Growth, Health and Nutritional Status of Secondary School Children (15-18 years) in Machakos District as affected by certain factors.

by

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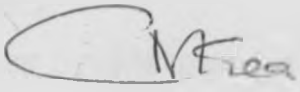
This thesis is my original work and has not been presented for a degree in any other University.



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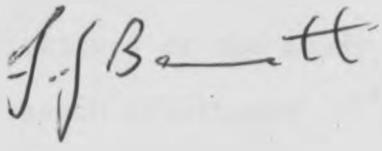

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PREFACE

Many boys and girls pass through puberty in the last years of primary school but some mature sexually and physically in secondary school. The stresses of greatly increased growth at adolescence and of social, emotional and sexual development, then take place in this critical transition phase between primary and secondary school or in the early years of secondary school. , When studying a secondary school child we are actually studying an adolescent with his problems.

Adolescence is characterized by a series of biochemical, anatomical and mental changes that are not found in members of other age groups. It is these rapid, extensive changes that differentiate adolescents from children and from adults and make this a special and an interesting group to study. And these differences must be taken into account when adolescents and their health problems are being given attention. Since the adolescents differ physiologically and psychologically from children and adults, these differences should be better understood and analysed. Only when this has been done, will it be possible to take adequate account of such factors as the rapid growth of

adolescents, their high degree of activity, the interrelationship of their growth and their endocrine systems, their high nutritional requirements and their requirements for a healthy personality development.

It is therefore hoped that this study will provide valuable and needed information on the adolescents, their health, growth and nutrition and feeding habits; and the findings therefore will motivate further research in other areas of interest related to this group.

The first three Chapters of the study are on general motivation as stimulated by sources such as literature on previous studies done on adolescents, mostly in schools and institutions in other areas. As this study was done in Machakos District in Kenya, a brief outline of this district, its geographical aspects, its medical and educational facilities, and of its people, the Akamba with their customs and behaviour is given in Chapter Four. Chapter Five, Six and Seven contain the methods used for collecting the data, the findings and discussions on the findings of the study. The final Chapter is on conclusions and recommendations.

SUMMARY

Chronological age is a poor index of growth and maturation during adolescence because of the wide variation in stage of development among persons of the same age. A study done in four secondary schools in Machakos District, Kenya in 1976-77 on boarding school children and day students of ages between 15-18 years has brought out this fact clearly. Of the 102 girls who had to fill out questionnaires to show whether they had had menarche, 98% of them had had their menarche. This showed they were in physical development already adult female. Whereas of the 80 boys examined physically we find that 5% were still in stage 0-1 of their sexual maturation, 4% were in stage 2, 16% in stage 3, 31.3% in stage 4 and 43.8% in stage 5. This shows only 43.8% of the boys were adults compared to 98% of the girls in the same age group. From the boys anthropometric measurements, it is observed that between stage 1 and stage 5 there is an increase of 18.5 kg. mean weight and 19.6 cm. in mean height.

Of the clinical disorders of the adolescent, anaemia was found in 4% of the girls and 5% of the boys. However the difference was not significant.

Pallor was more significant in girls than in boys. The Hb levels were found to be higher in boys than in girls in all ages. Goitre and obesity of milder forms were more significant in girls than in boys. Cheilosis of lips was the most common deficiency sign found in both sexes; 30.6% of the girls and 39.5% of the boys. More day girls were obese compared to the boarding girls.

52.6% of the boarding boys and 33.3% of the day boys were found to be underweight for age compared to 4.3% boarding girls and 3.4% day girls. Of the boys 66.6% mid-adolescent boarding boys, and 41.2% mid-adolescent day boys were found to be underweight for age compared to 22.2% post-adolescent boarding boys and 15.5% post-adolescent day boys.

A total of 25.5% of the students examined had parasite infections, of these 59% showed clinical signs of nutritional deficiencies as well. 41.5% of the boarding girls had intestinal parasites compared to 16.7% day girls, 21.6% boarding and 23.5% day boys. A significant difference in the presence of intestinal parasites existed between the boarding and day girls. Schistosomiasis mansoni was present in 12.4% cases, Hookworm 6.5%, Ascaris 4.6% and Trichuris Trichura in 2% cases.

Through questionnaires, it was seen that these adolescents had a very poor knowledge of the causes of malnutrition and the nutritional needs of the vulnerable groups. Mothers' answers to their questionnaire revealed that they had an idea of the nutritional needs of the members of the families.

Meal patterns of the day students revealed a very low intake of meat and fruits in their diets. For the boarders, a very low intake of vitamin A is revealed in their diets. Girls getting 8.7% and boys getting 15.9% of their recommended allowances. Other low intakes are Calcium, riboflavin and niacin. Protein, Thiamin and Ascorbic acid intake for both sexes exceeded the recommended allowance. 14% of the total protein intake was from animal source, and maize was the main contributor of the protein.

Of the 62 homes visited 37% of the fathers and 55% of the mothers had had no formal education. 45.2% of the fathers were farmers, and only 6.5% were employed in high skilled jobs. Of the fathers who had had no education approximately 48% were farmers, 25% were employed as unskilled labourers. Thus housing conditions examined protrayed a low

level of living conditions as seen in the number of rooms, building materials and type of fuel used. This is expected when considering that quite a number of the fathers are lowly paid people.

This study was therefore done in a community where the children in secondary school come from mostly poor agricultural backgrounds and it is thus fairly representative of much of rural Kenya.

CHAPTER I

INTRODUCTION

1.1. General Introduction

Today it is clearly recognized in most African countries that no successful economic development can be achieved by people who live under conditions of poor health and nutrition. Much has been done in Kenya by the Government, and private (voluntary) national and international organizations to improve the health of families through medical services and nutrition education. Nutritional rehabilitation centres, for example, have sprung up in most parts of Kenya. These were established specifically to improve the health of the malnourished preschool child and the health and nutritional knowledge of the mothers.

Nutrition, in some secondary schools is given as a subject and a set syallabus is given by the Government. This shows the concern of the Government in trying to improve the health and nutrition of its people. The Ministry of Health has a special nutrition section which conducts research and sometimes distributes D.S.M. (milk), all in the bid to improve the nutritional status of the people. School lunch programmes are also run by bodies such as the

National School Feeding Council and the Government in various parts of the country.

Research has been done by the Government, through the Ministries of Health, and Housing and Social Services and voluntary bodies to study the nutritional problems of various groups. Most of the groups studied have been the pre-school child, infants and expectant mothers. The study of the nutritional status of the adolescent has somehow been left out.

This study looks at the nutritional status of the secondary school child who is passing through his adolescence in Kenya today. The area chosen is Machakos District. The parameters used are the height, weight, arm circumference, and triceps skinfold. In addition clinical examination was done, biochemical and laboratory tests carried out and dietary habits and food consumption were examined. The homes were visited to determine the level of living.

1.2. Historical Background of Nutrition

To show the importance for good health in food and nutrition a brief historical outline of the subject seems appropriate.

Man's interest in food began before the dawn of civilization and it has continued to grow throughout the ages. However, this interest did not develop into a distinct science of nutrition until the nineteenth century.

Scheidner (Gothrie 1967) has very aptly divided the history of nutrition into 3 eras:

1. the naturalistic era (400 B.C. - 1750 A.D.)
2. the chemical analytical era (1750 A.D.-1900)
3. the biological era (1900 to the present).

During the naturalistic era people had vague ideas about the quality of food, most of which revolved around taboos, magical powers or the medicinal value of food. In Biblical times Daniel observed that men who ate pulses and drank water thrived better than those who ate at the King's food and drank wine. Hippocrates, the father of medicine, in his discussion of food in health and disease in 400 B.D. considered food one universal nutrient. Sanctorius, Italian physician made observations on body weight. Harvey and Apallanzani both with their interest in circulation and digestion, made observations that eventually facilitated the study of nutrition. In 1747 Lind, a British physician made the first controlled nutrition experiment to find a cure of scurvy from twelve soldiers with six different substances. He determined that either lemon or lime juice was more effective than others in curing the disease.

The chemical - analytical era in the study of nutrition was initiated in the 18th century by Lavoisier, a French scientist who became interested in the study of metabolism or what becomes of the food

after it is digested. Lavoisier was followed in the nineteenth century by illustrious men such as Liebig, Voit and Rubner.

Early in the 20th century research workers in food chemistry and in physiology in Europe, America and Japan demonstrated the need for good-quality protein for the growth of animals. Later the concept of the number and the type of minerals needed for growth came to include trace elements, as well as those present in larger amounts. At the same time other workers had shown the presence and the need for certain "accessory food factors", later called vitamins. Then followed in rapid succession studies of amino acids, essential fatty acids, hormones, enzymes, chemical regulators and intermediary products of digestion and metabolism.

Research methods and scientific tools have kept pace with changing concepts. Nutrition research today encompasses more and more facets requiring teams of scientists from several disciplines. Survey teams conducting nutritional status studies may require a physician, a nutritionist, a nurse, a biochemist, an anthropologist and a laboratory technician. New methods and tools for research have permitted progress from the earlier and sometimes crude animal experiments to more accurate observations on humans.

The importance that political leaders attach to nutrition is best illustrated by the fact that the first agency authorized within the United Nations (U.N.), was the Food and Agricultural Organization, commonly known as FAO. In 1945 it was charged with the responsibility of devising ways to improve the nutritional status of the world's population as one of the major pathways to peace. Since then interest in international nutrition problems has increased rapidly. Numerous conferences are devoted to discussion of efforts to improve the nutritional status of the expanding world populations. The necessity of making maximum use of indigenous food products to provide a level of nutrition capable of supporting the health and promoting individual productivity is an ever-present challenge to nutritionists and planners.

1.3. Definitions of terms used

In order to come to a common understanding of certain of the terms to be used in this study, it seems well to consider what is meant by various related terms.

1.3.1. Nutrition

Turner, D. (1965) defined nutrition as: "Combination of processes by which the living organism receives and utilizes the materials (food) necessary for the maintenance of its functions and for the growth and renewal of its components".

The same definition applies in this study.

1.3.2. Nutritional Status

Turner (1965) defines nutritional status "The condition of the body resulting from the utilization of the essential nutrients available to the body".

It may be good, fair, or poor, depending on the intake of dietary essentials, on the relative need for them, and on the body's ability to utilize them.

Good nutritional status is noted when man benefits from the intake of a well-balanced diet.

Good nutrition is essential for normal organ development and function, for normal reproduction; growth and

maintenance; for optimum activity and working efficiency; for resistance to infection, and for ability to repair bodily damage or injury.

Poor nutritional status results when man is deprived of an adequate amount of the essential nutrients. This is relative. Demands may go up at times e.g. as in illness, and intake being constant, may become inadequate.

1.3.3. The Pathogenesis of Deficiency

A nutritional deficiency disease ultimately develops when inadequate amounts of essential nutrients are provided to the cells for their normal metabolic functions. The nutritional deficiency may be (a) primary nutritional inadequacy caused by a faulty diet i.e. one that lacks essential nutrients either in kind or amount or provides an imbalance of nutrients.

(b) Secondary or conditioned nutritional inadequacy resulting from factors that interfere with the ingestion, absorption, or utilization of nutrients as well as from metabolic or functional conditions that increase the requirement for or

cause unusual destruction or abnormal excretion of nutrients. (Jolliffe, N. 1962).

1.3.4. Malnutrition

Malnutrition has recently been defined as a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients, this state being clinically manifested or detected only by biochemical, anthropometric or physiological tests (Jolliffe 1966).

1.3.5. Undernutrition - the pathological state resulting from the consumption of an inadequate quantity of food over an extended period of time.

1.3.6. Specific deficiency - the pathological state resulting from a relative or absolute lack of a specific nutrient.

1.3.7. Overnutrition - the pathological state resulting from the consumption of an excessive quantity of food, and hence a calorie excess, over an extended period of time.

1.3.8. Puberty and Adolescence

The term puberty is used in the medical and legal literature to describe several slightly different phases of sexual maturation lying between childhood and adulthood.

The term 'adolescent' was used by Ellis and others to refer to girls who had passed menarche (the first menstruation) but not yet reached maturity and to boys in a roughly similar stage. (Mitchell, 1950). Both the terms adolescence and puberty are used interchangeably in this study. In general, it may be stated that girls reach puberty about one to th.se years sooner than boys. The menarche is often used as a dividing line between pre and post puberty in the female. No such sharp division can be used in boys (Watson 1967).

1.3.9. Nutrients

Nutrients in food are those chemical components that perform one of three roles in the body: to supply energy, to regulate body processes, or to promote the growth and repair of body tissue.

1.3.10. Health

Health can be defined as "soundness of body", "state of bodily or mental and social well-being". Health is in fact, a variable condition of body as in good, bad, poor or ill health. At its best it is "that state of being in which all parts

and organs are sound and in proper conditions; that condition of the body and its various parts and functions which conduces to efficient and prolonged life." It implies moreover, the ability to produce and rear offspring fitted to live efficiently to perform the ordinary functions of their species. This optimum state of being can be attained, when, but only when, the animal organism is adequately nourished.

CHAPTER 2

REVIEW OF THE PROBLEM

2.1. Adolescence and Puberty (General Physical Growth)

Rates of Growth

Krause (1966) puts the rates of growth in four simple phases: a period of very rapid growth in both height and weight during infancy (birth to 1 year); a period of slower but fairly uniform gain throughout early and middle childhood (1 year to 12 years); a period of marked acceleration during adolescence (13 years to 19 years); and a period of gradual decline of growth until its cessation (20 years and on).

This study is on adolescence (age 15-18), and will therefore concentrate on the stage of marked acceleration of growth in adolescence. By general usage the term adolescence is associated with the last stage of growth, the development of secondary sexual characteristics and the decelerating growth pattern which follows. It represents the period of change from childhood to adulthood. Puberty is a narrower span of time which marks the beginning of sexual maturation and occurs, usually, a little before the mid-point of adolescence. It should be recalled that growth is not complete until several years after

full sexual development, but the final sharp advance is followed by a marked deceleration and is apparently conditioned by the attainment of sexual maturity. This period of physical change is accompanied by psychological developments.

The Adolescent Growth Spurt or Pubertal Spurt

During the period of adolescence there are two years in both sexes which are marked by acceleration of growth and this is known as adolescent gro :h spurt or pubertal spurt. The adolescent growth spurt is a constant phenomenon; and its onset varies from one child to another. Both Sinclair (1973) and Tanner (1962) agree that the spurt begins about the age 10½ to 13 years in well nourished girls and 12½ to 15 years in well nourished boys, though wide variations are possible. In both sexes the spurt lasts for 2 to 2½ years. In boys the spurt is responsible for a height gain of about 20 cm. (range 10-30 cm.) accompanied by a gain in weight of about 20 kg. (range 7-30 kg.). Girls gain about 16 cm. in height and 16 kg. in weight during the spurt. The difference in size between adult men and women is to a large extent the result of this difference in adolescent growth spurt.

After the spurt, growth decelerates rapidly, girls reach 98 per cent of their final height by

the average age of 16½, whereas boys do not reach the same stage until the age of about 17¾ years: again there is a wide variation around the means. Up to the adolescent spurt there is little difference between the average heights of boys and girls, but because the spurt begins earlier in females there is an age at which girls become taller (and heavier) than boys of the same age.

Although noticeable growth in height stops about 18 in the female and 20 in the male, there is evidence to show that in some individuals growth continues for some years after this. Like height, weight may increase after maturity has been reached, but this increase is to a certain extent within the control of the individual. An adult can put on weight by exercising the muscles while at the same time eating a diet which is satisfactory in quantity and quality, or by eating too much especially a diet containing excess calories.

Many children put on excess fat just before the adolescent spurt, and this may lead to emotional problems. During the male spurt the fat on the limbs decreases and is not gained back until the late twenties. In girls there is no such decrease, additional deposition of fat may temporarily be interrupted. In both sexes fat on the trunk continues to increase fairly steadily, but in girls

additional fat is laid down in a secondary sex distribution pattern.

Practically all skeletal and muscular dimensions take part in the adolescent spurt. At adolescence a marked increase in athletic ability occurs particularly in boys. Not only the muscles increase in size and strength, the vital capacity of the lungs, that is the amount of air they will hold on maximum inspiration less the amount retained after maximal expiration, also shows a pronounced increase in boys. The number of red blood cells, and hence the amount of haemoglobin in the blood, also rises sharply in boys, but not in girls.

Though the main change at puberty is in body size, there is also a considerable change in body shape. The shape changes differs in the two sexes, so that boys acquire the wide shoulders and muscular neck of the man, and girls the relatively wide hips of the woman. Thus at adolescence there is a great and sudden increase in body size and strength and a change in many physiological functions beside the reproductive ones.

2.2. Nutrition of the adolescent

As previously stated, the adolescent years are the second period of rapid rate of growth, but vary greatly for individuals even of the same chronological age. These years are also about the

most active period of life, noting that athletic ability especially in boys occurs here. Because of the double demands of activity and growth, food needs are high.

The nutritional requirements of the adolescent are conditioned primarily by the "spurt" in growth which occurs at puberty. The additional food requirements are indicated to the adolescent by his increased appetite and should be met by providing sufficient of the necessary nutrients. If this is not done the adolescent satisfies his appetite by snacks between meals, as is clearly indicated by investigations of the caloric consumption of boys at boarding schools. Unfortunately the character of the snack foods is usually such that they do not contribute materially to the balanced nutrient intake of the day. According to Toverud and her collaborators* "During adolescence, nutritional requirements are increased not only by more rapid growth and greater activity but also by the imbalance existing during these years in metabolic processes and in rates of development of different organs. Thus, the growth of the skeleton is at times more rapid than of the organic matrix, a situation which often makes mobility of the young awkward and accompanied by many unnecessary movements.

* as quoted by Martin E. A. 1963,

In addition to the imbalance in physical development of various parts of the body, the adolescent girls and boys are usually emotionally unstable, which has a bearing on nutritional requirements, food intakes, absorption, and utilization."

2.2.1. Food and eating habits

Physical and psychosocial pressures influence eating habits. Eating what their classmates eat, and enjoying food in their company, satisfies an emotional need and helps to develop the eating pattern at this period. By and large the adolescent boy fares better than the girl. His large appetite and the sheer volume of food it leads him to consume usually assure his intake of adequate nutrients. Girls, while watching their figures are likely to omit or restrict essential nutrients. Although individual needs vary, girls consume fewer calories than boys (from 2,000 to 2,500 a day; boys need 2,500 to 3,000 a day). Sometimes the large appetite characteristic of this growth period leads an adolescent to satisfy his hunger with carbohydrate foods and to neglect essential protein foods.

Protein needs for adolescent growth are large, especially during pubertal changes, and for developing muscle mass in boys. From 50 to 60 g. of protein sustain daily needs and maintain nitrogen reserves (Refer to table 39).

Minerals particularly needed are calcium and iron. Menstrual iron losses in the adolescent girl predispose her to simple iron deficiency anaemia. In some area where iodized salt does not ensure sufficient iodine for the increased thyroid activity associated with growth, a deficiency state may result (Refer to table 39).

Vitamins are necessary regulators of metabolic activity. The B vitamins are needed in increased amounts, especially by boys to meet the extra demands of energy metabolism and muscle tissue development. Intakes of needed vitamin A and C may be low because of erratic food intake (Refer to table 39).

Three well balanced meals, including liberal amounts of the protective foods, and also concentrated sources of energy,

should be included in an 'ideal' adolescent diet. Besides the three regular meals a day, additional food such as an after-school snack, may be advisable or necessary providing there is considerable exercise or outdoor activity. Snacks should be considered as a part of the day's food and should contribute to the total nutrient intake.

In addition to supplying energy for activity and meeting the demands of rapid growth, good food habits in growing-up years contribute to the individual's good health and well-being as an adult. As parents of tomorrow, these young people will be better able to bear children and teach their own children sound food habits.

In the case of early pregnancy, in adolescence, not much information on dietary needs of the pregnant adolescent is available as yet. But resulting from surveys done by Blackburn and Calloway (1974) and King, Calloway and Margen (1973) it was recommended that protein allowance for the pregnant adolescent girl should be increased by 30 g. per day and energy requirement be increased by 300 calories per day. (McLaren and Burman 1976). Specific attention has not yet been directed towards the increased needs in vitamins and minerals of the pregnant adolescent.

2.3. Studies on nutritional status

This section will examine various studies done in Africa and other countries on the dietary habits and the effects of the resulting nutritional status on the appearance and adjustment of the individual. It is hoped that this will bring out a better understanding of the scope of nutritional problems occurring during adolescence. A summary of these studies is included at the end of the section.

2.3.1. Studies done in other countries

2.3.1.1. Nutritional Status of children VI Blood serum vitamin A and carotenoids by Robinson, A. et al (1948)

Sampling 348 children 2-18 years old from five Michigan child-caring agencies.

Methodology

1. Measurements were made at different seasons and on successive days to permit evaluation of the influence of seasonal changes in the dietary pattern and the extent to which daily variation in fasting

blood serum protein may be expected in children. In addition it was possible to analyse for vitamin A and carotene the food consumed by selected subjects during the periods of blood sampling.

