)	
	100% Ref.	80% Ref.	100% Ref.	82.5% Ref.
75	9.7	7.8	15.0	12.4
76	9.9	7.9	15.1	12.5
77	10.2	8.1	15.2	12.5
78	10.4	8.3	15.2	12.5
79	10.6	8.5	15.3	12.6
80	10.8	8.6	15.4	12.7
81	11.0	8.8	15.4	12.7
82	11.2	8.9	15.5	12.8
83	11.4	9.1	15.5	12.8
84	11.6	9.3	15.6	12.9
85	11.8	9.4	15.6	12.9
86	12.0	9.6	15.7	13.0
87	12.1	9.7	15.7	13.0
88	12.4	9.9	15.7	13.0
89	12.6	10.1	15.8	13.0
90	12.8	10.3	15.8	13.0
91	13.0	10.4	15.8	13.0
92	13.2	10.6	15.9	13.1
93	13.5	10.8	15.9	13.1
94	13.7	11.0	16.0	13.2
95	14.0	11.2	16.0	13.2
96	14.2	11.4	16.0	13.2
97	14.5	11.6	16.1	13.3
98	14.8	11.8	16.1	13.3
99	15.1	12.1	16.2	13.4
100	15.4	12.3	16.2	13.4
101	15.7	12.5	16.2	13.4
102	16.0	12.8	16.3	13.4
103	16.3	13.0	16.3	13.4
104	16.6	13.3	16.4	13.5

(Combined Sexes)

Height/Length (cms)	Weight (kgs)		Arm Circ. (cms)	
	100% Ref.	80% Ref.	100% Ref.	82.5% Ref.
105	16.9	13.5	16.4	13.5
106	17.2	13.8	16.5	13.6
107	17.5	14.0	16.5	13.6
108	17.8	14.2	16.6	13.7
109	18.1	14.5	16.7	13.8
110	18.4	14.7	16.7	13.8

REFERENCE ANTHROPOMETRIC DATA ACCORDING TO AGE AND SEX FOR ARM CIRCUMFERENCE AND TRICEPS FAT FOLD

	Arm Circumference (cms)				Triceps Fat Fold (mms)			
	100% Ref.			82.5% Ref.	100% Ref.	60% Ref.	100% Ref.	60% Ref.
Age in Months	Males	Females	Both Sexes	Both Sexes	Males		Females	
0	10.2	10.0	10.1	8.3	7.2	4.3	7.6	4.6
1	11.3	11.1	11.2	9.2	8.4	5.0	8.3	5.0
2	12.2	12.1	12.1	10.0	9.5	5.7	9.0	5.4
3	13.0	12.9	12.9	10.6	10.3	6.2	9.6	5.8
4	13.7	13.6	13.6	11.2	11.0	6.6	10.1	6.1
5	14.2	14.2	14.2	11.7	11.5	6.9	10.5	6.3
6	14.7	14.7	14.7	12.1	11.8	7.1	10.9	6.5
7	15.1	15.1	15.1	12.5	12.0	7.2	11.1	6.7
8	15.4	15.4	15.4	12.7	12.1	7.3	11.3	6.8
9	15.6	15.6	15.6	12.9	12.2	7.3	11.4	6.8
10	15.8	15.8	15.8	13.0	12.2	7.3	11.5	6.9
11	15.9	15.9	15.9	13.1	12.1	7.3	11.6	7.0
12	16.0	16.0	16.0	13.2	12.0	7.2	11.6	7.0
13	16.0	16.0	16.0	13.2	11.9	7.1	11.6	7.0
14	16.1	16.0	16.0	13.2	11.8	7.1	11.6	7.0
15	16.1	16.0	16.0	13.2	11.7	7.0	11.6	7.0
16	16.1	16.0	16.0	13.2	11.6	7.0	11.6	7.0
17	16.2	16.0	16.1	13.3	11.5	6.9	11.6	7.0
18	16.2	16.0	16.1	13.3	11.4	6.8	11.6	7.0
19	16.2	16.1	16.1	13.3	11.3	6.8	11.6	7.0
20	16.2	16.1	16.1	13.3	11.2	6.7	11.6	7.0
21	16.2	16.1	16.1	13.3	11.1	6.7	11.5	6.9
22	16.3	16.1	16.2	13.4	11.0	6.6	11.5	6.9
23	16.3	16.1	16.2	13.4	10.9	6.5	11.5	6.9
24	16.3	16.1	16.2	13.4	10.8	6.5	11.5	6.9
25	16.3	16.1	16.2	13.4	10.7	6.4	11.5	6.9
26	16.3	16.1	16.2	13.4	10.6	6.4	11.4	6.8
27	16.4	16.2	16.3	13.4	10.6	6.4	11.4	6.8
28	16.4	16.2	16.3	13.4	10.5	6.3	11.4	6.8
29	16.4	16.2	16.3	13.4	10.4	6.2	11.3	6.8
30	16.4	16.2	16.3	13.4	10.3	6.2	11.3	6.8
31	16.4	16.2	16.3	13.4	10.2	6.1	11.3	6.8
32	16.4	16.2	16.3	13.4	10.1	6.1	11.2	6.7

