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NUTRITIONAL STATUS OF PRESCHOOL CHILDREN IN CASSAVA PRODUCING AREAS OF NIGERIA AS ASSESSED BY NUTRITIONAL ANTHROPOMETRY AND FOOD INTAKE

BY

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ABSTRACT

In order to assess the nutritional status of preschoolers in cassava-growing areas of Nigeria, anthropometric measurements of 437 preschoolers aged 0-5 years were taken in 378 randomly selected farm-households in 63 villages from cassava-producing areas of Nigeria. Growth deviation from NCHS median, percentage prevalence and severities of undernutrition were calculated based on the National Centre for Health Statistics (NCHS) reference. Also calculated were mean daily food nutrient intakes and adequacy ratios, using food composition table. Calculations were made for overall sample of the preschoolers and by age groups and gender. Association between anthropometric indicators and household characteristics, health and socio-economic factors, household cash income, expenditure, and consumption on all food, cassava and on other staples respectively were assessed. Significance of difference was determined by Chi-Square or General Linear Model.

On the overall basis, calcium, vitamins A and C intakes were higher than FAO/WHO/UN (1995) requirements. Other nutrients intakes of the preschoolers were lower than their body needs. The growth deviations of the preschoolers in the overall sample by the three indicators (below median - 2SD weight for age, height for age, and weight for height) were above median - 2SD. The differences in the growth deviations were significant and highest in the age group 48-60 months. Energy and protein adequacy ratios for the youngest age group (0 - < 12 months) and protein for 12 - < 24 and 24 - < 48 months old exceeded that of requirements. The same is true of iron, vitamins A and C in

all the age groups except of vitamin C in the 48 - <60 months age group. Female preschoolers deviated less from the NCHS reference population than male. The nutrient adequacy ratios of both the males and females were lower than the requirements except for iron and vitamins A and C.

The growth deviations were significantly less among preschoolers in large than in small households, and in those whose mothers' had some formal education. It was less among preschoolers in households with access to potable water supply in those that had not suffered from diarrhoea, and among those from high sales income households. The deviations were less among preschoolers from high than among those from low cassava food expenditure households except in the case of weight for height indicator. The deviations were significantly less among children from high than among others from low total food expenditure households for all three indicators ($p<0.05$).

Three conclusions emerge from this study: first, the nutritional status of the preschoolers is above median - 2SD NCHS reference population: however, there are significant differences between sexes and among age groups and association with some household characteristics, health and socio-economic factors. Secondly, total expenditure on all food rather than expenditure on individual food items determined the nutritional status of preschoolers. Thirdly, children from high cassava food expenditure households had better nutritional status because such households had higher sales incomes and hence spent more on food than low cassava food expenditure households.

DEDICATION

This project is dedicated to my beloved mother, Mrs. C. U. Asinobi and in memory of my late father, Chief M. I. Asinobi.

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CERTIFICATION

I certify that this research was carried out by Miss Chinagorom Asinobi of the Department of Human Nutrition, University of Ibadan.

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CHAPTER ONE

INTRODUCTION

1.1 Background Information

Malnutrition, a public health problem is as common in Nigeria as elsewhere in Africa, Asia and south America but it is not universal within each country or continent. It occurs in certain places, at certain times and among certain people. The exact incidence and prevalence in Nigeria are unknown despite several nutritional surveys on both local and national levels in the past years (Morley, Woodland, Martin and Allen, 1968), and huge volume of knowledge on human nutrition. Goldsmith (1975) has no doubt that throughout the whole country, the incidence of malnutrition is high although the true nature and extent throughout the country is largely unknown.

This public health problem is most prevalent in preschool children because of the nature of their vulnerability to ill-health (their requirement for achievement and maintenance of health include extra requirement for growth and development) and increase in the proportion of preschool children in the total population of many developing countries (Indian Council of Medical Research, (ICMR), 1974). Consequently, the nutritional status of the population of preschool children has come to be generally accepted as an indicator of the nutritional status of the community (Akinlosotu and Hussain, 1985).

Early malnutrition which stunts growth has been repeatedly reported to contribute to poor intellectual and physical development of children (Soysa and Waterlow, 1981;

Hoorweg, 1976) and consequently stifles development. Morbidity and mortality which are some of the disastrous effects of malnutrition in children in particular are common phenomena in many technologically developing countries of the world (Goldsmith, 1975). Severe or moderate malnourishment of children under five is inconsistent with building the long-term future generation of a country; protecting the nutritional status of children is not "just welfare", it is economic investment of the most fundamental sort related to economic production in the long term.

There is now a growing realization that malnutrition is not only a problem of food supply but can be a function of more complex factors. The nutritional status of an individual is the outcome of a complex interaction of broad range of host and environmental factors, the latter encompassing physical, biological and especially socio-cultural ones (Pellet, 1983; Taylor, 1978; Sahn and Scrimshaw, 1983). Atinmo (1983) has observed that socio - cultural factors such as social position of each individual in the family , sequence in which meals are served, attitude toward food, food as an expression of prestige, taboos and the obligations of hospitality are also important in considering the quality and quantity of food consumed by a member of the community. It's etiologies include low income, uneven household food distribution, poor sanitation, infection, inadequate food marketing and preservation (Berg, 1987), as well as poor knowledge of nutrition (Chen, Chonedhury and Huffman, 1980). Household socio-economic characteristics also determine to a large extent the nutritional status of children.

Since malnutrition is a very complex problem, multifaceted strategies are required to combat it. It is therefore important to determine its causative factors before appropriate intervention can be implemented. To develop an effective preventive program against malnutrition, it is necessary not only to assess the nature and magnitude of the problems but to identify factors affecting it and their relative importance. Anthropometric and food consumption surveys are reliable methods of assessment of nutritional status of people in a community (Davison, Passmore, brook and Truswell, 1975).

The inextricable connections between social conditions, economic development, and the nutritional status of human groups have been of research interest to nutritionists. Anthropometry is the readily available method of assessing nutritional status. It includes weights, heights, head, chest, mid-upper arm circumference, triceps and skinfold thicknesses. Skinfold thicknesses are meant to reinforce and improve clinical judgement in assessing nutritional status and growth of children (WHO, 1987). Anthropometric data in spite of their limitations provide the most valid assessment of physical growth, body composition, and general nutritional status that is feasible for use in screening programs and standard physical examination (Roche and Mckigeyi, 1975; Benefice, Chevssus-Agnes, Maria and Ndiaye 1980). Children at the extremes of distributions of anthropometric indices are more likely to be either over-nourished, under-nourished, or suffering from disease.

1.2. Identification of problems:

Cassava (manihot utilisima) is an extensively grown food crop in Nigeria. It is grown over a wide range of climate, soil, and other ecological factors in all states of the country. In the southern states, a cassava based farming system is widely identifiable. Cassava is a basic food staple of most people in Nigeria. Depending on variety and cyanogen content, it can be eaten raw, boiled, pounded into *fufu* or as processed *garri*, *lafun*, etc. Its role in supplementing household income is not in doubt (Nweke, 1996). In some areas, it accounts for as much as 50 percent of household income. It is a security crop as it ensures food supply when all other crops have failed. In all considerations, its importance in the rural farm economy food security is well established. Yet, food production is low and most of cassava products, e.g. garri are not affordable to many households.

Cassava has for long and erroneously been considered to be an inferior commodity (Ekpere, Ikpo, Gleason and Gebremeskel, 1986). There is a perceived inverse relationship between cassava consumption and standard of living. For instance, high cassava consumption is often presumed to associated with malnutrition (Ekpere, et al.,1986). This myth associated with cassava in the past, in some parts of Nigeria, made the crop appear inferior to yam. It is believed that kwashiorkor due to protein deficiency is more common in young children weaned onto cassava rather than millet or maize (Tylleskår and Tylleskår, 1988). Few studies conducted on the nutrition are fragmented, controlled by different authors (Nnayelugo, 1982; Nnayelugo, King, Ene-obong and Ngoddy 1985) with different methodologies at different periods of the year. Other works (Akinlosotu and Hassain, 1985; Addo, 1984) were not specific on preschoolers. In addition, there is hardly any work that has included an analysis of the effects of socio-economic factors of preschoolers in Nigeria. There are not only age, or sex-related differences in the nutritional status but also socio - economic and geographical location differences. In some geographical areas there is a relatively high prevalence of wasting with relatively low prevalence of stunting, whereas in other areas the opposite is found (Keller and Fillmore, 1983; Anderson, 1979).

There is need for comprehensive data that would address the magnitude and nature of malnutrition of preschoolers for the entire cassava growing areas of Nigeria for the same period of time for use in the national nutrition policy, public health, and nutrition programs, planning and for international comparison. Such data will provide useful information for food and nutrition policy formulation and for long term nutrition and health surveillance activities at national level. It will also provide extra data on the evaluation of health, education and agricultural services and action.

1.3 Data Source:

This work is based on information the researcher collected in the year, 1992 during Collaborative Study of Cassava in Africa (COSCA), funded by the Rockerfeller Foundation. COSCA's aim was to collect authoritative information over a wide area on cassava production systems, processing methods, market prospects, and consumption patterns and nutritional status, as a guide for cassava research. COSCA covered Cote d'Ivoire, Ghana, Nigeria, Tanzania, Uganda and Zaire, which together produce about 70% of the cassava output in Africa. These countries were sufficiently variable in the key factors (climate, demographic and market-pressures) that were hypothesized to be determinants of cassava production in Africa (Carter and Jones, 1989).

COSCA is being executed in three phases as follows:

Phase I involves a broad characterization of the following:

1. Environment (physical, social, economic)
2. Production
3. Processing
4. Marketing
5. Consumption

Phase II deals with cassava production details such as:

1. Yield
2. Land area
3. Utilization (sale/home use, processed/fresh use)
4. Input/output
5. Production practices

Phase III involves detailed studies on postharvest issues:

1. Processing

.Characterization of techniques

.Product quality assessment (nutritional, toxicity, and quality assessment)

2. .Marketing

3. .Nutrition/Consumption/demand

Phase I survey was conducted in 1989, Phase II in 1991, and Phase III in 1992.

1.4 Objectives

Overall:

to assess the nutritional status of preschoolers in cassava growing areas of Nigeria

Specific:

1. to determine the anthropometric values and food intakes of the preschoolers
2. to compare the anthropometric values of the preschoolers with those of NCHS (1976) reference population with a view to finding level of malnutrition
3. to compare the nutrient intakes of the preschoolers with those of FAO/WHO/UN (1985) and WHO (1967) recommended nutrient requirements
4. to determine any age group and gender differences in the anthropometric indices and food intakes of all the preschoolers
5. to determine whether there are differences in the mean indices of the nutritional status of preschoolers by some household characteristics, health and socio - economic variables
6. to examine statistical association between the nutritional status indicators of

preschoolers and other household characteristics, health and socio-economic classification and non - classification variables

1.5. Hypothesis

1. the mean anthropometric indices from preschoolers and NCHS international standard are equal
2. the nutrient intakes of preschool children and FAO/WHO/UN (1985) and WHO (1967) recommended nutrient requirements are the same
3. no significant differences exist by age group and gender of the preschool children at 5% level of probability in:
   - a) the anthropometric indices
   - b) the percentage prevalence of malnutrition
   - c) the nutrient intakes
4. no significant differences exist by each of the following factors' sub - groups of preschoolers in the mean anthropometric indices
   - a. household characteristics
   - b. health factors
   - c. socio-economic factors
5. the level of nutritional status of preschoolers is independent of the household characteristics, health and socio-economic variables

CHAPTER TWO

LITERATURE REVIEW

2.1 Nutritional status and methods of assessment

The state of health of an individual taken in conjunction with his food intake and determined by this intake is referred to as his Nutritional Status (Nnanyelugo, Ngwu, Asinobi, Uwaegbute, and Okeke, 1992). According to encyclopedia of Food Science, Food Technology and Nutrition (1993), nutritional status of the community is defined as the presence or absence of diet-related diseases which is related to the health and well-being of the community.

Nutritional status data assess the prevalence of malnutrition in cross-sectional studies and/or the study of the association of malnutrition and its determinant in longitudinal studies (Encyclopedia of Food Science, Food Technology and Nutrition , 1993). An additional and important use of these data is for surveillance or intervention programs (WHO, 1987). In this case the data collected is often limited to the most relevant indicators of major risk for the population surveyed. The most vulnerable groups inside the population are pregnant and lactating women, children, adolescents, and the elderly. Consequently, nutritional status can play an important role in solving or preventing nutrition problems.

Many authors have used different methods singly or in combination for assessing the nutritional status of their target populations such as anthropometry and clinical signs (Nnanyelugo, 1980b and 1982b), clinical examinations, biochemical, and dietary (Davison et al., 1975) and anthropometry which has greatly been used in several African countries to obtain the incidence of malnutrition (Anderson, 1979; Aguillon, Caedo, Arnold and Engel, 1982) as in different part of Nigeria and other developed countries (Chen et al., 1980; Grantham - Mcgregor, 1980; Demey, 1983).

It is widely accepted that for practical purposes anthropometry is the most useful tool for assessing the nutritional status of children (WHO, 1987). Besides being rapid, portable , non invasive, inexpensive and simple in principle (WHO,1987; Jelliffe, 1966), mainly useful in population based field research, it can be a valuable adjunct to clinical appraisal providing a quantitative indication of the rapidity of size increase, the relative amount of different tissues present and an indication of the effective calories excess in children and adults. The classical use of anthropometry as the most readily available method of assessing nutrition status is therefore logical. Other methods, such as biochemical and immunological test, intake studies or the use of clinical signs are relatively uncommonly used because they tend to suffer from one or more of the following drawbacks, insensitive to subclinical protein-energy malnutrition, liable to short term variation, feasible only on a small scale, due to personnel equipment and time requirements, and methodological difficulties, inaccurate, or susceptible to researchers subjectivity (Hitching, 1982).

Although biochemical and clinical techniques may provide more specific information on the existence of individual nutrient deficiencies, in many cases these examinations become depleted. Thus these latter techniques are useful in characterizing existing nutritional problems, but are less helpful when predicting the likelihood of future deficiency status.

Specifically, dietary studies are difficult to collect and analyze. Although many authors have used it in the nutritional status assessment (Addo, Sampson, Kareem and Jibrim, 1988; Allen, Black and Bacststrand, 1991; Chandhung, 1984) it has some limitations. While anthropometry may index the problem, e.g. growth failure, it does not by itself identify the specific cause or indicate the specific solution. For instance, identification of poor growth only indicates that nutritional problems exist, without denoting the specific limiting nutrients or the cause of deficiency. It is therefore not always a satisfactory index of response.

Since each of these assessment techniques provides different and incomplete information on nutritional status, they must often be used in concert to characterize the nutritional condition of an individual or population.

2.2 Nutritional anthropometry and physical growth achievement

Nutritional anthropometry is concerned with the measurement of the variations of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition (Jelliffe, 1966). Food Science, Food Technology and Nutrition encyclopedia (1993) defined anthropometry as comprising techniques which readily contribute to a more in-depth understanding of body composition and nutritional status allowing the quantification of observations and the observation of changes with time.

According to Seone and Latham (1995), anthropometry involves the measurements of growth and stature. This physical growth is considered one of the major outcomes of the interaction between nutrition and the environment. Similarly, Hitchings (1982) defined anthropometry as concerned with the evaluation of growth-related outcome variables, e.g. the human biology variables relates intake, absorption, and health to nutritional status in a dynamic framework. Behavioral/anthropological factors determine food preparation, intra-family distribution and breast-feeding practices, given a level of food availability. The types and quantities of food for consumption are influenced by tastes and preferences, but largely derive from economics and agriculture, public health can change the purity of water, the exposure to infection, and sanitation facilities in the environment. The variables greatly affect nutritional status in one way or the other.

Anthropometric methods are based on a model of body composition which consists of two distinct compartments: fat mass and fat free mass (Food Science Food Technology and Nutrition encyclopedia, 1993). This two compartment model of the body composition defines the fat-free mass as a compartment consisting of body cells including skeletal muscle, extra cellular water, the skeleton and connective tissue. Anthropometric measurement can indirectly assess the two body compartments and thus provide an index of nutritional status. Alteration in body fat content generally are sensitive to changes in energy balance. Chronic malnutrition is reflected in changes in protein stores found predominantly in skeletal muscle in the body. Selected body measurements can therefore give valuable information concerning certain types of malnutrition in which body size and gross body composition are affected. Jelliffe (1966) demonstrated the dramatic historical examples of the effect of nutrition on anthropometric measurements in the lower weights and heights of European school children in Paris following prolonged and severe war-time dietary restrictions. Conversely, and probably mainly because of improving nutrition, the stature and weight of children and adults have increased progressively over the past hundred years in both North America and Europe and more recently in Japan and Jamaica .

The measurement of anthropometry classified into four broad categories as follows (Food Technology and nutrition encyclopedia, 1993) explains the link between anthropometry and growth.

1) Body weight. Growth increases as body weight increases.

2) Linear measurement, such as supine crown heel and crown-rump lengths in early infancy or standing and sitting height after 2 years of age, limb lengths, the distance between specific anatomical landmarks, such as the width of pectoral and pelvic girdles and head circumference - these are all functions of skeletal growth,

3) Limb and abdominal circumferences, which are used as indirect indices of soft tissue mass.

4) Skinfold thicknesses at anatomically defined sites. Suitable combination of skinfolds

thickness measurements predict body fat mass and when combined with measurements of limb circumference and bone diameter, can be used to derive estimates of skeletal muscle growth.

Jelliffee (1966) grouped the measurement as Body weight, linear measurement and soft tissues.

The use of anthropometry in the assessment of physical growth dimension has been widely recommended (WHO, 1983) and used primarily owing to widely accepted practical purpose of anthropometry. Measurements of weight, height, arm circumference, and triceps skinfolds thickness are commonly recognized as important indices of nutritional status that is of protein-energy malnutrition. Height, usually assessed in relation to a population standard and expressed as height for age is commonly used as an indicator of the chronicity of undernutrition, longitudinal measurements of height velocity are particularly helpful in this respect (Nabarro, 1983). Weight, usually assessed as weight for height responds rapidly to changes in nutritional status and provides a useful indicator of nutrition of the individual during the immediate preceding period (WHO, 1988).

More subtle conclusions about the history of an individual's growth status can be derived through the use of additional anthropometric parameters especially those that provide an index of body composition. This method has been widely used by Cole and Udekwe (1989) on the analysis of the body composition, energy, protein and iron intake of Nigerian female nursing students. However, Balogun, Olawoye and oladipo (1994) used

Body mass index (BMI) also called the Quetelet (Wt/Ht^2) to determine anthropometric indices of male and female Nigerians of different age groups.

Anthropometric assessment of fat-free mass and fat mass are obtained by the use of upper arm. It contains both muscle and subcutaneous fat, so that measurement of the circumference of the mid upper arm may be used as an index of nutritional status. In under developed countries where the population is often malnourished and with little fat reserves a change in this measurement can reflect total body protein stores. Serial measurement of the upper arm circumference may be used to monitor nutritional intervention. Others are mid arm muscle circumference and mid arm muscle area.

2.3 Anthropometric Indices and growth interpretation

The common anthropometric measurements used are weight, height, and age (WHO, 1987), and these parameters are combined to form the anthropometric indices such as weight for age, height for age and weight for height. Weight is the simplest anthropometric measurement of growth and nutrition. Presentation of weight levels of community can be expressed for children in terms of percentage in various percentiles of standards or as percentage in the degree of malnutrition proposed by Gomez (1956). Alternatively, weight can be classified in Gomez scale as having first, second and third degree malnutrition. This preposition for Gomez is sometimes criticized for being made with reference to international standard of weight for age, for example Gomez classification put against standard value, 90% normal, 90-75% mild malnutrition (grade 1), 75-61%

moderate malnutrition (grade 2) and less than 50% severe malnutrition.

As there is considerable dispersion of individual body-weight even within presumably well - nourished communities, it may be better to express weight in relation to some fixed parameter rather than in absolute terms (Garn, 1962). For instance, body-weight may be related to head circumference in early childhood, but this is not always satisfactory in practice owing to the difficulty in obtaining the later measurement accurately. Also weight correlated with height (or length) can be employed to detect both under and over nutrition. This can be explained by Waterlow classification of malnutrition (Table 1).

Table 1 : Classification of malnutrition by Waterlow (1977)

Height for Age	Weight for height % of International Standard		
% of International Standard	<80%	>80%	110%
< 90%	Stunting and Wasting (Acute or chronic PEM)	Wasting and/ or Stunting Chronic (PEM)	Obese
> 90%	Weight loss but no Stunting (acute PEM)	Normal	

The disadvantage is that height is also affected by malnutrition during growth. Nevertheless, the correlation can be useful in assessing protein-calorie deficiency of early childhood, because the growth retardation that occur affects weight markedly and height only to a limited extent.

The heights of individuals are sometimes preferable if ages are known, to demonstrate the physique of individuals in graphic presentation by combining age and weight and height indices (Jelliffe, 1966; Waterlow, Buzina, Keller, Lane Michannan and Tanner, 1977). The former normally grows relatively faster than other parts of the skeleton so that change in leg length, or height, may provide a sensitive index of inadequate nutrition in children.

Skinfold thickness has provided the only simple means of measuring subcutaneous fat in human being . Skinfold parameters are used to determine the body composition. The importance of measuring body composition in relation to problems of nutrition is now becoming apparent (Jelliffe, 1966). The balance of evidence at present favours measurement over the triceps as index of nutritional status (Nnanyelugo, 1982b).

Measurement of the circumference of the mid-upper arm may prove to be a useful and practical means of assessing protein-calorie deficiency of early childhood. In addition, if the biceps and triceps skin-folds have been measured, an estimate of the arm muscle size can be made (Jelliffe, 1966; Nnanyelugo, 1980b).

Two methods are commonly used in developing countries to relate the measurements of weight and height to the NCHS (1976) reference population. The first is known as the percentage of median method and the second as the Z-score method. The Z-score method is the approach preferred by international child growth experts for statistical reasons.

In the percentage of median method, the weight or height value of a child is expressed as a percentage of the median weight or height value in the NCHS (1976) reference population for a child of the same age and sex. However, the percentage of median has some limitations, which are related to problems associated with the nutritional interpretations of percentage of median values at different ages, as well as across the different indicators of weight for height, height for age, and weight for age (Martorell, 1982). One problem is that the value of percentage of median does not have a constant meaning over different age groups. For example, 95 percent of the median height for age is very different at the age of 12 and 48 months. At 12 months, 95 percent of median height for age represents the 8th percentile of the reference population, whereas at 48 months it represents the 12th percentile (Waterlow, et al., 1977). A larger problem is that percentage of median values does not have the same nutritional meaning across the three indicators of weight for height, height for age and weight for age. For example, 90 percent of the median corresponds to the 13th percentile for weight for length at 95 centimeters, but to less than 1 percentile for length for age at 36 months, which is about the age when girls achieve the median length of 96 centimeters (Martorell, 1982). On the other hand, in developing countries the percentage of median approach has been used for many years by health workers for assessing nutritional status. As a result, these professionals appear to be more familiar with it than with the Z-score method, which is discussed below.

The other method of calculating nutritional indicators involves calculating standard deviation scores, commonly referred to as Z-scores. In recent times, WHO (1983) has recommended to member countries the use of Z - scores for monitoring nutrition and health progress. This was on the grounds that Z-score has statistical meaning and adequate for use with the reference population. Z- scores show the relative position of each child's weight and height values of the NCHS (1976) reference population. Experts in child growth highly recommend the use of Z-scores over percentage of the median because Z-scores provide a better statistical assessment of nutritional status, which remains stable over different age groups as well as across the different indicators of weight for height, height for age, and weight for age (Waterlow, et al. 1977; Martorell, 1982). In interpreting Z-score for nutrition and health purposes, several possibilities of classification of the nutritional indicators by comparison with a reference population are possible (WHO, 1983). The classifications were as shown in table 2.

Table 2 : Classification of nutritional indicators by reference population.

Standard deviation	Classification
Between -1SD and +1SD	normal
Above median +1SD	Above normal (or high)
Below median -1SD	below normal (or low)

In high and low classifications, various cut-off points (or class limited) can be established such as multiples of 1 standard deviation (e.g. ±1.5, ±2 or ±2.5). These may vary from one program to another, depending on such factors as the level of precision chosen for the statistical analysis, the expected prevalence of protein energy malnutrition (PEM) in the population, and the frequency of severe malnutrition (WHO, 1983).

However, in countries where growth failure in children is widespread and severe such targets would be unrealistic and unattainable and therefore would appear that many of the rural preschool children were suffering mild to moderate malnutrition. In this respect, the international reference is shifted downwards for developing countries. The conventional cut-off point for Africa is -2SD (WHO, 1983). Thus the prevalence and severity of malnutrition can be determined using Z-score approach. A reclassification is therefore obtained for developing countries (Beaton, 1990) as shown in table 3.

Table 3 : Re - classification of the nutritional indicators for developing countries

Standard deviation	Classification
Above median -2SD	mild (no risk)
Between median -3SD and -2SD	moderate
Below median -3SD	severe (clear risk)

NCHS (1976) has used percentile approach in the growth interpretation as shown in table 4.

Table 4: Percentile classification for nutritional indicators

Percentile	Classification
75th-25th	mild (normal/no risk)
10th-5th	moderate risk
<5th	severe or clear risk

2.4 Anthropometric statistics (z-score) of preschoolers in developing countries

2.4.1 Overall status: Several studies have been conducted on the anthropometric measurements of children in the developing countries. Chen and Taren (1995), Tylleskar and Tylleskar (1988), Yambi, Latham, Habicht and Hass eported that children anthropometric measurements were comparable to international standard for the first months of life with negative deviation for weight for age and height for age Z-scores. Tylleskar and Tylleskar (1988) reported -1.25±1.14 SD score as the mean weight for age for the whole group of Sakata, Zaire (now Democratic Republic of Congo) children aged 0-3 years. The mean Z- score for height for age in the whole group was -1.20±1.21. Chen and Taren (1995) observed that the mean weight for height values started above the NCHS (1976) standard mean until about 65cm in length and remained between the NCHS (1976) mean

(0) and -1.00 SD for children between two and five years of age. Yambi et al. (1991) studied the anthropometric measurements of 2452 children from 6 to 36 months of age at baseline and at two-month intervals thereafter in Tanzania in relation to mortality risk. The mean anthropometric indicators for all the children at baseline expressed in Z-scores were -1.7 ± 1.0 for weight for age, -2.1 ± 1.1 for height for age and -0.5 ± 0.9 for weight for height.

2.4.2 Age class: The reported work of Tylleskär and Tylleskär (1988) on the mean Z-score for weight for age (1.52 ± 1.04) of preschoolers was lowest in the age group 6-11 months. Other age ranges were as follows: -0.37 ± 1.18 for 0-5 months, -1.48 ± 1.08 for 12-17 month, -1.40 ± 0.80 for 18-23 months, -1.39 ± 1.10 for 24-29 months and 1.50 ± 0.99 for 30-35 months.

The height for age mean Z - score (1.50 ± 1.21) for6-11 months old, was the lowest (Tylleskär and Tyleskär, 1988). Other age groups had mean height for age as follows -0.87 ± 1.12 for 0 - 5 months old, -1.37 ± 1.24 for 12 - 17 months old, -1.37 ± 1.72 for 18-35 months old, 1.40 ± 1.24 for 24 - 29 months old and 1.36 ± 1.34 for 30 -35 months old.

For weight for height the mean Z-score was + 0.34 ± 1.01 for 0-5 months old, -0.45 ± 0.97 for 6-11 months old, -0.81 ± 0.85 for 12-17 months old, -0.90 ± 0.83 for 18 - 23 months old, -0.58 ± 0.89 for 24 - 29 months old and -0.77 ± 0.83 for 30 - 35 months old (Tylleskär and Tyleskär, 1988).

2.4.3 Gender: Considering gender issues, Chen and Taren (1995) reported that the mean weight for age and weight for height values for both boys and girls under six months were greater than zero, and the mean height for age was near zero. The scores did not indicate any consistent difference between the growth of boys and girls for any of the age groups studied compared with the reference standards. They further reported that after six months of age, the mean weight for age fluctuated around - 1.00SD for both boys and girls while the mean height for age was comparable to the median NCHS (1976) within the first few months of life. At 12 months it was about -1.00SD, and by 36 months it was about -2.00 SD.

WHO (1987) has recommended the use of standard deviation Z-scores in the calculation of the anthropometric statistics of children. However its use has slowly diffused in the nutritional literature because of difficulties to calculate these Z-scores without computer program considerably slows down the acceptance in developing countries.

2.5 Malnutrition and its prevalence in preschoolers in developing countries

The term malnutrition may correctly imply either under nutrition, overnutrition, or an imbalance of nutrients. However in the context of developing countries because of the widespread poverty and elevated rates of infectious diseases characteristic of these settings, the term is usually applied in the more limited sense to refer specifically to undernutrition. Hence this study is concerned primarily with the problem of undernutrition in developing countries. Nevertheless, it should be recognized that many of the chronic diseases of overnutrition that are generally associated with more affluent, industrialized countries also seem to be occurring at increasing rates among adults in some developing countries .

Malnutrition in developing countries is due to underlying socio-cultural and environmental circumstances, climatic, geographic, economic and political factors that influence the production, storage, distribution, trade and pricing of foods which directly affect household food availability; likewise, local knowledge and cultural beliefs will influence food choices, processing techniques and intra-household distribution. Inadequate intake of food results in problems of malnutrition and undernutrition. Malnutrition has a very complex etiology and is usually related not only to the quantity and quality of food, but also to unsatisfactory physical and psychological environments, poverty, infections, ignorance, lack of adequate medical care, irregular food supply, inadequate distribution, limited purchasing power and interaction with infections. It leads to unacceptable levels of mortality which could be reduced considerably if effective interventions were implemented.

According to encyclopedia of Food Science Food Technology and Nutrition (1993), the major functional consequences of protein energy malnutrition (PEM) include reductions in ultimate body size and muscle mass, decreased physical activity and work capacity, altered behavioral development, and immunosuppression and consequent increased risk of infection. Perspective field studies from several different regions of the world indicate that as many as one third of childhood deaths occurring between 6 months and 5 years of age in developing countries may be associated to PEM. Some of the reported effects of malnutrition and its various manifestations include stunted physical growth, retarded mental achievement, low productivity, low resistance to diseases and infections, nutritional deficiency diseases, adverse effects during and after pregnancy and high mortality and morbidity rates (Nnayelugo (1992; Van der Vynckt, 1986; Stoch and Smythe, 1976; Hoorweg, 1976). Preventive measures that would minimize the consequences of malnutrition should therefore be encouraged.

2.5.1 Undernutrition prevalence

2.5.1.1 Overall status: National reports on undernutrition from various rural and urban areas of nations have been published. A national survey in Nigeria in (1986) conducted on children below five years of age reported 35.7 percent below -2SD weight for age , including 12.0 percent severely underweight (under -3SD) (NDHS, 1986). Also in 1987, rapid survey conducted by the Nigerian Federal Ministry of Health and United Nations Childrens' Fund (UNICEF) in five states of Nigeria showed that prevalence of underweight among under-five were 25% for Kwara, 28% for Cross River, 30% for Ondo, 39% for Bauchi, and 40% for Oyo States. Another survey conducted in Ondo state by National Demographic Health Survey (NDHS, 1986) on children aged 6-36 months showed a prevalence of 28.1% underweight. A nutritional study of an ethnic group in northern Bandundu region in Zaire (now Democratic Republic of Congo), (Tylleskār and Tylleskār, 1988) on 359 children aged 0-3 years showed that 27.6% had a weight for age below median - 2SD.

Globally, the proportion of children under 5 years of age with low weight-for-age with respect to the international reference median is greatest in south Asia, followed by Southeast Asia, sub-Saharan Africa, North Africa and the Middle East, Central America, and South Africa. The overall rate of low weight-for-age appears to have fallen from about one third of children over a decade, moreover, because the total population of under-fives increased concomitantly, the total number of malnourished children worldwide actually increased during the decade. More than 175 millions of under-five worldwide are presently believed to be undernourished according to the weight-for-age criterion (Encyclopedia of Food Science, Food Technology and Nutrition, 1993).

It is impossible to measure accurately the number of malnourished people in the world's developing countries, where nutritional problems are most prevalent. The United Nations recently estimated that some 150 million children are under-weight, about 20 millions low birth weight infants are born each year, and some 40 million children are afflicted with vitamins deficiency (United Nations Administrative Committee on Coordination - Subcommittee on Nutrition (UN/ACC/SCN, 1991). Malnutrition as represented by the prevalence of underweight affect the preschool children greatly in most African countries. It appears from available data (Table 5) from some of the African countries that although the average requirement figure usually compares favourably with the average food availability figure, the same countries have a large percentage of underweight children. It is estimated that underweight children in 1980 made up 24 percent or 16 million children in these countries. The corresponding percentage was 25 in 1985 due to the rapid population growth; the increase in the absolute number of children affected was an additional four million, i.e. a total of 20 million. In the early 1980's, the highest prevalence, greater than one third of the child population, was believed to be in Ethiopia and the Sahel countries (UN, 1987).

Despite general improvements in food availability health and social services, hunger and malnutrition exist in some forms in nearly all countries. Between 1975 and 1990 the average prevalence of PEM in children in Africa, Asia, the middle east, and the Americas combined, as estimated by FAO/WHO (1992) was reduced from 47.5% to 40.8%. Nevertheless, there were 155 million underweight children in Asia in 1990, representing 44% of children under five years of age (FAO/WHO, 1992). Grant (1992) reported the prevalence of low birth weight in infants and underweight children as of 1990; Japan and China had the lowest percentage of low birth weight and India had the highest (Table 6).