2. A blood serum was analysed for vitamin A and carotenoids by the methods of Bessey and co-workers using Beckman spectrophotometer adapted to examination of small quantities of solution. Analyses were made in duplicate. Food composites were analysed for vitamin A by the Carr-Price reaction.

Findings

1. Only 27% of the group had serum carotenoid levels above 160 mcg per 100 cc., but after 4-5 weeks 55% had risen to that level.

2. Few of the subjects were entirely dependent upon the usual dietary sources of vitamin A.

3. The various groups of children differed markedly in level of blood carotenoids, suggesting differences in dietary pattern.

4. A seasonal difference was evident for vitamin A, and autumn values being higher than spring.

5. Rises in levels of serum carotenoids and vitamin A were found in response to favourable circumstances and ample supplies of fresh,

green and yellow vegetables provided during a six week camping experience.

2.3.1.2. Nutritive intake of adolescents by Wharton, M.A. (1963)

Sampling: 421 adolescent boys and girls aged between 13-18 years from 3 schools in Southern Illinois.

Methodology

1. 3 day dietary records kept by the subjects.
2. Questionnaire regarding food habits, food list for "liked", "disliked" and "never eaten" foods. Dietary records were collected on Tuesday, Wednesday, and Thursday. Data was collected in the Springs of 1956, 1957 and 1958.

Findings

1. Calcium, iron, vitamin A and ascorbic acid were consumed in the lowest amounts.
2. Boys' diets were significantly higher than the girls' diets for protein, calcium, phosphorous, iron and riboflavin.

3. Girls consumed a greater portion of the Recommended Dietary Allowances for calories, niacin and ascorbic acid.

4. The older adolescents had a higher intake of vitamin A.

5. The nutritive intake of the Negro group was significantly better than for the Whites for calories, iron, vitamin A, thiamin and niacin.

6. The Negroes consumed 35-38% of their calories as fat and the White students 40-48%.

7. The girls ate more snacks than that of the boys.

8. Coefficients of correlation were presented for all individual intakes of all pairs of nutrients. The relationship between most nutrients were high except for vitamin A and ascorbic acid.

2.3.1.3. Gingivitis - Ascorbic acid deficiency in the Navajo by McDonald, B.S. 1963

Sampling - 283 boys and girls aged 11-22 years from Intermount Indian School in Navajo.

Methodology

1. Dental Officers of the school health centre selected 283 pupils in the following way: An inflmed gum condition described as hemorrhagic hyperplastic gingivitis was

the basis for selecting 186 students. For each 2 students with inflamed gums, 1 student without gingivitis was chosen as a control i.e. a total of 97 controls. Cases of severe gingivitis due to poor oral hygiene were not included.

2. Blood samples were taken to determine ascorbic acid of white blood cells.

3. Those with gingivitis were divided into Group I and II matching age, sex and gum condition. The controls were divided into group III and IV in a similar way. Group I and III received 300 mg. ascorbic acid in tablet form daily for 21 days. Group II and IV received placebos.

4. At the end of 3 week period dental examinations were repeated and second blood samples taken.

5. Six months later, the students were re-examined and third blood sample taken.

6. Group II received an ascorbic acid supplement for 3 weeks following the study period. An additional blood sample was taken of those children at the end of that time.

7. All others received ascorbic acid only from food sources during the 6 months.

8. Ascorbic acid in mixed dishes was calculated as students kept dietary records of their individual food intake in the day before the study began and on 5 days of 21 day period. All completed their dietary records.

Findings

1. Mean dietary ascrobic acid intake was 69 mg. The average for the 160 girls was 62 mg; for the 122 boys, 78 mg. There were no significant differences in intake between any study group.

2. 17% of the students had food intakes meeting their recommended allowance for ascorbic acid.

24% consumed less than 2/3 of their allowance.

3. More children with adequate intakes were in the year 11-12 year group.

4. The percentage of subjects having deficient intakes of ascorbic acid increased with age, reaching 27% in the 16-19 year age group.

5. More boys met their allowance than girls.

2.3.1.4. Influence of breakfast on total day's food intake by Ohslon, M.A. and Hart, B.P. (1963)

Sampling: 15 girls between ages 14-16 years all pubescent in America.

Methodology

1. 3 breakfasts were planned with from 9-24 gm. protein and 553-650 calories. The higher caloric value of "breakfast 3" was related to the increased intake of fat from the animal protein, even though the fat spread for the bread was reduced to the least acceptable amount.

2. The 15 subjects were randomly assigned to the experimental breakfasts. A given breakfast was eaten for 6 days after which a second breakfast was served for 7 days. The study terminated for each student after breakfast on the last day, thus providing complete food intake records for 2, six-day periods for each subject. Breakfast was served in the metabolic ward between 7 and 7.40 a.m. The students chose the food eaten during the rest of the day according to taste.

3. Each kept a detailed notebook of all foods eaten away from the ward for the entire period.

Findings

1. In general the younger girls tended to eat more food than the older girls.

2. Mean nutrient intake for each group approximated or exceeded the allowances except for calcium and iron.

3. Protein intakes met or exceeded the allowances in all cases.

4. Food groups rich in iron and thiamine in appreciable quantities were eaten regularly but in small daily amounts, but despite this there was no obvious evidence of iron deficiency in these girls.

5. A preliminary check of food records suggested high intake of snack and sweets.

2.3.1.5. Dietary Survey of Adolescents in the Virgin Islands by Spauve, M.E. and Dodds, M.L. (1965).

Sampling - 68 subjects - 22 boys and 46 girls in the eleventh and twelfth grades in two secondary schools at St. Thomas, in the Virgin Islands.

Methodology

1. Seven-day records of foods eaten recorded by the subjects.

2. Questionnaire schedules on personal data.

Findings

1. The diets provided 2/3 of recommended nutfients with the exception of calories and calcium. Mean calcium intake of the 22 boys was slightly below 2/3 of the allowance and average caloric intake of the 46 girls was low.

2. Average intakes of both boys and girls exceeded the vitamin A and Ascorbic acid allowances. The mean intake of vitamin A of the girls was almost twice the recommendation.

3. Native dishes contributed 14% of total calories and 16% of total protein for boys; and 11% of total calories and 14% of total protein for girls.

4. Only 32% of the boys in the study had an average daily intake of calcium that met or exceeded 2/3 of the recommended allowance due to low consumption of milk.

5. Mean intakes of calcium and vitamin A were greater for boys eating lunch at school than for boys eating lunch at home.

2.3.1.6. Teenage food habits by Schorr, B.C. et al (1972)

Sampling - 118 students from grade 7-12 from a school in a small village in Western New York State.

Methodology

1. 3 day dietary intake recorded by the students.

2. Questionnaires were filled in order that information could be obtained concerning:

a) life-style characteristics of the teen-agers and their families and the adolescents' food preferences.

b) list of the kinds of foods and drink they "like most", "like least of all", and have "never tasted".

Findings

1. Complexity of an adolescent's diet increased significantly with an increase of his father's and mother's occupational level, his mother's educational level, the extent of his social participation and with his employment but was not related to his age, sex, family size and the number of his nutrition fnformation channels.

2. Dietary complexity also increased as intakes of calcium, iron, ascorbic acid and vitamin A rose. The percentages of subjects consuming less than 2/3 of their ascorbic acid, calcium, vitamin A and iron allowances were 21, 44, 51 and 69 respectively.

3. The nutritive intake of boys was considerably superior to that of the girls.

4. The subjects liked many good sources of all the nutrients except vitamin A.

2.3.1.7. Nutritional Status of Children by Cooperstock, M. et al 1948

Sampling - 99 children 6-15 years, from underprivileged families, all of Michigan were selected, to spend 6 weeks at Bay Cliff Health Camp on the shore of Lake Superior about 40 miles from Michigan.

Methods

Each child was examined by a paediatrician at admission to the camp and the supervisory staff noted variations in eating habits.

Those chosen fell into the following categories; cardiac involvement, speech and hearing defects, orthopaedic ailments, general malnutrition.

Results

The examination on admission showed each child to have some oral abnormality or infection, e.g. dental caries, excessive dental repair, gum hypertrophy, gingivitis. 61 children in addition showed evidence of inferior nutritional status designated as: undernutrition, pallor, granulation of eyelids, smooth tongue, follicular conjunctivities or rough dry skin.

93 of 99 children increased their weights by 0.1 - 25.1% during the six weeks. 6 had net weight losses.

After 3-4 weeks at the camp determinations of 61 children showed none with serum vitamin C value below 0.4 mg.; 51 with values of 1.0 mg or more; 5 from 0.8-1.0 mg. and only 5 below 0.8 mg. per 100 cc.

2.3.1.8. Nutritional Status of Children: XII Haemoglobin by Kaucher, M. et al. 1948.

Materials and Methods

Haemoglobin was determined in fasting, whole blood from 392 children 2-18 years, old in the care of 5 Michigan agencies, by a micro-method (determined by the alkaline method developed by Bessey and Lowry).

10 cu. mm. of fresh whole blood were placed in 4 cc of 0.5% solution of concentrated ammonia. The resulting colour intensity at a wave length of 540 microns was measured in a Beckman spectrophotometer.

Determinations were obtained in both spring and the fall for 155 of the children.

Results

Values for all subjects ranged from 10.5-18.0 gm. of haemoglobin per 100 cc. of blood averaging 13.5 gm.

32% of the values were below 13.5gm.

16% were below 12.5 gm.

4% were below 12.0 gm.

No significant differences were found among values for the different groups of children or between determination in the fall and in the spring.

Average values of girls rose from 12.4 gm. at 3 years to 13.4 gm. per 100 cc. at 10 years, followed by a slight increase in level but no evidence of consistent change for older girls.

Values for boys increased from 12.4 gm. at 3 years to 13.8 gm. during the 14th year to 14.7 gm. of hb. per 100 cc. in the 17th year.

2.3.1.9. Nutritional Status of Children by Beach, E.F. (1950)

Materials and Methods

61 adolescent boys 14-16 years old from Boys Republic in Michigan were selected.

Height and weight measurements were obtained. A physician made a thorough medical examination of each boy.

Blood samples were collected from finger-pricks for microdeterminations of haemoglobin, serum protein, vitamin A, carotenoids, vitamin C and alkaline phosphotase.

1 hour fasting samples of urine were obtained for thiamine, riboflavin, creatine, creatinine and nitrogen analyses.

Thiamine was determined by the thiochrome method (described by Hennessy) and Riboflavin by the Forrebee procedure with modifications.

Results

No extreme underweight only 1 instance of gross overweight was noted.

Mean haemoglobin level was 13-15=14.7g.

Considering age and weight, mean daily intakes of calories, fat, protein and carbohydrates were adequate when compared with recommended allowances.

Mean serum protein was 6.7g/100cc.

Vitamin A (42 ccg/100 cc)

Urinary riboflavin values reflected dietary intakes which were greater than those recommended.

Clinical examination showed boys to be nutritionally good, although there were some early, mild deficiency symptoms suggestive of inadequate intakes of vitamin A, riboflavin and vitamin C.

2.3.1.10. Diet and Nutritional Status of Iowa School Children by Eppright, E.S. and Roderuck, C. (1955).

Material and Methods

A random sample of 1,200 children aged 6-18 years were chosen from 61 schools in Iowa.

Under the supervision of a qualified dietitian 7 day dietary records were kept by the children or their mothers.

5 body measurements were made of each child and samples of finger-prick blood were taken for the determination of haemoglobin

For approximately 700 children in cities and small towns determinations were made of the serum concentrations of ascorbic acid, carotenoid and alkaline phosphotase.

Dental and medical examinations were made of approximately 300 children.

Findings

The mean daily intake of calcium was low due to low intake of milk.

Vitamin C and A intake were low due to low intake of fruits and vegetables.

Oversized girls were found to have poor diet, thus body size was unrelated to their apparent intake of most nutrients.

Principal health problems with nutritional implication were dental carries for all children and weight control, particularly for the teenage girls.

Physical measurements and haemoglobin concentrations of the blood indicated a fairly satisfactory state of nutrition.

2.3.1.11. Nutriture of school girls of different physiques by Gschneidner, M.P. and Roderuck, C. 1960

Material and Methods

Nutritional status of 183 girls in 4 consolidated schools in Stowy Country, Iowa was studied over a period of 3 years.

61% of the families represented by 183 girls lived on farms.

4% lived in rural non-farm locations.

30% lived in small towns.

The girls were measured in November 1953. Again in April and September 1954.

The weights and heights were plotted on the Wetzel grid.

For this study 151 girls remained in the same physique groups during first year; 27 in the very heavy or obese groups 96 in the thin group; and 28 in the thin group.

The remaining 32 girls moved from one group to another during the year.

At intervals throughout the study height was measured to the nearest 1/10th of an inch and weight to the nearest half pound. Skinfold thickness were made with a Glogau vernier caliper 4 times during the study. Skinfolds were measured on the left lower chest and in the left sub scapular area on the back.

2 day records of food intakes several times a year were taken by the girls, the caloric value of the daily foods was done.

4 times during the investigation each girl recorded her physical activity for one day.

7 times during the investigation, blood samples were taken and analyzed by microchemical methods for haemoglobin, serum ascorbic acid, and serum alkaline phosphotase.

Results

The heavy girls gained more weight than the medium sized girls during the first interval, but the medium sized girls gained more during the 5th and 6th intervals.

Gains du ng winter months exceeded those during summer except for the medium sized girls during the first interval.

After 3 years the medium girls averaged 1 inch taller than the heavy girls.

Heavy girls matured earlier than thinner ones.

Both the heavy and medium girls averaged the same hours for activities during the day.

Similar mean values were found for the two physique groups for blood haemoglobin, serum ascorbic acid, and serum carotenoids. Differences between the two groups in mean concentrations of serum alkaline phosphate were statistically significant.

2.3.1.12. Standards for subcutaneous fat in British children. Percentiles for thickness of skinfold over triceps and below scapula by Tanner, J.M. and Whitehouse, R.H. (1962)

Materials and Methods

A sample of 5-16 year old children, 1,000 children of each sex at each age was selected from the London County Council.

Two measurements of subcutaneous skinfolds, triceps and subscapular were taken by Harpenden Skinfold Calliper.

Findings

The boys' triceps skinfold reaches its lowest value (for the 50th percentile) at about 8 years and then rises to reach a peak between 12 and 12½ years. (This is the so called pre-adolescent fat wave described by Tanner 1962.

The girls' triceps skinfold shows its lowest value at 7 years, a year earlier than the boys. The same rise then occurs as in boys but not the same fall. At age 12 the amount of fat increases again in girls.

The boys' subscapular skinfold has its lowest value at about 7 years and

thereafter rises, but with a slight plateau visible at age 11-12 years. After the plateau the curve rises again.

The girls' subscapular skinfold has its lowest value at 6-7 years and thereafter rises steadily without any interruption at adolescence.

2.3.1.13. A cross-sectional and anthropometric study, with an interval of 7 years, on 611 young adolescent school children by Durmin, J.V.G.A. et al 1974

Materials and Methods

A study of food intake for 7 consecutive days was made of 192 boys and girls aged 14 years attending Glasgow schools in 1964 was taken.

A similar study was done in 1971 on 419 boys and girls of the same age. The children came from the various socio-economic backgrounds and were subdivided into 4 social groups.

Heights and weights were taken in both groups.

Results

Percentage contribution of fat to the body weight had increased in the boys.

Between 1964 and 1971 there had been a decreased in the mean energy intake of both boys and girls of between 0.8-1.0 MJ (200-250 KCal). A similar proporticnate decrease had also occurred in the protein, fat, carbohydrates, calcium and iron content in the diet.

No individual had low protein intake.

Only boys of the poorest social group showed lower intake of nutrients than the other groups. There were almost no differences between the girls from the different socio-economic groups.

Eating school meals did not affect levels of total energy and nutrient intake.

There was a consistently lower energy intake in all social groups by the fattest girls.

2.3.2. Studies done in Africa

2.3.2.1. An investigation of the daily intake of individual boys at a boarding school in Uganda by Schwartz, R. and Dean, R.F.A. (1955)

Materials and Methods

1. Those who took part were volunteers aged between 9-20 years from a school in Buganda Province about 11 miles from Kampala.. 24 boys

were in primary and 8 were in secondary. This sample is approximately 1/10 of the school population which had 303 boys.

2. Food intake was measured daily for 7 days, using a spring balance, any left overs were also weighed and recorded.

3. Most of the extra items bought by the boys were weighed at meal times, especially in the two tea breaks. Foods eaten in the dormitories was weighed by a house prefect provided with a balance.

4. Food values were calculated from tables of food composition (Platt, 1945) McCance 1946, Chatfield 1953), the factors 4.1, 9.3 and 3.75 being used for calorie value of protein, fat and carbohydrates respectively.

5. The findings were compared with earlier studies done on British boys.

Findings

1. Total carbohydrates eaten by African and British boys were equal. Total protein was lower for African boys. Animal protein and fat was even much lower.

2. In the school diets, the contributions of animal protein and fat were very small. Carbohydrates was responsible for ¾ of total calories.

3. The calories obtained from the school diet were supplemented by the extras bought by the boys.

4. The mean amount of extra sugar eaten in a week was about 420 g. 300 g. were supplied by school. Therefore making a total of 720 g. sugar per week.

5. There was a low calorie intake of the children probably due to small amounts of food given to children as there were no left overs.

6. There were no clinical signs of under-nutrition in the children who took part in the investigation.

7. All boys supplemented school food - mainly sugar, chiefly in afternoon tea in large quantities.

2.3.2.2. Incidence of endemic goitre in Kenya and outline for its prevention. by Bohdal, M., Gibbs, N.E. and Simmons, W.K. a WHO/FAO/UNICEF assisted project 1968

Sampling Total of 28,520 school children in 108 schools in Kenya.

Methodology

Clinical examination of the schcol children

Findings

1. Total incidence of goitre in school children in 1962-64 is as follows:

1st degree	21.95%
2nd degree	7.13%
3rd degree	1.14%
Total	30.22%

2. In Machakos District 21.4% of the children examined had goitre (grade 1).

2.3.2.3. <u>WHO Nutrition Team Conducted the study on the incidence of fluorosis in 1963-1964 under Dr. Munoz</u>

<u>Materials and Method</u>

A total of 18,997 school children in 72 schools in Kenya were examined.

<u>Findings</u>

1. The endemic dental fluorosis of degrees 3-6 were diagnosed in 8,382 pupils i.e. 44.1%

2. The degree of fluorosis had no significant influence on the incidence of caries.

3. The group with fluorosis and caries were surprisingly high.

4. The incidence of fluorosis was higher in younger children (lower forms).

2.3.2.4. <u>The Pattern of disease and accidents in Nigerian children of school age by Oduntan, S.O. (1973)</u>

<u>Methodology</u>

A total of 17,006 health records for school age children were analysed from various medical centres in Ibadan City.

Findings

1. Ulcers and abrasions, parasitic and infectious disease including malaria, tetanus and tuberculosis were shown to be the most important diagnoses made. Other diseases such as otitis media, conjunctivitis and the pneumonias were also commonly seen.

2. The main causes of death were malignant diseases mainly Burkitt's tumour, bronchopneumonia, tetanus and tuberculosis.

3. The majority of diseases that affected these children were potentially preventable and remedial e.g. high frequency of intestinal helminths and gastroenteritis and were related to their way of life and the low standard of public and personal hygiene. in the community.

2.3.2.5a. Health Survey of primary school children in Uganda: Incidence of Anaemia, Splenomegaly, Hookworm and Malaria by Brown, R.E., Wilks, N.E., and Allen, D.M. (1970).

Materials and Methods

2,899 African school children in grades 1-7 were examined in 14 randomly selected schools in Uganda. Two thirds were male and they were composed of more than 35

different tribal groups represented. The school children were aged 4-20 years.

Examination team consisted of 3-5 physicians, 3 laboratory technicians and several recorders.

Thick and thin slides of capillary blood were made from every child and two heparinized microhaematocrit capillary tubes were filled with blood from the same finger prick.

The thin blood slides were fixed with mothyl alcohol and stained with Giemsa. These were examined for the percentage of eosinophils by counting 100 leucccytes and recording the number of eosingophils present.

Thick films were stained and examined by experienced hematology technicians for malarial parasites.

Within several hours of collections, the capillary tubes ere spun, using a Hawksley microhaematocrit centrifuge at 2,500 Mom, and the packed cell volume read with a Coleman microhaematrocrit reader. The capillary tubes were then put in a refrigerator and maintained at -70°C. for subsequent determination of malaria antibody titres by means of the indirect fluorescent technique.

A stool specimen was obtained from most children, kept refrigerated at $4^{o}C$. and examined by skilled technicians who recorded ova and parasites found by means of the direct saline smear-technique.

To analyse the information collected, a punch card was devised in which the significant data for each child were first coded and subsequently recorded on an 80 column punch card. These cards were electonically sorted, counted, and then analysed for possible correlations.

Findings

1. Overall mean haematocrit was not depressed.

2. There was found to be an association between haemotocrit levels and age, the older children having higher packed cell volumes, and between malaria incidence and the presence of hookworm.