	Arm Circumference (cms)				Triceps Fat Fold (mms)			
	100% Ref.			82.5% Ref.	100% Ref.	60% Ref.	100% Ref.	60% Ref.
Age in Months	Males	Females	Both Sexes	Both Sexes	Males		Females	
33	16.4	16.2	16.3	13.4	10.1	6.1	11.2	6.7
34	16.4	16.3	16.4	13.5	10.0	6.0	11.2	6.7
35	16.5	16.3	16.4	13.5	10.0	6.0	11.1	6.7
36	16.5	16.3	16.4	13.5	9.9	5.9	11.1	6.7
37	16.5	16.3	16.4	13.5	9.8	5.9	11.1	6.7
38	16.5	16.3	16.4	13.5	9.7	5.8	11.0	6.6
39	16.5	16.4	16.4	13.5	9.7	5.8	11.0	6.6
40	16.5	16.4	16.4	13.5	9.6	5.8	11.0	6.6
41	16.5	16.4	16.5	13.6	9.6	5.8	10.9	6.5
42	16.5	16.4	16.5	13.6	9.5	5.7	10.9	6.5
43	16.5	16.5	16.5	13.6	9.4	5.6	10.8	6.5
44	16.6	16.5	16.5	13.6	9.4	5.6	10.8	6.5
45	16.6	16.5	16.5	13.6	9.3	5.6	10.7	6.4
46	16.6	16.5	16.6	13.7	9.3	5.6	10.7	6.4
47	16.6	16.6	16.6	13.7	9.2	5.5	10.7	6.4
48	16.6	16.6	16.6	13.7	9.2	5.5	10.6	6.4
49	16.6	16.6	16.6	13.7	9.1	5.5	10.6	6.4
50	16.6	16.7	16.6	13.7	9.1	5.5	10.6	6.4
51	16.7	16.7	16.7	13.8	9.0	5.4	10.5	6.3
52	16.7	16.7	16.7	13.8	9.0	5.4	10.5	6.3
53	16.7	16.7	16.7	13.8	8.9	5.3	10.5	6.3
54	16.7	16.8	16.7	13.8	8.9	5.3	10.4	6.2
55	16.7	16.8	16.7	13.8	8.8	5.3	10.4	6.2
56	16.7	16.8	16.8	13.9	8.8	5.3	10.3	6.2
57	16.8	16.9	16.8	13.9	8.7	5.2	10.3	6.2
58	16.8	16.9	16.8	13.9	8.7	5.2	10.2	6.1
59	16.8	16.9	16.8	13.9	8.6	5.2	10.2	6.1

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