Bellamy (1996) reported for developing and least developed countries 19% and 24% respectively low birth weight children suffering from underweight, moderate and severe, 35% and 41% respectively, and severe underweight, 12% and 13%, respectively. Sierra Leone National Nutrition Survey (1978) on the nutritional status of young children and their mothers comprising of 4880 children aged at 3-59 months reported that 24.2% of the young children were chronically undernourished.

Table 5: Nutritional Status of Young Children in selected countries and national level food availability (DES) and requirements

Country requirement	Year	Percentage of samples underweight	Calories/caput per day availability	DES requirement
Cameroon	1978	21.3	2202	2117
Congo	87	23.6	2627	2118
Ethiopia	82	38.1	1707	1887
Gambia	85	37.5	1707	1887
Ghana	85	23.9	2350	2059
Kenya	83/84	15.6	1171	2047
Lesotho	76	35.0	2229	1906
Madagascar	83/84	23.9	2229	1992
Mauritius	85	27.8	2448	2114
Rwanda	76	-	2721	2148
Seychelles	84	7.8	2003	1906
Sierra Leone	78	30.5	2303	2114
Togo	77	25.3	2019	2038
Zambia	84	26.9	2175	2042

Source: FAO, strategies for combating malnutrition in Africa, Rome, 1990.

Table 6: Percentage of children (0 - 4) with low-birth weight and of children who were underweight children (moderately or severely) in selected Asian Countries, 1990

Country	low birth weight	Under weight (0-4 yrs)
China	9	21
India	33	63
Indonesia	14	40
Japan	6	-
Malaysia	10	-
Pakistan	25	40
Philippines	15	34
Sri Lanka	25	29
Vietnam	17	42
Thailand	13	26

Source: Grant, 1993

The prevalence is lowest in infants, increases after 12 months of age and reaches a plateau from 21 to 59 months. However the prevalence rate for chronic undernutrition was lower in urban (17.4%) compared with rural Sierra Leone (26.6%) (Sierra Leone National Nutrition Survey, 1978). The same survey reported 30% of young Sierra Leonean children as acutely undernourished and 30.5% of young children as underweight.

The global estimates of under weight among the most vulnerable groups especially children under five years of age are large. Over 20% of all infants born in developing countries are underweight. Some 17 million annually, are low birth weight infants, most of whom reflect inadequate maternal nutritional and health (Sierra Leone National Nutrition Survey, 1978).

In a nutrition surveillance conducted in four poor rural countries of Hubei Province, China (Chen and Taren, 1995) which included 25 villages and 3,564 children aged 0-5 years, to determine early feeding practices and the nutrition status of preschool children, low birth weight (<2,500g) was reported in 5.5% of the children. The percentage of children with a weight for age below -2.00 SD was lowest during the first year of life (6.1%) and at 12-17 months (32.6%). In a study on the impact of supplementary feeding programs on the Nutritional status of beneficiaries in Addis Ababa, Demeke and Wolde - Gabriel (1985) showed that the proportion of children aged 6-72, with sample size 40,339 in the reference population falling below the median minus 2SD weight for age, was 30.9%. Twenty percent of the children born in Africa are low birth weight infants (FAO, 1990) who constitute a very high risk group for survival. In 1990 the continent had 29 million children who were underweight (low weight-for-age).

2.5.1.2. Age class: The same nutritional survey in Nigeria (1993) reported on children below five years of age according to age-groups showed that the proportion of preschoolers below -2sd weight for age NCHS reference values were 26.3% for those under 6 months of age, 38.5% for 6-11 months, 44.6% for 24-36 months, 43.8% for 36-47 months, and 29.9% for 48-59 months of age. Sierra Leone National Nutrition Survey (1978) reported that the prevalence of acute malnutrition is low throughout all areas of the country. It reaches a peak of 9.3% in 12-14 months olds, while the prevalence of underweight was lowest in children aged 3-5 months, but increased rapidly after six months and reached a peak throughout the second year of life, reducing slightly after this. The rural Sierra Leone had underweight prevalence of 32.4% compared with 29.3% for urban areas.

2.5.1.3 Gender: The report of Nigeria nutrition survey (1993) classified by gender, showed that 41.2% of females were below -2sd weight for age. No values were recorded for males for weight for age. The prevalence of malnutrition by sex reported by WHO (1989) were 32.7% and 29.3% (weight-for-age) for females and males, respectively.

2.5.2 Stunting and wasting prevalence

Stunting (height for age) and wasting (low weight for height) are parameters most frequently used to describe nutritional conditions. They differ in their diet-related specificity. Stunting generally reflects not only prolonged (chronic) dietary inadequacy, but also other aspects of poverty and deprivation characteristic of poor household environments, e.g. frequent infections and inadequate access to health care (Beaton, Kelly, Kevany, Martowell and Masson, 1990). Stunting is therefore usually the single best anthropometric indicator because it is closely associated with household diet, and there are usually more stunted than wasted children in the one to five years age group. Chronic malnutrition or stunting during early childhood, may result from intrauterine growth retardation, or from poor dietary intake and/or high prevalence of infection postnatally. These factors commonly co-exist in individual children (FAO, 1990).

On the other hand, wasting is sensitive to the current nutrition situation especially energy balance and acute infection, and may not accurately reflect the longer term nutrition environment.

2.5.2.1 Overall status: Stunting and wasting are commonly found among children below five years of age. In Nigeria, these nutritional problems have been observed mostly in preschoolers due to the nature of their vulnerability. A recent national survey conducted in 1990 (NDHS 1990) reported 43.1 percent stunting (below -2sd height for age) including 22.2, percent severe stunting (under -3sd), while corresponding levels of wasting were 10.0 and 1.8 percent. An anthropometric survey conducted in (1991) on Nigerian preschool children 2-5 year old in seven states showed that stunting was 14% in Ijero-Ekiti in former Ondo state now Ekiti state but 46% in Kaduna in Kaduna State (Nigeria Nutrition report, 1993). A rapid survey conducted by the Federal Ministry of Health and UNICEF in 1988 in five Nigerian states showed that the prevalence of stunting among under fives was 39% for Kwara, 22% for Cross River, 25% for Ondo, 54% for Bauchi and 41% for Oyo states. Another survey of children aged 6-36 months in Ondo state reported prevalence of 32.4% for stunting and 6.8 % for wasting (Nigeria Nutrition report, 1993).

A prevalence of wasting among under-fives reported during 1983-84 by National

Health and Nutrition Status (HANS) survey of the Federal Office of Statistics was around 20% (20.9% for urban, and 19.7% for rural). The figure was considerably higher than the 1990 NDHS (Africa, 1993) figure of 10.0% for wasting (Nigeria, Nutrition report, 1993). WHO (1989) reported common prevalence of wasting (below -2sd weight for height) in 6 to 60 months old children in 1980's in different developing countries. In Nigeria wasting prevalence was 21%. About 40% of all children under five in developing countries, some 125 million children, are stunted from chronic protein-energy malnutrition, and about 12 percent, some 40 million children are wasted from acute protein-energy malnutrition (Stephen, 1985). This was obtained on the global estimates of malnutrition among the most vulnerable group, children under five years of age.

According to FAO (1990), 39 million children born in Africa are suffering from stunting and 11 million from wasting (Carlson and Wardlan, 1990). A nutritional study of an ethnic group in northern Bandundu region in Zaire (now Democratic Republic of Congo), (Tylleskär and Tylleskär, 1988) carried out on 359 children aged 0-3 years reported that 30.1% the children had low height for age and 5.3% had low weight for height . These figures are relatively good compared with other rural African child populations.

The percentages of children suffering from wasting (moderate and severe) in developing and least developed countries were 6% and 10% respectively and for wasting 42% and 50% respectively (Bellamy, 1996). In a study on the impact of supplementary feeding programs on the Nutritional status of beneficiaries in Addis Ababa, Demeke and Wolde - Gabriel (1985) showed that the proportion of children aged 6-72 months, with sample size 40,339 in the reference population falling below the median - 2SD height for age was 27.1% and weight for height was 1.2%.

Common prevalence of wasting generally in 6 to 60 months old children in 1980's has been reported (WHO, 1989) in different developing countries as Burundi 6%, Kenya 5%, Malawi 3%, Tanzania 5%, Uganda 4%, Ghana 7%, Côte d'Ivoire 9% and Bangladesh 16%.

2.5.2.2 Age class: Nigeria National report (1993) on stunting and wasting according to age groups in under five of Nigerian preschoolers were as follows: 12.4% and 7.6% respectively for preschoolers under 6 months old, 25.3% and 35.11% for 6-11 months old, 44.6% and 45.3% for 12-23 months old, 53.3% and 45.6% for 24-35 months old, 50.5% and 37.1% for 36-47 months old, and 52.9% and 36.0% for 48-59 months old.

A commonly observed pattern of change in developing country populations is that growth in weight-for-height begins to fall at 3-6 months, reaches a minimum at 12-18 months, (due to the effect of weaning practices on the children in developing countries and then returns towards normal by three years, leaving a child who is stunted but not necessarily underweight. In a nutrition surveillance conducted in four poor rural areas of Huber Province, China (Chen and Taren, 1995), which included 25 villages and 3,564 children aged 0-5 years, in which early feeding practices and the nutrition status of preschool children where to be determined showed that the percentage of children below -2.00 SD for height for age increased from 9% for children under one year old to 44% for those 18-23 months old. However, two-year-old preschoolers showed a decline in the percentage with low height for age (30.5%), but increased in each age group until five years of age (43%). Children within 12-17 months had the greatest percentage with weight for height values below -2.00 (9-2%), compared with less than 2% for those three and four years old.

In addition, percentage of children in each age group below -2SD value of NCHS reference of weight for age was reported by Tylleskår and Tylleskår (1988) as follows: 5.9% for 0-5 months, 30.8% for 6-11 months, 36.5% for 12-17 months, 25.0% for 18-23 months, 30-40% for 24-29 months, and 37.5% for 30-35 months. The same authors reported that the percentage of children in each age group below -2SD value of NCHS - reference for height for age were 13.2% for 0-5 months old, 38.5% for 6-11 months old, 32.4% for 12-17 months old, 27.5% for 18-23 months old, 34.8% for 24-29 months old, and 35.7% for 30-35 months old.

For weight for height, the percentage were 1.5% for 0-5 months old, 5.8% for 6-11 months old, 6.8% for 12-17 months old, 7.5% for 18-23 months old, and 5.8% for 24-29 months old and 5.4% for 30-35 months old respectively.

The prevalence of wasting and stunting among children in India and Pakistan was also higher than in other countries (Grant, 1993). The values were as shown in table 7.

Table 7 : Prevalence wasting and stunting among children in Asian countries

	Wasting (12 - 23 months)	Stunting (24-50 months)
China	8	41
India	27	65
Indonesia	-	-
Japan	-	-
Malaysia	6	-
Pakistan	11	60
Philippines	14	45
Sri Lanka	21	39
Vietnam	12	49
Thailand	10	28

Source: Grant, 1993.

WHO (1989) recorded the prevalence of wasting and stunting for different developing countries using the median ± 2SD cut off point. The report showed that 21.4% of Nigeria rural preschoolers were wasted (Federal Republic of Nigeria, 1984); Kenya 2.4% and 22.4% wasted and stunted for age range 0.25-0.99, 10.2 and 41.1% for 1 year, 3.8% and 49.2% for 2 years respectively, and 2.5% and 39.1% for 3 years and 3.8% and 34.9% for 4 years; Zaire (now Democratic Republic of Congo), 0.0% and 17.7% wasted and stunted for age range 0.5-0.99 years, 6.3% and 45.9% for 0.5 years, 4.5% and 57.5% for 1 year, 9.1% and 59.1% for 2 years, 2-0% and 58.0% for 3 years, 12.8% and 55.4%

for 4 years, and 9.7% and 61.3% for 5 years old (Vuylsteke, and Vlietinck, unpublished); and Zambia 3.9% and 20.5% wasted and stunted for age range 0-0.99 year, 12.0% and 47.1% for 1 year, 4.4% and 35.7% for 2 years, 4.0% and 42.0% for 3 years, 0.3% and 44.0% for 4 years and 1.4% and 43.1.% for 5 years.

Demeke and Wolde - Gabriel (1985) reported 23.3%, 39.1%, 28.2% and 28.5%, low levels of weight for age for 6-11.9 months old, 12-23.9 months old, 24-47.9 months old, and 48-71.9 months old respectively.

Besides, the prevalence of malnutrition was lowest among children from 6 to 11.9 months old, and highest among children from 12-23.9 months old from the point of weight for age and height-for age values. Demeke and Wolde - Gabriel (1985) further confirmed that the weight for height indicator showed the highest prevalence in the youngest age group, 6-11.9 months old. The authors rather confirmed that prevalence of malnutrition tend to decrease as children grew older but highest in the 12-23.9 months age group.

2.5.2.3 Gender: Information by gender of Nigerian preschoolers on the prevalence of stunting and wasting reported in Nigerian situation nutrition report (1993) was 43.4% for stunting and 35.8% for wasting for males and 42.7% for stunting and 35.7% for wasting for females. The prevalence of malnutrition by gender reported by WHO (1989) was 43.9% for males and 42.9% for females for height for age and 0.3% for males and 2.0% for females for weight for height respectively. From the data it was confirmed that more boys than girls were malnourished at the start of the survey in terms of weight for age which were 32.7 percent for males and 29.3 percent for females, and for height for age indicator, 43.9 percent for males and 42.9 percent for females respectively. The differences were not statistically significant. However, weight for height indicator relationship was higher in girls 0.3 percent than in boys 2.0 percent. They further confirmed that more girls were malnourished than boys at the end of the survey, but less malnourished at the start of the survey for all indicators. These differences were not statistically significant.

2.6 Food nutrient intakes, adequacy ratio and nutritional status of preschoolers

2.6.1 Overall status: Food nutrient intakes of preschoolers have been reported by many investigators. Ngwu, Nnanyelugo Asinobi and Ezumah (1989) have observed that none of the preschoolers in cassava growing areas of Bendel state , Nigeria met their thiamin and riboflavin needs while only 1.39%, 2.78%,5.5% and 2.78% met their energy, protein, calcium and iron needs respectively. Fashakin and Abayomi (1987) have reported adequacy of diets of Nigerian preschoolers in wet and dry season in urban and rural areas. The energy needs met was 97.9%, protein 84.0%, calcium 47.0%, riboflavin 11.3%m and niacin 226.3% for rural preschoolers in Ondo state while in Oyo state in urban areas the energy needs met was 89.3%, protein 80.1%, calcium 45.0%, riboflavin 70.6% and niacin 216.8% .

2.6.2 Age class: Nnanyelugo et. al. (1992) have observed that 24 - 36 months old preschoolers met their 88% and 85% of their energy needs in wet and dry season, 97% and 102% for protein, 59% and 77% for calcium, and 62% and 66% for riboflavin espectively. Those that are 48 - 60 months old met 97% and 97% of their energy, 98% and 09% for protein, 64% and 78% for calcium, and 48% and 56% for riboflavin during wet and dry season respectively.

2.6.3 Gender: The proportion of nutrients met by preschoolers aged 3 - 5 years have been reported by Ngwu et al. (1989). The values obtained for male preschoolers were 58.05% for energy, 45.04% for protein, 38.25% for calcium, 72.94% for iron, 44.94% for thiamin, and 18.60% for riboflavin while 75.5%, 58.09%, 88.41%, 96.62%, 36.64% and 20.27% respectively for females.

Current theory holds that good nutrition of preschoolers depends on household food security, adequate health environment, and adequate maternal and child care (UN/ACC/SCN, 1991). Moreso, protein and energy deficiencies diminish a child's growth and specific nutrient deficiencies diminish the body's ability to resist infection, leading to a higher incidence, longer duration, and greater severity of illness. According to Davison et al. (1975) malnutrition induced by dietary and related factors contributes to the breakdown of the wide range of human defense mechanisms that protect against infections. Davison et al. (1975) have also shown that calorie consumption at the household and preschooler level is positively and significantly associated with preschooler anthropometry.

Low intake of energy, protein, minerals and vitamins, aggravated by frequent severe infections, produced malnutrition in children. The rapid growth of children requires more energy and nutrients per kilogram of body weight than is necessary at other ages. Institutes of Nutrition of Central America and Panama (INCAP), (1972) and Valverde Arroyave, Guzman and Flores (1982) have reported that protein energy malnutrition and vitamin A, iodine, iron and riboflavin deficiencies have caused growth retardation in preschoolers as measured by weight and height in Central America and Panama.

2.7 Validity of use of recommended average intake levels to represent minimum requirement.

Measuring dietary intake can be compared with theoretical requirement to predict the risk of nutrient deficiency. In a typical analysis, average per capita energy requirements are matched with apparent per capita intake of calories and those whose intakes fall below the average are considered malnourished. However, inter individual variations in true requirement, inadequacy of many dietary intake analysis methods, and uncertainty regarding the bioavailability of specific nutrients from mixed diets reduce the reliability of these predictions. Many surveys have been conducted on food consumption levels, comparing the results Dietary Reference Values (DRVs) or Recommended Dietary Allowances (RDAs) in the various countries by many authors. Cole, Omowumi and Nwagbara (1997), Nnanyelugo (1982, 1985), Fadayomi (1983), Fashakin and Abayomi (1987) have observed that the use of FAO/WHO requirement or RDA by different scientists in Nigeria may give misleading information about the nutritional status of Nigerians. Besides the fact that the dietary standards are based essentially on observed intakes of groups of healthy individuals living in the more developed countries with different geographical locations, there are genetic differences. For instance the estimated average Nigerian consumption of calorie 2,130 per day compares unfavourably with 3,300 Kcal for the United Kingdom and 3,120 Kcal for the United States of America (Igben, 1983). Sukhatme (1977), argued that it is unrealistic to believe in the existence of some universal, invariant calorie standard, even after age, sex and activity are taken into account. He further stated that proper estimation requires adjustments for individual variations. In the models of individual caloric requirements prepared by Sukhatme and further clarified by Srinivasin (1980), two sources of error due to inter-individual and intra-individual variations in requirement are explicitly considered. To compare energy intake directly with a recommended allowance implies the assumption that there are no inter-and intra-individual variations. There can be little disagreement that inter-individual variations is not zero. With regard to intra-individual variation, Sukhatme shows sufficient evidence to prove not only that intra-individual variation is not equal to zero, but positive and constitutes most of the population variation (Sukhatme 1977).

For these and other reasons, energy requirements are bound to be different. It is then suggested that the nutritional status of any given country be obtained through existing local standard obtained under conditions prevailing in the country. However, the fact that the RDA is not attained by a small fraction of the population does not mean that those people are malnourished. According to Encyclopedia of Food Science, Food Technology and Nutrition (1993), the RDA are supposed to cover the needs of almost all the population, and a level of intake that is inferior by 20% or even by 40% can still be compatible with adequate nutrition.

2.8 Factors affecting growth and nutritional status of preschool children

Growth is influenced by biological determinants, including sex, intra-uterine environment, birth order, birth-weight in single and multiple pregnancies, parental size and genetic constitution, and by environmental factors, including climate, season and socio-economic level (Jelliffe, 1966). In the final analysis the environment seems to produce its effect mostly by the presence or absence of infective, parasitic and psychological illnesses (WHO,1983) and, above all, by the plane of nutrition. These factors require differentiation, but, under practical circumstances in many developing tropical regions, they may together form part of a person's total disease burden, and have secondary nutritional consequences. It is difficult, if not impossible, to disentangle these secondary effects underlying primarily dietetic malnutrition. This is especially so in kwashiorkor one of the two principal forms of severe protein-calorie malnutrition of early childhood. This condition is almost never exclusively dietary in origin, but rather the result of other cumulative stresses as well, including the nutritional ill-effects of intestinal helminths, bacterial and viral infections (such as tuberculosis, whooping cough and measles), persisted malaria, and psychological trauma associated with weaning (Jelliffe, 1966). Socio-economic levels have also been shown to contribute to difference in stature of today's children and adults (Demeke and Wolde-Gabriel, 1985; Gremer and Latham, 1981).

2.8.1 Internal factors

2.8.1.1 Genetic effects:

Genetic factors set the limits to individual growth and development. One of the bases for this is the fact that individuals who have differing genetic backgrounds have differing nutritional needs. For this reason, various human ills may arise because the individuals concerned do not get all of the nutrients in amounts compatible with their own distinctive requirements. Besides potential form, size, and functional capacity, organism is closely related to genotype. Studies of monozygotic twin reared apart yielded correlation coefficients of >0.9 for mature height in both males and females. A general relationship can be seen between the adult stature of an individual's parents and the individual's mature size. In addition, studies of family associations have revealed significant correlations ($r=0.4$ for height) between both parents and offspring and between siblings of the same gender.

More detailed analysis of these anthropometric data reveals that the mature body weight of male monozygotic twin is highly correlated (0.9), although that of female twin is much lower (0.58). Similar observations have been made in family studies, there are consistent significant parent-offspring correlations ($r=0.4$-0.6) for a variety of indices of skeletal growth, but consistently poor correlations for indices of soft tissue and fat deposition ($r=0.052$-0.2) (Encyclopedia of Food Science, Food Technology and Nutrition, 1993). These findings suggest a strong genetic influence on skeletal growth and shape, whereas the soft tissue and fat and, hence bodyweight gain, are primarily influenced by environmental factors. Genotype also exerts a dominating influence on the processes associated with physiological maturation. Thus age at menarche and the rate of skeletal maturation and tooth eruption are found to be significantly correlated within families, especially among monozygotic twins reared together.

Differences in genotype appear to underline certain characteristic growth traits of various races. Asiatic populations are shorter than Europeans or African-American groups, even under favourable circumstances (Encyclopedia of Food Science, Food Technology and Nutrition, 1993). The most obvious difference among races, however, is in shape for example, sitting height for a given leg length is greatest in young Europeans and Chinese, lowest in Australasian aborigines, and intermediate in African populations. However growth in leg length, occurs faster at an earlier age in the Chinese (Encyclopedia of Food Science, Food Technology and Nutrition, 1993). Skeletal shape differences are also seen in the ratio of shoulder span to hip width, with Europeans and Asians having higher values than Africans.

2.8.2 External factors

In the absence of endocrine disorders, the most important influence on growth is the environment within which the individual lives. In developing countries growth deficits are caused by two preventable factors, inadequate food and infection. In general, infections influence body size and growth through their effects on metabolism and nutrition (WHO, 1987). On the other hand, inadequate intake of foods results in malnutrition. Some of these manifestations are undernutrition, wasting, and stunted physical growth (Nnanyelugo, et al., 1992; Goldsmith, 1975). In this respect, adverse factors to nutritional status that should be prevented are morbidity and poor nutrition. According to Nnanyelugo et. al. (1992) environmental factors, however, particularly nutrition determines whether the individual's potential is achieved. Thus evaluation of association between the dimensional and compositional growth with nutritional status can reflect past exposures to deleterious environmental factors, many of which adversely affect the nutrition of an individual (Wenlock, 1980).

2.8.2.1 Household Characteristics Effects:

2.8.2.1.1 Household size: Household size has strong effects on quantity of food consumption; larger households allot a smaller share of income to food, and buy cheaper food at home. Household size variable has an impact on nutrient availability . Investigators have found large family size to be significantly negatively associated with good nutritional status (Aguillon et al., 1982; Ballweg, 1972). This was attributed to the inability of mothers to provide adequate care for their young children, especially where there was more than one pre-school child in the family. The effect of intra-family members which allows older members to receive the largest share (Augillon et al., 1982) has contributed to poor nutritional status. However, in a study in Madhya Pradesh, in India (Grewal, Gopaldas and Gadre, 1973; Gopaldas, Patel and Bakshi, 1988) toddlers from large families were reported to have better nutritional status than those from medium sized or small families. It was hypothesized that in large or joint families there is a greater likelihood of adult women being available to care for the young children.

Result of a study (Melville, Willam, France, Lawrence and Collings, 1988) on the determinants of childhood malnutrition in Jamaica showed that household size was statistically significant with nutritional indicator weight for age. The weight for age declined as the number of persons in the household increased. This is in agreement with other studies (Desai, Standard and Miall, 1985; Marchione, 1980; Ryan, Bidinger, Prahlad Rao and Pushpamma, 1984).

2.8.2.1.2 Number of wives: Large number of wives per man provides room for other members of the family to look after a child even in the absence of the mother. In a situation of a working mother who cannot spend much time on child care and food preparation situation members of the family make up the difference. Evidence from the Philippines (Evenson et. al., 1979) shows that such substitution takes place, but there has been uncertainty about whether the quality of the care given by other family members is equivalent to that which would be provided by the mother. Bennett, (1988) has also observed that mothers input into the health and nutritional status of the child are complemented by those of other members of the family and in some cultures by kin or neighbourhood-support group as well.

2.8.2.1.3 Education of mother: It is quite reasonable to expect that women with at least some primary education know more, than women without any formal education, about proper nutrition, the dangers of contaminant water, importance of vaccination, and other preventive measures. However, such knowledge alone is not the key factor where socio-economic conditions are at their worst (Kabir and Mohiuddin, 1986).

Consistent evidence supports the value of the mother's level of education in increasing the life expectancy of her children. Both in Costa Rica and in Latin America as a whole, an enormous difference exists in the mortality of children under two years old between those whose mothers are illiterate and those whose mothers have several years of education (Thomas, Stauss and Henriques, 1987; Horwitz, 1987). For the years 1975-1979, the rates were 33 and 16 per 1,000 live births, respectively (Rosero-Bixaby, 1985). However, there was marked diminished infant mortality between 1965 and 1969 in both levels of schooling. Ahn and Shariff (1995) in the study of determinants of child height in Uganda showed the need for a correction bias in those factors that affect child's height. They reported that without correction, the association between mothers' education levels and height was positive but not significant. After correction for selection bias, secondary education of mothers shows a significant advantage in improving child height by 1.2% compared with the children of uneducated mothers. Similarly, the magnitude and level of significance of primary education also increased after correction. This suggests that the regular uncorrected ordinary least square (OLS) did underestimate the effect of female education on the dependent measures. It has often been found for many African countries

(Desai, 1991) that there is no significant association between height for age and mothers' education. This could largely be due to non-correction for the selection bias. Thus in societies where female literacy is low, a higher level of maternal education is necessary to produce long term health in children. Mckenzie, Lovell, Standard and Miall (1976) and Caldwell (1979) have associated improved levels of maternal education with reduced child mortality; low levels of education have been found in mothers of malnourished children (Richardson, 1974; Grantham-McGregor, Stewart and Desai, 1980; Galler, Lawell, Ramsy and Solimano, 1988). The mother's education according to Caldwell (1979) can influence child health and mortality in many ways. In Libya (Popkin, 1980) and in Philippine (Aguillon et al., 1982) observed a decrease in the incidence of secondary and third degree malnutrition among pre-school children with an increase in the level of education of mothers. Bhuiya et al. (1986) also reported a positive impact of mother's education on boys' nutritional status. This effect was only attributed to the support from male decision - makers which may give more support to the boys than girls. In this way boys may benefit more from having more educated mothers. Preston (1978) have argued that advances in female education may represent a potent and cost effective means of reducing child mortality. Cochrance (1980) confirmed this view by reviewing a large number of studies. In Peru, maternal education is a better discriminant than place of residence (urban or rural) for the infant mortality rate (Moser, 1985). In the urban setting primary education of the mother was associated with 37% lower infant mortality rate than that for children of mothers with no schooling. Secondary education was associated with an additional 50% reduction in the children of mothers with only primary education. Mortality of children of mothers without schooling was 5.3 times as high as among those whose mothers had secondary education. In the rural setting primary education was associated with a 5.7% reduction infant mortality rate (Mardones, 1986).

Data for Sri Lanka showed that both maternal literacy and paternal completion of primary education interact (Meegama, 1980). In the urban setting the latter appears associated with greater differentials in infant mortality rates than the former. In estate (plantation) rural settings, paternal education appeared to have no effect when the mothers are illiterate. These examples demonstrate the complexity of interactions among variables associated with the education of mothers or parents in relation to infant mortality. Kabir et al. (1986) showed that the higher the level of education, the lower the estimated child mortality. He also observed that after all ages, the ratio of the cumulative childhood mortality for those whose mothers have no schooling is almost 3:1. On the other hand, the ratio of implied infant mortality for those whose mothers have no schooling to those whose mothers have 10 years and more is more than 2:1. He further reported that both infant and child mortality declined as the mothers' education increased. The mother's attainment of primary school education has a significant impact on child survival. In general the effects of parental education may be greater than those of income and access to health facilities combined. Evidence from around the world suggested that higher levels of education for women are associated with better health and nutrition, increased programme participation and effectiveness, and generally better economic development. Moreover, researchers in other fields, e.g. biology and agricultural economics, have shown that improved education plays a major role in efficient resource allocation.

Recent data on nutritional "positive deviance" from Bangladesh, Kenya, Mexico and the Philippines suggest that, among households at the same poverty level, some mothers handle child care, hygiene and feeding in a better, more adaptive way, and their children are better nourished as a result.

Some countries in which per capita income is high and where women are suppressed in their social development have malnutrition rates that are not very different from those of countries which are poorer economically but are more accepting of female advancement (Wandel, 1995). Access to formal and informal employment opportunities and to many kinds of social participation, even including health education programs is made difficult, if not impossible, by female illiteracy. Rural females who are most lacking in access to literacy and educational programs are the mothers of the majority of malnourished children. In many of these situations, primary health services may be available, but the social support services that would influence the home environment are lacking.

Furthermore, Wandel, (1995) reported that education of parent variables use in regression have interesting effects, suggestive of increased concern for health at higher levels of education. There is a positive effect on most nutrients, significant for Vitamin C and folate. However, university education has a negative effect on calories, fat, niacin and thiamine and post-secondary education has a negative effect on thiamine (intake of the B vitamins is frequently correlated with calorie intake).

2.8.2.1.4 Mothers' age: The mother's age when the child is born shows a positive but declining effect on the height of children after correction for selection bias (Ahn and Shariff, 1995). The association reaches the maximum at 38-40 years of age after which it is negative. The standardized height (i.e the percentage of the reference median height for age) decreases as children grow older, until the minimum is reached at 46 months of age.

2.8.2.1.5 Gender of household heads: Male-headed households with no wife present are likely to spend more on food as a proportion of their income. Despite changing gender roles in housework, food preparation still remains primarily female responsibility. Men without wives are substantially less likely to cook for themselves and are likely to prepare more convenient and usually more costly, items when they do cook.

Moreover there is a proportion of households in which women are the sole or major economic providers as a result of factors such as family dissolution and migration in such a case women income is the main determinant of food consumption. Increases in maternal influence over income allocation lead to the devotion of more resources to the child, better dietary intake for the child and improved child health and nutritional status (Wendel, 1995). The income of women are more likely to be spent on food and other basic household needs than is income earned by men and thus has a greater positive effect on children's nutritional status (Kumar, 1979; Loose, 1980). This is explained at least in part by the fact that women in virtually all parts of the world have traditionally had major responsibility for feeding and caring for children. In all cultures, women are the providers of food, they prepare it, and they mediate its distribution among household members. The capacity of women to generate income is often underutilised and even more often unrecognized, but there is some evidence that women in control of household resources demonstrate a preference for ensuring adequate food consumption above other goals (Kumar, 1979; Tripp, 1982). This women's ability to create income and to control resource allocation directly affects the nutritional status of children throughout their growth.

2.8.2.2 Health and Sanitation Effects

In poor communities, both urban and rural, both malnutrition and parasitic infections are highly prevalent. They sap the energy of the population, they result in much chronic morbidity and they often silently retard the development of each new generation. Preschool children are particularly at risk as regards both malnutrition and diarrhea. Both disorders affect the child most often and severely between 16 and 23 months of age. But infants below one year, particularly bottlefed ones, are also often affected (WHO, 1988).

Infections and malnutrition have a well-proved synergistic effect, inducing high morbidity and mortality. Among them diarrhea and respiratory infections occur with high frequency in developing nations. Infection affects food intake through appetite suppression and the utilization of foods, increases nutrient loss during illness, and creates a metabolic response that both stimulates the immune response and suppresses body growth (Haddah, Bhaittara, Immink and Kumar, 1996). On the first point for instance, during the acute phase response to infection, the metabolism of many nutrients is altered and the requirements for some nutrients are increased (Beisel, 1984). During acute respiratory infections, for example, vitamin A requirements increase substantially because of the excretion of retinol in the urine (Stephensen, Alvarez, Kohatsu,Hardmeier, Kennedy and Gammon, 1994). Measles and diarrhea have also been associated with an increased vitamin A deficiency (Bhaskaram, Reddy, Raji and Bhatnagar, 1984) that contributed to the depletion of body stores (Campos, Flores and Underwool, 1987) and the emergence of severe deficiency symptoms such as xerophthalmia (Mahalanabis, 1991).

Morbidity and poor nutritional status act synergistically to suppress growth. Thus illness not only reduces voluntary food intake, but also increases nutrient needs, while poor nutritional status lowers immune competence and therefore increases susceptibility to infection (Latham, 1995). If episodes of illness or undernutrition are not extensive, recovery is accompanied by a temporary acceleration in weight gain, the phenomenon of catch-up growth, and a return to individual's previous growth trajectory. If episodes of illness are repeated frequently, complete recovery may not occur, especially if these periods of infection and inadequate nutrient intake coincide with periods in which growth potential is high. This frequent concurrent episodes of infection and poor nutrient intake are the major factors underlying the short stature of some individuals, particularly those whose socio-economic status is low, those who live in rural versus urban areas, those who are younger sibs in large families and those children who live under stressful conditions. Many geographical differences also can be explained on this basis.