3. Older children were generally found to be better nourished and to have higher haemotocrit values.

4. Areas with low incidences of both malaria and hookworm disease had children with higher mean haematocrit levels.

5. Children over age of 13 years tended to have lower hookworm incidence than those

who were younger.

6. The presence of malaria parasites on thick films was closely correlated with spleen rates, and with malaria antibody titres.

7. No relationship was established between the incidence of hookworm in the stools and presence of a latrine at home.

2.3.2.5b. Health survey in Ugandan Primary Schools an approach to health education by Brown, R.E. and Wilks. N.E. 1966

Methods and Materials

2,900 children of ages 4-20 years from 14 schools in Uganda were selected. 2/3 of the sample were boys.

Questionnaires filled for socio-economic data.

Physical examinations were carried out.

Laboratory tests were done. Samples of blood were collected by a finger-prick and thin and thick blood slides prepared. Capillary tubes were filled for haematocrit and measurements of malaria antibody titres.

Stool samples were collected for parasites.

Findings

Average number of children in each family was 8.

The children travelled an average of 2.1 miles to school, majority coming on foot.

43.8% children, when asked, had had nothing to eat for breakfast.

33.8% had drunk nothing. The majority of those who had had breakfast, had cold plantain, some blood or porridge, very few had fruit, milk or other protein.

Water was obtained from either well, spring, or municipal supply. Over 83% had latrine, majority being pit latrines.

Palpable spleens were correlated with the presence of malaria on thick films or a higher than average malaria antibody titre.

Anaemia was more common among the young children living in areas where either hookworm or malaria was frequent.

28% of the sample had hookworm.

13% of roundworm infection.

Overall malaria incidence was 11.4%. Very little tapeworm (0.9%) and Bilharzia (0.3%) was present.

2.3.2.6. Sexual maturation and variation in the height and weight growth of Bantu girls in Durban by Kark, E. 1957.

Materials and Methods

First examination of the girls was carried out in June, 1950, and thereafter periodic examinations took place in November and December just before the winter vacation of the years 1950, 1951 and 1952.

The initial examination included 365 girls. As new girls entered the school each term they were included in the study, making a total of 578 girls by December 1952, when this aspect of investigation was concluded.

Results of 1,983 individual examination was available for analysis.

Measurement of weight and height at six months intervals was done.

Assessment of Progress in Sexual maturation, by observations in breast development, pubic and axillary hair growth was made at 6 monthly intervals, at the same time each girl was interviewed as to the occurrence of the menarche in pre-

menarched girls, or the periodicity of menses of those girls with menarche.

Maturity Grading - girls were classified thus:

Non-pubescent:- those girls who showed no evidence of development of secondary sex characters and had not attained manarche.

Pubescent:- those girls who showed development of any of the secondary sex characters (breast enlargement, pubic or axillary hair-growth), but had not attained the menarche.

Adolescence:- Those girls who had attained the menarche. They also evidenced further maturation in breast development, pubic and axillary hair growth.

Maturity grading was assessed at the initial examination.

The mean heights and weights of the girl is shown:-

a) in relation to their chronological age and b) in relation to chronological age and maturity grade.

Findings

The age group of girls who had not yet manifested any signs of pubescence was from 8-13 years.

By age of 11 years, 72.5% were pubescent. Among 13 year old 30% were adolescents.

14 year olds 61.8% were adolescents.

15 year olds 93.8% were adolescents.

16 year olds, all girls were adolescents.

Thus within the age range of 9-15 years there were a number of girls of same chronological age but at different level of maturation.

While the measurements according to chronological age indicate increased growth rates from 11-14 years, it is only when this is considered in terms of maturity grade that the significance is revealed.

Pubescent girls in each half-year group between 10 and 12 years are taller and heavier than the less mature non-pubescent girls in the same age group.

Similarly adolescent girls between 13-15 years are taller and heavier than pubescent girls of the same age.

In each age group the more mature girls are at least 1½ times in advance of their less mature school mates.

2.3.2.7. The diet of some Uganda school girls by Burgess, A.P., Norton, C. and Burgess, H.C.L. 1962.

Sampling

4 groups each of 10 girls were studied from Gayaza Secondary school.

Group 1 - consisted of 'mature' girls in the form before the highest in secondary school.

Their diets were measured at the end of October 1959 near the middle of the term.

Group II - from 3 classes in the secondary school and had been menstruating from 12-18 months. Their average age was 15 years.

Food was measured in 3rd week of term September 1960.

Group III- were in the top class of the Primary school and who, according to data obtained at the school (Burgess 1962) would not be expected to menstruate until 12-18 months later. Average age was 11 years 11 months.

Their diets were measured in mid-term June, 1960.

Group IV consisted of new girls in first class of the Primary School. Average age was 7 years 5 months.

Their diets were measured in the second and third weeks of term in February 1960.

Methods

7 days diets were measured and analysed, All wastes and extras were measured.

The nutritive value of composite recipes was calculated by using food tables after weighing the prepared raw foods and the final cooked dish so that contribution of each ingredient could be estimated.

The nutritive value was compared with the diets of British children.

Data on height and weight for age and the age at which menstruation begins had been collected earlier from the school.

Results

Total calories intakes of the children in group I, II and III were very like those of the British children. Those in Group IV had 300 calories less than British children.

Less protein and fat is taken than British children but more carbohydrates is taken by the African children.

Total calorie intakes of African children increased with age.

The intakes of older children were less than those of British children after theonset of menstruation.

Groups I and II had about 4% of total calories in the form of animal protein, Groups III and IV had about 6%.

In all groups 12-13% of calories were derived from total protein, 23-30% from fat and 53-63% from carbohydrates.

2.3.2.8. Endemic goitre in Kenya an intermediate evaluation of an experimental control programme by Hanegraaf, T.A.C. 1977

Materials and Methods

Three study groups comprising the total number of pupils of one or more primary sdhools in three geographically and tribally different areas of Rift Valley Province, selected in 1969 for their known and obvious presence of endemic goitre. The areas are:

i) Eburru co-operative settlement scheme situated between Lake Naivasha and Lake Elmentaita.

ii) Buret Location in Kerisho district which represents the larget and best known goitre area in Kenya. ,

iii) Kaptumo (and neighbouring) location which is situated in the south of Nandi District, between the South Nandi forest and the Nyando Escarpment.

The studies were done in the three years 1969, 1972 and 1974.

Resulting from a previous study by Munoz and the 1969 done by the author there was evidence that a moderate degree of iodine deficiency exists in Kenya's established goitre areas, warranting the taking of national control measures.

Preventive measures started in 1970 by iodization of locally produced salt (degree of iodization 1:50,000). This programme was followed up in 1972.

Results were unsatisfactory and in 1973 the degree of iodization was increased to 1:33,000. This was followed up in 1974. This is a report on the last survey.

All pupils present on that day of visit to the schools under study were subject to a thyroid examination. All observations for all surveys were made by the same person.

The results were tabulated on special forms showing the goitre sizes according to age group and sex.

No record was kept of the degree of absenteeism in school during the study visit.

Goitre rates (GR) presented are the combined percentages of grades 1, 2 and 3 goitre; visible goitre rates (VGR) are the combined percentages of 2 and 3 grade goitres only.

From subsamples in the three study groups comprising both sexes and various age groups, casual urine samples were collected in iodine - free receptacles which were sent to the Laboratory for Pathological Chemistry, University of Leiden, for iodine and creatinine determination. Urinary iodine excretions per 24 h. being a fair measure of the dietary iodine intake, were derived from iodine/ creatinine ratios of casual samples and are presented as the arithmetic mean for each of the 3 study groups.

In 1969 and 1972 a small number of samples (ranging from 4-8 per area per survey) were colledted for PBI)protein bound iodine) determination.

Findings

1. The overall goitre prevalence in Eburru showed a significant and uniform decrease ($p < 0.001$) through

the years of investigation (rate of decrease 3.4% annually).

2. There is no significant difference in the goitre rates in 1969, 1972 and 1974 in Buret, Kerisho ($p=0.20$) and Kaptumo, Nandi ($p=0.70$).

3. The visible goitre rates (VGR) show a highly significant decrease in all regions:

i) in Eburru the VGR decreased at a rate of 6.4% annually ($p < 0.001$)

ii) in Buret the rate of decrease was 5.3% annually ($p < 0.001$).

iii) in Kaptumo decrease was at a rate of 2.1% annually ($p < 0.001$).

4. An analysis of variance applied to the results of the mean 24-h iodine excretion per area shows uniformly rising values from 1969-1974 in Eburru ($p < 0.001$) and Kaptumo ($p < 0.001$) but no significant rises in Buret ($p > 15$).

5. The mean PBI values in all three study areas shifted from low marginal in 1969 well into the normal range in 1972, indicating normal thyroid function. Taking of blood was omitted in the 1974 survey.

2.3.2.9. The Growth pattern of East African School girls by Burgess, A.P. and Burgess

Materials and Methods

All the girls in the school were measured a few days after the beginning, and within a few days of the end, of each term from December 1959 until December 1962. Both height and weights were taken.

Birth dates were obtained from birth certificates, or, if those were not available, by questioning the girls and their parents. A total of 364 school girls of the Bantu speaking Baganda tribe aged 6-18 years were studied for 3 years. Early in 1960 all the girls in the middle forms of the school, most of them 10-16 years, were asked whether or not they had had their first menstruation period. Reliable answers were given by 168 girls. The percentage af girls menstruating at each year of age was calculated by logit analysis.

Results

The mean age of menarche was calculated to be 13.40 ± 0.165 years. The pre-adolescent peak height velocity was 8.8 cm. a year and it occurred at about 11¼ years,

that is, two years before the mean age of menarche.

When their measurements are compared with girls of the same ages from other countries it is noted that the Baganda girls were taller and heavier than South African Bantu speaking girls, and heavier than Nigerian Ibo girls; they reached menarche earlier than both these groups. Their height was slighly below that of British girls althouth their weight was approximately the same and for a given height they were heavier; they reached menarche 0.3 years later.

2.4. Conclusion

Studies discussed in this chapter were done on adolescents using either advanced technological methods or simple field or dietary surveys in both developing African countries (namely Nigeria, Uganda and Kenya) and developed countries namely America and Britain. The following has been shown by these studies:-

1. There are 2 years in both sexes which are marked by accelerated growth known as the growth spurt or pubertal spurt. This spurt begins at age 10½ - 13 years in well nourished girls and 12½ - 15 years in well nourished boys. This shows that girls mature earlier than boys. The growth spurt is responsible for a gain height of about 20 cm. in boys and 16 cm. in girls; and a weight gain of 20 kg. in boys and 16 kg. in girls. After the spurt growth decelerates rapidly (Tanner 1962, Sinclair 1973).

2. Within age range of 9-15 year old girls, there are a number of girls of same chronological age but at different level of maturation i.e. some are non-pubescents, some pubescents and some are adolescents (Mark, 1957).

3. Heavy girls mature earlier than thinner girls (Gschneidner 1960, Kark 1957).

4. Because of the spurt, nutritional requirements are increased (Krause 1967), metabolic rate is relatively increased compared to other age groups (Watson and Lowrey 1969).

5. Nutritive intake of boys is more superior than that of the girls (Mcdonald 1963, Beach 1950, Spauve 1965, Schorr 1972).

6. There is a low intake of the following nutrients; calcium, vitamin A and C (Eppright and Roderuck 1955, Beach 1950, Spauve 1965), iron (Ohslon and Hart 1963) and calories (Wharton 1963, Spauve 1965).

7. The following nutritional diseases are found among the adolescents; anaemia (Brown and Wilks 1966) and goitre (Bohdal 1968, Hanegraaf 1977).

8. Presence of intestinal parasites (Brown and Wilks 1966, 1970, Oduntan 1973).

9. More carbohydrates is taken by the African children compared to British children (Burgess, Norton and Burgess 1962), and the total intakes of African children increase with age.

Total intakes of older children were less in African children than those of British children after onset of menstruation.

10. The girls ate more snacks than the boys (Wharton 1963).

11. Complexity of an adolescents' diet increased significantly with an increase of his father's and mother's occupational level, the extent of his social participation and with his employment but was not related to his age, sex, family size and the number of this nutrition information channels (Schorr 1972).

12. Oversized girls were found to have poor diet, thus body size was unrelated to their apparent intake of most nutrients. (Eppright and Roderuck 1955, Durwin 1974).

13. Contributions of animal protein and fat are very small (Swartz and Dean 1955).

14. Presence of fluorosis in adolescents (Bohdal 1968), and dental carries (Bohdal 1968, Eppright and Roderuck 1955).

15. Majority of diseases which kill Nigerian children of school age are potentially preventable and remedial e.g. high frequency of intestinal helminths and gastroenteritis and were related to their way of life and the low standard of public and personal hygience in the community.

CHAPTER 3

PURPOSE OF STUDY, OBJECTIVES, AND HYPOTHESES

3.1. Introduction

This study has been done to investigate some factors which affect the nutritional status and health of adolescents, specifically secondary school children in Machakos District. Factors investigated included occupation and education level of the parents, and home environment of the day student. Diet was also one of the factors investigated, for both the day and the boarding students. As the boarders spend two-thirds of the year at school, the school environment has also been examined. By school environment here is meant the conditions of dormitories, the number of children per dormitory and size and sanitary and dining facilities. The nutritional knowledge of both adolescents and mothers was also evaluated using a questionnaire.

3.2. Purpose of Study

Several authors have studied the adolescent period, during human development; but the role of nutrition during this period is a relatively new

field of research. Adolescence we have seen, is a period of accelerated growth and development which preceeds and follows puberty. The demands for nutrients during this transitional period from childhod to adulthood are increased. Menarche in girls enhances the need for iron and protein. Normal physical activity during adolescence adds another increment to nutritional requirements (see table 16).

In Kenya hardly any study has been done on nutritional status of adolescents in the rural areas. Much research has been done on infants and the preschool child. The adolescents are somehow ignored, probably because the more severe forms of protein energy malnutrition is rarely seen in this group. On the other hand Jelliffe (1966) states clearly that school children in tropical regions are often undernourished with positive clinical signs and subnormal anthropometric measurements, such as low weight for height and thin subcutaneous fat but without sufficient symptoms to warrant attendance at hospital or health centre. This is likely to happen when children walk long distances to school with little if any breakfast, when no school meals are provided, and when assistance with heavy manual

household chores, such as chopping wood or herding animals, is expected of them when they return home in the evening.

Studies done, both in developed and developing countries have revealed that nutritional deficiencies among school children may occur. As already mentioned (2.3), in Nigeria, Tabrah and Hawck (1963) revealed a high incidence of reduced haemoglobin, protein and riboflavin levels. It is well known that malnutrition opens the door for a variety of infectious and parasitic diseases, such as tuberculosis, a disease most prevalent in the teens, and linked to lower resistance caused by inadequate diet. Resistance to diseases in general is optimised by adequate diet, and recovery from disease is generally speaking better in a well-nourished individual. Anaemia caused by lack of iron, and lack of calcium have been found in studies of adolescents in the United States (Kraucher et al 1948, Everson 1960). Other studies have revealed lack of various other nutrients such as Vitamin A, iodine and Nicotinic acid.

It is necessary to study the nutritional status of adolescents in order to prevent and cure eventual deficiencies. The adolescents as a part of the community, are going through dramatic

physiological changes which increase their needs.

Regrettably incidence of pregnancies (and lactation) among adolescents is on the increase. This being the case, it is of paramount importance that young girls are in a good nutritional state to be able to cope with pregnancy, and to ensure a healthy child.

It seems that a study of adolescents is quite appropriate in a country like Kenya which is concerned with the development of its people as whole.

3.3. Objectives of the Study

General Objectives

To study the nutritional status of adolescents as related to environmental factors.

Specific Objectives

1. To examine family factors influencing the nutritional status of the adolescents namely:

a) Economic Status of the family

b) Food availability

c) Marital Status of the father and mother

d) Size and composition of the family

e) Formal education of parents

f) Environmental facilities at the home such as water supply, lighting, cooking, storage and sanitary facilities.

g) Cultural background of the child concerning foods and food habits.

2. To examine the possible relationship between nutritional status and disease.

3. To examine school factors such as boarding facilities, water supply, sanitary facilities, catering facilities, teaching of nutrition and health subjects and other facilities essential for health in the school.

3.4. Research hypotheses

This study will test the following hypotheses:-

1. There will be a significant difference in nutritional status between students in boarding schools (provided with school meals) and those attending day schools (not provided with school meals).

2. There is a difference in nutritional status between the boys and the girls in all ages.

3. Because of the increased iron requirement in girls after puberty there will be more anaemia in girls than in boys.

4. There will be a weight gain in the children at the beginning of the term compared to the end of term in boarders.

5. There will be a significant difference in nutritional status between those children who live under better socio-economic conditions and those whose parents have received formal education than among those who are less privileged.

CHAPTER 4

MACHAKOS DISTRICT IN GENERAL

4.1. Selection of the area

Various reasons led to the selection of Machakos District as a study area.

1. Transport from Nairobi to Machakos is very regular and easily obtained, so travelling to and from the research area was convenient.

2. Machakos being so near Nairobi whenever help was needed from the Faculty of Medicine, Department of Community Health (University of Nairobi) from doctors for the clinical assessment of the secondary school children, it was readily obtained.

3. A district hospital is available with a laboratory where microscopic examinations on stools to determine presence of intestinal parasites could be carried out without having problems of transporting samples to Nairobi. Treatment of those found sick or with presence of intestinal parasites could be provided at the hospital.

4. Much research and study of the area has been done by 4th year medical students of the Nairobi University in the nutrition and health of communities and in health centres but little has been done on the adolescents

as a community. In obtaining some information on nutrition and general health of the adolescents, this could help increase the knowledge of the health situation of the area so that when the Government has decided to improve the nutritional condition of the dictrict it has dome complete information on the health condition of the community of the whole both in schools and village of Machakos District.

For the purpose of this study a sample of boys and girls was selected from four secondary schools in Machakos District, three schools being Government and one being a Harambee Secondary school.

4.2. Information on Machakos District

Machakos District is one of the largest districts in Kenya covering an area of 14,156 sq. km. It is situated in the Eastern Province of Kenya. A large part of Machakos District can be described as scrubland, and is very hot, and has a very low and unreliable rainfall of 381 to 600 mm annually.

A second zone known as Medium Potential Zone has also unreliable rainfall of 762 mm to 1016 mm annually. A third area, which is

Map 1

Map of Kenya showing the position of the study area.

Map 2

The Study Area

the highland belt found in the west and north of the district has an annual rainfall of 900 mm to 1270 mm, in two separate rainy seasons of the year.

4.2.1. Agriculture

Coffee is the main cash crop in the district, other cash crops are cotton and tobacco and sunflower. Fruits of various kinds (passion fruits, quavas, peaches, pawpaws, oranges, tomatoes are widely grown to meet the demand for local market as well as for export to Nairobi, Thika and Mombasa. The other staple foods such as maize, beans, wheat, cowpeas, sugar cane, pigeon peas, mangoes, bullrush millet, and sorghum are also grown. One of the major occupations in the District especially in the Athi-Kapiti plains is grazing cattle (for both beef and milk) as well as goats and sheep. Small numbers of pigs and chickens are also kept.

4.2.2. Population Estimates and Distribution

The estimated population for Machakos District is approximately 887,674 inhabitants scattered unevenly over an area of 14,156 sq. km. This is based on the 1969

census record and annual population increase of 3.3% in Kenya. Population distribution in the district was influenced by historical factors of land settlement, migration patterns, availability of surface water, rainfall reliability and the nature of soils. Thus we have the highland zone around Iveti with a population density of over 300 persons per sq. km. while in the semi-arid zones of Kikumbulyu and Yatta Plateau, only 10 persons per sq. km.

4.2.3. Medical Facilities

Machakos District Hospital is situated in the centre of Machakos Town. There is a total of 6 hospitals, 7 health centres and 30 dispensaries to provide medical services in the District.

4.2.4. Education

For various reasons, not all school age children attend school in Machakos District. However education in the district is provided by over 905 primary schools, with a total enrolment of nearly 260,000 pupils. Secondary education is provided throughtout the district by 14 Government schools, 24 Government Aided Schools and the 73 are either

Harambee or Private Schools. A teacher training college, a Technical High School and a school for the blind are present within Machakos Town.

4.3. The Attitudes, Beliefs, Customs and Practices of The Wakamba

4.3.1. General Information

Historically, it has been shown that the Akamba tribe who inhabit Machakos and Kitui Districts moved inland from the Coastal areas and first settled in Mbooni Hills. Later on as the tribe became large and clans began to fight among themselves, some sections of the tribe moved out and settled among other parts of Ukambani.

The main occupation of the tribe is tilling land, while those in drier areas specialise in cattle grazing. The majority however, combine both grazing of animals and tilling of land. Other occupations like wood-carving and trading are also important.

The tribe is divided into several clans with members of one clan being related by blood. They look upon themselves as descendants of one common ancestor and therefore feel that marriage among members should be exogamous (outside the clan). The tribe trace their descent through the father's line (patrineal) and after marriage children born to a couple take the father's clan. However a married woman retains her father's clan even after marriage and consequently, change of domicile.

The relationship between parents and children is distant and rather restrained. The older children are not allowed to go near parent's bedroom as it is an incest taboo. The children would however be free, cordial and friendly with the grand-parents (Ndeti 1972).

In traditional circumstances learning among the Akamba is achieved unconsciously through play, games, hobbies, hunting and social ceremonies or informally through the media of work, imitation and oral literature. Most of this is acquired between the ages of 7 to 13 years. The girl learns skills such as fetching firewood, and water, cooking , etc. and the boy learns herding, making bow and arrows, etc. Formal instructions were also given through the constant corrections and

warnings to children by parents and peers.

4.3.2. Initiation Rites

Each individual undergoes a regular cycle both formal and informal stages, marked by rites. Through the Akamba rites a person became fully incorporated into the local community and hence into life of the nation; he learnt to participate in its duties, responsibilities, privileges and activities. Although changes can be observed, this pattern of life is still basically the same (Mbiti 1966).

Both boys and girls are circumsized before the age of 10. This as an important social event for the child and his relatives. It is after circumcision that the young begin to feel and be recognized as full members of the society. Local boys of one age set are circumsized in one batch, and they feel bound to one another for life.

At about age 15 boys and girls go through yet another initiation "second circumcision". This is an educational period which groups of boys and girls who were circumsized at the same time remain in the woods separated from the rest of the families

to be given instruction about life of the nation for about 10 days and then return to rejoin relatives. Because of formal schooling, today second circumcision is omitted, but every boy must at least receive physical circumcision. This makes them respected members of the community and they can get married or become warriors.

At age 40 they become ageing men. They have large families, can belong to men's clubs, drink beer and participate in ritual and jucicial matters.

As they become elders, they have grandchildren and are highly respected and give words of wisdom.

4.3.3. Marriage

Bride wealth is given in the form of cattle, sheep, goats, money, food-stuffs, other gifts and labour given by the man and his relatives to the girl's and her relatives. When marriage is edtablished, divorce is virtually non-existent. Polygamy was, and is, an accepted and respectable institution.

Children are the glory of marriage, and Akamba parents endeavour to have as many as possible.

4.3.4. The family and the homestead

The family consists of parents, children, brothers, sisters, grandparents and often other relatives. Kinship through blood and betrothal plays an important role in Akamba life, and there are about a hundred kinship terms. Every person knows how he is related to others.

The traditional homestead of a Mukamba is made up of several houses and grain stores, belonging to a man's several wives and children. On the same compound, or nearby, are the similar homesteads of his brothers and their families. The oldest member of the homestead, whether man or woman is technically the "head" of the homestead and is consulted in all matters affecting the welfare of the family. The houses are round in shape, with their doors facing the centre of the compound. A courtyard, as well as a cattle shed are situated in the centre of the homestead.

At night the courtyard is used by men and boys for story-telling and for giving traditional education to the young. Women and girls on the other hand sit inside the house.

The fields for growing food are scattered in different places. Men clear and burn the woods, women help in planting, young men and women help in scaring the birds and squirrels when seeds are growing. All the family clear the weeds and harvest together. Neighbours help each other sometimes in working in the field.

4.3.5. Diet and Entertainment

Milk was an essential part of the Akamba diet. Hunting was cherished by the Akamba and they use wild animals for meat sometimes. Customarily while entertaining friends a chicken, goat or even a bull could be slaughtered as an expression of hospitality. Bee-keeping being one of the popular men's occupation means honey is obtained easily. This is eaten at home, some is given to friends and relatives and some is used for part of bridewealth, and some is used for brewing alcoholic beverages.

Food taboos are almost nonexistent although certain sea foods such as fish, oysters and crabs are not accepted since

they are not commonly found here.

4.3.6. Entertainment

Dancing is the chief form of exercise and entertainment for both the young and the old. Many of the traditional songs are accompanied by dancing or some form of rhythmic movement. Dancing is normally done and enjoyed at night, when people have finished their work and have had their meals. Dancing is more frequent during the harvest period.

Games, sports such as swimming, running, etc. are done by the young people while children play with toys made of clay and wood. Story-telling is another form of entertainment.

4.3.7. Cultural Change

Like all other cultures in the world, the tribe is undergoing an era of social, economic and cultural changes. The traditional extended family system is slowly giving way to the nuclear family system. These changes are bringing new norms of behaviour, values, beliefs, and attitudes. In particular, the role of the eldest man in the family which was mainly to act as a

councellor and arbitrator in matters involving land, marriage and clan, is on the decrease. Nowadays, the young, educated members of the family have assumed greater authority because of the prevailing economic conditions. The collective responsibility of an extended family unit in caring for the sick and the aged is beginning to be replaced by the individuals taking care of their health status with their wives and children.

Though many customs and beliefs still persist even today, it is important to note that most do not retain the same tenacity or consensus among all members of the tribe. The hierarchy of those on top of the ladder (Politicians, teachers, chiefs, the education urban elites) are by and large acquiring new norms, beliefs and practices as they mix with members of other cultures. The influence of the mass-media, the agricultural extension agents and other forces are eroding the traditional beliefs and practices of the tribe in varying rates depending on the degree of exposure and the capacity to absorb the changes by individuals or communities (Muchunga 1977).

4.4. The Selected Schools

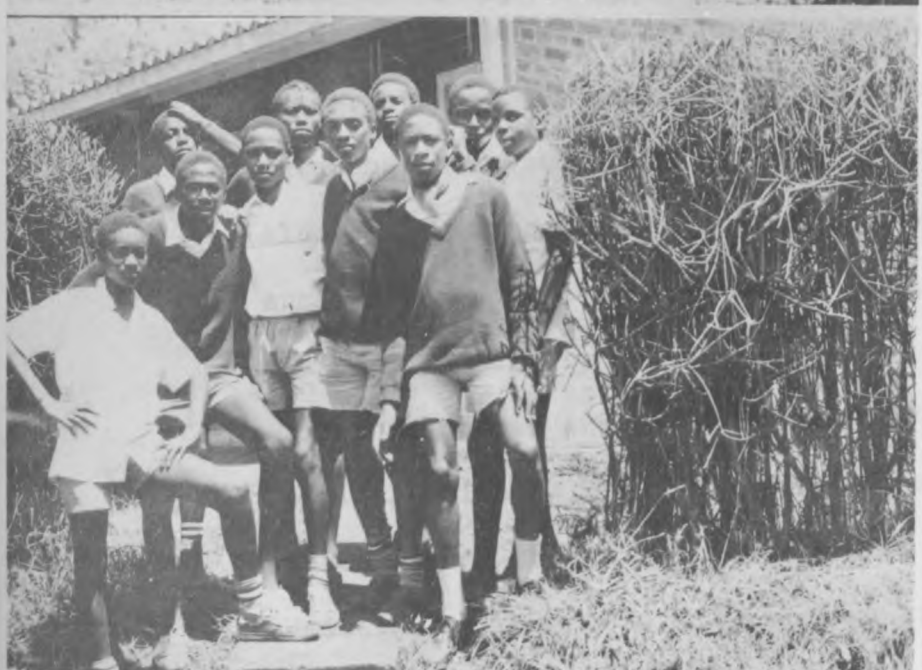
The study was carried out between the months of March and November, 1976. 194 students aged 15 to 18 years were selected randomly from Machakos Girls' High School, Mumbuni High School, Kyanguli High School and Kangundo High School all of Machakos District. By going through the school register, the first 15 students in each class who fell in the ages 15-18 years were picked, in order to make up the total number of students required for the sample. The selected students were from Form I to Form IV. Of those selected 108 were girls; 50 girls from Machakos Girls' High School and 58 girls from Kyanguli Secondary School. 86 were boys, 39 boys from Kangundo High School and 48 boys from Mumbuni High School.

4.4.1. Kangundo High School

Kangundo High School is a boys' Government boarding school in Kangundo Location, Machakos District. It is about two kilometres from Kangundo Town, and about 60 miles from Machakos Town. It has 440 students and consists of students from

1.

2.



Some healthy adolescents in the sample from Kangundo High School. In the background is seen a modern laboratory of the school.

Form I to Form 6 double stream. 4 hostels varying in size consist of double deckers and single beds. Each hostel contains 110 students and all are rather crowded. Generally the school is quite neat and clean in both the hostels, the dining area and the classrooms. Both pit and water borne lavatories are used in the school. Septic tanks and pits are used to get rid of dirty water and rubbish.

A matron trained in Institutional Management, supervises the catering Unit and has a small supply of aspirins for treatment of headaches, etc. at the school. She acts as a cateress supervising the planning of meals and also as the school nurse treating minor ailments such as headaches and treating wounds, and providing first aid to the students. Any major or serious illnesses are referred to the Kangundo Hospital which is 2 km. from the school. All students must have a medical check up before admission. Four cooks are incharge of preparing meals for the students. They use 6 boilers and ample other equipment in preparing the meals. Adequate and clean arrangement has been made for the storage of raw food and kitchen equipment. Food is delivered to the school by tender holders.

Sometimes the young farmers club provides cabbages from their garden, but this is not regular. There is no school canteen, but shops are about 50 yards away from the school in case the boys need any snacks. Biology is the only subject taught in the school which includes some health education. A radio and newspapers are available in the school for recreation purposes. A careers master acts as a counsellor for the students.

4.4.2. Machakos Girls' High School

This is a Government boarding school. It is about 2 km. from Machakos Town, and is in Iveti Location of Machakos District. It has 550 girls drawn from all parts of the Eastern Province. Majority of the girls are Kambas. The school has from Form I up to Form 6. 9 hostels of various sizes have an average of 30 double deckers for 61 girls. This actually makes the hostels rather crowded.

Adequate water borne lavatories and pit latrines are used in the school. An incinerator is present and cess pits are available for disposal of refuse. The school as a whole is quite neat both at the

3.

4.

Picture 3: One of the schools in the study showing a neat and healthy school environment

Picture 4: Healthy school girls from Machakos Girls' High School, near the school classrooms.

hostels, on the compound and in the classrooms. All girls at the school are boarders and a cateress trained in Institutional Management is the one who supervises meals and preparation of these. 7 cooks prepare meals using 6 boilers and 1 ring.

Two stores are available for storing dry groceries, and one for vegetables. The green groceries storage is not very satisfactory, as it has no shelves or racks, but the food is kept on the floor. Storage of equipment is neatly done on shelves around the kitchen. Some of the food is delivered to the school and the school sends its vans sometimes to collect supplies. A school garden provides some vegetables sometimes for the school meals. There is no school shop or canteen at the school which could provide snacks or other necessities.

Two well equipped buildings are available for the teaching of the home economics subjects (namely Food and Nutrition, Home Management and Clothing and Textiles). Three qualified teachers teach the subjects up to 'O' level. Biology is also one of the subjects taught at the school.

It might be interesting to note that before admission all first and fifth formers are taken to Machakos Hospital for examination. The sick

are treated. All have to be physically fit on admission. A dispensary is available at the school with facilities for admission of the very sick students. Both a trained school nurse and matron are available to run the health unit. In case of very serious illnesses, Machakos District Hospital is about 1 km. away, and these cases are referred there. Most teachers act as counsellors and help the girls with their private problems. Visiting lecturers and speakers such as the Family Life Education Group are often invited in the school to give talks on health and sex education to the girls.

For recreation purposes, a radio, television and newspapers are provided for the girls. School clubs are also run as extra curricular activities.

4.4.3. Mumbuni Secondary School

The school is about 3 km. from Machakos Town. It is in Iveti Location. It is a Government day school for boys, although some facilities are available for the few students whose homes are far from the school. One domitory and a few beds are available for these few. Those boys who have to board there have to provide their

own meals individually. A few other students have rented rooms at a shopping centre nearby and these also have to provide their own meals.

Of the 330 students in the school, the majority are day scholars, and are Kambas by tribe. Pit latrines and rubbish pits are used as means of disposing of waste. A canteen is available at the school which provides cold snacks for the students. Biology is the only subject taught at the school which could cover some health education.

There is no dispensary at the school and all cases of sickness are referred to Machakos Hospital which is about three kilometres away.

Newspapers are provided for the students and school clubs are run to provide recreational activities.

4.4.4. Kyanguli Secondary School

This is a co-educational Harambee Secondary School. It is a double stream school from Form I to Form 4. It has 399 students, of which 276 are boys and 123 are girls. It is about 5 km. away from Machakos Town, along the Machakos/Kangundo road, in Iveti Location.

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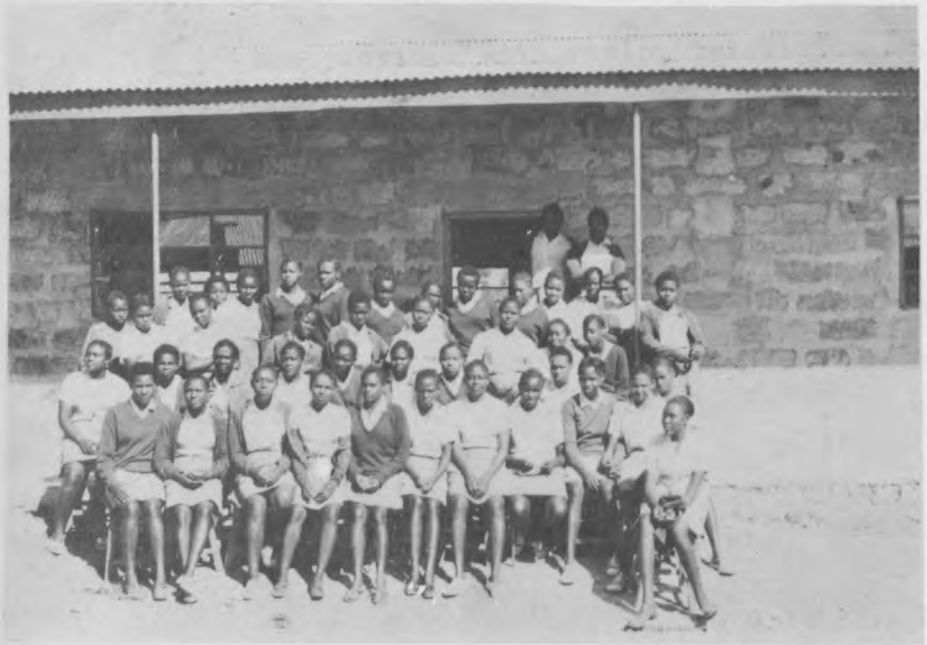


Kyangali Secondary School - some of the students in the sample and the classrooms.

The general appearance of the school is fair and the school has 7 pit latrines available for the students and teachers. All the students are day scholars and there is no canteen available at the school, although a shopping centre is about half a mile from the school.

Health Science is the only health education subject taught at the school alongside other subjects. There is no dispensary run by the school so all cases of sicknesses are referred to Machakos General Hospital, which is about 5 km. away, in Machakos Town. The children are not provided with radio, television or newspapers for recreational purposes.

CHAPTER 5

METHODS

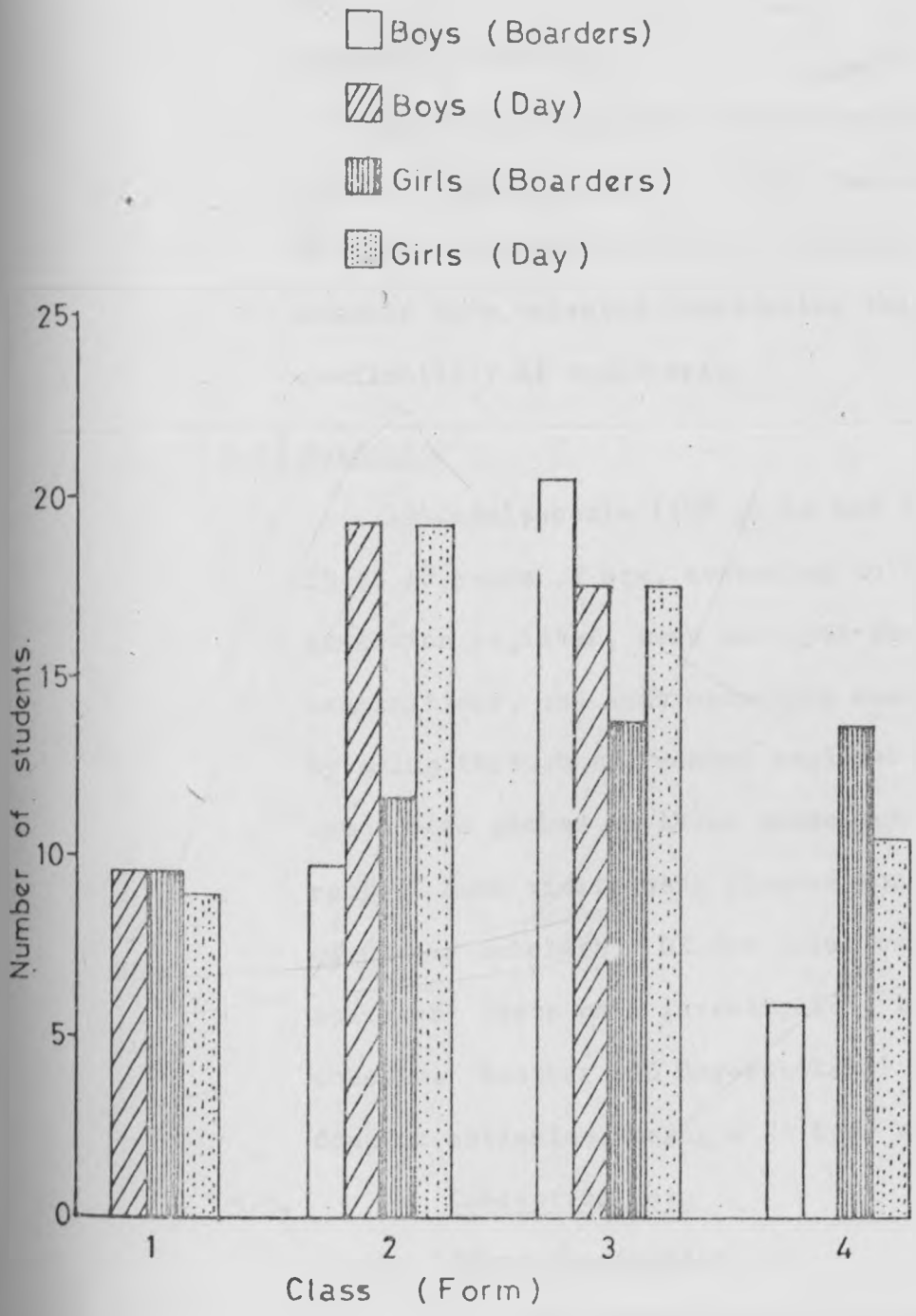
5.1. General

The investigation was carried out between the months March to November 1976 only to be interrupted during the holidays. Physical examinations and interviews had to be done mostly on Saturdays or after school so that there was no interference in the adolescents' classroom work. On only two occasions examinations were done during school time; this was when the clinical tests were being carried out. This had to be done to ensure the full attendance and participation of the students.

The headteachers in all schools visited were very understanding and co-operative and, apart from a few cases of students disappearance and absenteeism, most of those students selected turned up for the questionnaires and examinations and measurements. Empty rooms in the schools, a dispensary were made available for the medical examinations to take place.

A baraza was arranged in the study area by the Chief and attended also by the sub-chief to explain to parents that their homes were to be visited in connection with their adolescents

Fig. I Distribution of children in classes



attending schools.

A week was spent to study the location of some of the secondary schools. With the help of the District Education Officer at Machakos, the above schools were selected considering the means and availability of transport.

5.2. Subjects

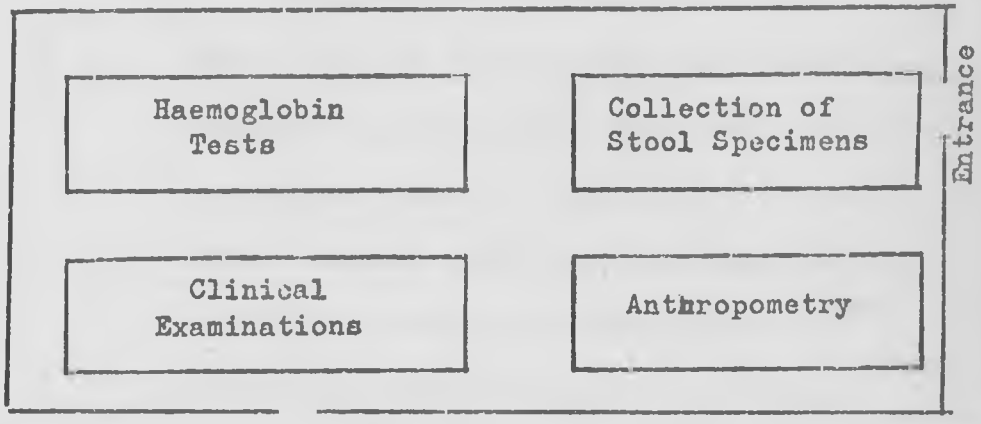
194 adolescents (108 girls and 86 boys) from 15 to 18 years of age, according to the school admission register, were selected for the medical examinations, and anthropometric measurements. By going through the school register all the names were picked of those whose ages fell in that range. Home visits were planned for a random sample of 62 day scholars. Of the total sample 88 boarders' diets were investigated, in the boarding schools. Another 100 day-scholars' diets were done on estimates, using a 24 hour recall method.