2.8.2.2.1 Source of water supply: Water supply, particularly house connections, sewage-disposal and basic sanitation systems, particularly if combined with hygienic practices, help reduce childhood morbidity and mortality from communicable diseases (Esrey and Habicht, 1987; Strauss, 1987). It is one of the community-level aggregates of the risk factors included to pick up the effect of the quality of the exogenous environment. Poor water source has unacceptable levels of coliforms by WHO standards. They are contaminated with intestinal parasites. In Chile, as in Costa Rica, Horwitz (1987) has reported a rapid decline in infant mortality from 1975-1982 in quantitative term due to increase of potable water and sewage in urban areas. Also Aho and Shariff (1995), reported a significant association with drinking water and child's height, which changes from negative to positive association as expected after correction. Similarly, Gopaldas et al. (1988), Powell and Grantham-McGregor (1971) found that poor sanitary conditions, specifically water source of supply and toilet, adversely affect the nutritional status of children below four years of age in Jamaica. It has been hypothesized that such an association may be due to the greater frequency of infectious diseases (Christiansen, Mora and Herrera, 1975).

2.8.2.2.2 Immunization: It is one of the elements in the UNICEF/WHO (1985) child survival strategies for eradication of communicable diseases e.g diarrhea and respiratory disease., etc. However, the efficacy of various vaccines depends upon the ability of the host to mount adequate and appropriate immune response to the concerned vaccine. Nutrition is an important modulator of immune response. High coverage by immunization against the communicable diseases of childhood is a safeguard for better nutrition and health. Severe PEM indices immunosuppression thereby increasing the succptibility of the child to infections. It also contributes to the severity of illness in a malnourished child.

2.8.2.2.3 Diarrhoea episode: Diarrhoea is a major problem of child health in developing countries (WHO/UNICEF, 1985; Santos, and Carandang-Bravo, 1986; Bertan, 1986). It is especially hazardous in children because it may result either in death due to dehydration and electrolyte imbalance or in malnutrition from repeated attacks (Santo, et al. 1986; Bertan, 1986). The major reason for malnutrition occurring during and after diarrhoea are due to anorexia and malabsorption and the associated food restriction instituted by mothers as therapy, loss of nitrogen, and other nutrients, and alteration in digestion, absorption and metabolism. In addition, parents adhere to superstition and traditions, and accept incorrect facts with respect to nutrition during diarrhoea (WHO/UNICEF, 1985; Mata, 1986; Brown and Machean, 1984; WHO, 1984). In most countries the high incidence of diarrhoeal disease is influenced particularly by increased environmental exposure to infection or toxic agents encountered in contaminated food or water and the habitat-home, school or place of work. But the effects and outcome of acute diarrhoeal diseases depend greatly on the prevailing nutritional condition of the subject and the diet adopted during attack. Diarrhoeal diseases are most frequent and severe in the preschool years, more particularly from 16 to 24 months of age (WHO,1988). Diarrhoeal diseases also occur however among younger infants both neonates and later in life. They are also not uncommon, although much less severe in their consequences, among children of school age and adults. The period from 6-35 months, and more particularly from 12-23 months is generally that of poorest nutritional status, faltering growth, and of the highest morbidity and mortality. During this period intakes of energy, protein, iron, vitamins A and other vitamins and minerals are all at their lowest level in relation to physiological needs in the Africa Region. A number of studies have revealed that acute diarrhoeal diseases were most severe in undernourished infants and young children (Nabarro, 1985; WHO, 1985). Field studies in developing countries have disclosed a strong correlation between the prevalence of diarrhoea and growth retardation (WHO, 1984; 1985). In addition, the mortality rate is relatively increased in patients with marasmus and kwashiorkor (WHO, 1984, 1985).

In a study on contribution of severe malnutrition to child mortality in rural Bangladesh from 1986 to 1987, one-third of all the deaths in children from 6 to 36 months of age were associated with severe malnutrition and 79% of those deaths were associated with persistent diarrhoea. The relative risk of dying from diarrhoea among severely malnourished children as opposed to those who were not severely malnourished was 17% (Fauveau, Briend, Chakraborty and Sarder, 1990). They estimated that 115 of the 222 deaths due to diarrhoea occurred among 977 severely malnourished children and by contrast that the remaining 107 deaths from diarrhoea occurred among 15,299 children who were not severely malnourished. Melville et al. (1988) have observed that both fever and diarrhoea were negatively correlated with weight for age . This was substantiated elsewhere (McLeod, 1985; Drake and Fajardo, 1976; Field, Miller, Drake and Kottar, 1981).

Certain factors have been reported to counteract the negative effect of diarrhoea, e.g increased appetite and breastfeeding. There may also be a period after an episode when appetite is increased. To the extent that appropriate foods are available to meet this increased appetite the negative effect of diarrhoea on energy balance may be offset. However research is necessary to determine whether this increase in appetite occurs and if so, when such increase occurs.

Secondly, breast-feeding has a special and previously unrecognized role in the relationship between energy intake and diarrhoea with respect to nutrition status. Its protective effect on risk of diarrhoea has long been recognized however. It has only recently been demonstrated that when infants who are receiving a major proportion of their energy from breast milk do get diarrhoea the illness does not have a negative effect on growth (Brown, Peerson, Kanashiro, Lopez and Black, 1991). Thus, efforts to promote increased energy intake among infants and young children should be coupled with efforts to promote exclusive breast-feeding through at least the first 4 months of infancy and partial breast-feeding through 24 months, when children are most at risk for diarrhoea (Brown, et al., 1991).

2.8.2.3 Socio-economic Effects

2.8.2.3.1 Household cash income: Income is considered to be a very important factor determining nutrition, at least in developing countries. According to Chandhury (1986) income is a mirror - image of a household's resources and provides an index of its purchasing capacity. The economic situation is a potent factor in determining how much and what kind of food will be available. It is therefore expected that with the improvement of household income, absolute expenditure on food is likely to go up as is the caloric and protein intake of the household (Gopalan, Rama and Balasubramaniam, 1981). Gullau (1981) has noted that high significant differences exist in income class of food consumption data in developing countries. In 1980, World Bank maintained that the serious and extensive nutritional deficiencies that exist in developing countries are largely a reflection of poverty; people don't have enough income for food (World development report, 1980).

It has been shown empirically that as income rises beyond a threshold level, people tend to spend proportionately less on food than on non-food items particularly on consumer durables. Although the proportion of income spent on food declines, absolute expenditure on food is still higher at upper income levels (Chandhury, 1986). Therefore it is posited that with the improvement of a household's income, absolute expenditure on food is also likely to go up and so is the calorie and protein intake of the household.

2.8.2.3.2 Market access infrastructure: Prevalence of malnutrition varies considerably among socio-economic group (UN, 1991). There were strong associations between child nutritional status and a set of community variables (Strauss, 1987). Generally, malnutrition is more prevalent in rural than urban areas due to lower income, poor access to services and overall food insecurity (UN, 1991; Thomas et al., 1987). Nutritional status survey data from Cameroon, Lesotho, Liberia and Togo show that the incidence of malnutrition in preschoolers as indicated by weight for age was 70% greater among rural than urban children, those communities close to roads usually suffer less malnutrition than those in remote areas (UN/ACC/SCN, 1987).

2.8.2.3.3 Population density: The contribution of high population growth rate to malnutrition in developing countries is controversial. One school of thought maintains that the two are closely, linked; an alternative theory holds that population growth enhances world resources and should not be a major focus in combating malnutrition. Population increase has both deleterious and favourable effect on the people. It is not an accident that food production in low income agriculture-dominated countries keeps rough pace with population growth. Population growth enlarges the rural labour force and hence the capacity to produce food. If mounting pressure on land resources reduces labour productivity, per capita income declines and per capita food consumption decreases comparably. Income-depressing effects may be reduced by longer working hours or by reduced production and consumption of non-food goods and services (Mellor, 1982).

CHAPTER THREE

METHODOLOGY

3.1 Background information of the surveyed population

The data were drawn from rural sectors of cassava producing areas of Nigeria. The sample population are farm - households with poor socio - economic background, health and sanitary facilities. They grow and sell mostly cassava. Other crops grown are maize, millet, yam, sorghum, legumes etc. The predominant religious practices of the people are Islam and Christianity.

3.2 Site and sample selection

Climate, human population density, and market infrastructure formed the bases for sampling. Following Carter and Jones (1989), four basic climate zones were defined from temperature and duration of dry periods within the growing season (table 8).

Table 8: Definitions of climatic zones of COSCA survey sites

Climatic zone	Temperature (oC)		Months of dry season
	Daily mean	Range	
Lowland humid	<22	<10	<4
Highland humid	<22	<10	<4
Sub-humid	>22	>10	4-6
Non-humid	>22	>10	7-9

information available on all-weather roads, railways and navigable rivers derived from Michelin travel maps was used to divide a market-access infrastructure map of Africa into good and poor zones according to the density of the roads, railways, or navigable water ways. Human population data from the United States Census Bureau were used to divide a population map of Africa into high demographic-pressure zones with 50 or more persons per km^2, and low, if less.

The three maps of climate, human population density, and market access infrastructure were overlaid to create zones with homogeneous climate, demographic pressure, and market access conditions. Each climate/population density/market access zone with less than 10,000 ha of cassava in each country was excluded. The remaining areas were divided into grids of cells 12' latitude by 12' longitude to form the sample frame for site selection. In Nigeria, 65 grid cells distributed among the climate/population density/market access zones in proportion to the zone size were selected by a random method. One village was selected, by a random method, within each of the grid cells; the locations of the villages are shown in fig. 1. A total of 65 villages were selected. The selected vilages were grouped according to the designated states in Nigeria.

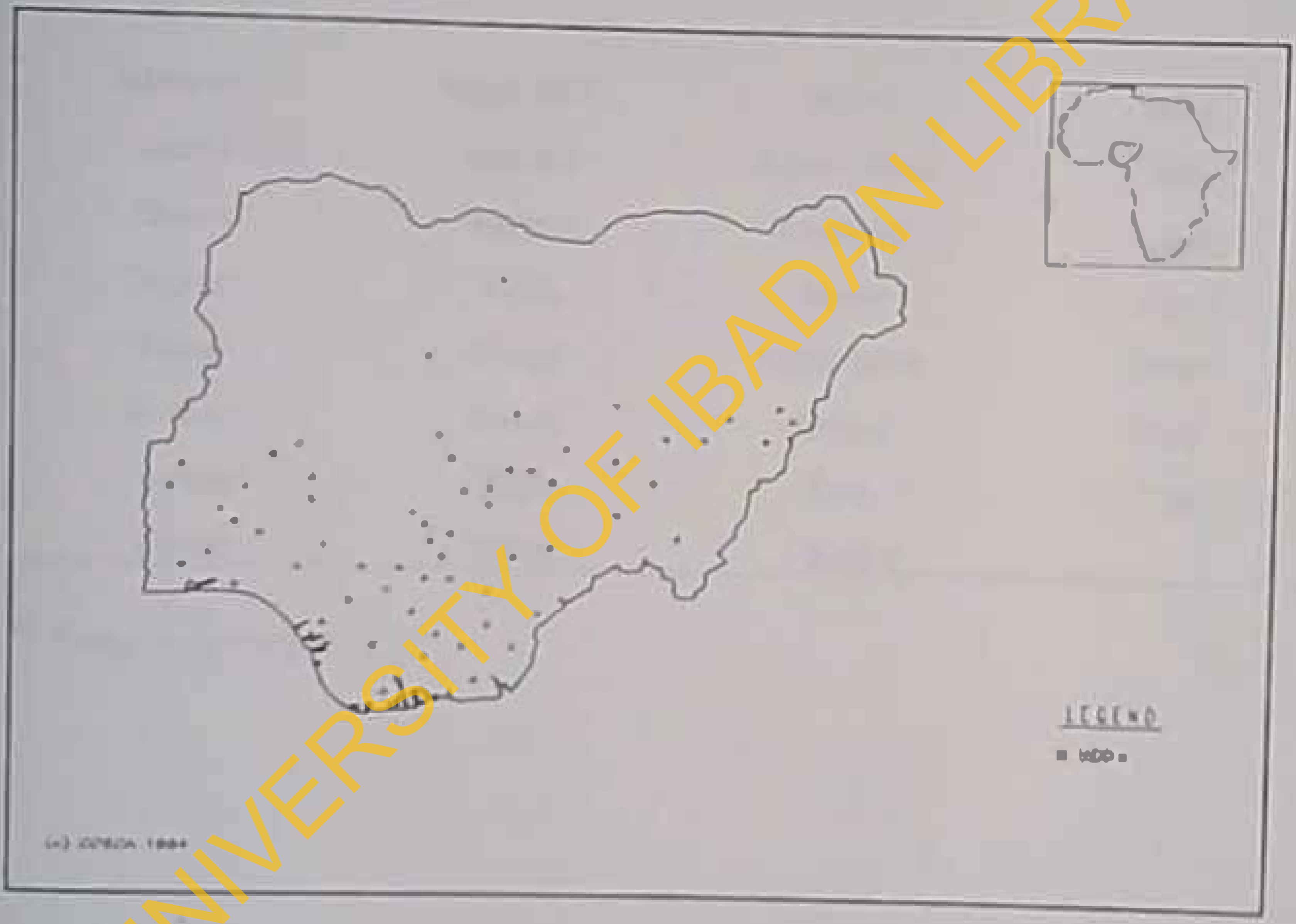

Fig 1: Locations of COSCA survey sites in Nigeria

The distribution of the states is shown below:

Adamawa	Abuja FCT	Abia	Delta
Bauchi	Kaduna	Akwa - Ibom	Edo
*Bornu	*katsina	Anambra	Lagos
*Jigawa	*Kebbi	Benue	Ogun
Kano	Kongi	Cross River	Ondo
Plateau	Kwara	Enugu	Osun
Taraba	Niger	Imo	Oyo
Yombe	*Sokoto	Rivers	

* States not surveyed

The distribution of selected villagess is shown below:

Namtariguerel
Golare
Malabu
Gombawa/Purakayo
Suwabariki
Gwaram/Alkal
Yarubawa
Zakwunbello
Udege-kasa
Ajaga
Wasee
Daboshu
Namu
Alogania
Arugwadu-Gona
Abbare
Garbabi
Sandaru
Donga

Zonzon
Kwaga
Gbarada
Zongondaji
Emekutu
Oduogboyaga
Ugwuoda-Idah
Angba
Ofobo
Bode-Saadu
Babanla
Isolo-opin
Rabba
Sabonwuse
Kadnawuse/Burum

Isiegun - Bende
Ikot - Ambom
Nkwelle Ogidi
Ankar
Andor
Uyanga
Ediba
Eme - Orimekpang
Busanfung
Nimbo
Nwofe
Agbogazi
Obinikpaezihe
Ngor
Okpolla/Eziala
Ogbakiri
Ogonokom

Ellu
Ugberikoko
Ebuebu
Ugboha
Afuze/Ojavum
Odogbawojo
Owojo
Eporo
Ipetumodu
Adana
Idi - apa
Igbojaye
Owode
Tokun - idode

In each of these selected villagess, a list of farm households was compiled and grouped into 'large', 'medium' and 'small' farm-holder households with the assistance of key village informants. Farm households which cultivated 10ha or more of all crops were excluded as unrepresentative of smallholder farm households. Two farm households were selected from each stratum. The total number selected in each village was 6. A total number of 390 farm households were selected. There were 437 preschoolers aged 0 - 5 years from the 390 farm households. The total number that were male and female, and in different age ranges is shown in table 9. The mean age was 32.12±16.41 months. 49 percent were males and 51 percent were females .

Table 9: Number of preschoolers in the study by age and gender

Age (months)	No. of males	No. of females	Total number
0 - < 12	25	23	48
12 - < 24	43	43	86
24 -< 48	88	98	186
48 -< 60	60	55	115
Total	216	219	435

3.3 Data collection

The following data was mainly collected during the hungrg season, in the year, 1992 during the the COSCA survey.

3.3.1 Nutritional Anthropometry:

Anthropometric data for the 437 preschool children from the ages of 0 - 5 years in the selected farm - households were taken by direct measurements of the following parameters following standard procedures established by WHO (1976) and UN (1986). The anthropometric parameters measured were as follows:

3.3.1.1 Weight of child: Weight of the selected subjects were obtained by use of infantiometer for toddlers and portable salter scale (Hanson, Ltd., Ireland) which has maximum reading of 130kg with accuracy of 50g. The subjects were weighed with minimum indoor clothing.

3.3.1.2 Height of child: Height of each subject was determined in a free standing position without shoes using stadiometer (ROE, Ltd., USA) for infant and preschool children of maximum reading of 200cm with accuracy of 0.5cm.

3.3.2 Age of child: The child's age was obtained from their birth certificates. In case of the birth certificate is absent the child's age was determined by carefully questioning the mother with the aid of local events calendar to assist them in their recall.

3.3.3 Household characteristics, health and socio-economic indices:

Household socio economic information was collected by interviewing the household head or (in the case of his or her absence) another senior household member. A household is defined as a person or group of people living together and sharing a common pot of food. The variables included among others are income, mother's education, mother's age, presence or absence of diarrhea, presence or absence of immunization, gender of household head, number of wives (only number of wives of the household head), sources of water supply, and household major food expenditure. The determining questions were as follows:

Household size: The determining question is 'What is the size of your family' i.e those who normally (almost everyday) eat from your kitchen.? Information was obtained from the head of the households.

Number of wives per household: The determining question is ''What is the relation to household head''. The response obtained is recorded in the questionnaire.

Mothers' education: This was measured in terms of number of years of schooling. The determining question is 'What is the number of years successfully completed in formal or Islamic school.

Age of the mother: This was obtained by asking the mother of the preschoolers such question as ''How many years are you ? ''

Gender of household head: The determining question is '' What is the sex of the household head? ''

Source of water supply: The determining question is '' Where do you get your drinking water from?''

Immunization: The question asked to the mother of the preschoolers is ''Has the child been immunized? ''

Diarrhea episode: The determining question is '' Did your child suffer from diarrhea in the last two weeks? ''

Market access: The categories of means of access to the market are obtained by village interview. The determining question is " How many kilometers from your household to the market where you sell your cassava products? "

Climate and Population density: The methodology has been stated in the sampling procedure. The detailed questionnaire is shown in Appendix 'A'.

3.3.4 Food consumption:

Information on food consumption and nutrient intake was obtained from the selected households using seven-day food recall method and a pretested questionnaire. Each woman in the selected household was asked to recall the quantity of each staple food item the entire household members consumed the previous week . The woman was asked to present the unit of measure of each food item consumed the previous week and the food item, where available for weighing. Otherwise weight of food is obtained by measuring the equivalent in the village market. Questions were asked on the number of visitors hosted. Adjustments were made in quantity of food consumed by the household.

Market value of non-staple food items consumed in the previous week by each household were elicited from the women interviewed. Unit price of each non-staple obtained from the village market was used to convert market value of consumption at the household level to quantity consumed.

3.3.5 Limitations:

This survey is multi-disciplinary in nature and therefore was not strictly designed for Nutrition. Certain limitations were encountered during the planning and execution of

Nutrition aspect due to authority beyond the researcher's control as well as resource availability. Among such limitations, is the inability to expand the sample size of the population surveyed. As a result, the sample size of this research is lower than anticipated. Besides, the sample population size obtained on the whole permits the estimation of the prevalence level of malnourished individuals for a predetermined (maximum) confidence interval (WHO, 1983).

The predetermined sampling design and method of data collection of COSCA survey allowed only one to seven day food recall method. Individual food intakes of the preschoolers in each households were therefore not possible. However, FAO/WHO/UN, (1985) consumption unit table (see Appendix B) was used to determine the food intake of each preschoolers in each household. The calculation for each food nutrient intake for preschooler using the consumption unit table is explained in Appendix C.

3.4 Data processing

3.4.1 Anthropometry:

3.4.1.1 Weight and height: The subjects were stratified into male and female; and also into four age classes according to WHO publication (1983) as was shown in table 9. A value of 1.5cm was subtracted from length measurements of children between 24 - 59 months to approximate standing height (Dibley, Staehling, Nieburg and Trowbridge 1987). The WHO reference standards were used to convert anthropometric measurements into indicators of height for age, weight for height, weight for age for assessment of nutritional status of the preschoolers. Z - score (standard deviation) of a nutritional indicator for an individual was calculated. Z - score indicates the direction and degree that any given raw score of the preschooler deviates from the mean of a distribution on a scale of standard deviation (S.D) units. The formula is as follows:

$$\text{S.D. score} = \frac{\text{Actual child's measure} - \text{median value of reference population}}{\text{Standard deviation value of reference population}}$$

Where :

S.D. = Standard deviation or Z-scores of the child.

Z-scores for weight for age and height for age that were less than -6.0 or greater than 6.0 , or Z-scores for weight for height that were less than -4.0 or greater than 6.0 were excluded. Distribution characteristics of the dependent variables were checked for normality.

National Center for Health Statistics (NCHS) reference population (WHO, 1983) was used for the comparison of the sample population height data against age, weight data against age, and of weight data against height. Preschoolers in the population falling below the median - 2 standard deviation units of NCHS reference population are considered to be low (malnourished) for the nutritional indicators. Percentage of preschoolers below or above _ 2 SD or between -3SD and -2SD NCHS reference population were determined. The children were classified on the basis of their height for age, weight for age, and weight for height using the NCHS (WHO, 1983).

3.4.1.2 Age-and-sex-of child: In the WHO publication (1983) tables are given with figures on, for example, the median weight and weight at -1SD, -2SD, etc., for each sex and age in months. Figures in those tables are approximated to one decimal place but age in this study is approximated to the nearest whole month below or above the actual age.

3.4.2 Food consumption:

Average quantity of each type of food consumed for seven days per household was converted into food nutrients using food consumption tables (Platt, 1975). To estimate per capita consumption, each nutrient in each food consumed by each household was totalled. The consumption unit (expected proportion of food intake) per person per household according to sex and age were obtained from FAO/UN (1990) consumption unit table. The total food consumption units for each household were calculated. Also determined was the food consumption units for each preschooler in each household. The proportion of food consumption unit of each preschooler relative to the total household consumption unit was calculated and multiplied by the total of each of the food nutrients for each household to obtain the amount of each food nutrient consumed by the preschooler in each household. The is shown below. Detailed calculation is shown in Appendix C.

$$NCPP = \frac{CUHP}{THCU} \cdot THQFC$$

where,

CUHP = consumption unit of household preschooler

THCU = total household consumption unit

THQFC = total household quantity of each food nutrients consumed

NCPP = Food nutrient consumed per preschooler in each household

Nutrient adequacy ratios (NAR) for each individual was estimated as percentage of requirements (FAO/WHO/UNU, 1985). Group mean intakes were calculated by the health zones, age group and sex. Nutrient adequacy ratio is taken as:

$$\frac{\text{Nutrient intake}}{\text{Recommended nutrient daily intake}} * \frac{100}{1}$$

3.4.3 Household characteristics:

Parameters such as household size, number of wives per man, mothers' education, mothers' age, and gender of household head were grouped as household characteristics. Average of household size and mothers' age for all the surveyed households was obtained. The preschoolers were then grouped according to whether they are from above average or average or less households for each variable. Other variables were grouped according to whether they are from educated mother or not, monogamous or polygamous households, or female or male headed households.

3.4.4 Health factors:

Source of water supply, immunization and diarrhea episodes were grouped under health factors owing to likeliness of providing avenue for pathogenic transmission or in case of immunization protective effect on pathogenic attacks . Diarrhea episode parameter was obtained for preschoolers and therefore analyzed at individual level. A preschooler was classified into 'Yes' if he has suffered diarrhea in the last two weeks prior to the survey otherwise "No". Immunization parameter was obtained for preschoolers and therefore analyzed at individual level. Each preschooler was classified into 'Yes' if preschooler is immunized or else 'No'. The source of water such as taps, bore wells, open wells, rivers, lakes, or ponds used by each household was classified into potable if from taps, or bore wells and non potable if from open wells, rivers, lakes or ponds.

3.4.5 Socio-economic factors:

For the purpose of this study, the indices of socio-economic factors are household cash income, village market access condition, village population density zone and household food expenditure.

3.4.5.1 Household cash income: The cash income of the household was reduced to per person basis by dividing by the number of persons in the household, i.e. the household size, and average for the 359 households determined. The preschoolers were then grouped accordingly to whether they were from high cash income household if they were from households with above the average cash income per person or from low cash income households if they were from households with average or less cash income per person.

3.4.5.2 Market access: The market access information as based on road maps varies widely in veracity. It was therefore considered essential to collect information during the survey that would permit a more objective definition of market access infrastructure. Accordingly, the farmers interviewed in phase I were asked to indicate the main market used to sell their cassava products, the proximity of the market in kilometers, and the means of access. This was by motor vehicle, foot or other means, including use of bicycles, animals, or boats. Proximity to market is grouped into categories above or below 10km, based on subjective estimates of the distance a farmer can walk in a day with a head load of cassava products.

3.4.5.3 Population density: For population density parameter, preschoolers were classified into low population density zones according to the location of their households i.e. low density zones if household is in areas with 50 or fewer persons per square kilometer and high if in areas with greater than 50 person per square kilometer.

3.4.5.4 Household food expenditure:

Household's total expenditure on all food items was reduced to per person basis by dividing by the number of person in the household and average for the 359 households determined. The preschoolers were then grouped according to whether they were from high total food expenditure households if they were from households with above the average total food expenditure per person or from low total food expenditure households if they were from households with average or less total food expenditure per person.

To determine the relationship between cassava consumption and the nutritional status of the preschool children, the nutritional status indicators of the preschool children were compared at two levels of household expenditure on cassava food products as well as on other food staples. Expenditure on food is used in preference to quantity of food consumed because food expenditure is easier to measure as its measurement is subject to less error than measurement of quantity of food items consumed.

Following the definition of a food staple by the International Institute of Tropical Agriculture (IITA) as a crop which constitutes at least 200 dietary kilocalories per day per person, sorghum which contributed 488 dietary kilocalorie per person, millet which contributed 421, yam 316, and cassava which contributed 306 kilocalories per person per day between 1964 and 1966 (FAO, 1971) are the Nigerian major for staples. Although maize contributed only 154 calorie per person per day in 1964 - 66 there is evidence that the importance of maize as a food staple has increased in recent times (Manyong, Smith, Weber, Jaglap and Oyewole, 1996). Because of their closeness, sorghum and millet are combined as one commodity in the following analyses.

Household expenditure on each of the four food staples was reduced to per person basis and average for the 359 households determined. For each of the staples, the preschool children were grouped according to whether they were from high expenditure households if they were from households with above the average expenditure per person for the particular staple or from low expenditure households if they were from households with average or less expenditure per person.

3.4.6 Determination of relationships between nutritional status indicators and various household characteristics, health and socio-economic factors

The children's Z -scores for weight for age, height for age and weight for height and their percentage distribution using the NCHS (WHO, 1983) are calculated and compared by the various household factor groups, health factor groups and by the socio-economic factor groups.

3.4.7 Statistical analysis:

Statistical analysis were performed on the IBM 486 computer. Student T-test was carried out to determine the levels of significance of the differences in mean weight for age, weight for height, and weight for height between the preschoolers sex groups while general linear model (GLM) was used for various age categories. Percentages were calculated and chi-square (X^2) test was used to identify household characteristics, health and socio - economic factors significantly associated with the subjects' nutritional status.

CHAPTER FOUR

RESULTS

4.1 Overall nutritional status of preschool children

4.1.1 Sample Z- score distribution

Majority of the preschoolers had their Z- scores below the median for weight for age, height for age and weight for height and peaked at -2SD , -1SD and -1.5SD (fig. 2), respectively after which a progressive decline was obtained. The percentage of preschoolers below median in each of the anthropometric indicators was 74.9% for weight for age, 74.2% for height for age and 66.2% for weight for height (table 16).

4.1.2. Physical characteristics

The greatest deficit in the means of the anthropometric indicators for all the preschoolers expressed in terms of standard deviation (Z- score) below median NCHS standards was in height for age Z-score of preschoolers (table 11). The mean Z-scores were less in the order of -1.30 for height for age, -1.10 for weight for age, and -0.43 for weight for height. This means that the mean deviation of the preschoolers from the normal growth range (-1 standard deviation to +1 standard deviation) for weight for height index was within normal growth range. The anthropometric indices of the preschoolers was above the conventional cut off (below median-2SD), the recommended cut off for use in African countries .

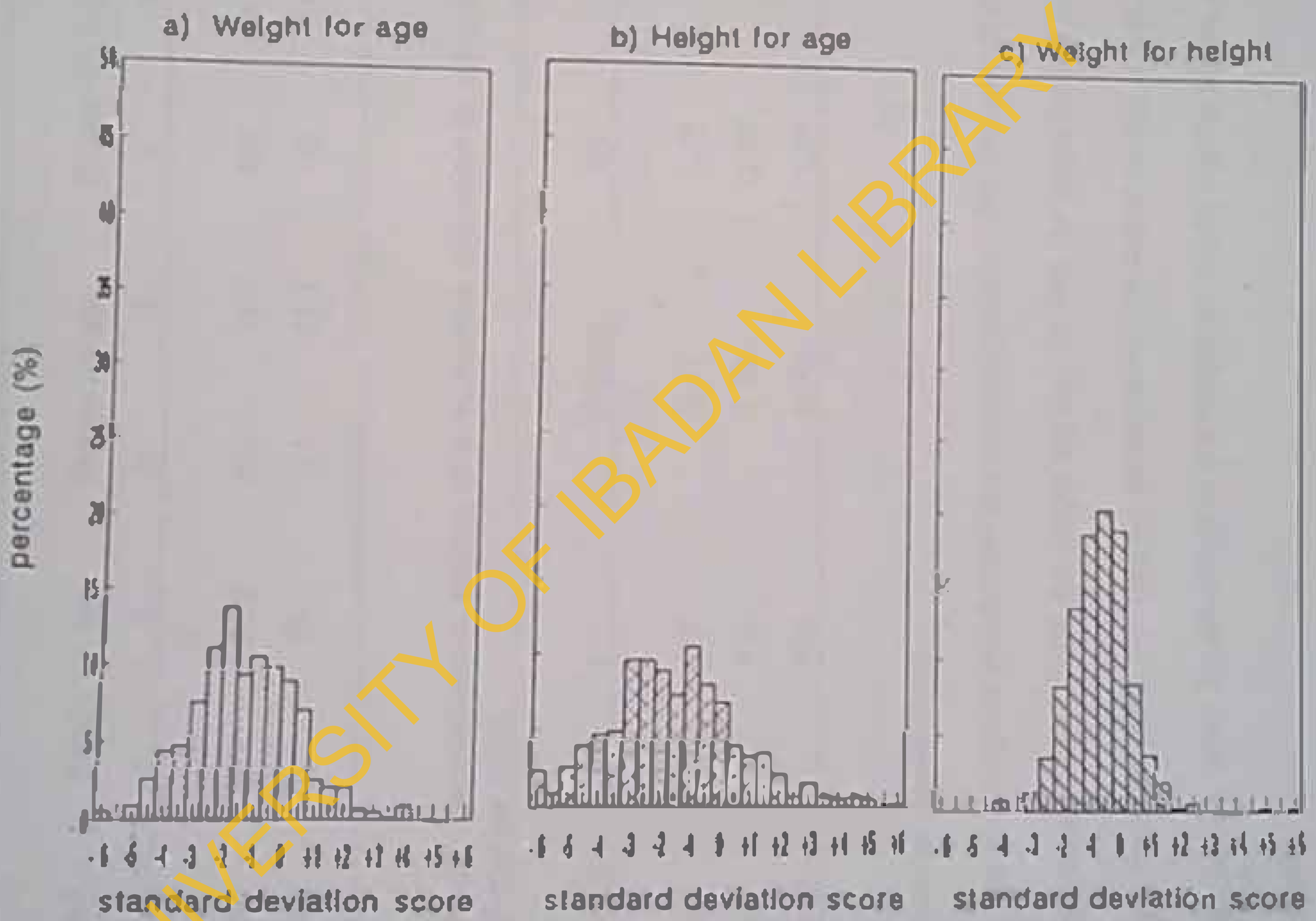

Fig 2 : Distribution of Z-scores for weight for age, height for age and weight for height in preschoolers

Table 10: Frequency distribution of anthropometric indices of preschoolers below and above median NCHS reference population

Nutrition level	Weight for age		Height for age		Weight for height	
	n	%	n	%	n	%
Below median	328	74.9	322	74.2	290	66.2
Above median	110	25.1	112	25.8	148	33.8

Table 11: Mean anthropometric indices of preschoolers expressed in standard deviation units

Nutritional Indicators	n	Z-Score	SD
Weight for age	426	-1.11	1.72
Height for age	432	-1.30	2.58
Weight for height	429	-0.43	1.07

4.1.3 Prevalence of malnutrition

The percentages of preschoolers that are below median -2SD for each of the anthropometric indicators are 31.11% for weight for age, 40.10% for height for age and 6.40% for weight for height (table 12). Thus the prevalence of low height for age is higher than low weight for age while the prevalence of low weight for height was the lowest of the three indicators.

4.1.4 Severity of malnutrition

Mild stunting was found in 59.9%, moderate stunting in 18.7 %, and severe stunting in 21.4 % of the preschoolers. Mild undernutrition was found in 68.9%, moderate undernutrition in 18.2% and severe undernutrition in about 12.9% . The distribution of the preschoolers in the case of wasting was mild 93.4%, moderate 4.3% and severe 2.3% (table 13).

Table 12: Percentage distribution of levels of nutrition in Preschool children

Nutrition level	Weight-for-age n	Weight-for-age %	Height-for-age n	Height-for-age %	Weight-for-height n	Weight-for-height %
Above median - 2 S.D	299	68.90	260	59.90	409	93.46
* Below median - 2 S.D	135	31.11	174	40.10	29	6.40

* Includes Preschool children below - 3 S.D

Table 13 : Percentage distribution of three levels of nutrition in Preschoolers

Nutrition level level	Weight for age (undernutrition) n	Weight for age (undernutrition) %	Height for age (stunting) n	Height for age (stunting) %	Weight for-height (wasting) n	Weight for-height (wasting) %
Mild	300	68.9	261	59.9	406	93.4
Moderate	79	18.2	81	18.7	19	4.3
Severe	56	12.9	93	21.4	10	2.3
Total	435	100.0	435	100.0	435	100.0

Overall assessment of the nutritional status of the preschoolers is be summarized table 14 with weight for height data on one axis and height for age data on the other. About 35.0% of the preschoolers fall on what could be called 'within normal range' (above median - 2SD) in both weight for height and height for age while 45.1 % were above median - 2SD for weight for height and below median -2SD for height for age. This means that more than 35 % of the preschoolers in cassava growing areas were neither wasted nor stunted. About 45.1% who were stunted were not wasted.

4.1.5 Food nutrient intake and adequacy ratio

4.1.5.1 Energy, protein and mineral intakes

The result of the dietary studies (mean energy, protein and mineral intakes) are presented in table 15. The mean daily energy intake of the preschoolers was 4.62 MJ or 1104 kcal, protein was 14.70g, calcium was 263.14 mg, and iron was 3.15 mg.

The preschoolers as a whole met 87% of their energy intake, 96% of protein, 64% of calcium, and 134% of iron needs (fig. 3).

4.1.5.2 Vitamin intakes

The mean daily vitamin intakes of the preschoolers were 471.83μg for vitamin A, 0.40 mg for thiamin, 0.45 mg for riboflavin, 42.85 mg for niacin, and 20.55 mg for vitamin C (table 16). It can be seen from fig. 3 that vitamin intakes of the preschoolers expressed as percentage of WHO (1967) requirement fell short of their requirements except in vitamin A and C. The percentage of vitamin A met by the preschoolers was 176% while vitamin C was 102%, other vitamins were thiamin 69%, riboflavin 57%, and niacin 48%. In general, the preschoolers in cassava producing areas had energy, protein, iron, calcium, thiamin, riboflavin, and niacin intakes that fell short of their requirement while vitamin A and C were more than adequate.

Table 14: Nutrition levels of preschoolers as indicated by the percentage distribution of Z-score of height for age and weight for height

Weight for height	height for age < -2 SD (within "normal")	-2 to -3 SD moderate stunting	< -3 SD severe stunting	Total
< -2SD (within "normal")	35	6.2	45.1	86.3
-2 to -3SD (moderate wasting)	0.7	0.9	1.8	3.4
< -3 SD (severe wasting)	7.1	0.0	3.3	10.4
Total	42.8	7.1	50.2	100.1

Table 15: Mean daily energy, protein, and mineral intakes of preschoolers

Nutrient intakes	n	Mean	S.D.
Energy (MJ)	435	4.62	2.69
(Kcal)	435	1104.00	484.00
Protein (g)	435	14.71	6.90
Calcium (mg)	435	263.14	164.29
Iron (mg)	435	6.71	3.15

Table 16: Mean daily vitamin intakes of preschoolers

Vitamin intakes	n	Mean	S.D.
Vitamin A (μg)	435	471.83	460.46
Thiamin (mg)	435	0.40	0.24
Riboflavin (mg)	435	0.45	0.24
Niacin (mg)	435	42.85	22.59
Vitamin C (mg)	435	20.55	19.41

4.2 Nutritional status of preschool children by age class

4.2.1 Sample Z- score distribution

A breakdown of the age range, zero to sixty months of the preschoolers shows that majority of the preschoolers were in the left of the normal distribution of the reference population median (fig. 4 - 6). About 20% of the preschoolers in the age range 0 - < 12 months had the highest Z-score at + 0.5 and -1.0 for weight for age, about 15% in the age range 12 - <24 months had the highest Z-score at - 2.0, about 15% in the age range of 24 - 48 months at -2 and 18% in the age range of 48 - <60 months at 1.5 (fig. 4). As indicated in table 22, preschoolers in the age range of 24 - < 48 months had the highest percentage below median NCHS reference population for weight for age.

About 20% of the preschoolers in the 0 - < 12 months range peaked at -3 SD for height for age , 15% in the 12-<24 months range peaked at -3SD, 13% in the 24-<48 months range peaked at -3SD, and 15% in the 48-<60 months range peaked at 2.5 SD (fig. 5).

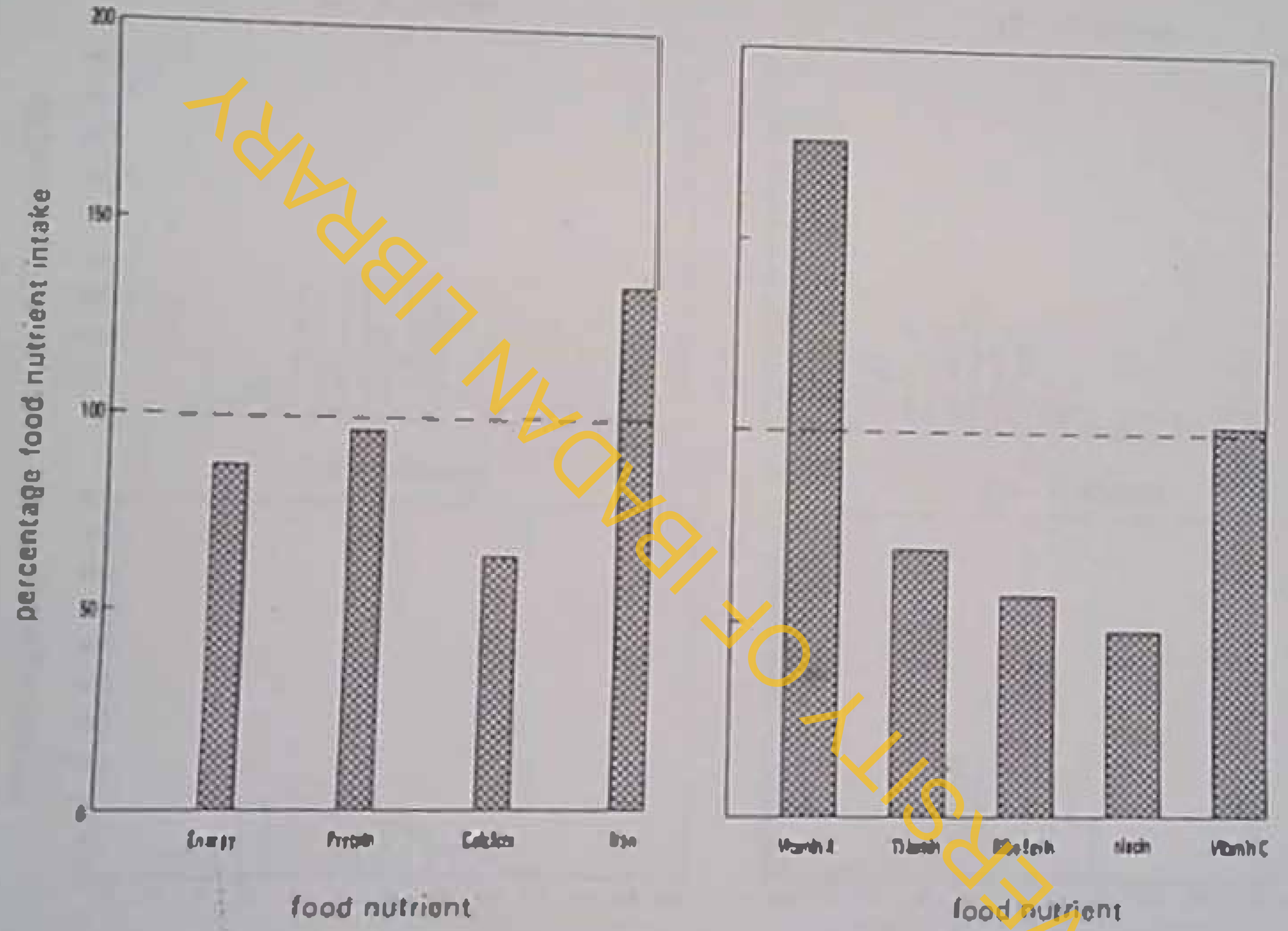

Fig 3 : Food nutrients intakes of preschoolers expressed as percentage of FAO/WHO/UN (1985) and WHO (1967) requirements

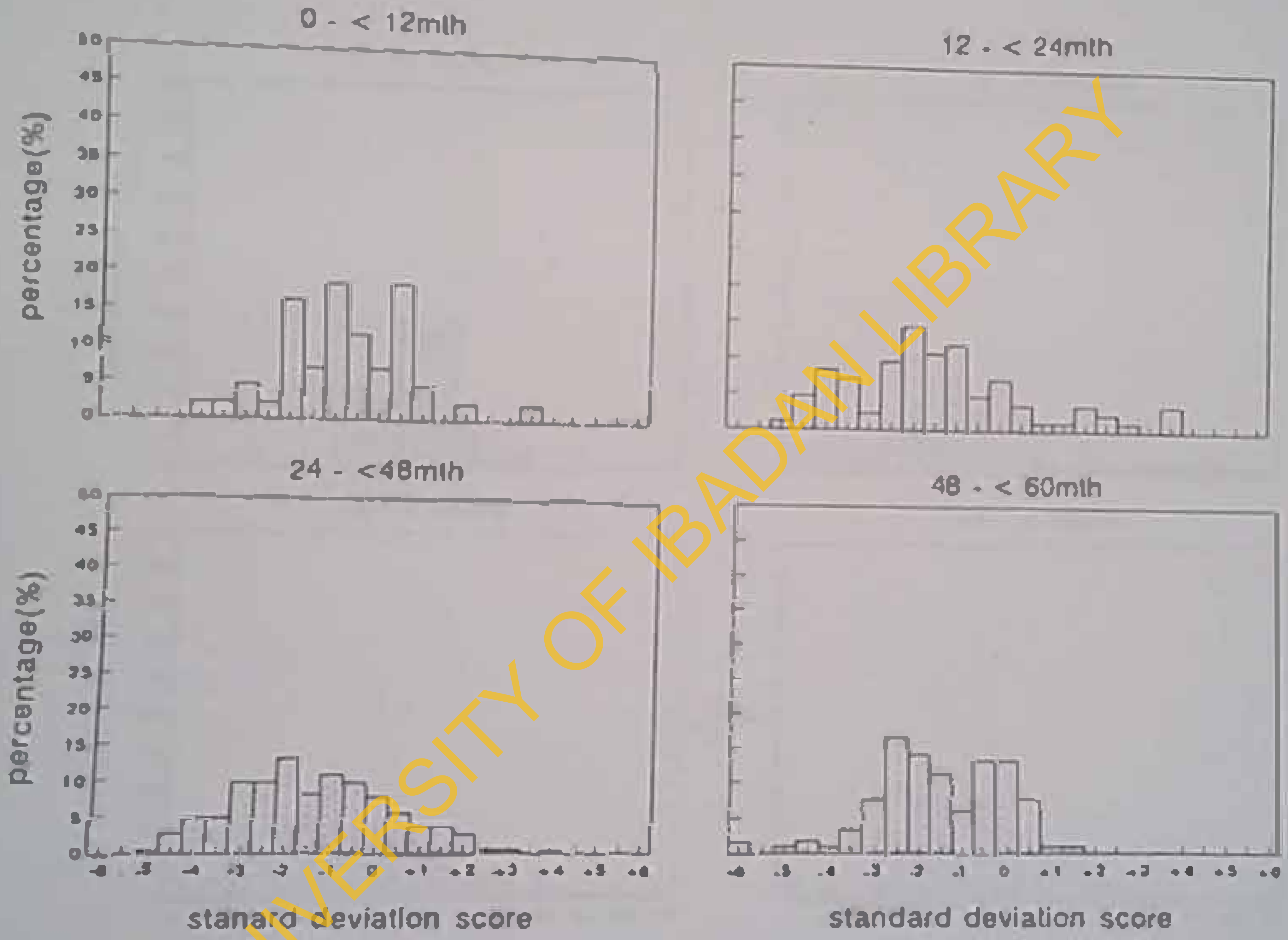

Fig 4 : Distribution of Z - scores for weight for age in preschoolers for different age groups

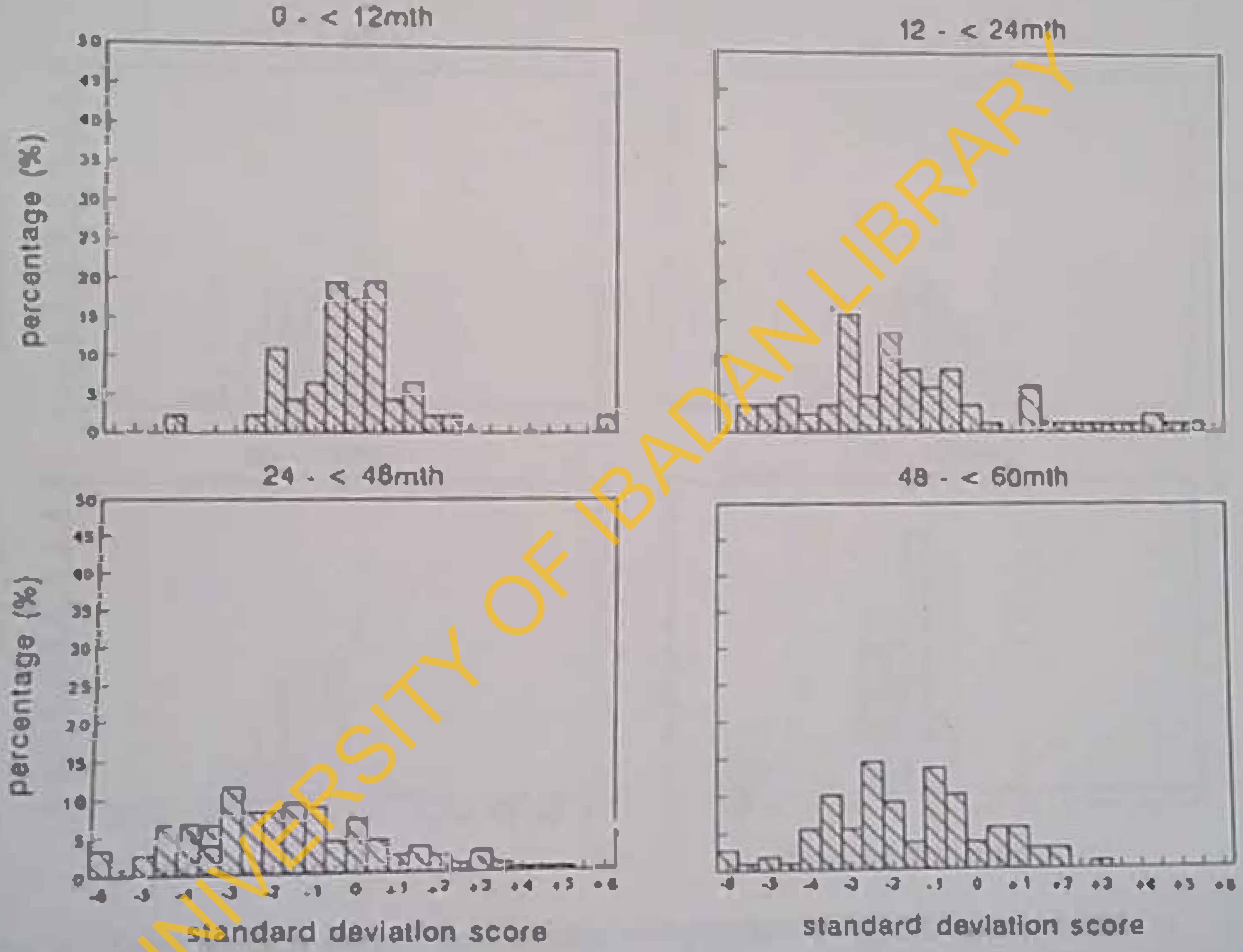

Fig 5 : Distribution of Z - scores of height for age in preschoolers for different age groups:-

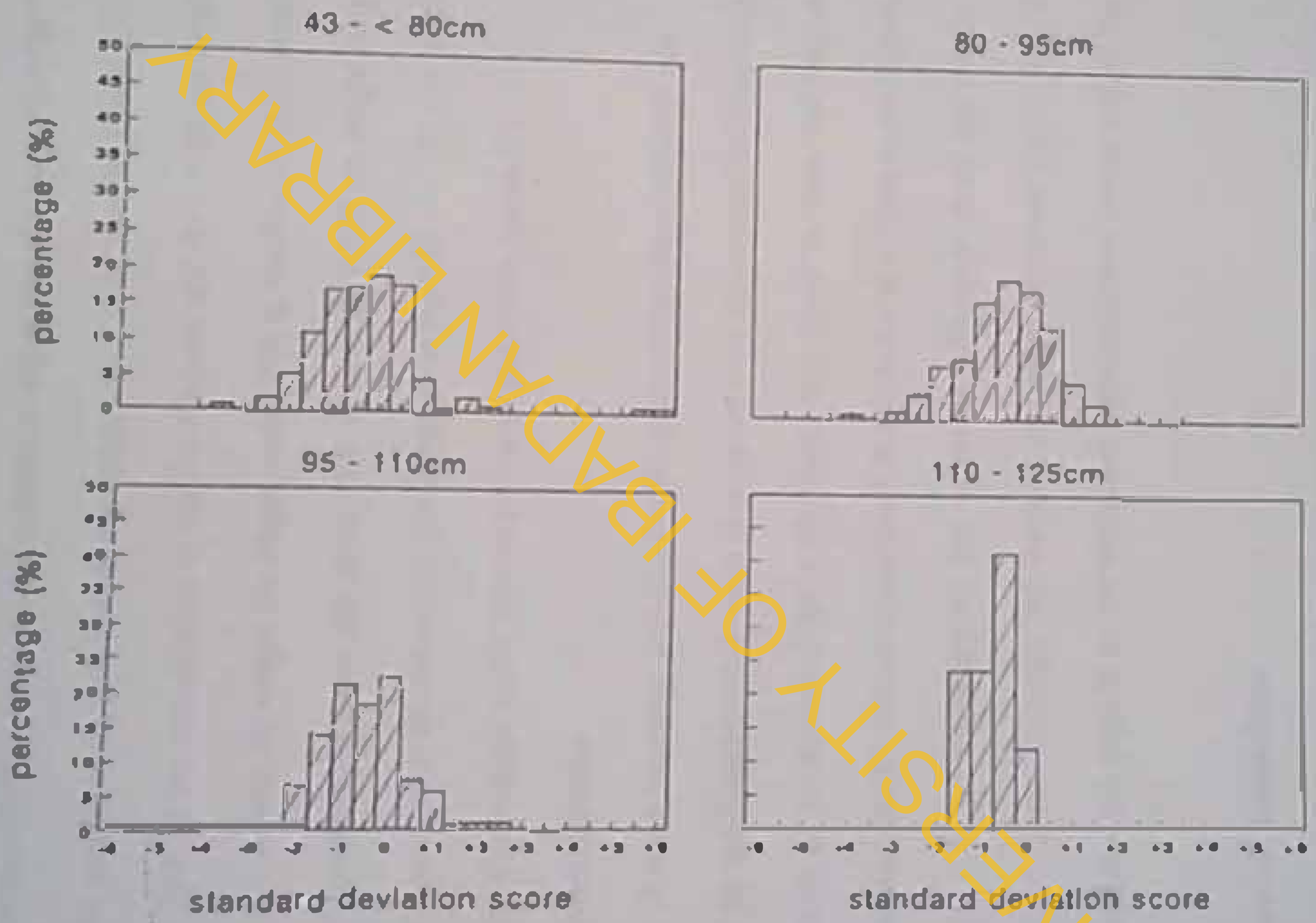

Fig 6 : Distribution of Z - scores for weight for height in preschoolers for different height ranges

The highest percentage (80%) below median reference population for height for age is observed among the preschoolers between the age range 48 - < 60 months (table 17).

More than 20% of the preschoolers in the 43-<80 cm and 80 - <95 cm height range peaked at + 0.5 Z-score for weight for height while 25% in the 95-< 110 cm height range peaked at 0 (median) Z- score and about 45% in the 110-< 125 cm height range peaked at +0.5 Z-score (fig. 6). However, preschoolers in the 110 - < 125 cm height range had the highest percentage below median reference population (table 17).

4.2.2 Physical characteristics

The mean Z-score (standard deviation) of the preschoolers decreases with age (table 18). Of all the age ranges that have been proposed as most appropriate for estimating the nutritional status of preschoolers, 48-<60 months was found to show the highest deviation below median NCHS reference population in height for age. Next to the highest was age range 24-<48 for the height for age indicators. However in all age ranges, preschoolers in 0-<12 months range had the least significant deviation ($p < 0.05$) compared with any other age range in all the nutritional status indicators except weight for height.

4.2.3. Prevalence of malnutrition

The ascending order of percentage prevalence of undernutrition was age range 0 - < 12 months (18.7%), 24 - < 48 (31.8%), 48 - < 60 (33.0%) and 12 - < 24 (33.4%).

Table 17 : Frequency distribution of preschoolers below and above median reference for indices of nutritional status

	Weight for age							
	Age ranges (months)							
Nutrition level	0 - < 12		12 - < 24		24 - < 48		48 - < 60	
	n	%	n	%	n	%	n	%
Below median	32	66.7	64	74.4	139	75.1	89	77.4
Above median	16	33.3	22	22.6	46	24.9	26	22.6
	Height for age							
Below median	29	60.4	65	75.6	136	73.5	92	80.0
Above median	19	39.6	21	24.4	49	26.5	23	20.0
	Weight for height							
	height ranges(cm)							
	45 - < 80		80 - < 95		95 - < 110		110 - 125	
Below median	113	73.4	95	60.1	67	62.0	15	82.0
Above median	41	26.6	63	39.9	41	38.0	2	11.8

Table 18 : Mean anthropometric indices of preschoolers by age classification

Age	Weight for age			Height for age			Weight for height		
		Z-			Z-			Z-	
(months)	n	score	SD	n	score	SD	n	score	SD
0 - < 12	43	-0.56^a	1.46	47	-0.21^a	2.07	147	-0.60^a	1.24
12 -< 24	85	-1.10^b	2.13	86	-1.05^b	3.18	157	-0.33^a	0.99
24 -< 48	183	-1.13^b	1.71	185	-1.42^b	3.19	108	-0.33^a	0.96
48 -< 60	115	-1.29^b	1.45	114	-1.74^b	2.39	17	-0.59^a	0.48

Mean values are expressed in standard deviation score (Z-score) of NCHS reference population. Means with same letter in a column are not significantly different by Duncan's Multiple Range Test ($P_{0.05}$).

$LSD_{(p\ 0.05)}$ = 0.582 for weight for age

$LSD_{(p\ 0.05)}$ = 0.844 for height for age

$LSD_{(p\ 0.05)}$ = 0.339 for weight for height

The differences were statistically significant ($p < 0.05$) among the age ranges (fig. 17).

Prevalence of stunting differed significantly ($p < 0.05$) among the age ranges ; it was however lowest in age range 0 - < 12 months (14.5%) and highest in age range 48-60 months (45.2%). There was no wasting in age range 48 - < 60 months . Percentage prevalence of wasting was significantly higher ($p < 0.05$) in age range 0 - < 12 months (11.6%) than in other age ranges.

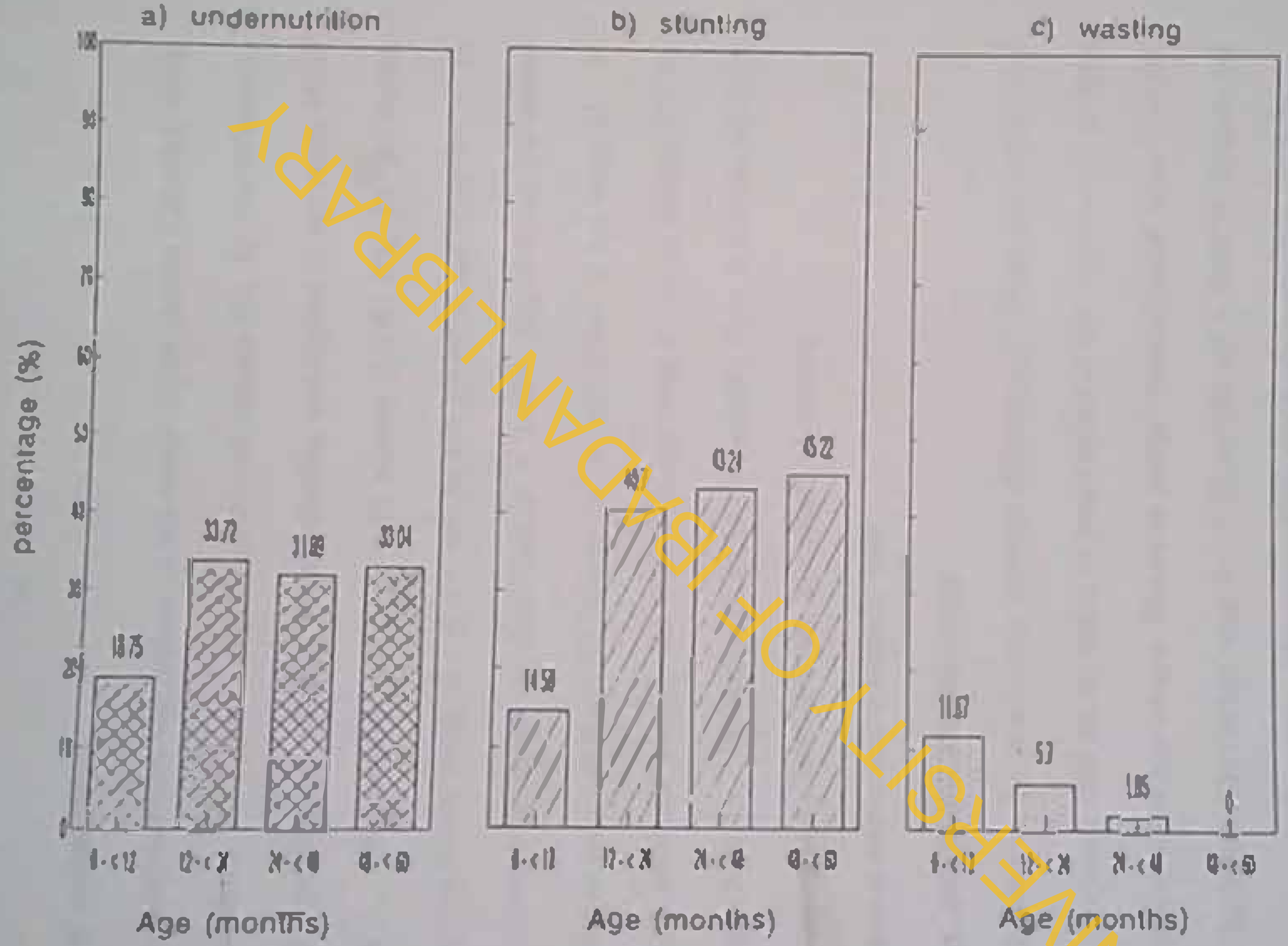

Fig 7 : Prevalence of undernutrition, stunting and wasting in preschoolers for different age groups

4.2.4 Severity of malnutrition

Severe undernutrition was highest in age range 12-24 months (22.0%), while moderate undernutrition was highest in age range 24 - 48 months (fig. 8); the differences were statistically significant ($p < 0.05$). Severe stunting was highest in age range 48-60 months (25.2%), and lowest in age range 0-12 months (2.0%) (fig. 8). Moderate stunting was highest in age range 12 - < 24 months and lowest in age range 0 - < 12 months; the difference was statistically significant ($p < 0.05$). Fig. 8 shows that severe wasting was highest in age range 0 - < 12 months (4.5%) and lowest in age range 24 - < 48 months (0.93%). Moderate wasting was highest in age range 0 - < 12 months (7.1%) and lowest in age range 24 - 48 months (0.93%). In general, there is a relatively high prevalence of stunting and a relatively low prevalence of wasting.

4.2.5 Food nutrient intake and adequacy ratio

4.2.5.1. <u>Energy, protein and mineral intakes</u>

Table 19 presents the relationship between different age ranges and energy and protein intakes. The mean daily energy intake of preschoolers in age range 0- < 12 months was the lowest among other age ranges. The mean energy intake obtained were 4·30 MJ or 1030 kcal for the preschoolers in age range 0 - < 12 months and 4.78MJ (1143Kcal) for those in age range 12 - < 24 months. The mean energy intake of preschoolers in age range 24 - < 48 months was 4.75 MJ (1136 kcal) and for preschoolers in age range 48 - < 60 months was 4.41 MJ (1054 kcal). This difference was not significant ($P > 0.05$).

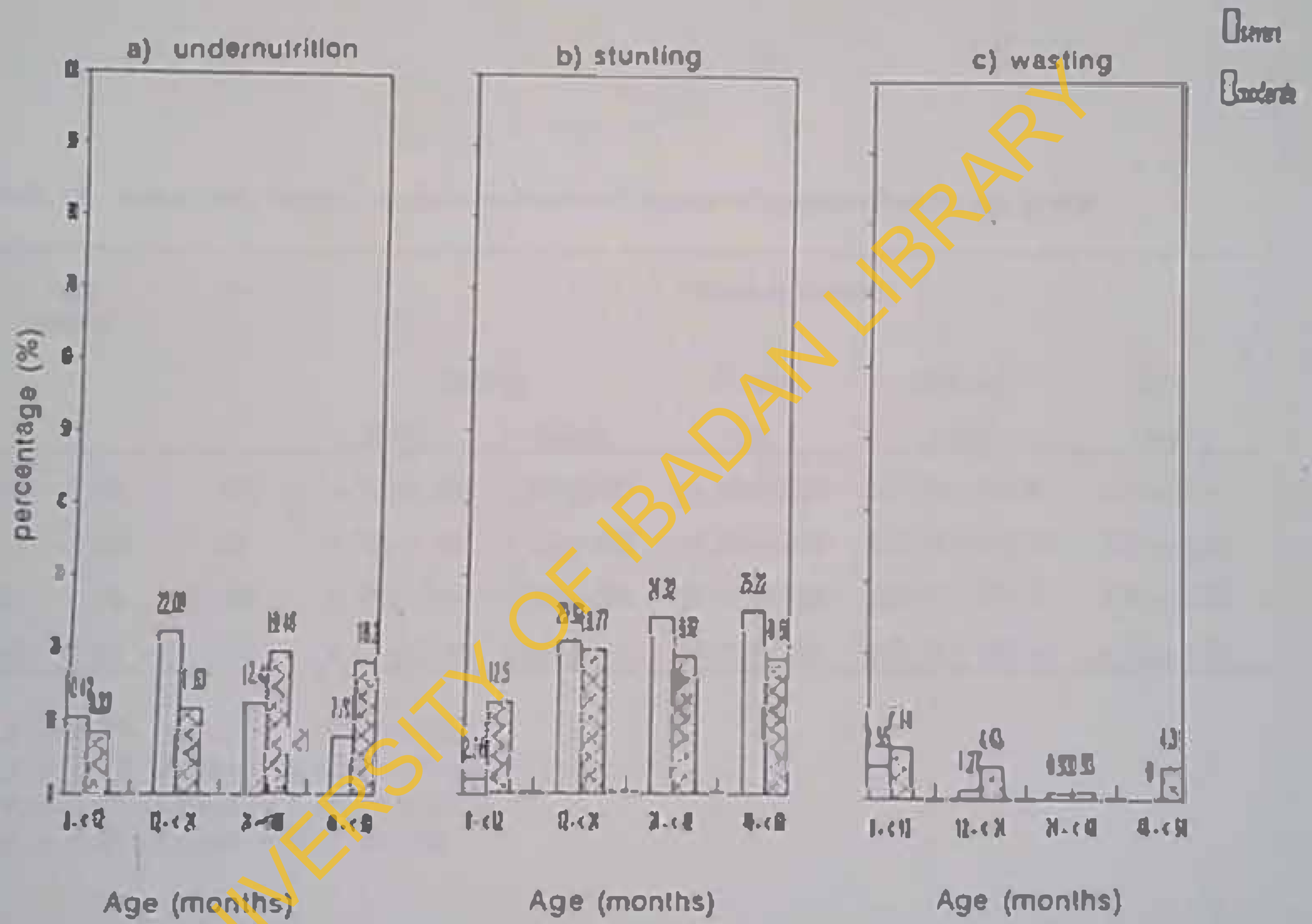

Fig 8: Prevalence of low levels of undernutrition, stunting and wasting in preschoolers for different age groups

Table 19: Mean daily energy, protein and mineral intakes of preschoolers by age group

Age months	n	Nutrient intakes				
		Energy		Protein	Calcium	Iron
		(MJ)	(Kcal)	(g)	(mg)	(mg)
0 - < 12	48	4.30±2.00	1030±495	14.60±7.20	252.28±156.90	6.61±2.99
12 - < 24	86	4.78±1.88	1143±450	14.80±6.00	258.48±153.79	7.03±3.25
24 - < 48	186	4.75±2.06	1136±494	15.20±7.30	280.25±179.41	6.80±3.08
48 - < 60	115	4.41±2.03	1054±486	13.90±6.60	243.16±147.44	6.36±3.25

a. $P > 0.05$; f-value = 1.16 for energy
b. $P > 0.05$; f-value = 0.87 for protein
c. $P > 0.05$; f-value = 1.26 for calcium
d. $P > 0.05$; f-value = 0.73 for iron

Figure 9 indicated that preschoolers energy adequacy ratio decreased with age. Their energy intakes in all the age ranges relative to their energy needs were low except for that of the youngest age range (0 - < 12). The intake exceeded their requirement by 25% for 0 - < 12 months old but fell by 1.0% short for 12 - <24 months old, 16% short for 24 - <48 months and 22% short for 48 -<60 months old. These differences were not statistically significant

(P > 0.05).