5.3. Collecting Data

5.3.1. First Examination

The examination of the school children consisted of a systematic search for nutritional deficiency signs, a series of body measurements, and an analysis of blood sample for haemoglobin.

Fig. 2 'Line of Flow' General Order of the First Examination in each school.



As the students entered the examination room, they had to place stool containers (given to them the day before), with the stool in a box at the entrance. Then they proceeded for anthropometric measurements; clinical examination (done by a medical doctor) and finally a blood sample from a finger-prick was taken and the haemoglobin concentration determined (by a qualified technician). No questionnaires were filled on that day.

5.3.1.1. Deficiency signs were looked for by a medical doctor on the basis of a check-list taken from Jelliffe (1966). See Appendix I. The majority of the deficiency signs could be indicated by a plus (+) or a minus (-) mark. (Those found to be anaemic were given iron tablets).

5.3.1.2. Anthropometry

Anthropometry was limited to a number of body measurements that make it possible to distinguish some levels of poor nutritional status. According to Jelliffe (1966) simple, quick and easy measurements which will produce maximum information concerning the nutritional status are necessary.

5.3.1.2.1. Weight

A bathroom scale was used in the taking of the body measurement. On one occasion a school lever balance Avery type 3306 ABW was used in taking the weights. This scale was checked later against the bathroom scale, and the difference in the weights rectified. The students had their shoes and socks and cardigans removed. Girls had a skirt and blouse on the boys were weighed in their shorts and nylon shirts.

5.3.1.2.2. Height

In every school height was taken with a subject standing straight against a straight wall. The straightness of the wall was checked by using

a block of wood (Latham, M.C. 1965). A tape measure was fixed on the wall. All subjects were asked to remove their shoes, and standing straight against the wall on a flat floor and feet parallel. The head held comfortably and arms hanging at the sides in a natural manner. (Jelliffe, 1966). A wooden block lowered gently, crushing the hair and making contact with the top of the head. The height measurement was thus taken.

5.3.1.2.3. Arm Circumference

Arm circumference was measured with a flexible tape measure which was placed gently but firmly at the left side of the body halfway between the acromial process of the scapula and olecranon process of the ulna. (See Fig. 3).

5.3.1.2.4. Triceps - Skinfold

Triceps skinfold thickness was measured with a Harpenden skinfold caliper over the m. triceps at the same level as the arm circumference (see fig. 4).

5.3.1.3. Blood Tests

Blood samples were collected to determine haemoglobin content of the

Fig. 3

Assessing midpoint of upper arm (halfway between the acromial process of the scapula and the olecranon process of the ulna

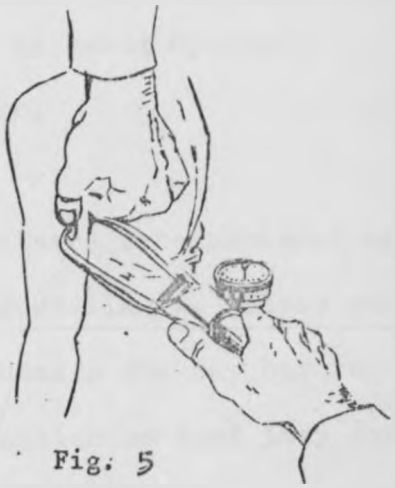


Fig. 5

Measurement of triceps skin-fold with harpenden calipers

Fig. 4

Measurement of mid-upper arm circumference

Figures taken from Jelliffe 1966

adolescents. The blood was collected from a finger prick. Haemoglobin estimation was done by using Spencer Haemoglobinometer.

5.3.1.4. Laboratory

Stool containers were numbered and preserved with formalin 4%. These were given to the students the day before the first examination so that they could be brought back with stool.

The stool was taken to Machakos Laboratory where the Ritchie Technique was used in finding out the presence of intestinal parasites.

Ritchie Technique (Ridley Modification)

This method is used for protozoa and all helminth eggs.

(a) Emulsify with pestle and mortar 1 to 2 grams of faeces in 10 ml. 10% formal saline.

(b) Strain through 60 mesh sieve through a small funnel into a centrifuge tube.

(c) Add 3 ml. of ether cork and shake vigorously for 1 minute.

(d) Centrifuge, regulating the acceleration so that 2,000 r.p.m. is attained in 2 minutes then switch off and allow to come to rest.

(e) Loosen fatty debris at the junction of the liquids with a swab stick.

(f) Pour away the whole of the supernatant together with the debris.

(g) Mix the small deposit with the remaining drop of fluid.

(h) Extract drop with pipette, place on slide and cover with a No. 1 cover glass.

5.3.2. Second Examination

The second examination was done also by a medical doctor to determine the stages of development of the reproductive system. Tanner (1962) has put all ratings for genital development and pubic hair on a scale from 1 to 5. In this study only the boys were examined and were rated in these 5 stages of development. Thus this examination was carried on in only two schools, namely Mumbuni High School and Kangundo High School. The girls were not examined, but were rated as to whether they had

reached their menarche or not, through a questionnaire (see Appendix I).

According to Tanner the rates of development for both genital and pubic hair are as follows:

Stage 1: Pre-adolescent.

Testes, scrotum and penis are of about the same size and proportion as in early childhood. No pubic hair.

Stage 2: Enlargement of scrotum and of testes. The skin of the scrotum reddens (in those with light coloured skins) and changes in texture. Little or no enlargement of penis at this stage with sparse growth of hair, appearing chiefly at the base of the penis.

Stage 3: Enlargement of penis, which occurs at first mainly in length. Further growth of testes and scrotum. Considerably coarser and more curled pubic hair spreading sparsely over the junction of the pubes.

Stage 4: Increased size of penis with growth in breadth and development of glans. Further enlargement of testes and scrotum; increased darkening of scrotal skin (in those with light colour). Pubic hair now resembles adult type but the area covered by it is still considerably

smaller than in the adult. No spread to the medial surface of the thighs. Usually appearance of axillary hair although there are a few exceptions. Facial hair begins to grow, especially at the corners of the upper lip. This hair eventually spreads to complete the moustache. First appearance of chest and abdominal hair. Stage 5: Genitalia adult size and shape. No further enlargement takes place after stage 5 is reached it seems on the contrary, that the penis size decreases slightly from the immediately post adolescent peak. The pubic hair is of adult in quantity, type and distribution. Facial hair also appears on the upper part of the cheeks and in the midline just below the lower lip, finally along the sides and lower boarder of the chin.

5.4. Questionnaires

Several questionnaire forms were used (see Appendices).

5.4.1. Onset of Menstruation

In order to find out whether the girls in the sample had had menarche, the following questions were asked (see also appendix 2):

1. Do you have your menstruation period?

Yes ☐ No ☐

2. If yes, when did you have the first period?

1970 1971 1972 1973

1974 1975 1976

By asking these questions it was possible to see how many girls were post-adolescent and how many girls were pre-adolescent. In addition it was easy to find out the approximate ages when they had their menarche, thus be able to find average age of menarche for Machakos Girls.

5.4.2. Questionnaire 3 (see also Appendix 3)

In order to find out the nutritional knowledge of the adolescent, general nutrition questions were set for the students in the sample.

In order to find whether the students knew the nutritive value of foods commonly used in their area, 3 questions were asked (1, 2, 3).

In order to find out whether the students knew about malnutrition and the causes of

deficiency diseases common in their area 3 questions were asked (4, 5 and 6), referring to anaemia, kwashiorkor and iodine deficiency.

The last set of questions were asked in order to find out whether the students knew the nutritional needs for people and special vulnerable groups of people (Questions 7 - 10).

5.5. Food Intake or Dietary Intake

In the two boarding schools, Machakos Girls High School and Kangundo High School, the weights and measures of the raw foods per day were obtained from the school's catcress. In both the two schools the diet was the same each day of the week. The same quantities of food were used in each school everyday. Machakos Girls High School however served rice once a week on Sunday evening instead of Njenga (Pounded maize), and an egg was added for braakfast on Sundays. In order to confirm the weights one of the days' weights and measures were checked in each school while the cateress was doing it. Since the fruits were given twice per week, the 7 days' quantity was obtained for the whole

school. The total number of the students in the school was obtained together with the total number of cooks who share the meals with them. The quantities for each student were then calculated from these figures. The methods and length of cooking were not taken into consideration. In addition, each student was asked to write down any extra snacks taken at odd hours in that particular week. This was done in order to find out if any extra nutrients are obtained apart from the school meals, and to find the snack pattern of these students.

In the two day schools, information on food intake was collected by means of 24 hours' dietary recall method which is one of the more accurate procedures for short term analysis, provided that a sufficient number of persons be interviewed. (Marr, J.W. 1971, Young et al 1960). The adolescents being old enough the information obtained is hoped to be reliable. Plates and mugs were used to ge an estimated quantity.

5.6. Home Visiting

Two assistants coming from the area who could speak Kikamba well, were used in home visiting. A week was used to go over the questionnaire on

socio-economic data and questionnaire for mothers (see appendix 4 & 5) and visiting three homes together. Emphasis was put on the kind of information expected for each questionnaire, and the kind of observation to be done during home visiting. Two sets of questionnaires were used to obtain information on standard of living and one on nutritional knowledge of the mother. 62 homes of the day students were visited.

As mothers filled in the questionnaire on standard of living - observations were made on the condition and type of homes and furniture, presence of a latrine and usage, storage facilities, number of rooms in use and whether kitchen was separate from the living room or not.

In addition to the above, information on food grown by the family and food purchased by the family was obtained. In accordance with Jelliffe, the following groups of foods were distinguished: (Jelliffe 1968)

- cereals and starchy foods
- legumes
- vegetables
- animal products.

CHAPTER 6

RESULTS

The results will be presented in various parts:-

Part 1 6.1. The First Examination

- 6.1.1. Selection of the Subjects
- 6.1.2. Clinical signs
- 6.1.3. Anthropometric findings - means and standard deviations
- 6.1.4. Weight gain
- 6.1.5. Anthropometric measures according to the percentage of the standard
- 6.1.6. Hb Levels
- 6.1.7. Stool results
- 6.1.8. Conclusion summing up the above

Part II 6.2. Second Examination

- 6.2.1. Developmental stages (sex maturity of the boys
- 6.2.2. Clinical signs in developmental stages
- 6.2.3. Anthropometry - mean values and standard deviations
- 6.2.4. Anthropometry - those below the standard, in their developmental ages
- 6.2.5. Hb Levels

6.2.6. Conclusion summing up the above

Part III 6.3. Questionnaires

6.3.1. Onset of menstruation (Appendix 1)

6.3.2. Knowledge of nutrition of the students (Appendix 3)

6.3.3. Knowledge of nutrition of the mothers (Appendix 4)

Part IV 6.4. Food Consumption

6.4.1. Food Availability

6.4.2. Food Purchase

6.4.3. Food pattern and menus for boarders

6.4.4. Food pattern and menus for day students

6.4.5. Nutritive value and adequacy of the diets

Part V 6.5. Home Visiting

6.5.1. Education of the Parents

6.5.2. Occupation of the household head

6.5.3. Hygienic Practices

6.5.4. Type of Housing

6.1. The First Examination at the School

A morning or an afternoon was selected for the medical examination of the students in each of the schools.

58 girls were examined at Kyanguli Secondary School.

50 girls were examined at Machakos Girls School.

48 boys were examined at Mumbuni High School and 38 boys were examined at Kangundo High School.

6.1.1. The Subjects

Five weeks were devoted to the examining of 194 students of the four schools, the examinations being done at the doctor's convenience. Table 1 shows the numbers of children selected, excluded and remaining.

Table 1: Numbers of Children Selected, Excluded, and remaining according to Schools and Sex.

Category	Boarders		Day Scholars		Total
	Kangundo Boys	Machakos Girls	Mumbuni Boys	Kyanguli Girls	
Selected	54	60	60	62	236
Excluded	16	10	12	4	42
Remaining	38	50	48	58	194

Data on 42 students were unusable: Some were constantly absent in attending the medical examination and in filling the questionnaires. Others had not returned from home due to lack of school fees as was found at Kangundo High School. One of the girls at Kyanguli Secondary School later left school because she was pregnant, thus she was dropped from the sample. On the questionnaire to girls to find whether they had had their menarche, one girl from Machakos Girls High School (15 years), and one girl from Kyanguli (16 years) had not had their menarche, so these two were also dropped from the sample. Thus data on 194 pupils i.e. 82.2% of the number selected was subjected to further analysis. The tests used in the study are the t-test and the Critical Ratio Test.

6.1.2. Clinical Signs

Table 2: Prevalence of deficiency signs for boys and girls.

Deficiency Signs		Girls N=108		Boys N =86	
		No.	%	No.	%
Conjuncital Wrinkling		4	3.7	7	8.1
Bitot's Spots		1	0.0	1	1.2
Corneal Scarring		1	0.0	0	0.0
*Pallor of Conjunctivae		10	9.3	2	2.3
" " Tongue		9	8.3	2	2.3
*Pallor of nail bed		7	6.5	0	0.0
Angular Stomatitis		3	2.8	1	1.2
Cheilosis of Lips		33	30.6	34	39.5
Spongy/bleeding gums		0	0.0	1	1.2
*Goitre (grade 1)		24	22.2	1	1.2
Other signs of nutritional significance					
*Number of decayed teeth	1	6	5.6	13	15.1
	2	1	0.0	5	5.8
Number of missing teeth	1	8	7.4	4	4.7
	2	2	1.9	0	0.0
	3	2	1.9	1	1.2
Number of filled teeth	1	1	0.0	2	2.3
	2	1	0.0	0	0.0
Mottling of teeth		14	13.0	9	10.5
*Obesity (grade 1)		22	20.4	1	1.2

* = Difference significant between boys and girls at 5% level according to Critical Ratio Test (C.R.T.)

Most common deficiency sign is cheilosis of lips with 33(30.6%) of the girls and 34(39.5%) of the boys.

Table 2.1. Prevalence of deficiency signs - Day Students versus Boarders

Deficiency Signs	Girls				Boys			
	Day n = 58		Boarders n=50		Day n= 48		Boarders n=38	
	No.	%	No.	%	No.	%	No.	%
Conjunctival Wrinkling	1	1.7	3	6.0	3	6.0	4	10.5
Corneal Scarring	1	1.7	0	0.0	0	0.0	0	0.0
Bitot's Spots	0	0.0	1	2.0	0	0.0	1	2.6
Pallor of Conjunctivae	3	5.2	7	14.0	1	2.1	1	2.6
" " Tongue	1	1.7	8	16.0	1	2.1	1	2.6
" " nail bed	0	0.0	7	14.0	0	0.0	0	0.0
Angular Stomatitis	0	0.0	3	6.0	1	2.1	0	0.0
Cheilosis of lips	16	27.6	17	34.0	17	35.4	17	44.7
Spongy/bleeding gums	0	0.0	0	0.0	1	2.1	0	0.0
Goitre (grade 1)	11	19.0	13	26.0	1	2.1	0	0.0

Other signs of nutritional significance

		Girls				Boys			
		Day n = 58		Boarders n = 50		Day n = 48		Boarders n=38	
		No.	%	No.	%	No.	%	No.	%
No. of decayed teeth	1	3	5.2	3	6.0	7	4.2	6	15.0
	2	0	0.0	1	2.0	5	14.5	0	0.0
No. of missing teeth	1	5	8.6	3	6.0	2	4.2	2	5.3
	2	0	0.0	2	4.0	0	0.0	0	0.0
	3	0	0.0	2	4.0	1	2.1	0	0.0
No. of filled teeth	1	0	0.0	1	2.0	2	4.2	0	0.0
	2	0	0.0	1	2.0	0	0.0	0	0.0
Mottling of teeth		12	20.7	2	4.0	4	10.4	4	10.5
Obesity (grade 1)		17	29.3	5	10.0	1	2.1	0	0.0

There was a significant difference at 5% level between the boarding girls and the day girls in mottling of teeth, obesity and pallor of nail bed (C.R.T.). There is no significant difference amongst the girls in any other deificiency sign. Amongst the day boys and the boarding boys, it is found that there is a significant difference in number of decayed teeth. There is no significant difference in any other sign examined.

N.B. Goitre grade 1 in this context is according to Jelliffe (1966) namely: Persons with palpable goitres. The thyroid is probably enlarged more than four to five times, although not visible with the head in the normal condition. Most cases will be readily visible with the head thrown back and the neck fully extended.

6.1.3. Anthropometry

As the children had no birth certificates, the ages given on admission to the school were confirmed, by asking each child in the sample his/her age. Most of the ages given by the children were the same as the ones appearing in the school's register. Those who were found to be older or younger were dropped from the sample.

Tables 3, 3.1, 3.2, 3.3, 3.4. show the means and standard deviations of all the anthropometric measures as well as the standard deviations of all the students in ages and various locations.

Table 3 : Mean values for anthropometric measurements for boys and girls in ages

Age (Years)	Weights (kg.)				Heights (cm)				Arm Circumference				Skinfold Thickness (mm)			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
15	41.6 (12)	7.9	51.3 (9)	6.5	154.1 (12)	9.4	159.6 (10)	6.7	21.4 (12)	2.3	24 (10)	1.7	7.8 (11)	3.1	17.4 (10)	4.6
16	47.2 (13)	6.0	50.7 (35)	5.1	160.4 (13)	6.8	156.6 (35)	5.8	22.6 (13)	1.6	24.3 (35)	1.6	7.4 (13)	1.6	17.4 (35)	4.7
17	(33)		(27)		(33)		(28)		(33)		(28)		(33)		(28)	
18	52.8 (28)	5.2	53.6 (32)	5.7	166.8 (28)	5.6	158.7 (33)	6.0	23.7 (28)	1.8	25.3 (33)	2.0	7.8 (28)	2.4	18.8 (28)	5.6

Between ( ) number of observations

In the table above, there is found to be a significant difference between the mean weight of boys and girls at age 15 ("t" = 2.99) mean weights of ages 16, 17 and 18.

A significant difference is found in the mean heights of boys and girls at ages 17 years ("t"=3.43) and 18 years ("t" = 5.4). There is no significant difference in mean heights at ages 15 and 16 years.

There is a significant difference in mean arm circumference between boys and girls in all ages. ("t" = 3.27), at age 17 years ("t" = 3.82) at 18 years ("t" = 3.47).

A significant difference in mean triceps skinfold thickness between girls and boys in all ages. At age 15 ("t" = 5.66), at 16 ("t" = 7.46), at 17 ("t" = 11.21), at 18 ("t" = 9.65).

Table 3.1. Mean values for weights (kg) for boarders and non-boarders according to ages.

Ages (years)	Girls				Boys			
	Boarders		Day		Boarders		Day	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
15	52.1 (8)	6.5	50 (3)	9.5	36 (1)	-	42.1 (11)	8.1
16	48.6 (11)	7.5	51.2 (24)	4.2	47 (4)	5.7	47.2 (9)	6.5
17	52.8 (14)	4.1	53 (13)	7.5	49.9 (22)	3.9	51.6 (12)	6.5
18	54.4 (14)	5.5	52.9 (18)	5.9	51.8 (11)	4.6	53.3 (16)	5.8

Between ( ) number of observations

Using the t-test there is no significant difference in mean weights between boarders and non-boarders in both sexes in all ages.

Table 3.2 Mean values for heights (cm) for boarders and non-boarders according to ages

Ages (years)	Girls				Boys			
	Boarders		Day		Boarders		Day	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
15	159.7 (9)	7.1	162.4 (3)	3.4	150 (1)	-	154.5 (11)	9.7
16	154.5 (11)	5.4 (24)	157.1 (24)	5.6	162 (4)	4.7	159.6 (9)	7.8
17	158.8 (15)	5.0	157.4 (13)	6.8	163.6 (22)	4.0	163.7 (12)	6.4
18	161.7 (15)	7.3	156.1 (18)	5.3	165.7 (11)	6.1	167.4 (16)	2.8

Between ( ) number of observations

Significant different is found in mean heights between the boarders and non-boarders girls at age 18 ("t" = 2.53). There is no significant difference in mean heights of boarders and non-boarders in other ages.

Table 3.3 Mean values for arm circumference (cm) for boarders and non-boarders according to ages.

Ages (years)	Girls				Boys			
	Boarders		Day		Boarders		Day	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
15	24.4 (9)	1.4	22.8 (3)	3.1	18.5 (1)	-	21.6 (11)	2.2
16	24.2 (11)	2.2	2 4.2 (24)	1.4	21.8 (4)	0.9	22.9 (9)	1.8
17	24.9 (15)	1.1	25.0 (13)	2.6	23.7 (22)	1.7	23.8 (12)	2.2
18	25.5 (15)	1.9	25.2 (18)	2.2	23.8 (11)	1.5	23.6 (16)	2.1

Between ( ) number of observations

There is no significant difference in mean arm circumference between the boarders and non-boarders of both sexes at all ages, using the t-test.