The mean protein intake was 14.60g for 0 - < 12 months old, 14.80g for 12 - <24 months old, 15.20g for 24 - < 48 months old and 13.90 g for 48 - <60 months old. There were no significant differences in the protein intakes of preschoolers among the different age ranges (P >0.05).

Preschoolers in the age ranges 24 - < 48 months and 48 - < 60 months did not meet their protein requirements. The percentage of protein intake met by those in age range 0 -<12 months was 108%, for 12 - <24 months 109%, for 24 - 48 months 98% and for 48 - < 60 months 79%. However, there were no significant differences among the age ranges.

The mean daily calcium intake of preschoolers was highest in 24 - <48 months old (280.25 mg), followed by intakes for 12 - <24 months old (258.48) and 0 - < 12 months old (252.28mg) and 48 - <60 month old (243.16 mg) in that order (table 19). The mean daily calcium intake differences were not statistically significant among the age ranges.

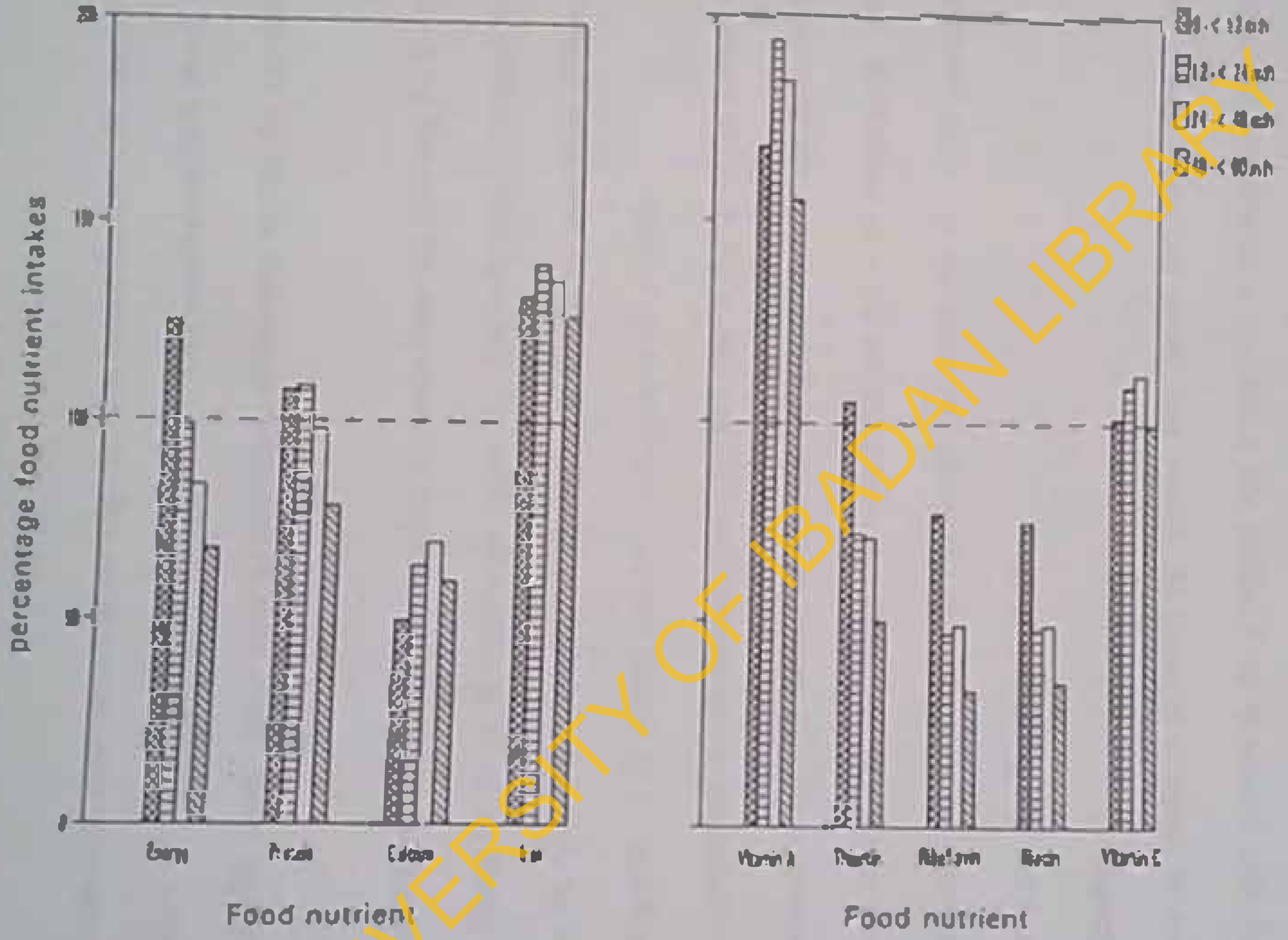

Fig 9: Food nutrients intakes of preschoolers expressed as percentage of FAO/WHO/UN (1985) and WHO (1967) requirements by age group

The calcium intake relative to their needs was low (fig. 9). The intake for 0 - < 12 months old fell 50% short of needs, 12 - <24 month old 36% short, 24 - <48 months old 30% short, and 48 - <60 month old 40% short. There were no significant differences among the age ranges $(P > 0.05)$.

The mean daily iron intake of the preschoolers increases from the 6.61 mg for 0 - < 12 months old up to 6.80 mg for 24 - < 48 months old (table 19). The iron intake decreased from 6.80 mg to 6.36 mg for 48 - < 60 months old. However, there was no significant difference between the age ranges 0 - < 12 months and 24 - <48 months $(P < 0.05)$.

Fig 9 indicates an improvement in iron adequacy from the first year of life up to the fourth year of life with a deterioration after 48 months of age. All the preschoolers in the different age ranges met their iron needs. The percentage met were 132% for 0 - < 12 months old, 140% for 12 - <24 months old, 136% for 24 - <48 months old and 127% for 48 - <60 month old. The differences were not significant $(p > 0.05)$.

4.2.5.2 Vitamin intakes

The vitamin A intake in different age ranges were above the WHO (1967) mean requirements. This was highest in the youngest age group 0 - < 12 months (506.10μg), followed by 12 - <24 months old (485.79μg) (table 20). the next was in 48 - < 60 months (467.53μg) and 48 - <60 months (459.46μg). The differences were not statistically significantly $(P > 0.05)$.

Table 20: Mean daily vitamin intakes of preschoolers by age groups

Age months	n	Vitamin intakes Vitamin A (μg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin C (mg)
0 - < 12	48	506.10 ± 173.61	0.37 ± 0.24	0.42 ± 0.27	40.66 ± 21.91	16.94 ± 13.81
12 - < 24	86	485.79 ± 177.93	0.43 ± 0.20	0.48 ± 0.23	43.74 ± 19.01	20.41 ± 17.13
24 - < 48	186	459.46 ± 127.93	0.28 ±0.22	0.47 ± 0.25	44.94 ± 25.59	21.69 ± 20.57
48 - < 60	115	467.53 ± 98.94	0.37 ± 0.21	0.42 ± 0.23	21.69 ± 20.57	20.23 ± 21.01

a. P > 0.05 ; f-value = 0.15 for vitamin A
b. P > 0.05 ; f-value = 1.28 for thiamin
c. P < 0.0001 ; f-value = 19.69 for riboflavin
d. P > 0.05 ; f-value = 1.40 for niacin
e. P > 0.05 ; f-value = 0.64 for vitamin C

The vitamin A adequacy ratio in all the age ranges exceeded that of the WHO (1967) requirement by 68% for 0 - < 12 months old), 94 % for 12 - <24 months old, 84% for 24 -< 48 months old and 55% for 48 - <60 months old (fig. 9). These differences were not statistically significant (P >0.05).

The thiamin intakes increases from 0.37 mg in the 0 - < 12 months age range to 0.43 mg in 12 - <24 months old. The difference was significantly higher (P <0.05) for 12 - <24 month olds to 24 - <48 months old and decreases thereafter. The thiamin intakes at the different age ranges were below the WHO (1967) mean requirement except in 0 - < 12 months old (table 20). Lower thiamin adequacy ratio persisted at all the age ranges but in the youngest age range (fig. 9). The preschoolers in the youngest age range (0 - < 12 months) had 5% thiamin adequacy ratio higher than their needs.

The riboflavin intakes were lower than their requirements in all the age ranges. However, the mean daily riboflavin intakes of the preschoolers was highest in 12 - <24 months old (0.48 mg) but lowest in both 0 - < 12 months old (0.42 mg) and 48 - < 60 months old (0.42 mg). There were no significant differences among the different age ranges (P >0.05).

The adequacy ratios of all the preschoolers from 0 - < 12 months old to 48 - < 60 months old were lower than their needs for riboflavin (fig. 9). However, 0 - < 12 months olds had the highest adequacy ratio (77%) for riboflavin while 48 - < 60 months olds had the least adequacy ratio (33%) for riboflavin (fig. 9). No age range met their riboflavin or niacin need.

The mean daily intake of niacin of the preschoolers in all the age ranges were lower than their niacin needs (table 20). Preschoolers in age range 48 - < 60 months had significantly least niacin intake (21.69mg) compared with their counterparts in other age ranges (P < 0.05), while those in age range 24 - < 48 months had the highest intake (44.94 mg). A similar pattern holds for the adequacy ratios of niacin intake (fig. 9). The adequacy ratios of all the preschoolers from 0 - < 12 months old to 48 - < 60 months old were lower than their needs for niacin. However, 0 - < 12 months olds had the highest adequacy ratio (75%) for niacin while 48 - < 60 months olds had the least adequacy ratio (35 %) for niacin (fig. 9). No age range met their niacin need.

Preschoolers in age range 0 - < 12 months had significantly least vitamin C intake (16.9 mg) than for other age ranges (P < 0.05). The mean vitamin C intake was higher than their needs in all age ranges but for those in age range 48 - < 60 months. However the differences were not significant (P > 0.05).

Those that are 0 - < 12 months old, 12 - < 24 months old and 24 - < 48 months old exceeded their vitamin C needs by 1.0%, 9.0% and 12% respectively. There were no statistically significant differences among the youngest age range and other age ranges (P < 0.05).

4.3 Nutritional status of preschool children by gender

4.3.1 Sample Z- score distribution

The Z score distributions of both the male and female preschoolers are skewed to the left of the normal curve for all the nutritional status indicators, many of the preschoolers are below the median (fig. 10 - 12). About 20% of the male preschoolers had the greatest Z- score at - 2SD as compared to 15% of the females with Z-score at 1.5 and 0 for weight for age (fig. 10), and about 15% of both sexes had Z-score at -3SD and - 1 SD respectively for height for age (fig. 11), and about 25% of both sexes had Z-score at 1.5 and 0 respectively for weight for height (fig. 12).

However, the percentage of preschoolers below median reference population is lower in female 70.6 % for weight for age, 70.6% for height for age and 62.9% for weight for height than male, 77.8% for weight for age , 79.3% for height for age and 69.6% for weight for height respectively (table 21).

4.3.2 Physical characteristics:

The standard deviations (Z-scores) in preschoolers were significantly higher ($p < 0.05$) in males than in females (table 22). This difference was true in case of all the nutritional status indicators reported ($p < 0.05$; t - ratio = -2.137 weight for age; $p < 0.005$;

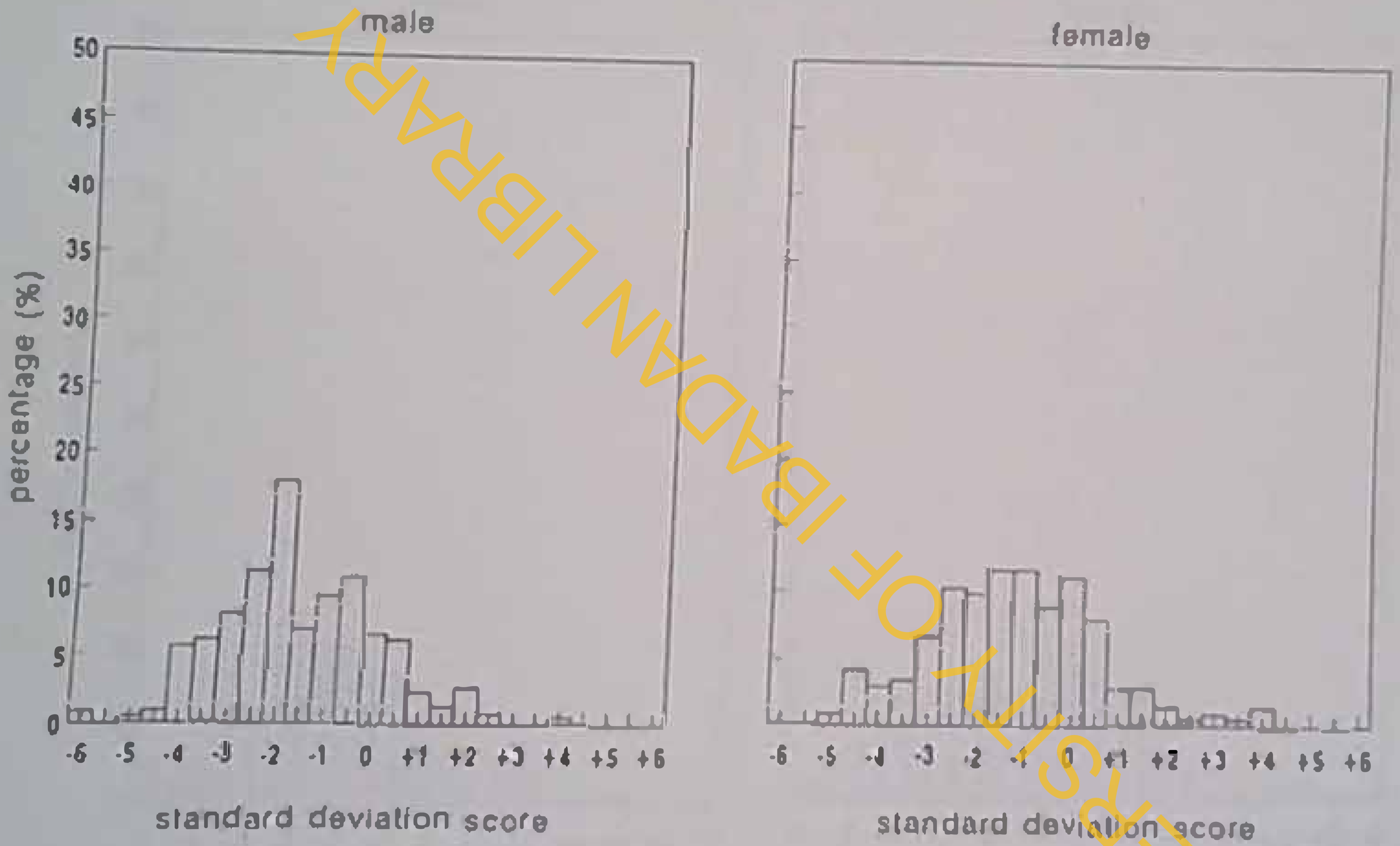

Fig 10: Distribution of Z - scores for weight for age in male and female preschoolers

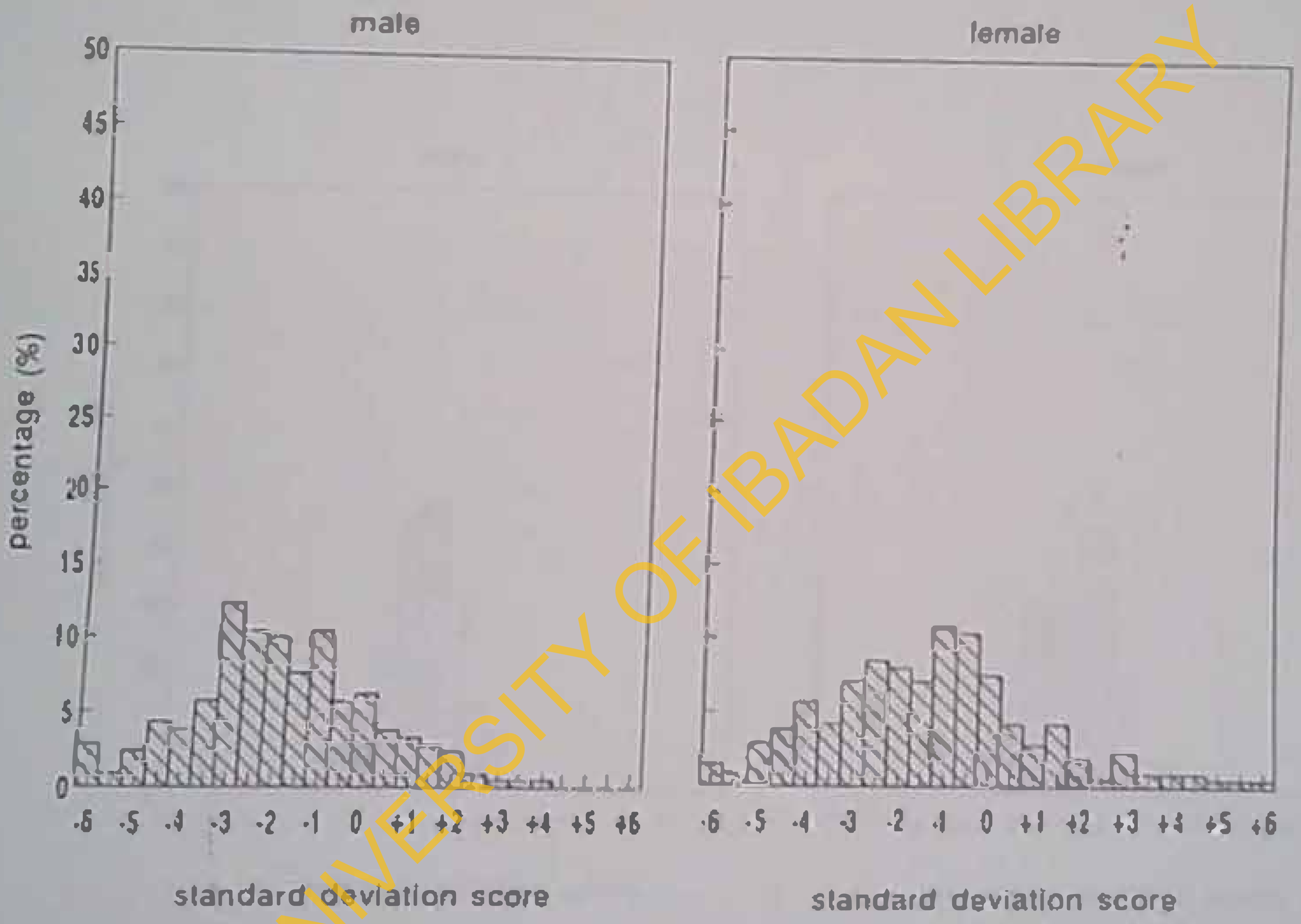

Fig 11: Distribution of Z - score for height for age in male and female preschoolers

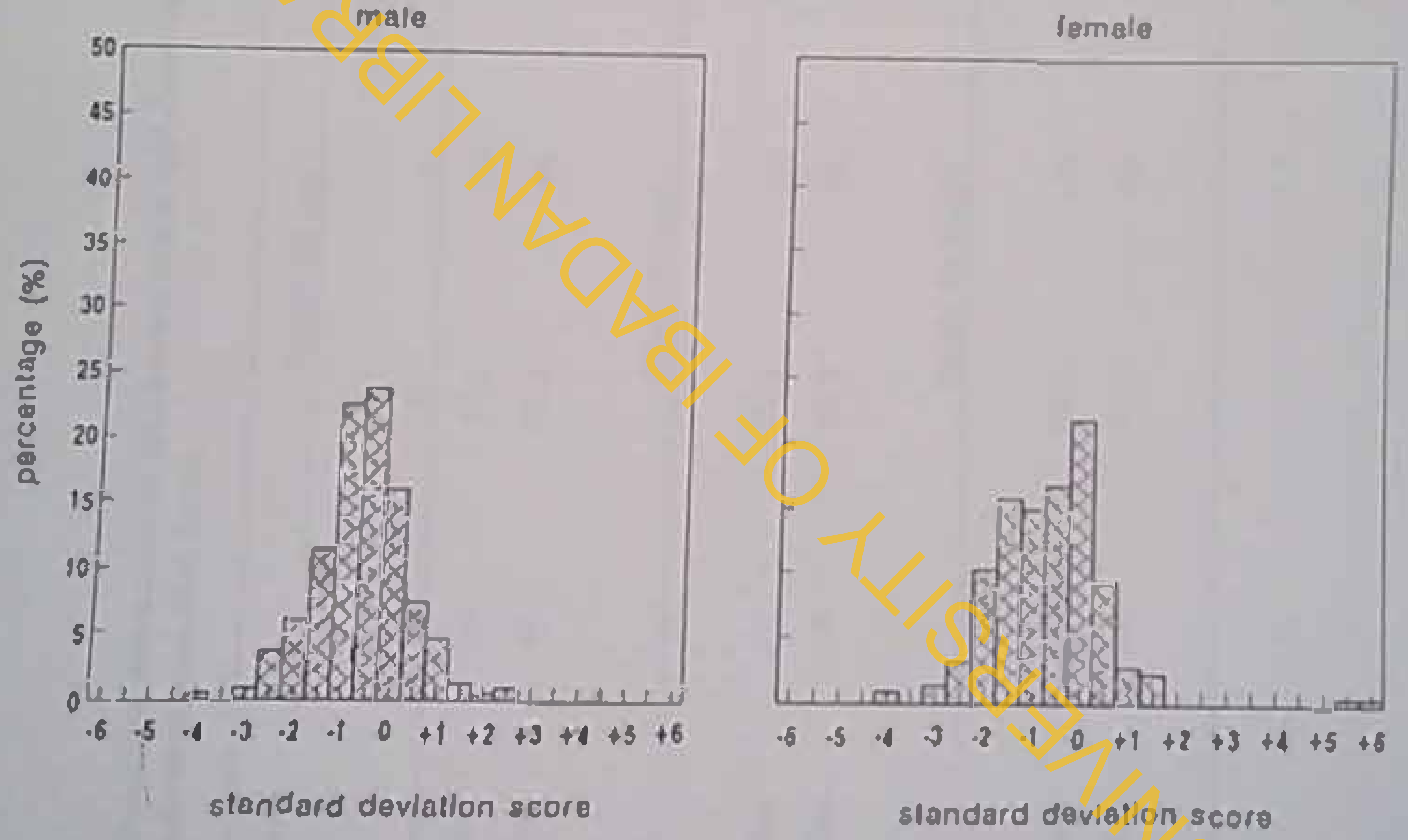

Fig 12 : Distribution of Z - scores for weight for height in male and female preschoolers

Table 21 : **Frequency distribution of preschoolers below and above median NCHS reference population by sex**

Nutrition level	Weight for age			
	Males		Females	
	n	%	n	%
Below median	168	77.8	154	70.6
Above median	48	22.2	64	29.4
	Height for age			
Below median	172	79.3	156	70.6
Above median	45	20.7	65	29.4
	Weight for height			
Below median	151	69.6	139	62.9
Above median	66	30.4	82	37.1

Table 22 : Mean Z-score anthropometric indices of preschoolers by sex

Sex	Weight for age			Height for age			Weight for height		
	n	Z-score	SD	n	Z-score	SD	n	Z-score	SD
male	213	-1.29^a	1.63	215	-1.65^b	2.39	213	-0.55^c	1.01
female	217	-0.93	1.79	217	-0.96	1.17	216	-0.32	1.10

Mean values expressed in standard deviation scores (Z-scores) NCHS reference

a. $p < 0.05$; t - ratio = - 2.137.

b. $p < 0.005$; t - ratio = - 2.804.

c. $p < 0.01$; t - ratio = - 2.418.

t - ratio = - 2.804 height for age; $p < 0.01$; t - ratio = - 2.418 weight for height), height for age had the greatest deviation from the median NCHS for both sexes although it was higher for males. Females were heavier and taller than their male counterparts.

4.3.3 Prevalence of malnutrition

Figure 19 shows that more male preschoolers were undernourished, stunted, and wasted than females. The percentage of male below median - 2SD were 33.33% for undernutrition, 44.44% for stunting, and 6.9% for wasting as compared to those of females 28.9%, 35.8%, and 6.3% respectively. Stunting seemed to be the most prevalent in the preschoolers. These differences were not statistically significant (t - ratio = 0.443 for undernutrition; 0.278 for stunting; and 0.465 for wasting; $p > 0.05$).

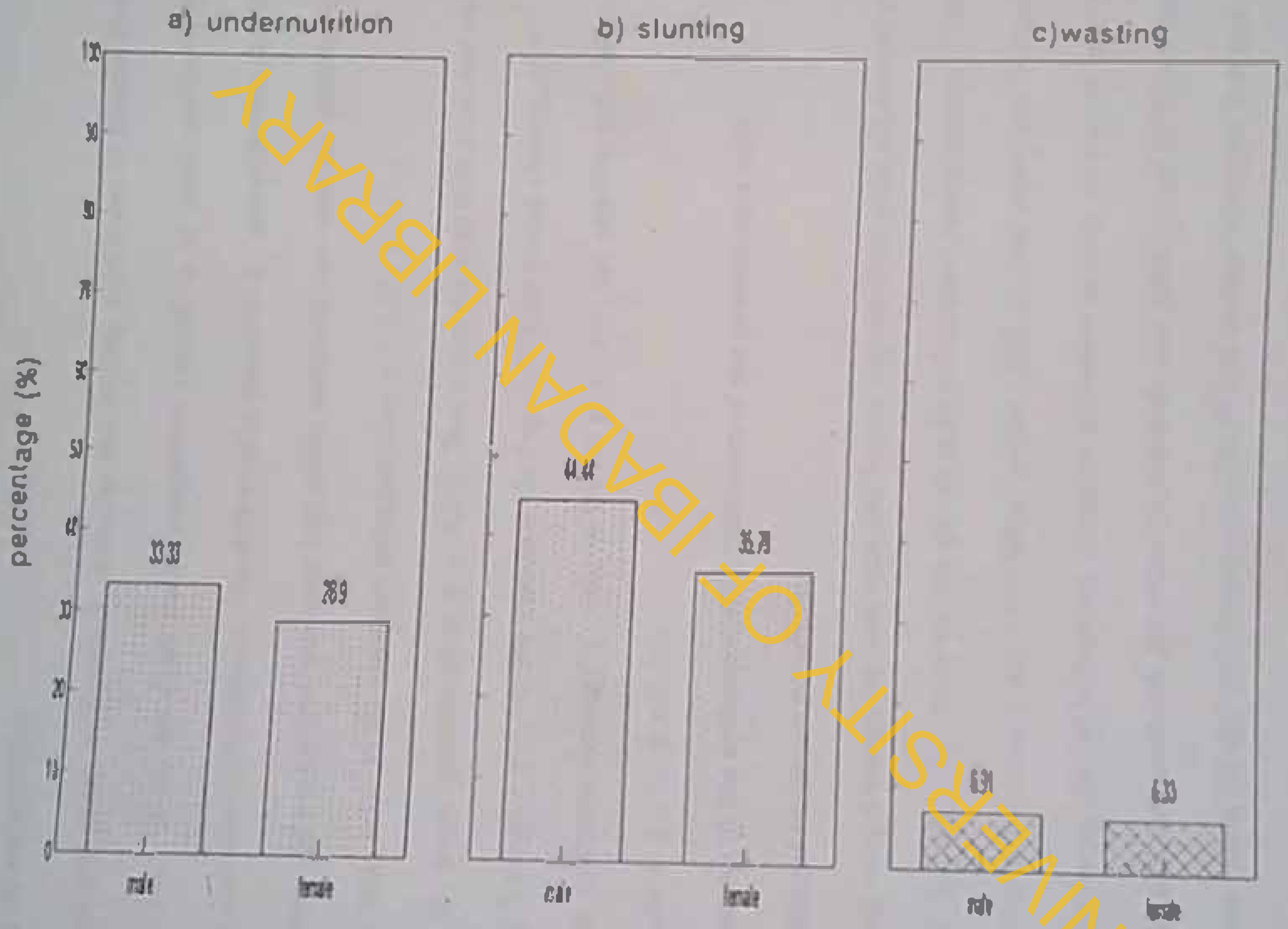

Fig 13 : Prevalence of undernutrition, stunting and wasting in male and female preschoolers

4.3.4 Severity of malnutrition

Moderate and severe undernutrition, stunting, and wasting were lower in females than in males (fig. 14). In all the cases male preschoolers seemed to be more nutritionally inadequate than their female counterparts. The difference in means of Z - scores for weight for age between male and female with moderate and severe undernutrition were not statistically significant (t - ratio = 0.135 for moderate undernutrition; p > 0.05) and (t - ratio = 0.324 for severe undernutrition; p > 0.05). This is also the case with moderate and severe stunting (t - ratio = 0.146 for moderate stunting; 0.579 for severe stunting; p > 0.05) and with moderate wasting (t - ratio = 0.243; p > .05) but significant for severe wasting (t - ratio = 2.273; p <0 .05).

4.3.5 Comparison of the anthropometric indicators of the preschoolers with international reference population

The mean weight for age for both male and female preschoolers under six months of age were above -1SD (fig. 15). However, the growth pattern fluctuated mostly between -2SD and median except in few cases where it falls below median - 2SD for both males and females. The mean weight for age did not indicate any consistent difference between the growth pattern of males and females compared with the reference standards until after the age of 30 months.

The mean height for age was comparable to the NCHS median within the first few

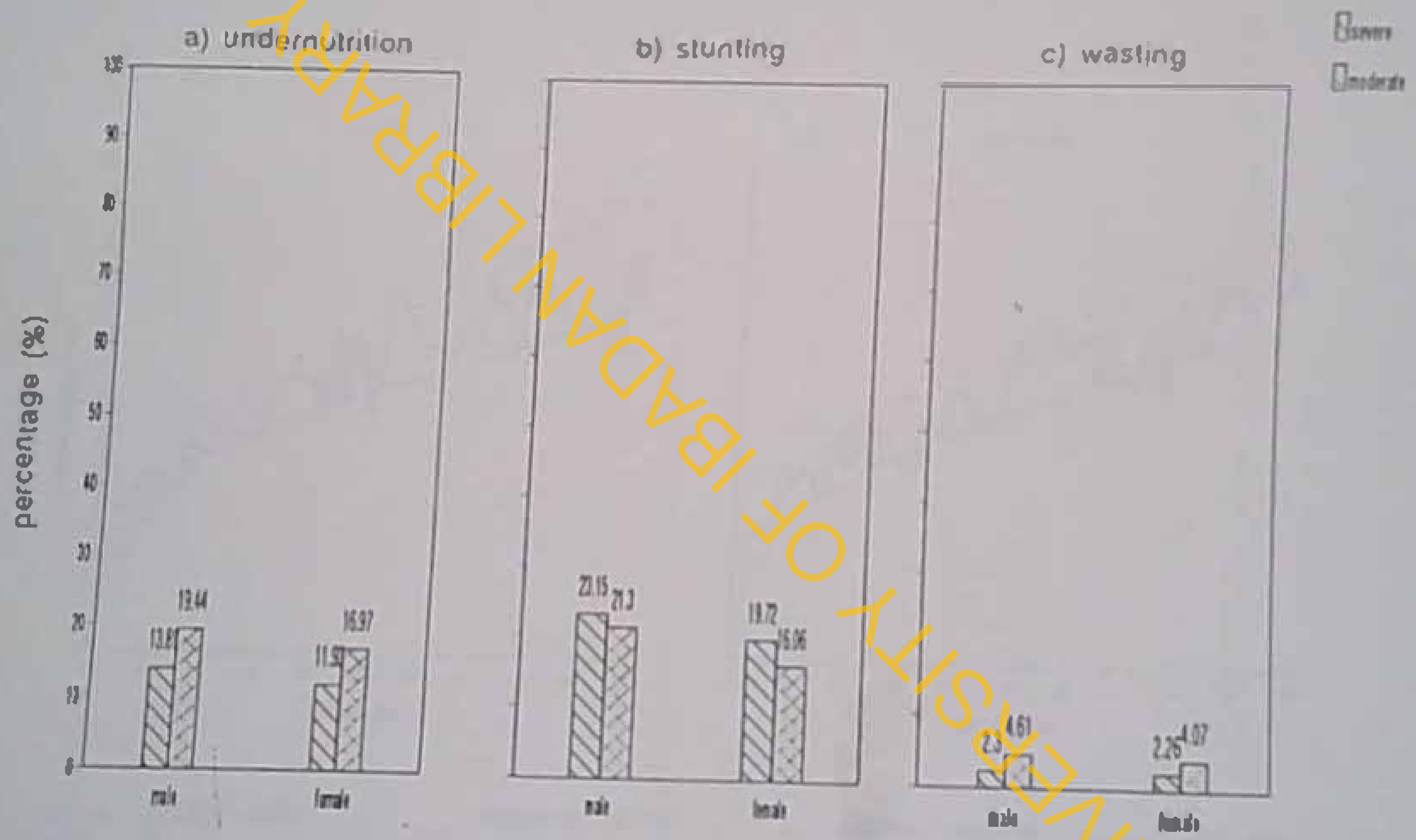

Fig 14 : Prevalence of low levels of undernutrition , stunting and wasting in male and female preschoolers

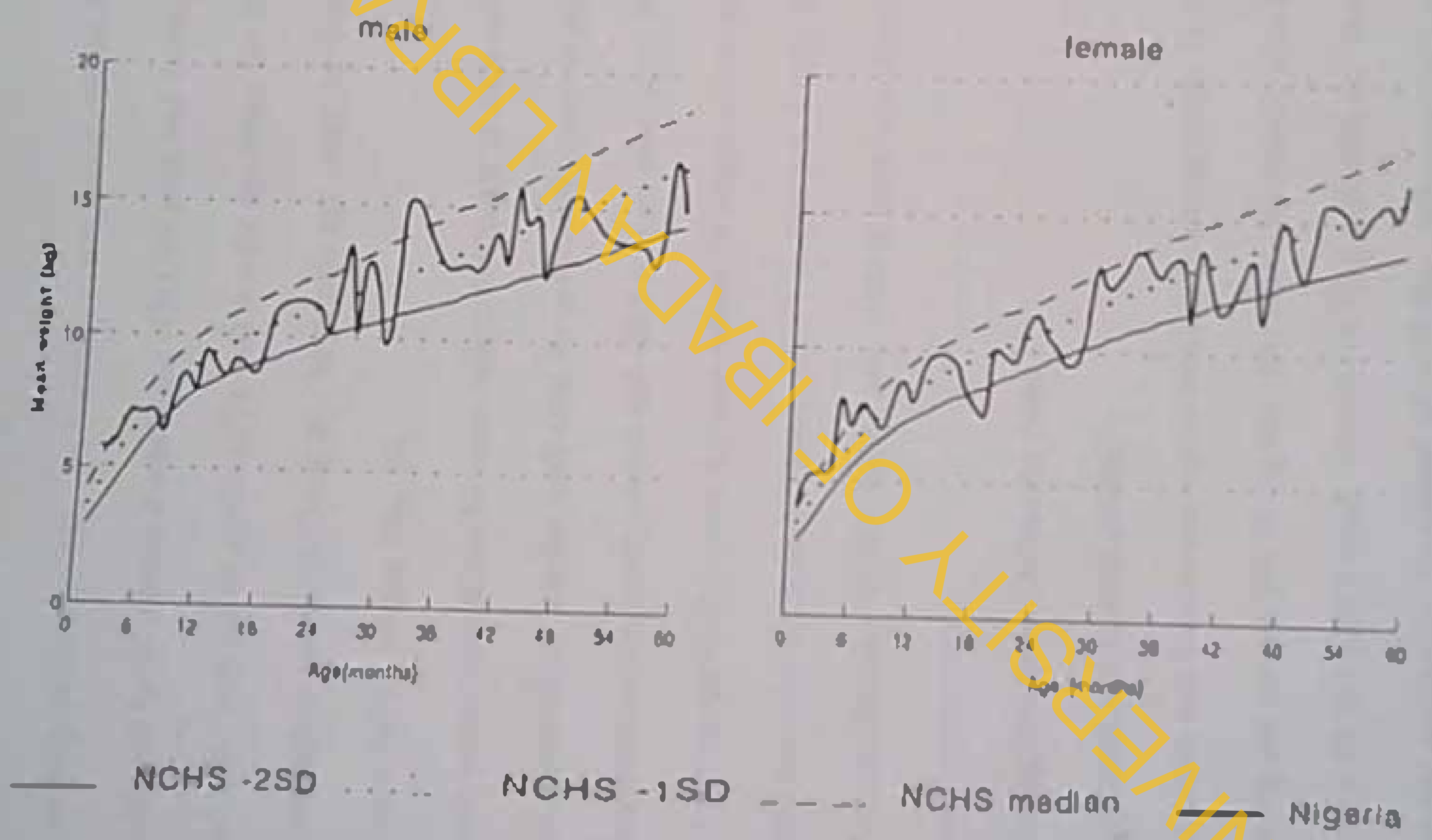

Fig 15: Mean weight measurements of preschoolers,by age,compared with NCHS reference population

months of life for both sexes (fig. 16). At 6 months it was above median for males but at median for females and by 12 months it was about -1SD for male and female. Afterwards it fluctuated around -2SD with the exception of 54 - 60 months age range for males with mean height for age scores below median -2SD and 30 - 36 months age range for females with mean height for age above NCHS median (fig. 16).