Table 3.4 Mean values for skinfold thickness (mm) for boarders and non-boarders according to ages

Ages (Years)	Girls				Boys			
	Boarders		Day		Boarders		Day	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
15	18.2 (9)	4.3	17 (3)	8.1	8.2 (1)	-	7.7 (10)	1.9
16	17.8 (11)	6.1	16.6 (24)	3.7	6.7 (4)	1.7	7.8 (9)	1.61
17	16.2 (15)	2.4	22.1 (13)	6.2	7.9 (22)	2.7	5.1 (12)	7.0
18	17.1 (15)	4.7	20.3 (18)	6.1	8.2 (11)	2.9	7.7 (15)	2.0

Between ( ) number of observations

There is a significant difference in mean skinfold thickness between the boarders and non-boarders girls at age 17 ("t" = 3.43). There is no significant difference in mean skinfold thickness between boarders and non-boarders in both sexes at others ages (15, 16, 18).

Tables 3.2, 3.3. and 3.4 show mean value and standard deviations for height, arm circumference and skinfold thickness for boarders and non-boarders according to their ages.

The following is observed:

(a) Significant difference is found in mean heights between the boarders and non-boarders girls at age 18 ("t" = 2.53). There is no significant difference in mean heights of boarders and non-boarders in other ages.

(b) There is no significant difference in mean arm circumference between the boarders and non-boarders of both sexes at all ages, using the t-test.

(c) There is a significant difference in mean skinfold thickness between the boarders and non-boarding girls at the age 17 ("t" = 3.43). There is no significant difference in mean skinfold thickness between boarders and non-boarders in both sexes at other ages (15, 16, 18).

6.2.4. Weight gain

To find whether there is a weight gain in boarders at the end of term (when they have been fed at school) and at the beginning of the term (when they have been fed at home) two weight measurements were taken at the end and beginning of a aterm. The table below showsthe results.

Table 4 Mean Weight and Standard Deviations of boarders at the beginning and end of term

Category	Number	First weight (kg)		Second weight (kg)	
		Mean	S.D.	Mean	S.D.
Boarding girls	42	52.2	6.3	52.7	6.3
Boarding Boys	38	50.0	4.7	49.8	4.7

Using the paired t-test there is no significant difference in first and second weight of boarding girls and of boarding boys. That is to say that there is no significant weight gain in boarding school children when they are fed at home or when they are fed at school.

6.1.3. Anthropometry Assessment according to the standards of Reference

As there are no local standards of references for anthropometric measurements, the assessment of these is obtained from various sources. The standards for heights and weights for ages 15, 16, 17 and 18 were obtained from Nelson, Vaugh, Mckay (1966). The 50th percentile was taken as the standard, and other standards (90%, 80%, 70%, 60% were calculated from this. The weight for height standards are Harvard Standards (Jelliffe, 1966). Triceps skinfold standard are given by Jelliffe (1966); for ages 16, 17, and 18, adult standards were used. Arm circumference standards are from Jelliffe (1966; for age 18, adult standard were used.

Table 5 Weight according to % of Standard of the adolescent boys and girls according to age

Age (years)	No.	<60%	60-70%	71-80%	81-90%	91-100%	101-109%	110%>
Boys								
15	12	2	2	2	4	2	0	0
16	13	0	3	3	5	1	1	0
17	34	0	3	10	18	2	1	0
18	27	0	1	10	10	6	0	0
Total	86	2	9	25	37	11	2	0
Girls								
15	11	0	0	0	4	2	2	3
16	35	0	0	2	8	15	7	3
17	27	0	0	1	4	13	7	2
18	32	0	0	1	5	13	8	5
Total	105	0	0	4	21	43	24	13

At age 15; 2(16.7%) boys are underweight (< 60%); 4(33.3%) boys are mildly underweight (60-80%); 6(50%) boys and 8(72.7%) girls are of normal weight (81-109%) and 3(27.3%) girls are overweight.

At age 16; 6(46.2%) boys and 2(5.7%) girls are mildly underweight (60.80%); 7(53.8%) boys and 30(85.7%) girls are of normal weight (80-109%); and 3(8.6%) girls are overweight.

At age 17; 13(38.2%) boys and 1(3.7%) girls are mildly underweight (60-80%); 21(61.8%) boys and 24(88.9%) girls are of normal weight; 2(7.4% girls are overweight.

At age 18; 11(40.7%) boys and 1(3.1%) girls are mildly underweight (60-80%); 16(59.3%) boys 26(81.3%) girls are of normal weight; 5(15.6%) girls are overweight.

Table 6 Weight according to % of standard of adolescent boys according to age and location.

Age (years)	No.	<60%	60-70%	71-80%	81-90%	91-100%	101-110%	110%
Boarders								
15	1	0	1	0	0	0	0	0
16	4	0	1	1	1	1	0	0
17	22	0	1	10	10	1	0	0
18	11	0	0	6	3	2	0	0
Total	38	0	3	17	14	4	0	0
Non Boarders								
15	11	2	1	2	4	2	0	0
16	9	0	2	2	4	0	1	0
17	13	0	2	0	8	1	1	0
18	16	0	1	4	7	4	0	0
Total	48	2	6	8	23	7	2	0

2(4.2%) of the day boys are underweight, their weight being below 60% of the Standard. Those who are slightly under weight (60-80% of Standard) are 20(52.6%) of the boarders and 14(29.2%) of the day boys. 18(47.4%) of the boarders and 32 (66.7%) are of a normal weight (80-110% of the Standard).

Table 7 Weight according to % of Standard and adolescent girls according to age and location

Age (years)	No.	<60%	60-70%	71-80%	81-90%	91-100%	101-109%	110% >
Boarders								
15	8	0	0	0	2	2	2	2
16	11	0	0	2	5	2	0	2
17	14	0	0	0	2	7	4	1
18	14	0	0	0	3	3	6	2
Total	47	0	0	2	12	14	12	7
Non Boarders								
15	3	0	0	0	2	0	0	1
16	24	0	0	0	3	13	7	1
17	13	0	0	1	2	6	3	1
18	18	0	0	1	2	10	2	3
Total	58	0	0	2	9	29	12	6

Among the girls none is below 60%. Two(4.3%) of the boarders and 2(3.4%) of the non-boarders are between 60-80% (slightly underweight). Those who have a normal weight 80-109% are 38 (80.99%) of the boarders and 50 (86.2%) of the day students. 7(14.9%) of the boarders and 6(10.3%) of the day students are overweight.

Table 8 Height according to % of Standard of adolescent boys and girls according to age.

Age (years)	No.	80-90%	91-100%	101-109%	110% >
Boys					
15	12	4	8	0	0
16	13	1	11	1	0
17	34	4	30	0	0
18	27	1	23	3	0
Total	86	10	72	4	0
Girls					
15	12	0	6	6	0
16	35	1	29	5	0
17	28	1	22	5	0
18	33	2	23	8	0
Total	108	4	80	24	0

Using WHO Standards (1976)

At age 15; 4(33.3%) boys are below the Standard height (90%); 8(66.7%) boys and all girls are of normal height.

At age 16; 1(7.7%) boys and 1(2.9%) girls are below Standard height (90%); 12(92.3%) and 34(97.1%) girls are of normal height.

At age 17; 4(11.8%) boys and 1(3.6%) girls are below Standard height (90%); 30(88.2%) boys and 27(96.4%) girls are of normal height.

At age 18; 1(3.7%) boys and 2(6.1%) girls are below Standard height (90%); 26(96.3%) boys and 31(93.9%) girls are of normal height.

Table 9 Height according to % of Standard of adolescent boys according to age and location

Age (years)	No.	<60%	60-70%	71-80%	81-90%	91-100%	101-110%	110% >
Boarders								
15	1	0	0	0	1	0	0	0
16	4	0	0	0	0	4	0	0
17	22	0	0	0	2	20	0	0
18	11	0	0	0	1	8	2	0
Total	38	0	0	0	4	32	2	0
Non Boarders								
15	11	0	0	0	3	8		
16	9	0	0	0	1	7	1	0
17	12	0	0	0	2	10	0	0
18	16	0	0	0	0	15	1	0

Taking 90% of the Standard being the normal height (WHO 1976) we find 4(10.5%) of the boarders and 6(12.5%) of the day students to be slightly below the Standard height. 34(89.5%) of the boarders and 42 (87.5%) of the day boys of the normal height.

Table 10 Height according to % of Standard of adolescent girls according to age and location.

Age (years)	No.	80-90%	91-100%	101-110%
Boarders				
15	9	0	5	4
16	11	0	10	1
17	15	0	12	3
18	15	0	9	6
Total	50	0	36	14
Non Boarders				
15	3	0	1	2
16	24	1	19	4
17	13	1	10	2
18	18	2	14	2
Total	58	4	44	10

Of the girls 4 (6.9%) day girls are slightly below the Standard height. 50 (100%) of the boarders and 54 (93.1%) of the day girls are of a normal height.

Table 11 Weight for height according to % of the Standard of adolescent boys and girls according to age and location

Age (years)	No.	70-80%	81-90%	91-100%	101-110%	110% >
Boys						
15	12	0	3	5	3	1
16	13	0	1	6	4	2
17	34	0	5	15	8	6
18	27	1	5	11	7	3
Total	86	1	14	37	22	12
Girls						
15	11	1	2	3	3	2
16	35	0	2	6	8	19
17	27	0	3	3	6	15
18	32	0	2	3	11	16
Total	105	1	9	13	28	52

At age 15; 1(1.2%) girls is mildly below standard (70-80%); 11(91.7%) boys and 8(72.7%) girls are of normal Standard (81-109%); 1(8.3%) boy and 2(18.2%) girls are above Standard.

At age 16% 11(84.6%) boys and 16(45.7%) girls are of normal Standard (80-109%); 2(15.4%) and 19(54.3%) girls are above the Standard (110% >).

At age 17; 28(82.4%) boys and 12(44.4%) girls are of normal Standard; 6(17.6%) boys and 15(55.6%) girls are above the Standard (110%).

At age 18% 1(3.7%) boy is mildly below Standard (70-80%); 23(85.2%) boys and 16(50%) girls are of normal Standard (80-109%) and 3(11.1%) boys and 16(50%) girls are above the Standard.

Table 12 Weight for Height according to % of Standard of adolescent boys accoring to age and location

Age (yoars)	No.	70-80%	81-90%	91-100%	101-110%	> 110%
Boarders						
15	1	0	0	1	0	0
16	4	0	1	2	1	0
17	22	0	2	13	4	3
18	11	0	3	4	3	1
Total	38	0	6	20	8	4
Non Boarders						
15	11	0	3	4	3	1
16	9	0	0	4	3	2
17	12	0	3	2	4	3
18	16	1	2	7	4	2
Total	48	1	8	17	14	8

1(2.1%) of the day boys is below the Standard ($\angle$80%). 34(89.5%) of the boarders and 39(81.3%) of the day boys are of the Standard weight for height. 4(10.5%) of the boarders and 8(16.7%) of the day boys are above the Standard.

Table 13 Weight for Height according to % of Standard of adolescent girls according age and location

Age (years)	No.	70-80%	81-90%	91-100%	101-110%	$\wedge$ 110%
Boarders						
15	8	0	2	2	2	2
16	11	0	0	2	4	5
17	14	0	1	2	2	9
18	14	0	2	2	4	6
Total	47	0	5	6	12	22
Non Boarders						
15	3	1	0	0	1	0
16	24	0	2	4	4	4
17	13	0	2	1	4	6
18	18	0	0	1	7	10
Total	58	1	4	7	16	30

1(1.7%) of the day girls is below the Standard. 23(48.9%) of the boarders and 27(46.6% of the day girls are of the normal Standard. 22(46.8%) of the boarders and 39(51.7%) of the day girls are above the normal Standard for weight for height.

Table 14 Arm circumference according to % of the Standard of adolescent boys and girls according to ages.

Age (years)	No.	60-70%	71-80%	81-90%	91-100%	101-110%	> 110%
Boys							
15	12	0	4	3	5	0	0
16	13	0	2	6	5	0	0
17	34	0	4	17	12	1	0
18	27	2	13	10	2	0	0
Total	86	2	23	36	24	1	0
Girls							
15	12	0	0	2	5	5	0
16	35	0	0	3	20	10	2
17	28	0	0	2	12	11	3
18	33	0	3	14	15	1	0
Total	108	0	3	21	52	27	5

At age 15; 4(33.3%) boys are below the Standard (70-80%) 8(66.7%) boys and all the girls (100%) are of normal Standard.

At age 16; 2(15.4%) boys are below the Standard (70-80%); 11(84.6%) boys and 33(94.3%) girls are of normal Standard (81-90%); 2(5.7%) girls are above the arm circumference Standard.

At age 17; 4(11.8%) boys are below Standard (70-80%); 30(88.2%) boys and 25(89.3%) girls are of normal Standard.

At age 18; (55.6%) boys and 3(9.1%) girls are below the Standard (60-80%); 12(44.4%) boys and 30(90.9%) girls are of normal Standard.

Table 15 Arm circumference according to % of Standard of adolescent boys according to age and location

Age (years)	No.	60-70%	71-80%	81-90%	91-100%	101-110%	110% >
Boarders							
15	1	0	1	0	0	0	0
16	4	0	1	3	0	0	0
17	22	0	3	10	9	0	0
18	11	1	3	7	0	0	0
Total	38	1	8	20	9	0	0
Non Boarders							
15	11	0	3	3	5	0	0
16	9	0	1	3	5	0	0
17	12	0	1	7	3	1	0
18	16	1	10	3	2	0	0
Total	48	1	15	16	15	1	0

9(23.7%) boarding boys and 16(33.3%) day boys are below normal Standard for arm circumference (60-80%); 29(76.3%) boarding boys and 32(66.7%) day boys are of Standard arm circumference.

Table 16 Arm circumference according to % of Standard of adolescent boys according to age and location

Age (years)	No.	60-70%	71-80%	81-90%	91-100%	101-110%	> 110%
Boarders							
15	1	0	1	0	0	0	0
16	4	0	1	3	0	0	0
17	22	0	3	10	9	0	0
18	11	1	3	7	0	0	0
Total	38	1	8	20	9	0	0
Non Boarders							
15	11	0	3	3	5	0	0
16	9	0	1	3	5	0	0
17	12	0	1	7	3	1	0
18	16	0	10	3	2	0	0
Total	48	1	15	16	15	1	0

9(23.7%) boarding boys and 16(33.3%) day boys are below normal Standard for arm circumference (60-80%); 29(76.3%) boarding boys and 32 (66.7%) day boys are of Standard arm circumference.

Table 17 Arm circumference according to % of Standard of adolescent girls according to age and location

Age (years)	No.	70-80%	81-90%	91-100%	101-110%	110% >
Boarders						
15	9	0	0	5	4	0
16	11	0	2	5	3	1
17	15	0	0	8	7	0
18	15	2	5	7	1	0
Total	50	2	7	27	15	1
Non Boarders						
15	3	0	2	0	1	0
16	24	0	1	15	7	1
17	13	0	2	4	4	3
18	18	1	9	8	0	0
Total	58	1	14	27	12	4

2(4%) boarding girls and 1(1.7%) day girl are below the Standard (70-80%); 47(94%) boarding girls 53(91.4%) day girls are of normal Standard; 1(2%) boarding girl and 4(6.9%) day girls are above the Standard for arm circumference.

Table 18 Skinfold Thickness according to % of the Standard of adolescent boys and girls according to age.

Age (years)	No.	<60	60-70%	71-80%	81-90%	91-100%	101-110%	>110%
Boys								
15	11	0	0	1	1	2	1	6
16	13	7	3	2	1	0	0	0
17	34	21	5	1	2	1	2	2
18	27	15	4	5	1	1	0	1
Total	85	43	12	9	5	4	3	9
Girls								
15	12	0	0	0	0	1	0	11
16	35	0	5	2	6	4	4	14
17	28	0	1	1	4	4	3	15
18	33	1	4	0	4	3	2	19
Total	108	1	10	3	14	12	9	59

At age 15; 1(9.1%) boy is mildly below Standard (70-80%); 4(46.4%) boys and 1 (8.3%) girl are of normal Standard. (80-109%); 6(54.5%) boys and 11(91.7%) girls are above the Standard.

At age 16; 7(53.8%) boys are below 60% Standard; 5(38.5%) boys and 7(20%) girls are slightly below the Standard (60-80%); 1(9.1%) boy and 14(40%) girls are of the normal Standard; 14(40%) girls are above the Standard.

At age 17; 21(61.8%) boys are below 60% of the Standard; 6(17.6%) boys and 2(7.1%) girls are slightly below Standard (60-80%); 5(29.4%) boys and 11(39.3%) girls are of normal Standard; 2(5.9%) boys and 15(53.6%) girls are above the normal Standard.

At age 18; 15(55.6%) boys and 1(3.8%) girls are below 60% Standard; (9(33.3%) boys and 4(12.;%) girls are slightly below Standard (60-80%); 2(7.5%) boys and 9(27.3%) girls are of normal Standard; 1(8.4%) boys and 19(57.6%) girls are above the Standard.

Table 19 Skinfold Thickness according to % of the Standard of adolescent boys according to age and location

Age (years)	No.	<60	60-70%	71-80%	81-90%	91-100%	101-110%	>110%
Boarders								
15	1	0	0	0	0	0	0	1
16	4	3	1	0	0	0	0	0
17	22	12	5	1	1	0	2	1
18	11	5	3	2	0	0	0	1
Total	38	20	4	3	1	0	2	3
Non Boarders								
15	10	0	0	1	1	2	1	5
16	9	4	2	2	1	0	0	0
17	12	9	0	0	1	1	0	1
18	16	10	1	3	1	1	0	0
Total	47	23	3	6	4	4	1	6

20(52.6%) boarding boys and 23(48.9%) day boys are below 60% Standard; 12(31.6%) boarding boys and 9(19.1%) day boys are slightly below the Standard (60-80%); 3(7.9%) boarding boys and 9(19.1%) day boys are of normal Standard; 3(7.9%) boarding boys and 6(12.8%) day boys are above normal.

Table 20 Skinfold Thinkness according to % of the Standard of adolescent girls accoring to age and location

Age (Years)	No.	<60	60-70%	71-80%	81-90%	91-100%	101-110%	110%>
Boarders								
15	9	0	0	0	0	0	0	9
16	11	0	2	0	3	0	1	5
17	15	0	1	1	4	2	2	5
18	15	1	2	0	3	0	1	8
Total	50	1	5	1	10	2	4	27
Non Boarders								
15	3	0	0	0	0	1	0	2
16	24	0	3	2	3	4	3	9
17	13	0	0	0	0	2	1	10
18	18	0	2	0	1	3	1	11
Total	58	0	5	2	4	10	5	32

1(2%) boarding girl is below 60% Standard; 6(12%) boarding girls and 9(12.;%) day girls are slightly below the normal Standard (60-80%); 16(38%) boarding girls and 19(32.8%) day girls are of the normal Standard; 27(54%) boarding girls and 32(55.2%) day girls are above normal in triceps skinfold thickness.

Table 21 Percentages of adolescents below selected anthropometric standards according to location and sex

Category	Weight/Height Wt/Age 80% (%)	Ht/Age 90% (%)	Wt/Ht 80% (%)	Arm Circum/ Age 80% (%)	Skinfold Thickness/ Age 80% (%)
Boarders					
Boys (38)	52.6	10.5	0	23.7	71.1
Girls(50)	4.3	0	0	4.0	14.0
Non-Boarders					
Boys (48)	33.3	12.5	2.1	33.3	68.1
Girls(58)	3.4	6.9	1.7	1.7	12.1

Between ( ) total number of obsdrvations

From the observations above it shows that more boys are found to be underweight than the girls, in both boarders and non-boarders. Whereas weight for height shows very low percentages of malnourished cases, the skinfold measures shows quite a high percentage of malnourished students especially the boys. A higher percentage of boarding boys are underweight compared to the non-boarders.

6.1.6. Biochemistry

Anaemia is a not uncommon finding among the adolescents. There may be several dietary and/or other factors responsible, e.g. deficiency of iron or folates, hookworm, malaria, other infections, genetic factors, etc.

Recently, new international haemoglobin standards have been established (WHO, 1968).

Age in years	Sex	Hb g/100ml
0.5 - 6	Males	11
6 - 11		12
Adult	Males	13
Adult	Females non-pregnant	12
Adult	Females pregnant	11

Using the above table we find that 4(3.9%) girls and 5(4.7%) boys to be anaemic. The difference is not significant.

Mean haemoglobin values are summarised in the following table.

Table 22 Mean Haemoglobin content (in g/100 ml) and standard deviations for boys and girls according to ages

Age (years)	Girls		Boys	
	Mean	S.D.	Mean	S.D.
15	13.8 (10)	0.4	14.4 (12)	1.1
16	14.2 (34)	0.5	14.9 (13)	1.2
17	13.8 (27)	1.6	15.1 (34)	0.8
18	14.1 (31)	1.0	14.9 (27)	0.4

Between ( ) number of observation

At agch age the mean Hb level in boys is higher than in girls. Using the t-test it is noticed that there is a consistent significant difference in Hb levels between boys and girls: at age 15 ("t" = 5.26), at 16 ("t" = 2.8), at 17 ("t" = 4.06), at 18 ("t" = 4).