The growth pattern determined by mean weight for height of male and female preschoolers was above NCHS median until after the preschoolers have attained about 63cm in length and later fluctuated between median and -2SD in most cases up to the length of 80cm (fig. 17). After the age of 24 months the mean weight for height scores were consistently above NCHS -1SD for males but fluctuated across NCHS median and +1SD. However, those of the females fluctuated between NCHS median and -1SD in most cases from about 80cm in length until 115cm respectively.

4.3.6 Food nutrient intake and adequacy ratio

4.3.6.1 Energy, protein and mineral intakes

Table 23 shows that females had higher mean daily energy intake (4.70 MJ, or 1126 kcal), protein 14.97g and calcium 266.91 mg than their male counterparts who had mean daily energy intake of 4.50 MJ (1083 kcal), protein 14.72 g and calcium 259.26 mg. The differences were not statistically significant ($P > 0.05$). Although iron consumption was slightly higher among males (6.77 mg) than among females (6.65 mg) the difference was not

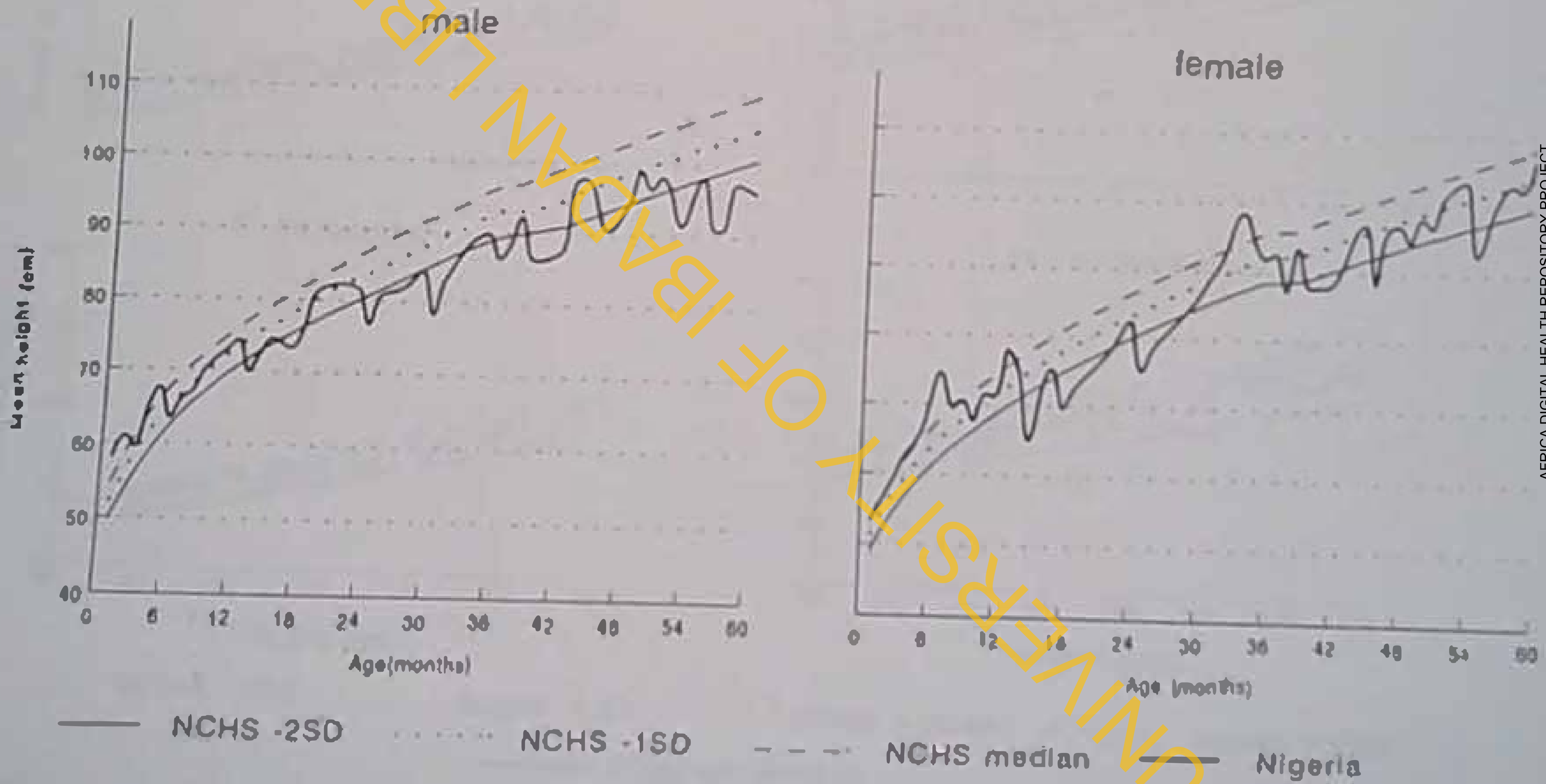

Fig 16: Mean height measurements of preschoolers,by age, compared with NCHS reference population

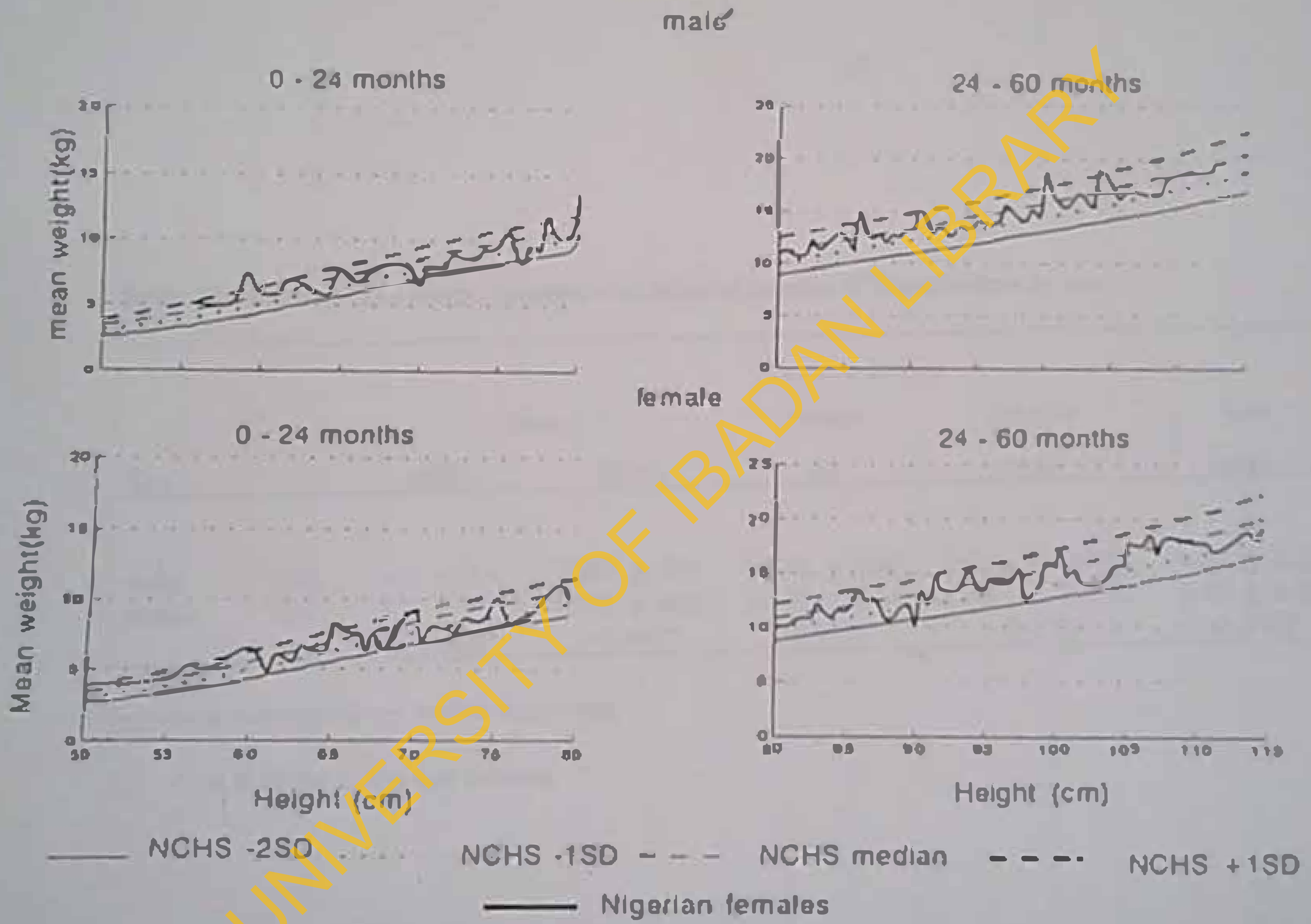

Fig 17:Mean weight for height of female preschoolers, compared with NCHS reference population

Table 23: Mean daily energy, protein, and mineral intakes of Preschoolers by sex

		Nutrient intakes				
		Energy		Protein	Calcium	Iron
Sex		(MJ)	(Kcal)	(g)	(mg)	(mg)
male	210	4.5 ± 2.1	1083 ± 503	14.72 ± 6.90	259.26 ± 167.55	6.77 ± 3.25
female	221	4.7 ± 1.94	1126 ± 466	14.97 ± 6.64	266.91 ± 161.36	6.65 ± 3.05
		(-0.842)[a]	(-0.842)[a]	(-0.022)[a]	(-0.470)[a]	(0.374)[a]

Figures in parenthesis are t-ratio equivalent.

a). $P > 0.05$ for males and females

statistically significant (P > 0.05).

Figure 18 shows that the intakes of female preschoolers fell short of FAO/WHO/UNU (1985) requirement by 11.0% for energy, 3.0% for protein and 37% for calcium while males fell short by 15% for energy, 4.0% for protein and 35% for calcium. Both males and females met their iron needs. The percentage of iron met were 135% and 133% for males and females respectively. The differences were not statistically significant (p >0.05).

4.3.6.2 Vitamin intakes

With the exception of vitamin C, the mean daily vitamin intakes were consistently higher in females than among males (table 24). The mean daily vitamins intakes of males were 477.43μg for vitamin A, 0.41mg for thiamin, 0.46 mg for riboflavin, and 43.68 mg for niacin as compared with intakes of females which were 466.08μg for vitamin A, 0.39 mg for thiamin, 0.44mg for riboflavin, and 42.0 mg for niacin. Student's t-test showed no significant difference at 5% probability. The vitamin C intake was 21.42 mg for males and 19.67 mg for females. The difference was not statistically significant (P >0.05).

The vitamin intake of the preschoolers by sex relative to their needs were low with the exception of vitamins A and C (fig 18). The vitamin intakes of the females fell short by 29% for thiamin, 52% for riboflavin and 49% for niacin WHO (1985) requirements while the intakes of males fell 33% short of thiamin, 53% for riboflavin and 53% for niacin. The intakes of females exceeded the WHO (1967) requirements for vitamin A by 74% and vitamin

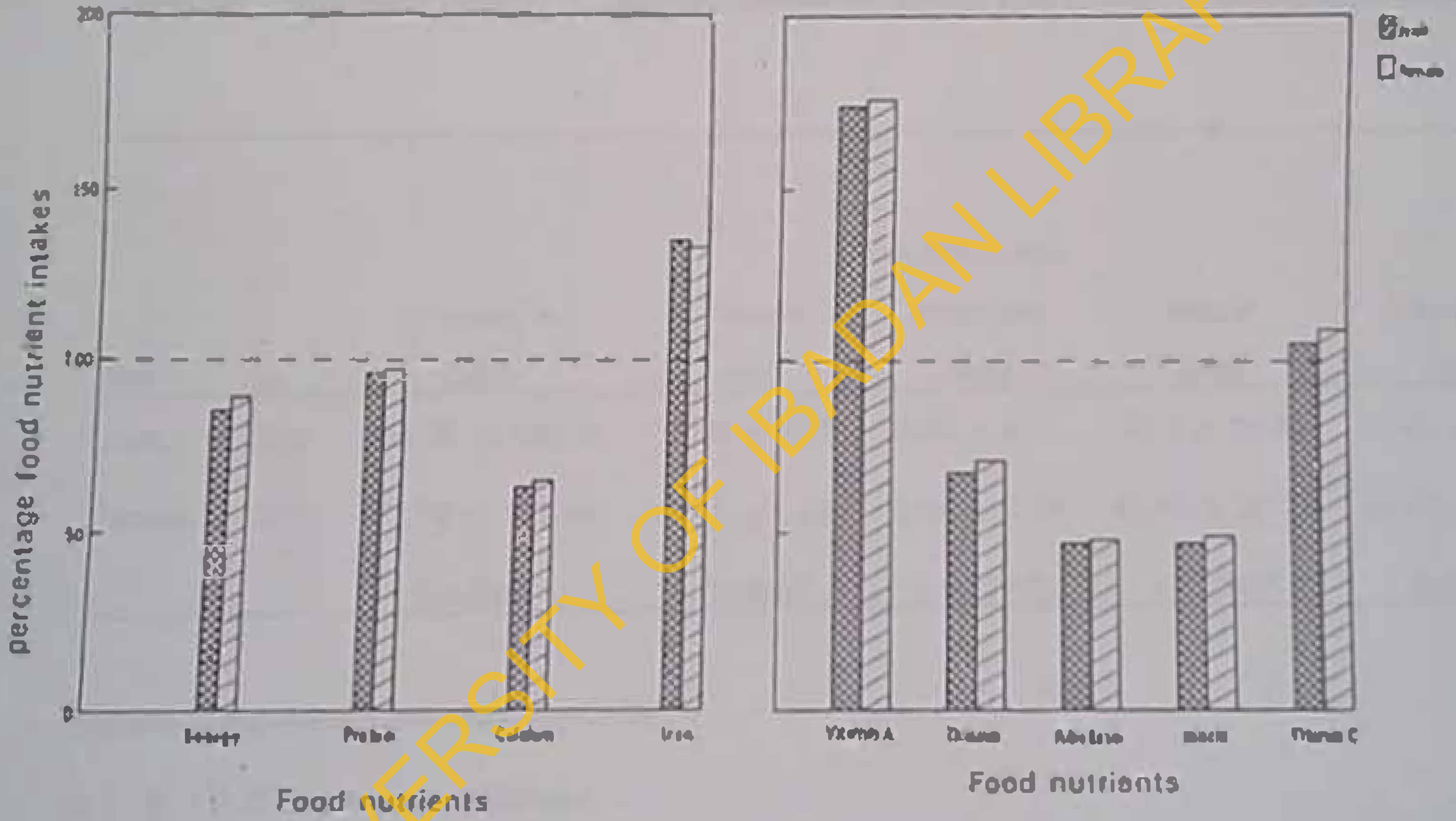

Fig 18 : Food nutrients intakes of male and female preschoolers expressed as percentage of FAO/WHO/UN (1985) and WHO (1967) requirements

Table 24: Mean daily vitamin A, thiamin, riboflavin, niacin, and vitamin C intakes of Preschoolers by sex

		Nutrient intakes				
		Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
Sex	n	(μg)	(mg)	(mg)	(mg)	(mg)
male	216	466.08 ± 170.32	0.39 ± 0.22	0.44 ± 0.25	42.0 ± 21.90	21.42 ± 22.53
female	219	477.43 ± 151.69	0.41 ± 0.21	0.46 ± 0.24	43.68 ± 23.27	19.67 ± 15.71
		(-0.248)[a]	(-0.864)[a]	(-0.774)[a]	(-0.754)[a]	(0.862)[a]

Figures in parenthesis are t-ratio equivalent.

a). P > 0.05 for males and females

C by 5% while male intakes exceeded the requirements of vitamin A by 76% and vitamin C by 9.0%. In most cases, The vitamin adequacy ratios of female slightly exceeded that of males although the differences were not statistically significant (P >0.05).

4.4 Household characteristics and anthropometric indices

4.4.1 Household characteristics

Out of the 445 households surveyed, 405 were headed by men and 40 were headed by women. There was an average of 12.9 persons per household with a range of 3 _ 46 and an average of 1.8 wives with a range of 0 - 9 (table 25). The mean number of years of formal education of the mothers was 0.2 with a range of 0 - 18 and the mean age of the mothers was 38.2 with a range of 12 - 75. As has been explained earlier for the purpose of comparative analyses, the preschoolers are grouped according to whether they are from large/high (above average) and small/low (average or less) households for household size and mothers' age. Thus a preschooler can belong to a large or a small household, to a household with large or small number of wives, and to a household with high or low age mothers. The preschoolers were also grouped according to whether their mother had any formal education or not, monogamous or polygamous households and according to whether they were from male or female headed households.

4.4.1.1 Household size: There was a significant difference (t - ratio= -2.56; p <0.05) in the mean Z-scores for height for age between preschoolers in large households and others

Table 25: Mean values of cash income, household size and characteristics of cassava Producing households

Household characteristics	Mean	Min.	Max.	SD.	n
Household size (number of person)	12.92	3.00	46.00	7.27	206
Number of wives per household	1.82	0	9.00	1.24	206
Mother's education (years)	2.43	0	18	0.38	200
Mother's age (years)	32.62	12.00	45.00	11.50	208

in small sized households (table 26). The mean Z- scores obtained for height for age was higher for preschoolers in large households (-0.88) than for others in small sized households (-1.49). However, no significant difference ($p>0.05$) was observed for weight for age or for weight for height indices, although preschoolers in large sized household had better nutritional status for weight for height than those in smaller households.

4.4.1.2 Number of wives per household: Preschoolers in polygamous households had higher Z - score values than other preschoolers in monogamous households for height for age and weight for height indices assessed except in the case of weight for age index. The differences were not statistically significant (t - ratio = 0.74 for weight for age , -1.57 for height for age and -0.75 for weight for height; $p < 0.05$) . The mean Z-scores of those in polygamous households were -1.18 for weight for age, - 0.15 for height for age, and -0.41 for weight for

Table 26: Mean anthropometric indices by household characteristics expressed as standard deviation score (Z-score) of NCHS reference

Household characteristics	Weight for age			Height for age			Weight for height		
	Z-score	SD	n	Z-score	SD	n	Z-score	SD	n
Household size									
above average	-0.69	1.08	171[a]	-0.88	2.56	171[c]	-0.33	1.44	171[a]
average or less	-1.99	1.51	271	-1.49	2.38	270	-1.51	1.02	272
		(1.501)			(-2.567)			(-1.704)	
Number of wives									
1	-1.05	1.89	152[a]	-1.56	2.20	157[a]	-0.49	1.06	152[a]
1+	-1.18	1.62	262	-1.15	2.70	263	-0.41	1.08	261
		(-0.7432)			(-1.5742)			(-0.7561)	
Mother's education (years)									
(0)	-1.25	1.69	250[c]	-1.28	2.48	251[a]	-0.41	0.94	248[a]
(1+)	-0.82	1.64	144	-1.35	2.57	148	-0.44	1.27	144
		(-2.4551)			(0.2672)			(0.3106)	
Mother's age (years)									
above average	-1.08	1.64	209[a]	-1.25	2.57	213[a]	-0.47	0.98	208[a]
average or less	-1.24	1.82	229	-1.47	2.69	231	-0.43	1.14	229
		(-0.9162)			(-0.9071)			(0.3871)	
Gender of household head									
male	-1.21	1.73	405[b]	-1.46	2.56	404[c]	-0.45	1.07	404[a]
female	-0.51	1.76	31	-0.16	3.29	32	-0.43	1.04	31
		(2.150)			(2.700)			(0.197)	

height while Z-scores values of -1.05, -1.56 and - 0.49 respectively were obtained for preschoolers in monogamous households.

4.4.1.3 Mothers' education: There was no significant difference ($p > 0.05$) in the mean Z -score for height for age and weight for height indices between preschoolers whose mothers had some formal education and others whose mothers had no formal education. The difference was significantly higher in the mean Z-score of preschoolers whose mothers had some formal education in the case of weight for age (t - ratio= -2.45; $p < 0.05$). However, preschoolers whose mothers had some formal education had lower mean Z - scores for height for age and weight for height indices than other preschoolers whose mothers had no formal education (table 21).

4.4.1.4 Mother's age: Preschoolers with older mothers had higher mean Z - scores for weight for age and height for age whereas preschoolers with younger mothers had higher mean Z - score for weight for height. The difference was not significant ($p > 0.05$).

4.4.1.5 Gender of households head: The mean Z-scores for weight for age and height for age for preschoolers in female headed households were significantly higher than those of preschoolers in male headed households (t - ratio = 2.150, $p < 0.05$ for weight for age; and t - ratio =2.700, $p < 0.01$ for height for age). The Z - score values were -0.51 for weight for age and -0.16 for height for age for preschoolers in female headed households and -1.21

for weight for age and -1.46 for height for age for those in male headed households. Preschoolers in the female headed households also had higher mean Z - score value for height for age index than those in male headed households although the difference was not statistically significant (p .0.05) (table 24).

4.4.2 Household characteristics associated with nutritional status

With the weight for age index (table 27) preschoolers in large sized households, or those in polygamous households, or whose mothers' had no formal education or those with younger mothers or those in female headed households had higher nutritional status. In most cases the percentage of preschoolers of normal and severe nutritional status in the above mentioned household characterics was higher and lower, respectively, than those in small households, or whose mothers' had some formal education or those with older mothers or those in male headed households. Chi-square test, indicated that these differences are not statistically significant ($p > 0.05$) in all the household characteristics examined.

Similar results were observed in the height for age index (table 28). With the exception of household size and mothers' education for height for age of preschoolers, other household characteristics factors examined did not associate significantly with the nutritional status of the preschoolers. Analyses could not be carried out for weight for height index because the expected frequency was less than 5.

Table 27 : Association between household characteristic and nutritional status of preschoolers as indicated by weight for age

	Nutritional status							
	Normal		Mild		Moderate		Severe	
Household characteristics	n	%	n	%	n	%	n	%
Household size[a]								
above average	88	51	33	19	27	16	25	14
average or less	110	40	68	25	57	21	41	15
Number of wives[b]								
1	64	39	45	27	32	19	25	15
1+	126	47	54	20	50	19	38	14
Mothers' education (years)[c]								
0	111	44	57	23	48	19	34	14
1+	67	44	36	24	28	18	22	14
Mothers' Age (years)[d]								
above average	88	41	51	24	45	21	29	14
average or less	110	47	50	21	39	17	37	16
Gender of household head[e]								
male	177	43	94	23	80	19	61	15
female	20	59	6	18	3	9	5	15

In this and other tables for association, nutritional status index (weight for age) is expressed in terms of standard deviation (SD) units from median NCHS international reference population as follows:

Normal = Greater than minus 1 Standard deviation
Mild = Between minus 1 Standard deviation and minus 2 Standard deviation
Moderate = Between minus 2 Standard deviation and minus 3 Standard deviation
Severe = Less than minus 3 Standard deviation

a $X^2 = 5.84, p > 0.05, df = 3$ c $X^2 = 0.09, p > 0.05, df = 3$ e $X^2 = 4.06, p > 0.05, df = 3$

[illegible]   d [illegible] $p > 0.05, df = 1$

Table 28 : Association between household characteristic and nutritional status of preschoolers as indicated by height for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
Household characteristics	n	%	n	%	n	%	n	%
Household size^{a}								
above average	89	51	20	12	30	17	34	20
average or less	104	38	54	20	53	19	65	24
Number of wives^{b}								
1	64	39	33	20	32	19	37	22
1+	112	46	38	14	50	19	58	22
Mothers' education (years)^{c}								
0	116	46	46	18	37	15	51	20
1+	63	41	21	14	37	24	32	21
Mothers' age (years)^{d}								
above average	90	42	27	13	43	20	53	25
average or less	103	44	47	20	40	15	46	20
Gender of household head^{e}								
male	172	42	68	17	77	19	95	23
female	20	59	4	12	6	18	4	12

a. $X^2 = 9.75 ; p < 0.05 ; df = 3$ b. $X^2 = 3.24 ; p > 0.05 ; df = 3$

c. $X^2 = 6.39 ; p < 0.10 ; df = 3$ d. $X^2 = 5.72 ; p > 0.05 ; df = 3$

e. $X^2 = 4.38 ; p > 0.05 ; df = 3$

4.5 Health factors and anthropometric indices

4.5.1 Source of water supply: Preschoolers in households which had access to potable water had higher mean Z - scores for weight for age and for height for age index than preschoolers in households without access to potable water. But the difference was significant only in the case of height for age. On the other hand, preschoolers in households without access to potable water had higher mean Z - score for weight for height index; the difference was not however significant (table 29).

4.5.2 Immunization: There was no significant difference between preschoolers that were immunized and those that were not immunized in the mean Z - score of any of the three indices. However, preschoolers that were not immunized appeared to have deviated less from the median NCHS reference population in all the three anthropometric indices (table 29).

4.5.3 Diarrhoea episodes. Similarly, there was no significant difference between preschoolers who suffered and others who did not suffer from diarrhoea in any of the three indicators. Preschoolers who suffered from diarrhoea however appeared to deviate less from NCHS reference population with respect to all indices than others preschoolers who did not suffer from diarrhoea (table 29).

4.5.4 Health factors associated with nutritional status

The results of the association between the health factors and nutritional status

Table: 29 Mean nutritional anthropometric indices by health factors expressed in standard deviation score (Z-score) of NCHS reference

	Weight for age			Height for age			Weight for height		
Health factor	Z-Score	SD	n	Z-score	SD	n	Z-score	SD	n
Source of water*									
Potable	-0.76	1.56	35[a]	-0.41	3.06	36[b]	-0.64	0.98	35[a]
Non-potable	-1.20	1.75	403	-1.45	2.58	408	-0.44	1.07	402
		(-1.4227)			(-2.2779)			(1.0947)	
Immunization									
Yes	-1.15	1.71	365[a]	-1.29	2.55	369[a]	-0.49	0.97	364[a]
No	-0.99	1.68	54	-1.14	1.74	57	-0.24	1.34	55
		(0.6312)			(0.4157)			(1.3057)	
Diarrhoea episode (Last 7 days)									
Yes	-1.00	1.85	60[a]	-1.28	3.10	60[a]	-0.35	0.93	60[a]
No	-1.17	1.71	359	-1.33	2.58	366	-0.48	1.04	359
		(-0.6695)			(-0.1507)			(-0.9342)	

* Water classed as potable if from community taps or bore wells; as non-potable if from open wells, rivers, lakes, ponds etc.

Figures in parenthesis are t-ratio equivalent

a. $P > 0.05$

b. $P < 0.05$

indices of weight for age and height for age of the preschoolers are presented in tables 30 - 31. Preschoolers in households with access to potable water had significantly higher proportion in the normal status and less moderate or severely malnourished preschoolers than those in households with non - potable water as indicated in weight for age (table 30) and height for age (table 31). However, the result showed that source of water supply affects significantly the nutritional status.

Preschoolers that were not immunized and those who have suffered from diarrhoea were more in the normal status for weight for age (table 30) than those immunized and those that have not suffered from diarrhoea . Furthermore, a larger proportion of the preschoolers that were not immunized and those who suffered from diarrhoea were severely malnourished than those that were immunized and those who had suffered from diarrhoea. For height for age, (table 31) the proportions were higher in normal and mild status and lower in moderate and severe status for those that were immunized and those that have not suffered from diarrhoea .However, the differences were not significant ($p > 0.05$).

4.6 Cash income, market access and population density factors and anthropometric indices

4.6.1 Household Cash income: The mean cash income per annum at current prices per household was 33,980 Naira. Out of the 438 preschoolers surveyed, 165 were from high (above average), and 273 were from low (average or less) cash income households.

Table 30 : Association between health factors and nutritional status of preschoolers as indicated by weight for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
Health factors	n	%	n	%	n	%	n	%
Source of water[a]								
potable	19	53	10	28	4	11	3	8
non-potable	179	43	91	22	80	19	63	15
Immunization[b]								
Yes	163	44	89	24	69	19	51	14
No	28	48	10	17	11	19	9	16
Diarrhoea episode[c] (last 7 days)								
Yes	29	48	17	28	6	10	8	13
No	161	44	82	22	73	20	54	15

a. Water classed as potable if community taps or bore wells; as non-potable if from open wells, rivers, lakes ponds, etc.
$X^2 = 3.44$;$p > .05$;df =3

b. $X^2 = 1.32$;$p > 0.05$;df =3

c. $X^2 = 3.84$;$p > 0.05$;df =3

Table 31 : Association between health factors and nutritional status of preschoolers as indicated by height for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
Health factors	n	%	n	%	n	%	n	%
Source of water[a]								
potable	20	56	8	22	3	8	5	14
non-potable	42	42	66	16	80	19	94	28
Immunization[b]								
Yes	160	43	63	17	75	20	74	20
No	29	50	9	16	6	10	14	24
Diarrhoea episode[c] (last 7 days)								
Yes	24	40	16	27	7	12	13	22
No	164	44	55	15	73	20	78	21

a. Water classed as potable if community taps or bore wells; as non-potable if from open wells, rivers, lakes, ponds, etc.
$X^2 = 5.58$; $p > 0.05$; $df = 3$

b. $X^2 = 3.62$; $p > 0.05$; $df = 3$

c. $X^2 = 6.38$; $p < 0.10$; $df = 3$

Preschoolers in high cash income households had higher Z-scores for all the anthropometric indices than preschoolers in low cash income households (table 32). There was however, statistically significant difference in only weight for height nutritional status indicator ($p<0.05$). Table 33 shows that percentage of preschoolers in the normal status or mild grade of malnutrition were greater for those in high cash income households. Likewise, a smaller proportion of preschoolers in high income households were moderately or severely malnourished (table 33) than those in low cash income households by weight for age but almost similar by height for age indices (table 34). These differences were not significant at ($p<0.05$).

4.6.2 Market access: Preschoolers in households closer to market centers had higher Z-scores for all three anthropometric indices assessed than preschoolers in households living further away from market centers (table 32). The differences were however not statistically significant ($p > 0.05$). Preschoolers in households that live closer to market centers had less severely malnourished preschoolers for weight for age and larger proportion of preschoolers in the normal status by height for age than others (table 33 - 34). The differences were significant ($p < 0.10$) only for heiht for age indicator.

4.6.3 Population density: Out of 438 preschoolers surveyed 65 were from households in high population density zones and 373 were from households in low population density

Table 32 : Mean anthropometric indices by cash income, market access, and population density expressed as standard deviation score (Z-score) of NCHS reference

	Weight for age			Height for age			Weight for height		
	Z-score	SD	n	Z-score	SD	n	Z-score	SD	n
Cash income									
above average	-1.08	1.64	164[c]	-1.33	2.38	165[c]	-0.32	0.92	165[a]
average or less	-1.20	1.79	273	-1.38	2.79	272	-0.52	1.14	271
		(-0.7308)			(-0.1690)			(-2.017)	
Market access									
less than 10km, foot	-1.05	1.65	276b	-1.27	2.61	281b	-0.36	1.13	275b
Any distant, Vehicle	-1.30	1.77	130	-1.43	2.54	125	-0.57	0.91	131
Greater than 10km, foot	-1.23	0.98	32	-1.46	2.67	32	-0.57	0.95	32
Population density									
Low (less than 50 person/sqkm)	-1.37	1.51	65[a]	1.48	2.49	67[c]	-0.53	0.92	65[c]
High (Greater than 50 person/sqkm)	-1.12	1.77	373	-1.34	2.66	371	-0.43	1.09	372
		(-1.0620)			(-0.4018)			(0.6889)	

Figures in parenthesis are t-ratio equivalent.

a. $p < 0.05$

b. $p > 0.05$; f-value = 0.21; height for age
$p > 0.05$; f-value = 0.98; weight for age
$p > 0.05$; f-value = 1.83; weight for height

c. $P > 0.05$.

Table 33 : Association between cash income, market access and population density and nutritional status of preschoolers as indicated by weight for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
	n	%	n	%	n	%	n	%
Cash income(Naira per person)^a								
above average	71	50	30	21	25	17	17	12
average or less	127	42	71	23	59	19	49	16
Market access^b								
Less than 10km by foot	129	46	67	24	52	19	33	12
Greater than 10km by foot	54	38	31	23	27	20	24	18
Any distant, vehicle	15	47	3	9	5	16	9	28
Population density^c								
Low (Less than 50 persons/sq km)	171	45	84	22	72	19	55	14
High (Greater than 50 persons/sq km)	27	40	17	25	12	18	11	16

a. $X^2 = 2.98$; $p > 0.05$; $df = 3$

b. $X^2 = 10.20$; $p > 0.05$; $df = 6$

c. $X^2 = 0.73$; $p > 0.05$; $df = 3$

Table 34 : Association between cash income, market access and population density and nutritional status of preschoolers as indicated by height for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
	n	%	n	%	n	%	n	%
Cash income (Naira per person)[a]								
above average	68	48	23	16	21	15	31	22
average or less	125	41	51	17	62	20	68	22
Market access[b]								
Less than 10km by foot	126	45	39	14	56	10	60	21
Greater than 10km by foot	53	39	32	24	23	17	28	21
Any distant, vehicle	14	44	3	9	4	13	11	34
Population density[c]								
Low(Less than 50 persons/sq km)	167	44	57	15	71	19	37	23
High(Greater than 50 persons/sq km)	26	39	17	25	12	18	12	18

a. $X^2 = 2.69 ; p > 0.05 ; df = 3$

b. $X^2 = 10.49 ; p < 0.10 ; df = 6$

c. $X^2 = 4.72 ; p > 0.05 ; df = 3$

zones. Preschoolers in households located in high population density zones also had higher Z - scores for all the three indices assessed than preschoolers in households located in low population density zones although the differences were not significant ($p > 0.05$). Preschoolers from households in low population density zones had higher nutritional status than those from households in high population density zones. The percentage of preschoolers of low population density zone households of normal nutritional status was higher than those from households in high population density zones ($p < 0.05$) (tables 33 - 34).

4.8 Household food expenditure and anthropometric indices

4.8.1 Household total food expenditure

Average expenditure on all food per person per week was 104.38 Naira, the range was 100.68 to 835.18 Naira (table 35); eighteen Naira was one US dollar in 1992. Expenditure on food, in this context, is the retail market value of food including purchased and self produced food items consumed. There was a highly significant association between the growth deviation and household total food expenditure by all three anthropometric indices ($p < 0.05$). The Z -score values were higher among preschool children from above average total food expenditure households than among preschoolers from average or below total food expenditure households by all three indices (table 36). The association of the household total food expenditure with the percentage of the children in the different levels of severity of undernutrition or stunting was also highly significant ($p \leq 0.001$). Above average total food expenditure households had

Table 36: Mean values of household expenditure on food items in cassava producing areas (Naira per person per fortnight)

Household food expenditure	Mean	Min.	Max.	SD	n
Cassava	17.74	0	0.79	0.14	207
Maize	8.35	0	0.62	0.08	207
Yam	14.61	0	0.77	0.15	207
Millet/sorghum	7.30	0	0.51	0.10	207
All other food items	56.34	0	0.79	0.19	207
Total (all food)	104.34	100.68	835.18	104.53	207

Table 36: Mean Z-score of anthropometric indices of preschoolers by major staple household food expenditure

	Weight for age			Height for age			Weight for height		
Household food expenditure	Z-score	SD	n	Z-score	SD	n	Z-score	SD	n
Cassava food expenditure									
above average	-1.12	1.88	144^{a}	-1.10	2.98	145^{a}	-0.53	1.29	143^{a}
average or less	-1.17	1.66	294	-1.49	2.45	299	-0.41	0.94	294
		(-0.2965)			(1.3707)			(1.0070)	
Maize food expenditure									
above average	-1.21	1.63	147^{a}	-1.35	2.38	148^{a}	-0.471	1.03	146^{a}
average or less	-1.13	1.79	291	-1.36	2.76	296	-0.44	1.09	291
		(0.4531)			(0.0467)			(0.4730)	
Yam food expenditure									
above average	-0.94	1.78	141^{a}	-1.17	2.69	142^{a}	-0.36	1.02	140^{a}
average or less	-1.26	1.71	297	-1.45	2.61	302	-0.49	1.09	297
		(1.7755)			(-1.0581)			(-1.2264)	
Millet food expenditure									
above average	-0.93	1.78	140^{a}	-0.98	2.73	143^{a}	-0.42	1.12	140^{b}
average or less	-1.26	1.71	298	-1.54	2.57	302	-0.46	1.04	297
		(1.8515)			(-0.3399)			(-2.0857)	
All food expenditure									
above average	-0.58	1.77	143^{c}	-0.54	2.57	143^{c}	-0.29	1.13	142^{b}
average or less	-1.44	1.65	295	-1.75	2.58	301	-0.52	1.03	295
		(-4.9479)			(-4.6019)			(-2.1253)	

[illegible]

smaller proportions of preschoolers in the moderate to severe status and large proportion in the normal status of both undernutrition and stunting (tables 37 and 38). Associating wasting in the preschoolers and household expenditure on food could not be assessed because of degrees of freedom limitations.

4.7.2 Household cassava and other staple foods expenditure

Average expenditure per week was 17.74 Naira on cassava food, 14.61 Naira on yam, 8.35 Naira on maize, 7.30 Niara on millet/sorghum, and 56.34 Naira on all other food items.

The growth deviations did not differ significantly between categories of households' expenditure on cassava food or on any of the other staples for any of the indices except for weight for height index of the preschoolers in the milletor sorghum expenditure households. However, the Z-score values for weight for age and height for age were higher for preschoolers from high cassava food expenditure households while the Z-score value for weight for height was higher for preschoolers from low cassava food expenditure households(table 361). In case of maize the Z-score values for weight for age and weight for height were lower for preschoolers from above average expenditure households. In case of yam or millet/sorghum the Z-score values were higher for children from above average expenditure households for all indices.

4.7.3 Household food expenditure associated with nutritional status

The associations between the percentages of the preschoolers in the different levels of

Table 37 : Association between household food expenditure and anthropometric indices of preschoolers as indicated by weight for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
Household food expenditure	n	%	n	%	n	%	n	%
Cassava food expenditure[a]								
average	75	39	37	19	43	23	35	18
average or less	123	47	64	25	41	16	13	12
Maize food expenditure [b]								
above average	62	37	45	27	39	23	22	13
average or less	136	48	56	20	45	16	44	15
Yam food expenditure [c]								
above average	94	53	27	15	25	14	30	17
average or less	104	38	74	27	59	22	36	13
Sorghum/millet food expenditure[d]								
above average	79	47	38	23	32	19	18	11
average or less	119	42	63	22	52	18	48	17
All food expenditure[e]								
above average	85	56	30	20	21	14	16	11
average or less	113	38	71	24	63	21	50	17

a. $X^2 = 8.74$; $p < 0.05$;df =3.
b. $X^2 = 8.73$; $p < 0.05$;df =3.
c. $X^2 = 16.49$; $p > 0.001$;df =3.
d. $X^2 = 4.53$; $p > 0.05$;df =3.
e. $X^2 = 13.72$; $p < 0.005$;df =3.

Table 38: Association between food expenditure and nutritional status of preschoolers as indicated by height for age

	Nutritional Status							
	Normal		Mild		Moderate		Severe	
Household food expenditure	n	%	n	%	n	%	n	%
Cassava expenditure [a]								
above average	76	40	23	12	37	19	54	28
average or less	117	45	51	20	46	18	45	17
Maize food expenditure [b]								
above average	65	39	31	18	29	17	43	26
average or less	128	46	43	15	54	19	56	20
Yam food expenditure [c]								
above average	85	48	21	12	30	17	40	23
average or less	108	40	53	19	53	19	59	23
Sorghum/Millet expenditure [d]								
above average	82	49	24	14	30	18	31	19
average or less	111	39	50	17	53	19	68	24
All food expenditure [e]								
above average	82	54	19	13	27	18	24	16
average or less	111	37	55	19	56	19	75	25

a. $X^2 = 10.74$;$p < 0.01$;df =3.
b. $X^2 = 3.53$;$p < 0.05$;df =3.
c. $X^2 = 5.92$;$p > 0.05$;df =3.
d. $X^2 = 3.44$;$p > 0.05$;df =3.
e. $X^2 = 12.78$;$p < 0.005$;df =3

severity of undernutrition and the expenditure on cassava food and on each of the other staples were all significant ($p < 0.05$) in each case by weight for age index except for sorghum/millet food expenditure. Above average cassava, maize or millet/sorghum food expenditure households had a larger proportion of their preschoolers in the moderate or severe undernutrition status (table 37). Above average yam food expenditure households had a large proportion of their children in the normal. On the other hand, the association with the percentage of the preschoolers in the various levels of severity of stunting was not significant with the household expenditure on any of the staple foods (table 38) by weight for age index except for yam and sorghum/millet food expenditure.

CHAPTER FIVE

DISCUSSIONS

5.1 Nutritional status of overall preschool children

The mean z-scores of the preschoolers in cassava growing areas of Nigeria were found to be closer to the normal range of NCHS (-1SD to + 1SD) international reference values. The mean Z-scores were considerably higher than those of most in other developing countries. Yambi, Latham, Habicht and Hass (1991) obtained mean Z-scores of -1.71 ± 1.0 for weight for age, -2.1 ± 1.1 for height for age and - 0.5 ± 0.9 for weight for height in the study of 2452 children from 6 to 36 months in Tanzania. The possible explanation for the differences could be in the age range used for the studies. Preschoolers from the ages of 6 to 36 months are more exposed to infections and dietary inadequacies owing to introduction of solid food. In 1988, Tylleskär and Tylleskär reported mean Z-scores of -1.25 ± 1.4 for weight for age, -1.30 ± 1.21 for height for age and -0.51 ± 0.99 for weight for height for Sakata preschoolers aged 0 - 36 months in Zaire. The mean Z-scores obtained were similar to those of the present study for height for age, but lower for weight for height and weight for age. The standard deviations in the present study are high because of the wider age range of the present sample. However, the difference observed in the height and weight for age could be explained by seasonality.

The findings of this study indicate that the percentage of undernutrition was 31.1%, stunting 40% and wasting 6.4%. The reports of nutrition situation in Nigeria (1993) showed that the proportion of under-five year olds underweight was 36%, stunted 43%, and wasted

10%. These values are comparable to the observations of the present study except in the case of wasting; the difference in that case could be due primarily to environmental factors.

Prevalence of underweight as observed in the present study (31.1%) was higher than two, equal to one, and lower than two of those obtained in five Local Government Areas in five states of Nigeria (Federal Ministry of Health/UNICEF, 1988), i.e 25% in Kwara, 28% in Cross River, 30% in Ondo, 39% in Bauchi and 40% in Oyo state. Prevalence of stunting observed in the present study (43.1%) was higher than in Kwara (39%), Cross River (22%), and Ondo (25%); it was about the same as in Oyo (41%) and lower than in Bauchi (54%) (Nigeria, Nutrition report, 1993).

Prevalence of wasting among preschoolers observed (6.4%) was lower than 9.6% reported in the Nigerian report (1993), and some reported in different States of Nigeria , for examples 10.2% for Kwara, 13.2% for Ogun, and 15% for Kaduna. Disparities may be due to differences in geographical location which has been shown to influence child caring and weaning practices (WHO, 1987; Anderson, 1979).

The observation that food nutrient intakes of the preschoolers were low relative to their FAO/WHO/UN (1985) and WHO (1967) recommended requirements has also been made by many investigators. Fashakin and Abayomi (1987) have observed that preschoolers in Ondo state of Nigeria did not meet their energy (97.9%), protein (84.0%), calcium (47.0%) and riboflavin (11.3%) requirements. The mean nutrient intake values observed in the present study were higher than the values reported by Fashakin and Abayomi (1987).

The variability in the intake could be attributed to the enhanced income generated from the sales of cassava products from cassava producing households. The enhanced economic conditions could have resulted in increase in intake of food as a result of increase household incomes. Chandhury (1986) reported 67% of energy adequacy and adequate protein intake for 99 Bangladesh children. Addo (1988) and Ngwu et al. (1989) observed that the diets of Nigerian children were deficient in energy, protein and calcium but sufficient in iron and retinol equivalent. The FAO/WHO/UN (1985) and WHO (1967) recommendation may be superior and in most cases could give misleading information about the nutritional status of the preschoolers. For this reason, adequacy ratio that is inferior by 20% or even by 40% can still be compatible with adequate nutrition (Encyclopedia of Food Science, Technology Nutrition ,1993). This appeared to be the possible explanation of the normal nutritional growth achievement in cassava growing areas in Nigeria when the food nutrient adequacy ratios were considered in relation to their anthropometric statistics. Table 39 shows that the nutrient level attained by the preschoolers provided a normal growth for their weight for age. Nweke (1996) has shown that cassava provides cash income for the cassava producing households because it is a cash crop and not a subsistence crop. On the other hand, Levinsor (1974) has noted that poor households must have to make substantial food purchases even to meet basic nutritional needs such as calories and protein.

Table 39: Standard deviation scores (Z-score) and energy and protein adequacy in preschoolers

	n	Body weight (kg)	Z-score for weight for age	Energy (MJ/day)	Energy adequacy ratio	Protein (g/day)	Protein adequacy ratio
Overall							
All preschoolers	435	11.77	-1.11	4.62 (1104)	87	14.71	96

Figures in parenthesis are energy intake expressed in Kcal

The observation that calcium, riboflavin and niacin were most deficient could be attributed to the fact that these nutrients are obtained by higher consumption of milk, eggs, offal and meat which are not commonly consumed in the rural setting. In addition, the replacement of animal protein with vegetable protein which is bulky and less easily assimilated because of the low contents of plant protein, and locally produced cereals with refined cereals which is poorer in protein and industrially milled with high extraction rate, accelerates the loss of the nutrients even further (Përisse and Kamoun, 1988). In general, the preschoolers on average could be said to have better nutritional status than expected. The energy intake in relation to their energy needs fell 13% short of energy requirement, the protein adequacy ratio 4.0% and the deviation of the weight for age indicator from the median NCHS reference population was -1.11. The deviation was not below -2SD median weight for age. This shows that, on the average the intake of the preschoolers as a whole were adequate for their normal growth and development.

5.2 Nutritional status of preschool children by age group

Preschoolers in the 48-< 60 months age range were found to have the highest deviation below median NCHS standard in height for age, followed by those in the 24-< 48 months age range while those in the 0-< 12 months age range had the least deviation. The standardized height of preschoolers decreases as the children grow older, until the minimum is reached at

46 months of age. This confirms the observation of Ahn and Shariff (1995) that younger children fare better than the older ones in comparison with the standard reference group. This suggests that the adverse health effects accumulate with age during the first few years of childhood. Younger children are exposed to a relatively better development environment than older ones. This has been reported by other investigators as well. In a study conducted in Jamaica, while about 215 of the children under one year old showed some degree of malnutrition by Gomez's classification, more than half of those over one year old show the degree of malnutrition (Powell and Granthan - Mcgregor, 1971). Earlier studies conducted also in Jamaica reported a similar pattern (Granthan-Mcgregor, Desai and Bach, 1972). The better nutritional status of infants is probably due to their being able to satisfy their nutritional needs through breast milk and some complementary foods. However, after the first year of life, when breastfeeding no longer meets their nutrient needs and complementary food is inadequate, there is likely to be an increase in the prevalence of undernutrition (Whitehead, 1979).

The difference in stunting among the preschoolers in different age ranges was observed to be significant and highest in those in the 48-60 months age range. Stunting process starts in first year of life up to second year of life (WHO, 1987; UN/ACC/SCN, 1993) but becomes more prominent at the later age. In addition, studies of rate of increase in length have revealed that the widespread stunting seen in many less developed countries in children aged between

3 and 5 years is the result of a process of slowed skeletal growth that starts in infancy (Waterlow, 1980).

There was a significant difference in wasting among the preschoolers in the different age ranges; those in the 0- < 12 months age range were found to have the highest percentage of wasting. This could be attributed to the weaning practices and exposure to infectious diseases (WHO, 1987). About 4-6 months through two years of age dietary deficiencies are common and diarrhoeal disease more frequent. This major effect tends to decrease later as the child becomes older.

The observation that the energy, iron, thiamin and vitamins A and C intakes of the youngest age range was adequate could be as a result of the contribution of breast milk. According to Ryan et al. (1984) breast milk contributes between 130 and 280 calories to the total caloric intake. The decreased intake of energy with age observed in the study concurs with their findings that energy inadequacies increase with age. However, the low nutrient adequacy ratios observed in other age ranges in this study have been observed by Nnanyelugo et al. (1992). This does not necessarily mean that the intake of the preschoolers were not sufficient for the maintenance of their nutritional status. As it is evident in the relationship between the energy adequacy by age range and the standard deviation score for weight for age (table 40). The energy adequacy ratio for preschoolers in the youngest age range (0- < 12 months) was

125 % and in the oldest age range (40 - < 60 months) was 78%. The standard deviation scores were - 0.56 and - 1.29, respectively. Protein adequacy among the age ranges showed a similar trend as was observed in the case of energy adequacy ratio and weight for age Z-score of the preschoolers in most cases. Thus, the higher the energy and protein adequacy ratios the higher the standard deviation scores and the less the deviation from median NCHS reference population and thus better nutritional status.

5.3 Nutritional status of preschool children by gender

Significant differences exist between the mean Z-scores of females and males in all the anthropometric indices. The rate of growth in height of females increases at a greater rate than in males from 0.7% to about 1.0 % after the control in standardized height over the period of 46 months (Ahn and Shariff, 1995). A female child has a better chance than a male child to improve her own height. WHO (1985) has observed fluctuation in the body fat of preschoolers from birth up to 6 years of age which affect body weight. During this period girls have slightly more body fat than boys. Another possible explanation could be the rate of physical activity; male preschoolers are very active and might be limited by special nutrient requirements of particular tissue essential for growth.

Data presented by Demeke and Wolde - Gabriel (1985) on representative samples of preschooler population in Addis Ababa show that among females, the percentage prevalence

Table 40: Standard deviation scores (Z-score) and energy and protein adequacy in preschoolers

Age (month)	n	Body weight (kg)	Z-score for weight for age	Energy (MJ/day)	Energy adequacy ratio	Protein (g/day)	Protein adequacy ratio
0 - < 12	48	7.56	-0.56	4.30 (1030)	125	14.60	108
12 - < 24	86	9.67	-1.10	4.78 (1143)	99	14.80	109
24 - < 48	186	12.19	-1.13	4.75 (1136)	84	15.20	98
48 - < 60	115	14.55	-1.29	4.41 (1054)	78	13.9	79

Figures in parenthesis are energy intake expressed in Kcal

of 32.7% for weight for age and 43.9% for height for age were higher than observed in the present study. However, the percentage prevalence for weight for height observed in the present study was higher than 0.3% observed by Demeke and Wolde - Gabriel (1985). Conversely, the percentage of malnutrition obtained for the male preschoolers in all the nutritional status indicators were higher in the present study than those of Demeke and Wolde - Gabriel (1985). The weight for height nutritional indicator values obtained for male preschoolers in the present study was 33.3% as against 29.3% obtained by Demeke and Wolde - Gabriel (1985). The values for height for age were 44.4% in the present study and 42.9% in Demeke and Wolde - Gabriel (1985) study. In case of weight for height the values were 6.9% in the present study and 2.0% in the study by Demeke and Wolde - Gabriel (1985).

Nigeria nutrition report (1993) observed a marginally higher level of prevalence of stunting 43.4%, wasting 35.8% in males than in females 42.7% for stunting and 35.7% for wasting. The present study observed a slightly higher level of stunting but lower level of wasting for males than for females.

The data from the present study were comparable with the NCHS growth data for the first six months of life, but thereafter preschoolers in developing countries had lower weight and height values for their ages. This is consistent with the work of the Ten Province Children Growth and Development Study Group (1987) which shows that the weight of infants in the first month of life is also greater than international reference. The decreased growth rate observed after 6 months of age could be the result of being fed solid food at this period of age, less overall food intake or an increased frequency of infectious diseases, including those due to parasites.

Comparison with the observations in rural developing areas of Hubei province in China, showed that the Nigeria male preschoolers had lower mean weight and height values before the age of 6 months, for both male and females while the males in Hubei province had lower mean weight and height values after one year of age and the females after six months.

The observation that the energy, protein, minerals, thiamin, niacin and riboflavin were not met by males and female concurs with the findings of Ngwu et al. (1989). The percentage adequacy ratios for energy, protein, iron, thiamin and riboflavin obtained in the present study for male and female preschoolers were higher than those obtained by Ngwu et. al. (1989). Their values were 58.05% and 75.5% for energy, and 45.04% and 58.09% for protein, 72.94% and 96.62% for iron, 44.94% and 36.64% for thiamin, 18.60% and 20.27% for riboflavin for males and females, respectively. Although the energy and protein needs of the male and female preschoolers were below their nutrient requirements, their growth deviations from median NCHS were not below median -2SD (table 41). The standard deviation score of the female preschoolers (-0.93) and energy and protein adequacy ratios were 89% and 97%

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while the standard deviation score, the energy adequacy and protein ratios obtained for males were - 1.29, 89% and 96% respectively (table 41). Females deviated less from median NCHS reference population and had higher energy and protein adequacy ratios than males.

5.4 Effects of household characteristics on nutritional status

The observation that preschoolers in large households had better nutritional status than those in small households is in consonance with that of Gopaldas et al. (1988) who observed that toddlers from large families had better nutritional status than those from medium-sized or small families. Also, Grewal et al. (1973) are of the opinion that in large or joint families there is a greater likelihood of adult women being available to care for the young children. This means that preschoolers in large households deviated less from the normal growth pattern of the NCHS reference population (NCHS, 1976) and therefore had better nutritional status than preschoolers from small sized households. Aguillon et al. (1982) and Ballweg (1972) observed that large family size was significantly and negatively associated with good nutritional status. This was attributed to the inability of mothers to provide adequate care for their young children, especially where there was more than one preschooler in the family. Aguillon et al. (1982) further explains that poor intra-family distribution of food, which allows older family members to receive the largest share, contributed to this effect.

The observation that preschoolers in polygamous households had higher nutritional

Table 41: Standard deviation scores (Z-score) and energy and protein adequacy in preschoolers

Gender	n	Body weight (kg)	Z-score for weight for age	Energy (MJ/day)	Energy adequacy ratio	Protein (g/day)	Protein adequacy ratio
male	216	11.78	-1.29	4.50 (1083)	85	14.72	96
female	219	11.76	-0.93	4.70 (1126)	89	14.97	97

Figures in parenthesis are energy intake expressed in Kcal

status can be explained by the opportunity created for other members of the family to look after the child even in the absence of the mother. This is in agreement with the observation by Bennett (1988) that mothers' inputs into the health and nutritional status of a child are complemented by those of other members of the family and in some cultures other kin or neighborhood support group as well. Evidence from Philippines has also shown that such substitution takes place. However, there has been uncertainty about whether the quality of the care given by other members of the family, especially siblings, is equivalent to that which would be provided by the mother. Also wives in polygamous households are conscious of the fact that the family economic and security that are provided by the male household head are likely to be insufficient. The women therefore make efforts to obtain finance through petty trading or jobs to supplement the household's economy in order to provide for the childrens' care and survival. This situation is usual in most of the polygamous families in Nigeria.

The observation that mothers' education was higher in those whose mothers had no formal education in all the anthropometric indices but significant only for weight for age index of the preschoolers is probably biased; the number of mothers who had some formal education is very low. It has been explained that women with at least some primary education are more aware of the needs for adequate nutrition and vaccinations as well as of dangers of contaminants from water. In addition, recent data on nutritional " positive deviance from

Bangladesh, Kenya, Mexico and Philippines suggest that among households at the same poverty and socio-economic level, some mothers handle childcare, hygiene and feeding in better ways, and their children are better nourished as a result. This shows that some elements of hygiene is practiced in communities even among illiterate women. The observation that mothers' education showed no significant association with weight for age index of the preschoolers was in contrast to the work of Caldwell (1979) who noted a negative association with maternal education and child mortality rate. The association between height for age index of the preschoolers concurs with the study of (Smith, Panlse, Fougers and Ritchey, 1983) who reported that mother's education was associated with the long term well-being of children represented by height for age. Ahn and Shariff (1995) have observed a positive association between mother's education and child's height. Bhuiya, Wojtyniak, D'sounza and Zimck (1986) and Devadas, Rajalakshmi and Kaveri (1980) have shown that the number of years of education of mothers had a definite relationship with the proportion of malnourished children because children's mean daily intake of nutrients increased with the increase in mothers' educational level. Richardson, (1974) and Granthan - McGregor (1980) have noted that low levels of education have repeatedly been found in mothers of malnourished children.

Although the observation that preschoolers with older mother had higher nutritional status for weight for age and height for age indices is not statistically significant, the observation is logical. In any socio-cultural set-up certain practices such as traditional child-care and feeding practices are conditioned. Demographic variables such as age and education of the mother will obviously affect the degree to which the individual has absorbed traditional practices as well as the degree to which she has access to and is responsive to alternative ways of doing things. The elderly mothers are in a better position to know the practices that are good for the nutritional status and the general well-being of children. Maternal age did not to associate significantly with the preschoolers weight for age and height for age indices although those whose mothers were younger had higher nutritional status. A younger mother is more active and attentive to the child's needs than an older mother. Thus, with an increase in maternal age there was a corresponding increase in the proportion of malnourished children.

The observation that preschoolers in female headed households had better nutritional status than their counterparts in male headed households is perhaps biased because of the very limited number of preschoolers in male headed households. Male household head had the responsibility to see to the welfare of the family and in most cases they are more employed than their wives. It is therefore their obligation to provide the needs especially food needs to their households. But some studies from Africa as well as Asia have observed that the income earned by men is less likely to be used to buy food for the family than that earned by women. Kumar (1977) and Tripp (1982) reported that mothers' income has a greater positive effect on child nutritional status than fathers' in both Asia (India) and Africa (Ghana), respectively. There was no significant association observed between gender of household head and nutritional status could of the preschoolers. This could be that the nutrition of the children is the responsibility of both parents. The parents have the responsibility of providing food and shelter for their children. This observation concurs with the findings of Moser (1985) and Mardones (1986).

No result was obtained in the associations of household characteristics variables and nutritional status for weight for height as indicator in this study. This could be as a result of the short term nature of the indicator in identifying those at risk (Beaton, Kelly, Kevany, Martovell and Masson, 1990).

5.5 Effects of health factors on nutritional status

The observation that preschoolers in households that have access to potable water supply had higher Z-scores for weight for age and height for age as nutritional status indicators than those that have access to non - potable water supply is due to the fact that the potable water has lower level of pathogens than non - potable water on the average. Preschoolers in the households that have access to potable water would have less frequent fever and diseases, which in turn would enhance the nutritional status of the preschoolers. Hirschorn (1980) and Merson (1985) have observed that repeated attacks of diarrhoea lead to malnutrition and growth retardation owing to anorexia and malabsorption and associated food restriction instituted by mothers as therapy. The observation that preschoolers who had access to non - potable source of water supply was associated with height for age indicator concurs with the findings of Christiansen et al. (1975). The relationship may be due to the greater frequency of infectious diseases in those preschoolers from households without access to potable water than those with access to potable water. A similar result was reported by Gopaldas et al. (1988).

The observation that there was no significant difference in the nutritional status indicators of immunized and non-immunized preschoolers may have been biased by the very low number of the non-immunized preschoolers. However, though immunization prevents communicable diseases, sometimes non-communicable diseases such as malaria can adversely affect the nutritional status of the immunized preschoolers. It was observed that immunization was not significantly associated with the weight for age and height for age indicators. Immunization is a means of preventing the communicable diseases in children and this indirectly promotes their nutritional status.

The observation that there was no significant difference in the nutritional status indicators assessed between preschoolers who suffered from diarrhoea and others who did not suffer from diarrhoea may have been biased by the very low number of those who suffered from the diarrhoea. However, that those who suffered from diarrhoea had better nutritional status than those who did not suffer from it is in consonant with Brown (1991) who noted that appetite could increase after an episode of diarrhoea to the extent that appropriate foods are available to meet the increased appetite, thus off setting the negative effect of diarrhoea on energy balance. The observation that diarrhoea episode was not observed to be significantly associated with the weight for age indicator has been reported by Mcleod (1985), Drake and Fajardo (1976) and Field et al. (1981) who found no significant association between diarrhoea and nutritional status. The association was significantly higher in those who did not suffer than those who suffered from diarrhoea for weight for age index. Fauveau, Briend, Chakraborty and Sarder (1990) observed that diarrhoea was positively associated with severe malnutrition in children of Bangladesh. In contrast, Ahn and Shariff 1995 found negative and significant association between diarrhoea and nutritional status before and after correction for selection bias. Melville et al. (1988) noted that both fever and diarrhoea were negatively correlated with weight for age.

5.6 Effects of cash income, market access and population on nutritional status

The level of nutritional status was better among preschoolers from above average cash income households than among others from average or below average cash income households. The low level of statistical significance of the difference in the nutritional status between children from above average and others from average or less cash income households is probably because the cash income was, in general, high enough to maintain adequate nutritional status in the cash income households. This assertion is supported by the fact that, as shown in chapter 4, on average, the nutritional status of the overall sample population was above the standard cut off for those at risk by all three indicators.

The observation that the nutritional status of the children from above average cash income households was better than that of children from average or less cash income households is confirmed by other studies (Gopalan et al., 1981; Joachim, 1994; Thomas et al.,1987 and Strauss, 1987). Income determines quantity and quality of food that would be available in the households. It is expected that with the improvement of household income absolute expenditure on food is likely to be high and so is the calorie and protein intake of the households (Gopalan et al. 1981). Besides, higher household cash income implies better access not only to food but to improved health care, good water supply, inoculations, better housing, education of mothers, nutrition knowledge, etc. which are shown above to be positively correlated with the nutritional status of the preschoolers.

The nutritional status was higher among preschoolers in households in villages which were located close to market centers than preschoolers in households in villages located in areas remote from market centers. The low level of statistical degree of significance of the difference is because proximity to market centers is not an adequate definition of ease of access to market centers. Some villages which go to market by motor vehicles probably also have easy access to market centers. As explained above only farmers who went to market on foot over long distances clearly faced difficult access to market. The villages of such farmers were few and constituted only 5% of the village surveyed.

That children from household close to market centers had higher nutritional status than children further from market centers confirms observations of other studies that nutritional status of preschoolers is better in urban than in rural areas (UN/ACC/SCN, 1991); villages around market centers are often peri-urban centers. Opportunities for earning cash incomes are better in peri-urban centers than in remote villages.

Nutritional status was also better among preschoolers in households in villages located in the relatively high population density areas than among others in households in villages located in lower population density areas. The low level of statistical significance of differences in the nutritional status of the children from households in high population density zones and other children from households in low population density zones is due to skewness in population density. It has been pointed out that out of the 438 preschoolers surveyed only 65 were from households in low population density zone. High population density villages are more common among peri-urban centers than among remote villages. According to Mellor (1982) high population density areas often coincide with areas of intensive commercial agricultural production where farmers have access to and are able to afford essential goods and services. Mason and Folkerts (1973) have noted that high population and high birth rate tend to nullify national efforts to raise average per capita income since there is less money for savings and development investments and therefore commit people to poverty. But Mellor (1982) argued that population growth enhances world resources and opined that its reduction should not be a major focus in combating malnutrition.