Mean Hb levels of 58 day girls and 55 boarding girls were 14.4 and 13.6 g/100 ml. respectively. The difference of 0.9 g/100 ml. is statistically significant ("t" = 2.78). The mean Hb levels of 48 day boys and 38 boarding boys were 14.9 and 14.5 g/100 ml. respectively. The difference is not significant.

6.1.7. Laboratory

Stool samples from 153 students were examined for parasite infestation. (21 samples from day boys, 37 from boarding boys, 41 samples from boarding girls and 45 from day girls). 39(25.5%) samples showed ova on microscopic examination.

Table 23 Number of students examined for presence of parasites for each school and number present and percentage

Category	Number Examined	Positive for ova		Negative	
		No.	%	No.	%
Boarding girls	41	17	41.5	24	58.5
Day girls	54	9	16.7	45	83.3
Boarding boys	37	8	21.6	29	78.4
Day boys	21	5	23.8	16	76.2
Total	153	39	25.5	114	74.5

Using the Critical Ratio Test there is a significant difference at 5% level of significance in the presence of parasites between the boarding girls and the day girls but there is no difference between the boarding boys and the day boys.

Table 24 Presence of Parasites and Percentages as observed in girls and boys

Category	Number	Positive for ova on microscope		Negative for ova on microscope	
		No.	%	No.	%
Girls	95	26	27.4	69	72.6
Boys	58	13	22.4	45	77.6

Using the Critical Ratio Test there is a significant difference between girls and boys of ages 15-18 years.

Table 25 Presence of parasites, types and percentages as seen in boarders and non-boarders

Category	No. examined	No. affected		Ascaris		Hookworm		Sch. Mansoni		Trichuris Trichura	
		No.	%	No.	%	No.	%	No.	%	No.	%
Boarding girls	41	17	41.5	0	0	9	22	7	17.1	1	2.4
Day girls	54	9	16.7	2	3.7	0	0	6	11.1	1	1.9
Boarding boys	37	8	21.6	5	13.5	0	0	2	5.4	1	2.7
Day boys	21	5	23.5	0	0	1	4.8	4	19.0	0	0
Total	153	39	25.5	7	4.6	10	6.5	19	12.4	3	2

Schistosomiasis mansoni was the most common parasite found (12.4%) cases. Hookworm was found (6.5%), followed by Ascaris 4.6%. Only 3 (2%) students had Trichuris Trichura.

Table 26 Parasite infection seen together with other conditions in students (15-18 years)

	Hookworm	Ascaris	Sch. Mansoni	Tr. Trichura	Total
Pallor of Conjunctivae	1	-	1	-	2
Palor of tongue	1	-	1	-	2
Pallor of nail bed	1	-	1	-	2
Angular Stomatitis	1	-	-	-	1
Cheilosis of lips	3	2	7	1	13
Spongy/bleeding gums	-	-	1	-	1
Goitre (grade 1)	2	-	2	1	5
Obesity (grade 1)	1	1	2	1	5
Anaemia	1	-	3	-	4
Parasites but no Nutritional sign	4	5	6	1	16

39(25.5%) students had parasites infection, of these 23(59%) showed clinical signs of other deficiencies as well. 16(41%) had just parasite infections alone. 13 cases with parasites

infections had also cheilosis of lips. 4 cases with parasite infection had anaemia as well. 6 cases with parasite infections had pallor. Only 1 case of hookworm was anaemic (Hb 10.7 g/100 ml.) and 3 cases of hookworm had pallor. One case of Schistosomiasis mansoni was seen together with pallor as well as anaemia (Hb 8.5 g/100 ml).

6.1.8. Conclusion

Below is a table showing a summary of the results found to be of significant difference.

Table 27: Summary of significant difference in clinical signs, anthropometry, haemoglobin levels and presence of parasites

Parameter Used	Boys v. Girls	B. Girls v. Day Girls	B. Boys v. D. Boys
Clinical Signs	Decayed teeth	Pallor of Conjunctivae P. of nail bed Goitre Obesity	Pallor of nail bed	Mottling of teeth	Decayed teeth
Height	Age 18 (Higher mean)	Age 17 (Higher mean)	Age 18 (Higher mean)	-	-	-
Weight	Age 15 (Higher mean)	-	-	-	-	-
Arm Circum.	-	Age 15,16, 17 (Higher mean)	-	-	-	-
Skinfold	-	15,16, 17, 18 (Higher mean)	-	Age 17 (Higher mean)	-	-
H.b. level	Ages 15, 16, 17, 18 (Higher mean)	-	-		-	-
Stool	-	-	more +ve cases			

From the table above, as far as the clinical s signs were concerned the girls showed more pallor (sign of anaemia), goitre and obesity and decaying of teeth. Mottling of teeth was more often found in the day girls and day boys and can probably be explained by a higher fluorine content of drinking water in the locality (whereas the boarders mostly come from elsewhere).

Body measurements showed difference in arm circumference and skinfold thickness. As expected girls had a higher mean than the boys in these ages. Others do not show much difference in any particular age group. The standards used for anthropometric measurements reveal that more boys are found to be malnourished than the girls, in both boarders and day scholars. A higher percentage of the boarding boys were underweight compared to the non-boarders.

The Hb levels were higher in the boys than in the girls, however a test revealed that there was no significant difference between the sexes. A higher mean Hb level was observed between the day and boarding girls.

From these observations, it can be seen that there was a slight difference between the boys and the girls, and also a slight difference between the day and boarding girls and the day and the boarding boys and day boys in their nutritional status.

6.2. SECOND EXAMINATION

> "The statement that a boys is 14 is in most contexts hopelessly vague; all depends, morphologically, physiologically and sociologically on whether he is pre-adolescent, mid-adolescent or post adolescent." (Tanner, 1968).

The second examination which was done on the boys only to find out the rate of physical maturity other than chronological age. This was based on the development of the reproductive system as stated by (Tanner, 1962), (Waldo Nelson).

80 boys were examined and the table below shows the findings.

6.2.1. Table 28: Boys grouped in their different stage of development

	Pre-Adolescent	Mid-Adolescent			Post Adolescent
	Stage 0-1	St. 2	St.3	St.4	Stage 5
Number	4	3	13	25	35
%	5	3.75	16.35	31.25	43.75

Table 28 shows that of the 80 boys examined aged 15-18 years, 4(5%) were pre-adolescents (i.e. those who have not entered their pubertal spurt), 41(51.25%) were mid-adolescents (i.e. those in pubertal spurt) and 35(43.75%) were post-adolescents or adults.

Table 29 shows the means in weights (in kg.) and heights (in cm.) arm circumference of the boys at different stages.

Stages	Number	Weights (kg) Mean	Heights (cm) Mean	Arm Circumference(cm) Mean	Skinfold Thickness(mm) Mean
0-1	4	35.8	146.7	21.0	9.6
2	3	38.3	153.5	20.7	7.4
3	13	46.6	160.9	22.5	7.8
4	25	48.1	161.8	22.0	8.1
5	35	53.3	166.3	23.9	7.1

It should be noted that there is an increase of both mean height and mean weight from one stage to the other. As children grew older, they also become heavier, so the results in the table will be expected on these basis alone. To prove that children in different stages differ in mean weight for the same age then one would have to control for age. This has not been done here.

Since the number of boys who are pre-adolescent is very low, the rest of the result will be expressed between the mid-adolescents (those in the pubertal spurt viz. stages 2, 3, and 4) and the post-adolescents, (stage 5).

6.2.2. Deficiency Signs

The frequency of the deficiency signs on the mid-adolescent boys and the post adolescent boys is summerized in Table 30.

Table 30 Prevalence of deficiency signs

Deficiency Signs	Mid-adolescents boys n=41		Post adolescents boys n=35	
	No.	%	No.	%
Conjunctival Wrinkling	2	4.9	4	11.4
Bitot's Spots	0	0	1	2.8
Corneal Scarring	0	0	0	0
Pallor of Conjunctivae	1	2.4	0	0
Pallor of Tongue	1	2.4	0	0
Pallor of nail bed	0	0	0	0
Angular Stomatitis	1	2.4	0	0
Cheilosis of lips	12	29.3	14	40
Spongy/bleeding gums	1	2.4	4	11.4
Goitre (grade 1)	0	0	0	0
Other signs of nutritional significance				
No. of decayed teeth 1	7	17.1	7	20
2	1	2.4	4	11.4
No. of missing teeth 1	0	0	2	5.7
2	0	0	0	0
3	0	0	1	2.8
No. of filled teeth 1	0	0	2	5.7
2	0	0	0	0
Mottling of teeth	7	17.1	4	11.4
Obesity (grade 1)	0	0	0	0

The most common deficiency sign is cheilosis of lips, which was present in 12 mid-adolescent boys (29.3%) and 14 post-adolescent boys (40%).

There is no significant difference in any of the deficiency signs (C.T.R.). Quite a number of cases have decayed teeth and 9 cases (17.1%) mid-adolescent boys and 4 post-adolescent boys (11.4%) show sighs of mottled teeth.

6.2.3. Anthropometry

The following tables give the mean values for all measurements for the mid-adolescent boys and the post-adolescent boys.

Table 31 Mean values and Standard Deviations for the anthropometric measurements for the mid-adolescent and post-adolescent boys.

Developmental Stage	Number	Weight (kg)		Height (cm)		Arm Circumference		Skinfold Thickness	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Mid-adolescent	41	46.9	5.4	160.9	6.0	22.1	5.3	8.0	2.4
Post-adolescent	35	53.3	4.9	166.3	6.3	23.9	4.6	7.1	1.9

There is a significant difference in weights ("t" = 5.37) and heights ("t" = 2.1) between the mid-adolescent boys and the post-adolescent boys.

6.2.4. Anthropometry Assessment according to those below the Standard.

Table 32 Percentages of mid-adolescents and post-adolescents boys below selected anthropometric standards according to locations

Category	Weight 80% %	Height 90% %	Wt./Ht. 80% %	Arm Circumference 80% %	Skinfold Thickness 80% %
Boarders					
Mid-adolescents (24)	66.6	12.5	0	29.2	17
Post-adolescents (9)	22.2	0	0	22.2	55.6
Non-boarders					
Mid-adolescents (17)	41.2	17.6	5.9	41.2	47.1
Post-adolescents (26)	15.4	13.3	7.7	26.9	61.5

Between ( ) total number of observations.

The table shows a higher percentage of mid-adolescents to be underweight than the post-adolescents, and boarder mid-adolescents to be more malnourished than non-boarders. In weight for height standards it is the non-boarders, both mid-adolescents and post-adolescents, who seem to have a higher percentage of low standards.

There is however no significant difference in arm circumference and triceps skinfold thickness between the mid-adolescent and post-adolescent boys.

6.2.5. Biochemistry

Table 33 Mean haemoglobin (g/100 ml) and Standard Deviations mid-adolescent boys and post-adolescent boys.

Category	Number	Hb (g/100 ml) Mean	S.D.
Mid-adolescent boys	41	14.6	1.2
Post-adolescent boys	35	15.3	6.0

Of the 41 mid-adolescent boys, 3 were anaemic (with 12.4 g/100 ml., 12.8 g/100 ml., 11 g/100 ml,), and the highest haemoglobin content being 17.0 g/100 ml. Only 1 post adolescent boy was anaemic (with 12.4 g/100 ml.) and the highest haemoglobin content of 18.0 g/100 ml. However there is no significant difference in haemoglobin content between the post adolescent and mid-adolescent boys.

6.2.6. Conclusion

Secondary sex age is a more accurate index of growth and maturation during adolescence because apart from chronological age, the stages of development among persons is taken into consideration. Of the boys (aged 15-18 years) examined, 5% were pre-adolescent (mainly aged 15 and 16), 51.25% were mid-adolescents (mainly aged 17 and 18, few cases of ages 15 and 16), and 43.75% were adults, or post-adolescents (mainly 17 and 18, one case of 15 and two cases of 16 years).

Body measurements showed an increase in weight and height from one stage to the other. A difference of 18.5 kg. is seen between the mean weights stage 1 and stage 5 and a difference of 19.6 cm. is seen between the mean heights of stage 1 and stage 5. A significant difference is seen in weights and heights between the mid-adolescent boys and post-adolescent boys. When selected anthropometric standards are used to determine the body measurements it is observed that a higher percentage of mid-adolescents are

underweight compared to post-adolescents, and boarding mid-adolescents to be more malnourished than the non-boarders. When using weight for height standards, it is the non-boarders, both mid-adolescents and post-adolescents, who have a few cases of malnourished students and none in the boarding school.

There was no significant difference in any clinical sign and in the Hb levels between the mid-adolescent boys and post-adolescent boys.

From the above observations, it can be seen that there was a slight difference between the mid-adolescent boys and post-adolescent boys, especially as shown in the body measurements. Post-adolescent boys having a slightly better nutritional status than the mid-adolescent boys.

6.3. Questionnaires

Several questionnaires were made to find out some more information. The results are given in this section.

6.3.1. Onset of menstruation (Appendix 1)

Of the 108 girls who were given the questionnaires to complete, 102 filled and returned the questionnaires. 2 girls, one aged 15 years

and one 16 years had not reached their menarche so these were dropped from the sample. 100 girls' questionnaires were finally analysed.

Table 34 Age at which menarche appeared for girls in Machakos District

Age at which Menarhhe appeared (years)	No. of Girls
10	1
11	1
12	6
13	16
14	31
15	34
16	11
17	2

From the table it appears that, menarche of these girls appeared between ages 10 to 17 years. The median age was between ages 14 and 15 years. Average age of menarche is 14.25 years.

6.3.2. Knowledge of Nutrition of the Students (Appendix 3)

Questionnaires on simple nutrition were set to find out the general knowledge of nutri-

tion of the students. 188 students answered at least two questions correctly. None of the students got all the answers correct.

Table 35 Frequency of answers to each question

Question	Correct Answers		Wrong Answers		Dont Know	
	No.	%	No.	%	No.	%
1. Beans contain less protein than maize Yes/No	159	84	26	14	3	2
2. Fruits are a good source of vitamin C Yes/No	170	90	15	8	3	2
3. Tinned fruits and vegetables are more nutritious than fresh fruits and vegetables Yes/No	145	77	41	22	2	1
4. Anaemia may be due to a deficiency of one of the following:- Calcium; Iodine; Iron	83	44	86	46	19	10
5. Kwashiorkor is a disease of young children brought about beaause of lack of calories in the diet Yes/No	85	45	101	54	2	1
6. A lack of iodine in the diet could result in one of the following diseases& anaemia; goitre; oedema	76	40	88	47	24	13
7. Breastfeeding alone does not provde sufficient nutrients for a baby aged 2 months and therefore should be supplemented with cow's milk, powdered milk and some other milk product Yes/No	133	71	46	24	9	5

...../

Table 35 (contd.)

Question	Correct Answers No.		Wrong Answers		Dont Know	
8. Which of the following member of the family needs more protein relative to calorie intake:- pre-school aged child, school child, hard worker, father, mother	42	22	133	71	13	7
9. A balanced diet is a diet containing all the nutrients necessary for body building, energy, giving and bodypprotection Yes/No	176	94	10	5	2	1
10. A pregnant woman needs more food intake than a non-pregnant woman Yes/No	43	23	141	75	4	2

From the table above, the first lot of questions (1, 2, 3) were the best answered questions (over 70% correct answers) with the exception of question 9, on balanced diet, whixh was the best overall question answered. This had 94% correct answers. A poor knowledge of malnutrition and its causes was shown by the students. The correct answers for number 4, 5 and 6 being 44%, 45% and 40% respectively. Their knowledge on nutritional needs of members of the family was very poor as shown in the answers given to questions 8 and 9, which had 22% and 23% respective correct answers.

6.3.3. Knowledge of nutrition of the mothers

62 of the homes of the students (day scholars) were visited. The mothers of these homes were interviewed to find out their level of education and their general knowledge of nutrition. Of 62 mothers interviewed 34(54.8%) had had no education at all. Only one of the mothers had had a form of training after standard eight; she was a teacher.

Table 35 The level of education of the mothers

Level of Education	Number
Nil	34
Std. 2	5
Std. 3	3
Std. 4	6
Std. 5	3
Std. 6	3
Std. 7	4
Std. 8	8
College 1	1

Those who did only the lower primary are 12(19.4%), and those who did go to the upper primary 13(21%) and only one mother (1.6%) had had college training. None of the mothers had had secondary education. 58(93.2%) of the mothers interviewed were married; 4(6.5%) were widowed. None of the mothers were single or divorced or separated.

When questionnaire 4 was put to the mothers, the following were the answers obtained:

Question:

What is the importance of protein foods? (This was asked by naming the protein foods).

Answers	Frequency
To build the bodies of the children	32
To make the children's bodies healthy and strong	22
To make the child strong	5
To provide growth for the children	2
To give energy to the children	1

To the question on whether children should be given eggs, all the 62 mothers agreed that children should be given eggs.

Question

If there was just a little money left for housekeeping, which of the following would you buy and why?

Answers:	Food	Frequency
	Maize flour	47
	Meat	37
	Eggs	32
	Sugar	17
	Bread	1

Most of the mothers mentioned more than two foods. Maize flour seemed to be more popular, as some of the mothers stated clearly that porridge was a more satisfying food.

Below are the reasons given as to why the above foods were chosen:

Reason	Frequency
It makes one healthy and strong	21
It satisfies one	18
Important food in the body	13
It is a good food	6
Money is too little to buy other foods	3
Cannot stay without tea	1

Question

There is only a little meat left over from yesterday's supper, to whom should you give the meat, and why?

Answers	%	Reason
To the younger children	93.5	Need to grow further
To the husband + younger children	4.8	Head who provides foods, Need to grow
Share equally to all members of the family	1.6	Everybody needs to build body

6.4. Food Consumption

6.4.1. Food Availability

During the home visiting in the 62 homesteads of the day scholars, a section was prepared to find out from the families which foods are purchased and what the family grows in their own shambas and gardens. This was done in order to find out whether the available foods are fully utilized in the meals of the students.

6.3.1. Cultivation

Cereals

Maize being the staple food was cultivated by all families. This is grown mainly for consumption. Millet is cultivated by 9(14.5%) families. Sorghum is cultivated by 12(19.4%) families and finger millet and wheat by only 3 families.

Legumes

The common bean (kidney bean) was cultivated by all families. This forms part of the staple food (isio) and is mainly cultivated for home consumption. Other legumes cultivated by these families are cowpeas by 39(62.9%) families, peas by 26(41.9%) families, beans by 4(6.5%) families.

Starchy fruits and tubers

Bananas, Irish and sweet potatoes, arrowroots and cassava were cultivated by most families. 40(64.5%) of the families grew bananas, 37(59.5%) of the families grew sweet potatoes, 22(35.5%) of the

families grew arrow roots and 39(62.9%) of the families grew cassava.

Vegetables

Cabbages were grown by 53(85.5%) families. 54(87%) families grew tomatoes, 33(53.2%) families grew pumpkins, 33(53.2%) families grew green vegetables (sukuma wiki and other wild spinaches). Other vegetab s such as onions, cucumber and carrots were grown by very few families.

Fruits

Guavas and bananas were grown by some families. 33(53.2%) of the families had guava trees. Mangoes, oranges, pineapples and sugar-cane were grown by very few families.

Others

Coffee as a cash crop is grown by 23(37%) families.

6.4.2. Food Purchase

All families visited markets and shops regularly. Market days were held twice a week, in addition to food crops, poultry, household objects, shamba equip-ment and second hand clothes were among the items trades. Foods were mainly sold

7.

A market place at Kangundo in Machakos District. Notice that food is neatly placed on racks.

in household measures such as tins and gourds of different sizes. Fruits, tubers and vegetables were sold in piles for fixed prices. Additional foods were sold in shops, often near or by the market places and butchers would provide beef and goats's meat.

The table 37 below shows the foods bought per week by families and the number of the families. This information was obtained by questioning the 62 families on what foods they had pruchased the previous week.

Table 37 Type of foods purchased by families per week and the frequency

Food	No. of positive answers
Meat	62
Sugar	57
Tea	47
Cabbages	46
Fat	46
Flour (Maize)	44
Rice	38
Tomatoes	20
Salt	15
Wheat flour	14
Maize (whole)	12
Beans	11
Milk	11

.../

Table 37 (contd.)

Food	No. of Positive Answers
Green vegetables	10
Irish potatoes	9
Cocoa	6
Sweet potatoes	4
Coffee	4
Fruits	2
Eggs	2
Fish	1
Carrots	1
Bread	1

Meat was purchased by the whole group (sample). Sugar also proved to be quite popular. Quite a number of families bought maize and beans which they also grow.

6.4.3. Food Pattern and Menus for Boarders

Machakos Girls High School

Fixed Menu (Daily)

Breakfast: Tea (with milk and sugar) Bread

Break (10.15 a.m.): Cocoa (with milk and sugar)

Lunch: Boiled then fried maize and beans (Isio)

Supper: Meat stew

Boiled Chenga (Broken maize)

Fried cabbages and potatoes

Extras:

On Mondays: a boiled egg added at breakfast

On Sundays: boiled rice in place of boiled chenga

Fruits: Twice a week at supper a fruit per person depending on season.