5.7 Effects of household food expenditure on nutritional status

The low level of statistical relationship between each of the nutritional status indicators and household expenditure on cassava food or on any other staple is evidence that the nutritional status of children did not depend on the level of household consumption of any individual food item. In contrast, the high level of statistical relationship of all the nutritional status indicators with household total food expenditure suggests that the nutritional status of the children depended on the level of household consumption of all food items combined. In other words, level of total food consumption rather than level of consumption of any individual food item determined the nutritional status of the children. This is logical, nutritional problems may be caused not by what is eaten but by what is not eaten.

In the particular case of cassava, the nutritional status of the children was higher among children from high cassava food expenditure households than among children from low cassava food expenditure households for weight for age and height for age indicators though not for weight for height indicator. It was pointed out earlier that height for age is usually the single best anthropometric indicator because it is associated closely with household diet. High cassava food expenditure households had significantly higher cash income per household (table 42) than low cassava food expenditure households.

Nweke (1994) reported that cassava is processed into a wide range of food products the most common ones being chips/flour, granules and pastes. The various cassava processed food products can be grouped into two with respect to convenience of preparation into a meal. The first group consists of products which enter the marketing system in ready (or near ready) to serve forms; *garri*, cassava toasted granules, is an example of the products in this group. Garri is made by advanced methods of processing, it is attractive to working class urban consumers because it is easily converted into food or it can be eaten directly without any further preparation; hence it competes effectively with grains in the market. The second group consists of products which need further processing or elaborate cooking at home; chips/flour is an example of the products in this group. Chips/flour is made by a wide range of methods some of which are quite rudimentary involving only peeling and drying of the fresh roots; the product is not as attractive to working class urban consumers and therefore does not have as much market opportunities as products in the first group.

Table 42 : Household cash income (Naira/household) expended on staple foods by household category, (1992)

Staple food	High expenditure households		Low expenditure households	
	No. of households	Naira	No. of households	Naira
Cassava	123	41,753	236	29,909
Maize	143	28,920	216	37,309
Yam	124	35,395	235	33,214
Millet/Sorghum	142	39,235	217	30,520

US$1.00 = Naira 17.0

Table 43 : Percentage distribution of surveyed households by the type of cassava products made

Cassava Product	High cassava food expenditure households	Low cassava food expenditure households
	123*	223*
	Percentage	
Chips/flour	57	79
Granules	36	14
Pastes	7	7
Total	100	100

* No. of households

Table 43 shows that proportionately more high cassava food expenditure households processed cassava into garri and hence had higher sales income earning opportunities than low cassava food expenditure households. With their higher sales income the high cassava food expenditure households had higher total food expenditure and hence had children with higher height for age (higher stature) indicator than low cassava food expenditure households.

CHAPTER SIX

CONCLUSIONS

6.1 Nutritional status of overall preschool children

Although stunting, wasting and undernutrition existed among preschoolers in the cassava growing areas, the prevalences were lower than expected. Prevalence of stunting was higher than that of either wasting or undernutrition. On average basis, the anthropometric statistics of the preschoolers in cassava producing areas of Nigeria were close to the normal range (- 1SD to + 1SD) and above median - 2SD conventional cut off recommended for use in Africa by all the nutritional status indicators. Cassava producing areas of Nigeria had comparatively a small percentage of the preschoolers undernourished, stunted or wasted than expected.

The energy and protein adequacy ratios of all preschoolers were lower than FAO/WHO/UN (1985) requirements. In general, the preschoolers in cassava growing areas seemed to have energy, protein, calcium, thiamin, riboflavin and niacin intakes that fell short of their requirement while iron, vitamin A and C were more than adequate. This has been the case with the studies done in many developing countries. The reason is that FAO/WHO/UN (1985) and WHO (1967) requirements were generally superior to the nutrient needs of communities. However, this intakes were able to maintain good nutritional status and normal growth potential for the preschoolers suggesting that their food nutrient intakes were adequate for growth and development but the FAO/WHO/UN (1985) recommended requirements were superior.

6.2 Nutritional status of preschool children by age class

Majority of the preschoolers in the different age ranges shifted to the left of the normal distribution of the reference population. The mean Z-score of the preschoolers decreased with age. The percentage prevalence of undernutrition, stunting and wasting were statistically significantly lower in 0 - < 12 months old than among other age classes including the moderate and severe malnutrition. This suggests that 0 - 12 months old preschoolers had better nutritional status than the older ones. This is mainly due to the intake of breast milk and complementary foods. Thus preschoolers in 0 - < 12 months old had the least significant growth deviation from NCHS reference population among the ages considering all the nutritional status indicators except in the case of weight for height indicator. It is therefore more likely that more older preschoolers may suffer from malnutrition especially when there is a younger sibling in the household. Child bearing mothers should be made aware of the consequences through nutrition education in village community fora to minimize long term effects of malnutrition to the community and nation as a whole. It is therefore evident from the study that age is a determinant factor of nutritional status of preschoolers.

There were no statistically significant differences in the mean daily energy, protein, calcium, vitamin A and riboflavin intakes among the different age classes of preschoolers but significantly different in riboflavin intakes.

The nutrient adequacy ratios of the preschoolers in different age classes were lower than FAO/WHO/UN (1985) requirements except energy and protein for the youngest age range, Protein for 12 - < 24 months old. Iron, vitamins A and C adequacy ratios were higher than WHO (1967) requirements in all age groups except in 48 - < 60 months olds.

6.3 Nutritional status of preschool children by gender

The sample Z-score distribution for both male and female preschoolers skewed to the left of the normal curve in all the nutritional anthropometric indices.

The mean Z-score were statistically and significantly higher in females than in males. This indicates that the growth patterns of females deviated less from NCHS reference population than males and thus confirms better nutritional status for females than for males. This suggests that there could be sex differences in factors that affects nutritional status of preschoolers. The present study therefore suggests that sex of the children should be considered as an important factor in studying the nutrition and factors that determine it in any given communities.

In addition, the percentage prevalence of malnutrition between sexes was not statistically significant for undernutrition, stunting and wasting but statistically significant only in severe wasting in both sexes. It can be said that the prevalence of malnutrition is the same for males and females although males appeared to have higher values than their female counterparts.

The mean nutritional status indicators compared favourably well with the NCHS reference population for both sexes up to 6 months of age. This implies that the male and female preschoolers in cassava producing areas of Nigeria have normal growth potentials in the first 6 months of age.

No statistically significant difference exists in the nutrient intakes of the male and female preschoolers. This could mean that there is no preference for sons over the daughters in the distribution of food in households. The nutrient adequacy ratios of the males and females were lower than FAO/WHO/UN (1985) and WHO (1967) requirements except iron, vitamins A and C intakes.

6.4 Effects of household characteristics on nutritional status

The effect of household characteristics on the nutritional status were statistically significantly higher in large sized households in the case of height for age, those whose mothers had some formal education in the case of weight for age index, and those female headed households in the case of weight for age and heigt for age indices. The differences were not statistically significant in the cases with the younger or older mothers, or monogamous or polygamous households. The better nutritional anthropometric indices of children in larger size households appeared to be due to motherly childcare rendered by adult women to the young children. The awareness of the benefits of adequate nutrition hygiene and vaccination to the well-being of children could account for the better nutritional status observed in those whose mothers had some formal education.

The nutritional benefits observed in the case of female headed households was mainly due to the fact that income of the women are more likely to be spent on food and other basic household needs. This has a greater positive effect on children's nutritional status. Increase in the income of women based on agricultural or fund raising activities can make a major contribution to solving preschoolers malnutrition. However, it can not in itself provide a complete solution in the problem of preschoolers malnutrition.

Household characteristics did not associate significantly with nutritional status of preschoolers for weight for age indicator but not statistically significant for height for age as nutritional status indicator in the case of houschold size and mothers; education. This means that household size,and mothers' education affect the nutritional status of preschoolers. This implies that malnutrition in preschoolers has many etiologies. Household characteristics also determine to a large extent the nutritional status of children. In order to improve on the nutritional status of children attention should be given to environmental issues emanating at household and community levels as complementary components of agriculture and nutrition policies and programmes.

6.5 Effects of health factors on nutritional status

The nutritional status of the preschoolers that had access to potable source of water was significantly higher than those that have access to non- potable water source for height for age indicators. This effect is due to the fact that potable water has lower level of pathogens than non -potable water. Preschoolers in households that have access to potable water would have less frequent fever and diseases which in turn would enhance the nutritional status of the preschoolers. Although there was no statistical significant difference for those preschoolers immunized or not, or those that suffered from diarrhoea or not, there were associations between diarrhoea for height for age nutritional status of the preschoolers. It is evident from this study that preschooler nutritional status are influenced by health factors. Factors such as availability of potable water supply, access to health centers and morbidity pattern and how these are influenced by changes in the health and sanitation environment, breast-feeding and weaning practices and other resources to the child can be as important as the diet in affecting the overall welfare of the child.

6.6 Effects of cash income, market access and population on nutritional status

Nutritional status of the preschoolers in high income household was higher than those in low income households because cash income availability implies access to health care, clean water supply, mothers education, etc. which have been shown to positively influence the nutritional status. The nutritional status of the preschoolers was also better among children from households located around market centers or in high population density zones because such households have better opportunities for earning higher cash incomes than households located elsewhere.

6.7 Effects of household food expenditure on nutritional status

Households' total food expenditure rather than household expenditure on individual food items determined the nutritional status of the preschool children. High level of cassava consumption at the household level did not have adverse effect on the nutritional status of preschool children. Rather children from high cassava expenditure households had higher Z-score values for height for age, the single best anthropometric indicator, because such households had higher cash income and hence higher total food expenditure than low cassava food expenditure households

CHAPTER SEVEN

SUMMARY OF OBSERVATIONS

This study is primarily concerned with ascertaining whether expenditure on cassava for consumption affects adversely the nutritional status of preschoolers in cassava growing areas of Nigeria. The components of the study include the Z- score distributions, mean Z scores, percentage prevalence and severities of undernutrition, stunting and wasting, daily food nutrient intakes and adequacy ratios of the preschoolers. The data were grouped into overall status (examination of the data for all ages and sexes combined), age classes and gender. Others are the effects of household characteristics, health, environmental factors, cassava and other household major staple food expenditure on nutritional anthropometric indices of preschoolers.

The standard deviation unit (Z- score) approach was used to determine the nutritional status of the preschoolers.

The hypotheses tested were as follows:

1. the anthropometric indices from preschoolers and international standard are equal
2. the energy and nutrient intakes of the preschoolers and FAO/WHO/UNU (1985) and WHO (1967) nutrient requirements are the same
3. no significant differences exist by age group and gender of preschoolers at 5% level of probabilty:

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3. no significant differences exist by age group and gender of preschoolers at 5% level of probability:

a) the anthropometric indices

b) the percentage prevalence of malnutrition

c) the nutrient intakes

4. no significant difference exist by the following factors sub - groups of preschoolers in the anthropometric indices

a) household characteristics

b) health factors

c) socio-econmic factors

5. the level of nutritional status of preschoolers is independent of the socio-economic variables as indicated in 5a - 5c above.

The statistical tools used to test the hypotheses are Student's T-test for differences between means of height for age, weight for height, and weight for height among the preschoolers sex groups while general linear model (GLM) was used for various age categories and Chi-Square (X^2) test to identify household characteristics, health and socio - economic factors significantly associated with the subjects' nutritional status.

The study is based on information collected with the framework of the COSCA. The data used in the analyses were collected at 'household level' in Nigeria. The summary and conclusions of major findings in the study are categorized under the following headings:

7.1 Nutritional status of preschool children by overall status

The sample Z-score distributions showed that the percentage of the preschoolers below median NCHS for each of the nutritional status indicators were 74% for weight for age, 74.2% for height for age and 66.2% for weight for age and the Z-score distribution peaked at -2SD, -1SD and -1.5SD respectively. The growth deviations from NCHS reference population was more in the order of height for age, weight for age and weight for height nutritional status indicators. These deviations were above -2SD the conventional cut off for use in Africa for those at risk. The percentage prevalence of undernutrition, was relatively lower than the values obtained in some Asian countries (table 5 and 6). Mild, moderate and severe forms were most prevalent in stunting. A cross combination assessment of nutritional status indicators with weight for height on one axis and height for age on the other showed that 35% of preschoolers in cassava growing areas were neither wasted nor stunted. About 45.1% who were stunted were not wasted (table 19). Percentage undernutrition Cassava producing areas in Nigeria compared have relatively lower than those obtained in the Asian countries (table 5 and 6).

The mean daily energy, protein, minerals and vitamins of the preschoolers were lower than FAO/WHO/UN (1985) and WHO (1967) recommended requirements.

7.2 Nutritional status of preschoolers by age class

The sample Z-score distribution showed that majority of the preschoolers in different age ranges shifted to the left of the normal distribution of the reference population median and about 20% of the preschoolers 0 - < 12 months old had the highest peak at +0.5, 15% of the 12 - < 24 months old and 24 - < 48 months old, had the lowest peak at -2.0 SD for weight for age. About 20% of the 48 - < 60 months old had the highest peak at 2.5 SD, and 20% of the 0 - < 12 months old, 12 - < 24 months old, and 24 - < 48 months old had the lowest peak at 3.0 SD for height for age, 45% of the 110 - < 125 cm height had the highest peak at 0.5 SD while 20% of the 43 - < 80cm, and 80 - < 95cm height, had the lowest peak at 0.5 SD for weight for height.

The mean Z-score of the preschoolers decreased with age. Preschoolers in 0 - < 12 months old had the least significant growth deviation from NCHS reference population among the ages in all the nutritional status indicators except in the case of weight for height indicator. This means that the weight for height indicator among the age classes did not differ significantly. This result agrees with the hypothesis that no differences exist in the indices of the preschoolers by age class.

The percentage prevalence of undernutrition and wasting were statistically significant among the age ranges. The percentage stunting did not differ significantly among the age classes. This supports the hypothesis that the percentage prevalence of malnutrition do not differ. The severity of malnutrition (moderate and severe) were statistically significant.

This result suggests that age is a determinant factor in nutritional status of preschoolers and that 0 - < 12 months old preschoolers had better nutritional status than the older ones.

There were no significant differences in the mean daily energy, protein, calcium, vitamins A,C, iron, thiamin and niacin intakes among the different age classes but significant difference were observed in riboflavin intakes. This result supports the hypothesis that the nutrient intakes of the preschoolers did not differ by age class.

7.3 Nutritional status of preschoolers by gender

The sample Z - score distribution for both male and female preschoolers skewed to the left of the normal curve in all the nutritional status indicators. About 20% of the male preschoolers had the highest peak at -2SD, and 15% of the females at 1.5SD and 0SD for weight for age, 15% of male and female at -3SD and -1SD respectively for height for age, and about 25% of male and female at -1.5SD and 0SD, respectively for weight for height.

The mean Z- scores of the preschoolers were significantly higher in females than in males in all the nutritional status indicators. This indicates that the growth patterns of females deviated less from NCHS reference population than males. This confirms better nutritional status of female than of males. This result is not in agreement with the hypothesis that no differences exist in the anthropometric indices of preschoolers by sex.

The percentage prevalence of malnutrition between sexes were not statistically significant for undernutrition, stunting and wasting. The hypothesis that no differences in the percentage prevalence of malnutrition by sex concurs with this result . The severity of malnutrition (moderate and severe) in undernutrition, stunting and wasting were lower in females than in males but statistically significant only in the case of severe wasting. Although females have less prevalence of malnutrition than males the prevalence of malnutrition is the same for both sexes except in the case of severe wasting.

The mean daily energy, protein, calcium, iron, thiamin, niacin, riboflavin, vitamins A and C were not statistically significant between the male and female preschoolers. This means that nutrient intakes of the male and female preschoolers were the same. Any observed differences may be due to sampling error. The hypothesis that no differences exist in the nutrient intakes of preschoolers by sex agrees with this result.

7.4 Nutritional status of the preschoolers with International reference population by sex and age

The mean weight for age did not indicate any consistent difference between the growth pattern of males and females compared with the reference standards until after the age of 30 months. The mean weight for height scores of preschoolers were comparable to the NCHS reference population for both sexes. The growth patterns of the preschoolers for weight for age, height for age and weight for height were above NCHS reference population in the first six months. The mean weight for height fluctuated consistently above -2SD NCHS. Thus the growth pattern of the preschoolers are in most cases were not the same with the international reference population. The hypothesis that the anthropometric indices from preschoolers and the international reference population are the same does not concur with this findings.

7.5 Nutrient intakes of preschoolers compared with FAO/WHO/UN (1985) and WHO (1967) requirements

The energy, protein and calcium adequacy ratios of all preschoolers were lower than FAO requirements. The preschoolers also fell short of their mineral and vitamin requirements except in the case of iron, vitamins A and C. In general, the preschoolers in cassava growing areas seemed to have energy, protein, calcium, thiamin riboflavin and niacin intakes that fell short of their requirement but exceeded the requirements of iron, vitamins A and C . The intakes of vitamins A , C and iron were highly comparable with the WHO (1967) nutrient requirements. This agrees with the hypothesis that the energy and the nutrient intakes of the preschoolers and FAO/WHO/UN (1985) and WHO (1967) nutrient requirements are the same.

The nutrient adequacy ratios of the preschoolers in different age classes were lower than FAO/WHO/UN (1985) requirements except energy and protein for the youngest age range, protein for 12 - < 24 months old and 24 - < 48 months old, iron, and vitamin A intakes. The vitamin C adequacy ratios were higher than WHO (1967) requirements except in 48 - < 60 months olds. The nutrient adequacy ratios of the males and females were lower than FAO/WHO/UN (1985) and WHO (1967) requirements except iron, vitamins A and C intakes.

However, these intakes were able to maintain their normal growth potential (table 41). The reason is that FAO/WHO/UN (1985) and WHO (1967) requirements were generally superior to the nutrient needs of communities. This suggests that their food nutrient intakes were adequate for maintenance of normal growth.

7.6 Effects of household characteristics on nutritional status

Considering the anthropometric indices of preschoolers by household characteristics, the mean Z - score for height for age of preschoolers in large sized families, mean Z- score for weight for age index of preschoolers in households whose mothers had some formal education, and the mean Z - score for weight for age and height for age of preschoolers in female headed households were significantly higher than others. The differences were not statistically significant between the younger and older mothers, or monogamous or polygamous households. Thus the higher the family size, number of years of mothers' education and female headed households, the better the nutritional status of the preschoolers while the state of nutritional status is the same for preschoolers with younger or older mothers, or those from monogamous or polygamous households. There were no differences in the nutritional status of preschoolers by age of mother and number of wives per household. The results do not agree with the hypothesis that no significant differences exist in the anthropometric indices of preschoolers by household characteristics.

Household characteristics were not significantly associated with nutritional status of preschoolers for weight for age indicator. The household size, number of wives, mothers education, mothers' age and gender of household head did not influence the weight for age as nutritional status of the preschoolers. There was significant effect of household characteristics on height fur age nutritional status indicators in the cases with household size and mothers' education. This shows that there are real association between nutritional status and household characteristics by height for age indicator. The result do not concur with the hypothesis that the level of nutritional status of preschoolers is independent of the household characteristics.

7.7 Effects of health factors on nutritional status

Preschoolers that had access to potable source of water had significantly higher mean Z-score for height for age than others and thus better nutritional status. However, there were no statistical significantly difference between those Preschoolers immunized or not, or those that suffered from diarrhoea or not. This findings do not concurs with the hypothesis that no differences exist in the anthropometric indices of preschoolers by health factors. Source of water supply was a determinant of height for age nutritional status of preschoolers while immunization or diarrhoea episodes may not influence their nutritional status. However, this could be due to the nature of the data collected on immunization and diarrhoea episode in the preschoolrers.

The association between source of water, immunization and diarrhoea episodes and nutritional status were not statistically significant for weight for age, but statistically significant for height for age nutritional status indicators of the preschoolers in the case of diarrhea episode among the children. Source of water and immunization have no real association with weight for age as nutritional status indicator but diarrhea episode in preschooler has a real association with height for age indices and therefore has effect on the therefore has effect on the nutritional status of preschoolers. This finding do not disagree with the hypothesis that the level of nutritional status of preschoolers is independent of the household characteristics.

7.8 Effects of cash Income, market access and population density on nutritional status

The socio-economic factors such as cash income, market access and population can affect the nutritional status of preschoolers due to variations in economic situations, proximity or location of market centers, labour force and resources respectively. The result showed that although the nutritional status indicators were higher for preschoolers in higher than in lower cash income households, none was statistically significant except that for weight for height index. The differences were not statistically significant for preschoolers in different market access zones and population density but higher for preschoolers in households closer to market centers and in high population density areas than their counterparts living further away from the market and in low population areas.

As it is evident, cash income influenced the weight for height nutritional status indicator of the preschoolers. There are no differences between the nutritional status of preschoolers in high and low income household, those closer or further away from the market centre or high or low population density areas by weight for age and height for age indicators. This result is in agreement with the hypothesis that no differences exist in the anthropometric indices of preschoolers by cash income, market access , and population density.

The association between cash income, market access and population density zones and nutritional status were statistically significant for height for age for only market access. This means that nutritional status is dependent on cash income, market access and population density. The factor therefore affect and determine in most cases the nutritional status indicators of preschoolers. This result does not concur with the hypothesis that the level of nutritional status of preschoolers is independent of the market access.

7.9 Effects of cassava and other household food expenditure on nutritional status

There was a highly significant association between the growth deviation and household total food expenditure by all three nutritional status indicators ($p \leq 0.005$). The Z -score values were higher among preschool children from above average total food expenditure households than among preschoolers from average or below average total food expenditure households by all three indicators (table 35). The mean Z- score values were consistently higher for above average than for average or below average expenditure households for all food staple by weight for age and height for age indicators except for preschoolers in maize expenditure households. However, the growth deviations did not differ significantly between categories of households' expenditure on cassava food or on any of the other staples for any of the indicators. The hypothesis that no significant differences exist in the anthropometric indices of preschoolers by household major food expenditure agrees with this finding.

The association with the household total food expenditure with the percentage of the children in the different levels of severity of undernutrition or stunting was also highly significant ($p \leq 0.001$).

The associations between the percentages of the preschoolers in the different levels of severity of undernutrition and the expenditure on cassava food and on each of the other staples were all significant ($p \leq 0.05$) except in the cases of sorghum/millet food expenditure. On the other hand, the association with the percentage of the preschoolers in the various levels of severity of stunting were not significant with the household expenditure on yam and sorghum/millet staple foods (table 38). The hypothesis that the level of nutritional status of preschoolers is independent of the household major food expenditure concurs with the finding for severity of undernutrition. Associating wasting in the preschoolers with household expenditure on food could not be assessed because of degrees of freedom limitations.

RECOMMENDATIONS

The study is aimed at determining the nutritional status of preschoolers. The nutritional situation for the preschoolers as a whole fell above median - 2SD NCHS reference population. A good nutritional status is consistent with building the long - term future generation of a country. It is economic investment of the most fundamental sort that is related to economic production in the long term. If a child is well nourished he can attain his intellectual potential and if a nation's children are well nourished that nation can reach its potential among the family of nations. In order to ascertain good nutritional status among the preschoolers the following should be promoted:

a). Monitoring of children's growth by their mothers or by health visitors with regular weighing and comparison with simple growth charts would help to diagnose undernutrition.

b). Establishment of inexpensive ways of lowering infant mortality and morbidity such as giving priority to good sanitary environment and agricultural developments in order to ensure adequate food supply to meet minimum food needs.

c). Emphasis on preventive medicine and on health centers able to deal with a range of problems can also reinforce the protection of mothers and children particularly as far as nutrition is concerned.

d). Fund generating activities especially for women due to the fact that poor economic and food situation directly affect access to health services, the state of nutrition of the populations and particularly the most vulnerable group, the children.

Quite often malnutrition is not obvious and in many cases children are very seriously underweight as a result of the high incidence of infectious disease which lowers the body's weight vitality. The association of household characteristics, health, socio-economic factors as well as household food expenditure and total food expenditure with the nutritional status of preschoolers indicates that socio-economic factors play important role in the nutritional status of preschoolers. In poor communities where stunting is prevalent, the causes are likely to be found in environmental factors characterized by generalized conditions of dietary inadequacies, infectious disease and social deprivation. For these considerations it follows that interventions intended to avoid growth failure or to promote health may have to be directed at a number of points on the causal chain. Besides ensuring adequate food supply, provision of potable water supply, good market access infrastructures, health centers etc. through communal effort or governmental services to rural areas would minimize the consequences of undernutrition. A short nutrition education that focuses on the relationship between the socioeconomic and other factors, and nutritional status should be targeted to both men and women in the entire communities and not only mothers whose children show faltering growth.

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APPENDIX A: Detailed structured questionnaire

COLLABORATIVE STUDY OF CASSAVA IN AFRICA
(COSCA)

Phase III Survey

II. HOUSEHOLD ROSTER

Country Name: ________ NO __

Village Name: ________ No. __
No. Phase I __
No. Phase II __

Urban Center Name: ____________ No ____

Household Name: ______________ No __
No Phase II __ (if applicable)

Survey Date: Day __ Month __ 19__

Interviewer Name: ________________ NO. __

VOLUME I

Page 1 HOUSEHOLD ROSTER

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	[illegible]
[illegible] ETC.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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1 In Columns 4, 5, and 6 [illegible]

15	16	17		18	19	20	21	22		23
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
		[illegible]	[illegible]					[illegible]	[illegible]	

[illegible]

Personal Relationships Codes

MALES

FEMALES

SEX BOTH OR NOT SPECIFIED

[illegible]

Same Generation

[illegible]

Younger Generations

[illegible]

66 Other grandchild

67 Other younger generation

[illegible]

Note: Use adoptive or non-adoptive relationships

99 Some other relationship

Occupation Codes

[illegible]

Processed Cassava Product Codes

[illegible]

A. CHILDREN 0 - 60 MONTHS ANTHROPOMETRY

[illegible]	[illegible]	DATE OF BIRTH		AGE		AGE ASSESSMENT D = 1 E = 2 G = 3	SEX M = 1 F = 2	HAD DIARRHOEA¹ IN LAST 2 WEEKS ? Y = 1 N = 2	AGE WHEN SOLID FOOD INTROD	FIRST SOLID OR SEMI SOLID FOODS USE CODE						AGE [illegible]	IMMUNIZATION Y = 1 N = 2	MID ARM CIRCUMFERENCE (cm)	HEIGHT OR LENGTH² NO SHOES (CM)		WEIGHT (Kg)	[illegible] CODE
		Yr.	mth	0-6 yr	0-11 mth					BASE FOOD			ADDED FOOD						H	L		
										1	2	3	1	2	3							

Y = YES, N = NO; M = MALE, F = FEMALE;
D = DOCUMENT (1), E = EXACT (2), G = GUESS (3).
¹ SIGNS OF DIARRHOEA: 2 OR MORE WATERY STOOLS IN A DAY
² H = HEIGHT FOR OVER 2 YRS; L = LENGTH FOR UNDER 2 YEARS

Type of Scale used ________

HOUSING AND UTILITY Cont'd

2k. If you wanted to sell this dwelling/flat/rooms today how much would you be able to get for it?
AMOUNT: ______

2l. If you wanted to rent this dwelling/flat/rooms today, how much would you be able to get for it?
AMOUNT: ______; TIME UNIT* ______

2m. How long do you expect your dwelling to last without major repairs? __ __ (no of years)

2n. If you wanted to replace this dwelling today, how much would you have to pay for it?
AMOUNT: ______

3. Utility Expenses and House Characteristics

3a. Water Supplies

WHERE DO YOU GET YOUR WATER FROM?	WET SEASON		DRY SEASON	
	Source (code)	Distance (km)	Source (code)	Distance (km)
DRINKING?				
COOKING?				
BATHING?				
LAUNDRY?				
CASSAVA PROCESSING				

SOURCE CODE

RIVER (1)	TAP, TREATED WATER (6)
STREAM (2)	VILLAGE WELL (7)
LAKE (3)	INDIVIDUAL WELL (8)
PUDDLE (4)	RAIN WATER (9)
TAP, UNTREATED WATER (5)	BOREHOLE (10)
	OTHER (Sp.____________) (11)

3b. How much was your household's last water bill? (ENTER ZERO IF NONE)
AMOUNT: ______; TIME UNIT* ______

3c. Was bill shared (or joint meter)? (Y = 1/N = 2) ____

3d. Is source of water shared with other households? (Y = 1/N = 2) ____

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*TIME UNIT CODES: DAY = 1; WEEK = 2 MONTH = 3, QUARTER = 4,
SEMESTER = 5, YEAR = 6

E. FOOD AND EXPENDITURE

PAGE 1 OF 3

STAPLE/BULK FOOD ITEM	DID MEMBERS OF YOUR HH CONSUME THE [illegible] ITEM PURCHASED OR NON PURCHASED [illegible]?	PURCHASED					NON-PURCHASED (Obtained from own production, as wages, gift or loan)				WORKSPACE						
		Total quantity purchased	Units	Price per Unit	Kg	Value purchased	Total quantity obtained	Unit	Kg	How much would it cost to buy this amount last week?	1	2	3	4	5	6	7
1. Cassava Fresh root bitter																	
Fresh root sweet																	
[illegible]																	
[illegible]																	
Fresh cassava dish prepared and eaten outside the household		▨	▨	▨	▨		▨	▨	▨								
2. Processing cassava Name: Code:																	
Name: Code:																	
Name: Code:																	
Name: Code:																	
Name: Code:																	
Processed cassava dish, prepared and eaten outside the hh		▨	▨	▨	▨		▨	▨	▨								
3. Yam Fresh tuber																	
Fresh yam dish prepared and eaten outside hh		▨	▨	▨	▨		▨	▨	▨								
Name: Code:																	
Name: Code:																	
Processed yam dish, prepared and eaten outside hh		▨	▨	▨	▨		▨	▨	▨								

E. FOOD AND EXPENDITURE (Cont'd)

PAGE 2 OF 3	DID MEMBERS OF YOUR HOUSEHOLD IN THE LAST ONE WEEK (7 DAYS) PURCHASE OR NOT PURCHASED [illegible]	PURCHASED					NOT PURCHASED (Obtained from own production, as wages, or gift or loan)				WORKSPACE						
STAPLE FOOD ITEM		What quantity purchased ?	Units	Price per unit	Id	Value purchased	What quantity obtained ?	Units	Id	How much would it cost to buy this amount last week	1	2	3	4	5	6	7
4. POTATO																	
[illegible]																	
5. CASSAVA Local type 1 ______																	
[illegible] type 2																	
[illegible] type 3																	
Cassava flour prepared and eaten		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]								
6. BANANAS/PLANTAINS (Cooking bananas or [illegible])																	
[illegible]																	
Plantain [illegible]																	
[illegible]																	
Banana/Plantain dish prepared and eaten outside [illegible]		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]								
7. PEAS AND BEANS Grain (small) type 1																	
Grain (small) type 2																	
Grain (small) type 3																	
Peas/beans dish prepared and eaten outside [illegible]		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]								

E. FOOD AND EXPENDITURE Cont'd.

PAGE 3 OF 3 STAPLE/BASIC FOOD ITEM	Did members of the HH consume it in the last one week either purchased or non-purchased Yes 1 No 2	PURCHASES					NON-PURCHASED (Obtained from own production, as wages, or gift or loan)				WORKSPACE						
		Total quantity purchased	Units	Price per unit	Kg	Value purchased	What quantity consumed?	Units	Kg	How much would it cost to buy this amount last week	1	2	3	4	5	6	7
8. Grain Maize																	
Millet																	
[illegible]																	
Guinea corn																	
Guinea corn beer																	
Grain dish prepared and eaten outside HH																	
9. Rice Local																	
Imported																	
Rice dish prepared and eaten outside HH																	
10. Wheat Flour																	
Other product 1.																	
Other product 2.																	
Other product 3.																	
Wheat product prepared and eaten outside the HH																	

Note the number of visitors taking meals in HH ______ Last seven days

APPENDIX B : Sample calculation of household consumption units

The consumption units of a household are an expression of its age and sex composition. They are calculated by adding together the consumption units for each household member.

Individual consumption units		
Age (year)	Females	Males
< 1	0.3	0.3
1 - 6	0.5	0.5
7 - 13	0.7	0.7
14 - 19	0.9	0.9
20 - 59	0.9	1.0
> 59	0.7	0.9

Example:

Household composition	Consumption unit
Women aged 30 years	0.9
Man aged 49 years	1.0
Girl aged 15 years	0.9
Boy aged 10 years	0.7
Household consumption units	3.5

The household cultivates 10 hectares, so the area cultivated per consumption unit is 10/3.5 = 2.9 hectares

Source: FAO, 1990

Appendix C:-Calculation of daily calorie consumption (for example) of a preschooler -from household daily food consumption

1. Obtain the average quantity of each of the food nutrients consumed for the seven days by each household using food composition table or otherwise.
2. Allocate the consumption unit for each member of the household using FAO/WHO/UN (1990) consumption unit table (see appendix B) according to age and sex.
3. Calculate the total consumption unit of the household. For example, if household size of a household is 5 and daily calorie intake is 6000 Kcal , the total household consumption unit is calculated as follows:

i) By listing the age and sex composition of the household members and allocating the consumption unit as indicated in consumption unit table

	Individual consumption unit	
Age (yr)	male	female
< 1	0.3	-
4	-	0.5
7	-	0.7
30	-	0.9
47	1.0	-
total	1.3	2.1

Grand total of household consumption unit = 1.3 + 2.1 =3.4

4. Calculate the consumpion unit of each preschooler in the household as follows:

	Age (yr)	consumption unit
preschooler 1	< 1	0.3
preschooler 2	4	0.5

5. Caloric intake for each of the preschooler per day from the household daily calorie intake is calculated as follows

i) Preschooler 1 = (0.5/3.4)*6000 = 882Kcal/day

ii) Preschooler 2 = (0.3/3.4)*6000 = 529Kcal/day