Kangundo High School

Fixed Menu

Breakfast: Maizemeal porridge (+ sugar)

Break (11.00 a.m.) Tea (with powdered milk and sugar

Lunch: (3 times a week): Boiled chenga (broken maize) Fried vegetables

(4 times a week)L Boiled chenga, meat and vegetable stew.

Supper: Maize and beans (Fried)

Extras:

Fruits: On Sundays and Wednesdays a fruit is given to everyone at supper depending on what is in season.

Note: Isio is the staple food of the Akamba people. The main ingredients are maize and beans. Dry or green maize is boiled together with dry benas until cooked. Most of the poor families and probably in the home of these students they would take it boiled.

At school, however it is fried after boiling in which case the caloric content is higher because of the oil or fat used for frying.

6.4.4. Food Pattern for the Day Students

Table below shows the types of foods which are eaten by the day students and the frequency of the foods eaten.

Table 38 Foods eaten by the day students (24 hour recall)

Food	Frequency
Maize and beans (Isio)	64
Ugali and vegetable stew	34
Maizemeal porridge	32
Tea without milk	20
Black coffee	15
Tea with bread	13
Maandazi (fried fritters) & tea	10
Cakes alone	10
Tea with milk	8
Bread alone	7
Bananas	6

..../

Table 38 (contd.)

Food	Frequency
Ugali and sour milk	5
Ugali alone	5
Milo or Cocoa	5
Guavas	4
Ugali and meat stew	3
Chaputi and meat stew	3
Coffee with cake	3
Mangoes	3
Rice alone	2
Rice and vegetables	2
Chapati and tea	2
Chapati and vegetables	2
Tea with maize	2
Milk	2
Millet porridge	1
Rice and meat stew	1
Cassava	1
Green bananas and potatoes	1
Tea with ugali	1

From the table above the most popular dish served is seen to be Isio (maize and beans). This is the main staple food of the Akamba. Ugali with vegetables also seems to be very popular dish. Meat is observed only on 8 occasions served with

either ugali, rice or chapati. Fruits are also rarely eaten, only 13 cases were observed.

Other observations made from the diet of these day scholars is that snacks are rarely eaten by the girls. Boys seem to be taking snacks in between meals more often than the girls, but still this custom is not found in many of the students. The majority of the students do not take anything between breakfast and lunch and between lunch and supper. 1 student had no breakfast, 18 students had either black coffee or black tea alone. A further 11 students had tea or cocoa or milo with milk but without anything else. 3 students had no lunch at all. All students seemed to have a meal for supper though. The fruits are taken either at breaktime or after supper. One student claimed to have taken only a banana for breakfast. Maandazi (fried fritters) and tea seem quite popular with 11 students during lunch hour.

The foods taken by the day scholars could be put into six groups when calculating the type of nutrients consumed later on.

Cereals	Tubers and Roots and Starch fruit
Maize grains	Cassava
Maize flour	Irish potatoes
Millet flour	Green bananas
Rice	Fruits
Wheat flour	Ripe bananas
Vegetables	Mangoes
Cabbages	Guavas
Sukuma wiki	Animal Products
Cowpea leaves	Milk (fresh and sour)
Kidney beans	Meat
Onions	Others
	Tea
	Coffee
	Fat
	Milo
	Cocoa
	Salt
	Seasonings

The average number of meals per day was 3. Out of 70 students only 1 student had had no breakfast and only 3 students had taken no lunch.

6.4.5. Nutrients content in meals and adequacy of the diets

In boarding schools i.e. Kangundo High School and Machakos Girls High School, it was possible to estimate the

daily intake of the nutrients per student. The calculations were done as explained in Chapter 5(5:7). Methods and lengths of cooking, food wastes and conditions of the raw foods were not taken into consideration. The calculations below are given from the raw foods some such as vegetables unpeeled.

Table 39 Table used for Recommended daily intakes of nutrients

Age (yrs.)	Calories	Proteins(g)	Calcium	Iron (mg)	Vitamin A (I.U.)	Thiamine (mg)	Riboflavin (mg)	Niacine (mg)	Ascorbic Acid (mg)
Children									
1	820	3/kg.	0.4	8	1500	0.4	0.6	6.6	15
1-3	1360	40	0.5	9	2000	0.5	0.8	9.6	15
4-6	1830	50	0.5	10	2500	0.7	0.9	11.2	19
7-9	2190	55	0.6	11	3000	0.8	1.2	13.9	22
Male adolescents									
10-12	2600	60	0.7	14	3500	1.0	1.4	16.5	25
13-15	2900	70	0.8	17	3500	1.2	1.7	20.4	30
16-19	3070	80	0.8	17	4000	1.4	2.0	23.8	30
Female adolescents									
10-12	2350	65	0.7	14	3500	1.0	1.4	16.5	25
13-15	2490	70	0.7	19	3500	1.0	1.4	17.2	30
16-19	2310	70	0.7	19	4000	1.0	1.3	15.8	30
Adult man (Moderately active)	3000	65	0.5	14	4000	1.3	1.8	21.1	25
Adult woman (Moderately active)	2200	60	0.5	16	4000	0.9	1.3	15.2	25

The table above was composed of nutrient requirements from different literature. The energy and protein requirements was from W.H.O. Technical Report Series, Number 522 (1973), and Latham, M.C. (1965). The calcium requirement is from Latham, M.C. (1965). Requirements of Ascorbic Acid, and Iron from W.H.O. Technical Report Series No. 452 (1970) and Latham, M.C. (1965). Requirements of Vitamin A from Latham, M.C. (1965). Requirements of Thiamine, Riboflavin and Niacin from W.H.O. Technical Report No. 362 (1967).

Table 40 Average nutrient intake and percentage adequacy per student per day

Nutrient	Boarding Girls Average Intake	Adequacy %	Boarding Boys Average Intake	Adequacy %
Calories	2068.0	89.5	2891.9	94.2
Protcins g.	72.5	103.2	95.5	119.4
Calcium g.	0.3	42.9	0.3	37.5
Iron mg.	19.6	103.2	27.4	161.2
Vitamin A I.U.	346.5	8.7	636.1	15.9
Thiamin mg.	1.9	190.0	2.5	178.6
Riboflavin mg.	0.85	65.4	1.0	50.0
Niacin mg.	12.9	81.6	19.9	83.6
Ascorbic Acid mg.	41.4	138.0	60.1	200.3

It should be noted from the table above that Protein intake, Iron intake, Thiamine and Ascorbic acid intake for both the girls and the boys are more than adequate.

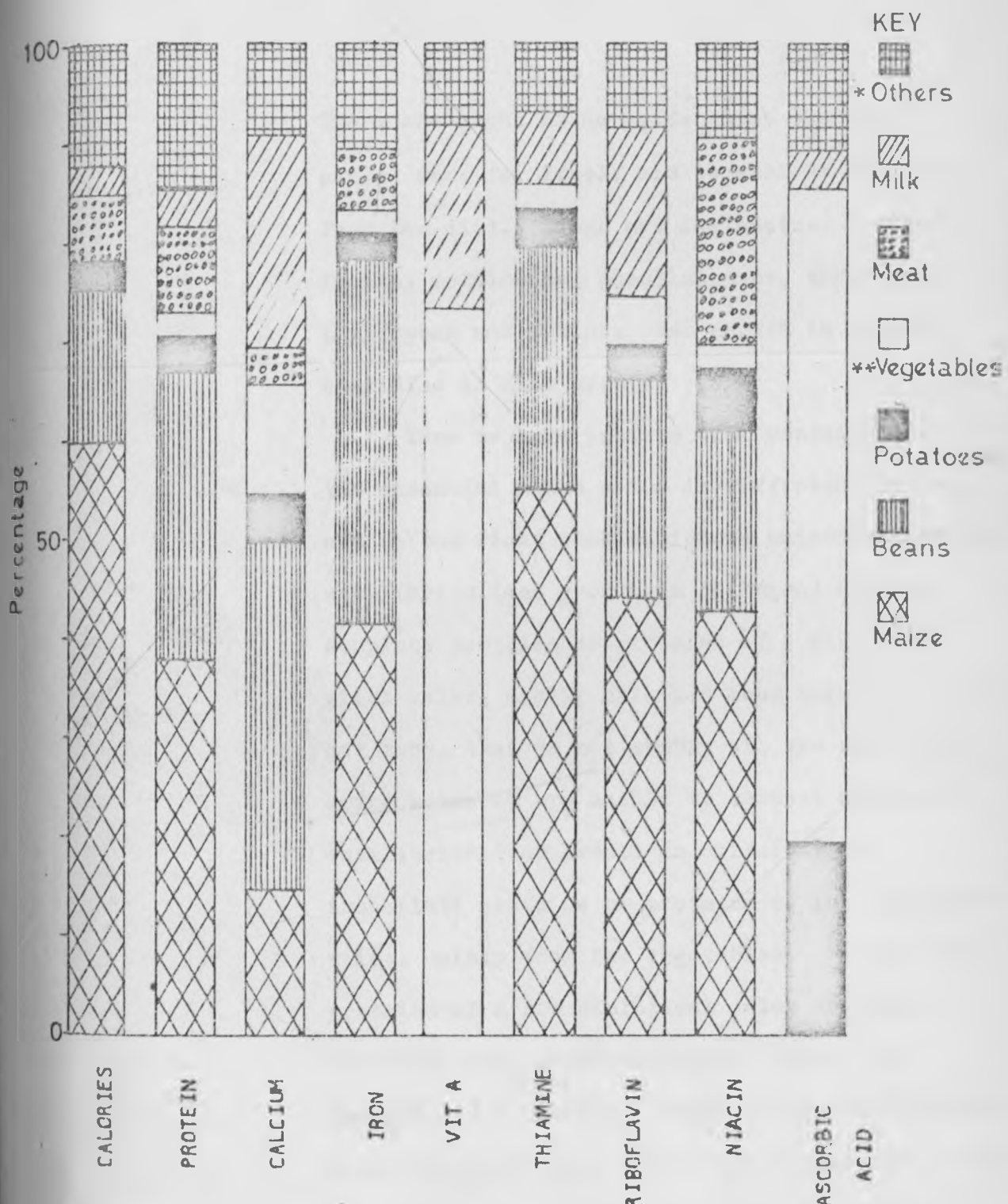
Sources of Calories

The principal source of calories is maize providing 59%. Beans contribute 15%. Other foods contribute very little quantities of calories.

Protein

The nutritive value of a protein depends to an important degree on its amino acids composition. There are about 22 amino acids recognized today as arising from the breakdown of proteins, that have been determined as being physiologically important. Plants can synthesize all the amino acids they need from simple inorganic chemical compounds, but animals are unable to do this because they cannot synthesize the amino (NH_2) group; so in order to obtain the amino acids necessary for building protein they must eat plants or other animals which in their turn lived on plants. The human body has certain limited powers of converting one amino acid into another.

Fig. 6 Average contribution of various foods to the total intake of different nutrients in two boarding schools in Machakos District 1976



* Others = Eggs, Tea, Fruits

** Vegetables = Onions, Cabbages, Carrots

There are eight amino acids which the body cannot make for itself and so must be obtained from the diet. These are isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. For growth in infants histidine is also needed.

Thus we have protein that contains all the essential amino acids in sufficient quantity and in the right combination to maintain nitrogen equilibrium (and growth in children) known as complete proteins or proteins of a high biological value, mostly obtained from animals; and those that do not supply all the essential amino acids so are unable to support nitrogen equilibrium (and growth in children) as incomplete proteins or proteins of low biological value, mainly from the vegetables. However if proteins of a low biological value are taken together, they supplement each other. For example, if a protein, deficient in one essential amino acid, is taken with another protein containing the missing amino acid in adequate amounts, N equilibrium and normal nutrition can be established.

Therefore the efficiency with which a protein is used for growth or maintenance is the quality as determined by its amino composition; quantity depending on the amount of food consumed and on the protein content of the food; and tha availability as some might not be available if digestion and absorption are not complete (as in the case of diarrhoea or during processes of food (heat).

Sources of Protein

Of the actual total protein intake 14% was from animal origin (milk, meat).

The main sources of protein is maize which contributes 46% of the total protein intake. Beans contribute 31%. Other foods such as potatoes, vegetables contribute much smaller quantities.

Sources of Calcium

The principle source of calcium is beans which contributes 36% of the total calcium intake. Milk contributes 23%, maize contributes 15%, vegetables 13%. Other foods such as meat contribute very little calcium.

Sources of Iron

Maize and beans are main contributors of iron. They contribute 44% and 37% of total intake, respectively. Meat contributes 8%, eggs, potatoes and vegetables contribute very little iron.

Sources of Vitamin A

The principle source of vitamin A in the form of carotene are vegetables, providing 75% of the total intake; milk provides 20%. It should however be noted that vitamin A intake is very low in both schools.

Sources of Thiamine

Maize provides 58% of total thiamine intake. Beans provide 24%, milk 10%. Other foods are much smaller contributors.

Sources of Riboflavin

46% of total riboflavin intake is from maize, 23% from beans, 18% from milk, vegetables contribute 5%, other foods provide very little riboflavin.

Sources of Niacin

The principle source of niacin is maize which provides 47%, meat 21%. Beans contribute

16%, potatoes 6%. Other contributors in small quantities are beans, potatoes, vegetables and beverages.

Sources of Ascorbic Acid

Vegetables are the main contributors with 69% of total intake. 20% is from potatoes. Milk, and fruits contribute very little ascorbic acid.

Conclusion

As the day students' food intake was not measure, the exact adequacy of the diets in the nutrients cannot be estimated. However the foods eaten are obtained from all the food groups, cereals, vegetables, fruits, tubers, roots and starchy fruit, animal products and miscellaneous. However less meat and fruit was taken by the day students.

On the other hand, the boarders' diet for both girls and boys school exceeded the 100% level as regards to proteins, iron, thiamine and ascorbic acid, low levels are observed in calories and niacin.

Very low intakes are observed in vitamin A content.

6.5. Home Visiting

In this section are to be given the results of the part of the questionnaire and observations made during the home visiting of the 62 homes of the day scholars. The purpose of this home visiting was to find out the level of living, hygienic practices, education and occupation of parents and housing conditions.

6.5.1. Education of the Parents

The results with regard to the kind and duration of the education of parents is summarized in the table below.

Table 41 Relative distribution of the parents of 62 day scholars, according to kind and duration of education

Kind of duration of education	Fathers No.	%	Mothers No.	%
None	23	37	34	55
Primary School				
1-4 years	20	32	14	23
5-8 "	15	25	14	23
Secondary School				
1-4 years	4	6	0	0

It should be noted that more mothers had had no formal education than the fathers. Only 4(6%) fathers had had secondary school education.

6.5.2. Occupation of the Fathers

Occupations of the fathers were classified in a limited number of categories. This classification was drawn up by means of estimate wage list for different jobs.

Table 42 Occupation of the fathers of the day scholars

Occupation	Number of Fathers	
	No.	%
Farmer	28	45.2
Lower skilled labour	16	25.8
Unskilled labour	10	16.1
Higher skilled jobs	4	6.5
Self employment	4	6.5

The occupations of fathers were categories in the following manner:

Unskilled labour: Farm labourer, herdsman, watchman, newspapers supplier, fitter.

Self employment: Shopkeeper, hotel keeper

Lower skilled labour: Driver, clerk, forester, printer, councillor, mechanic, engineer, supplies officer, fireman, carpenter.

Higher skilled jobs: Sub-chief, teacher, pastor.

Table 43 Level of education in relation to occupation of fathers

Level of Education	Farmer	Unskilled Labour	Self Employment	Lower Skilled Labour	Higher Skilled jobs
No education	14	6	2	1	0
1 - 4	11	2	1	5	1
Std. 5 - 8	3	1	1	9	1
Form 1 - 4	-	1	-	1	2

It should be noted that majority of the fathers who are farmers are those who had had no education at all. Quite a number of these fathers who had had no formal education also are unskilled workers. The majority of the fathers who had had 1 - 4 years education are also farmers. Only 4 fathers are higher skilled workers and of these 2 had had secondary education.

6.5.3. Hygienic Practices (related to parasites)

Three questions were included, concerning hygienic practices.

- presence and use of a latrine
- the type of water supply
- storage facilities

Observations of the above was also done.

Presence and use of a latrine

Most of the families did have a latrine and used them. (viz. 51 or 82% of the homes visited). 8(12.9%) had latrines but did not use them. Only 3(4.8%) of the families visited had no latrines at all and did not use any latrine.

Water Supply

Six sources of water were distinguished from the answers given to the questionnaires, namely spring, dam, well, river, roof and catchment.

Table 44 Frequency distribution of families according to the type of water supply

Type of Water Supply	Frequency
Well	29
River	11
Spring	8
Catchment	8
Roof	4
Dam	2

None of the families used tap-water. Majority of the families used the well for water supply. All families used river water. It should be noted that those families who use well, river, spring water i.e. 48(77.4%) families obtain from sources which are likely to be unhygienic. These sources are open, easily polluted and are probably responsible for transmission of human or livestock diseases.

Storage Facilities

Facilities for storage of both raw and cooked foods were observed. Poor storage of both raw and cooked food has been known to

lower the food value and also encourage contamination of food.

The results of this is shown below.

Table 45 Storage facilities for cooked foods and frequency of families

Storage Place	Frequency
In the cupboard	50
Cooking pots	7
On the table in plates	5

50 families store their cooked foods in cupboards. Other places for storing cooked foods are the cooking pots or covered plates on tables.

Table 46 Storage facilities of raw foods and frequency of families

Storage Place	Frequency
In the store	56
In a room in living house	6

All the families have a special room or store for the storage of their raw foods.

6.5.4. Housing

With regard to housing, the materials for the construction of roof, floor, were observed. The number of rooms in the house was investigated as well as the presence of a separate kitchen. The type and condition of the furniture was also observed and the lighting system. This was done in order to find the level of living of the families visited.

Roof

Common materials used for the construction of roofs were corrugated iron sheets. 50(80,6%) of the houses had iron sheets for roofs, 9(14.5%) had grass roofs, 2 houses had flattened tins and 1 house had both thatch and flattened tin.

Floor

Only two materials were observed on the floors of the houses visited. 32(52%) of the floors were cemented and 30(48%) of the floors were mud floors.

Number of Rooms

The table below shows the number of rooms in the visited houses, excluding the kitchen.

Table 47 Number and frequency of rooms in the visited homes

No. of Rooms	Frequency
0	1
1	3
2	12
3	16
4	20
5	3
6	5
7	1
12	1

Majority of the families had either 4 or 3 rooms. 20(32%) houses had 4 rooms, 16(25%) houses had 3 rooms apart from the kitchen. One house had only one rooms which acted both as a kitchen, living room and bedroom. One house had total of 12 rooms. 12 houses had two rooms.

Separate Kitchen

55(88.7%) of the families had a separate kitchen. 7(11.3%) of the families had one room as a kitchen as well as a living room.

Fuel used for cooking

Wood seemed to be the most popular fuel used for cooking. 59(95%) of the families used wood as a fuel for cooking. 2 families used both wood and charcoal for cooking, and 1 family used charcoal alone.

Lighting

Oil lamps and electricity are used for lights in these homes. 60(96.8%) of the families use oil lamps and two families use electricity.

6.6. Relationship between socio-economic factors to Anthropometric measurements and clinical signs of the children

The socio-economic factors examined during the home visiting were related to the anthhopometric measurements and clinical signs, in order to find out whether these factors have any bearing to the nutritional status of the adolescents, whose homes were visited. A chi square test was used to test these. The following tables show the results.

For the sake of the calculation of the chi square test, the occupation of the household head has been split into two sections i) namely unskilled labour which includes self employment and unskilled labour, i.e. those jobs which do not require training and ii) skilled labour including lower skilled labour and higher skilled labour - i.e. those jobs which require some training. Education has been dealt with in the following; those household heads who have had no formal education, and those who have had formal education. Size of the family has been put into two sections; the medium sized families (5-12 members) and the large families (13+ members). Anthropometric measures have been put into two sections 70-90% and 91% $>$. The combinations were necessary in order to bring the cell frequency to more than 5 for the expected value.

Table 48-1 Relationship between occupation of the Household Head (H/H) and weight/age of the children.

No. of the H/H = 62. No. of the children = 62

Occupation of H/H	No.	Weight/Age of children 70-90% Number	91%> Number
Unskilled labour	42	17	25
Skilled labour	20	4	16

Using the chi square test, the test is significant. That means there is a difference in weight for age of children of these household heads who are employed as unskilled labourers and those who are skilled labourers.

Table 48-2 Relationship between occupation of the H/H and Height/Age of the children.

No. of H/H = 62. No. of children = 62

Occupation of H/H	No.	Height/Age of children 80-100% Number	100%> Number
Unskilled labour	42	34	8
Skilled labour	20	8	12

Using the chi square test, there is a significant difference in height for age of children of those household heads who are unskilled labourers and those who are skilled labourers. $p < 0.005$ ($x^2 = 10.1$).

Table 48-3 Relationship between occupation of the H/H and weight/height of children. No. of H/H = 62. No. of children = 62

Occupation of H/H	No.	Weight/Height of Children 70-90% No.	91% > No.
Unskilled labour	42	2	40
Skilled labour	20	2	18

There is no significant difference in weight for height of children of those household heads who are employed as unskilled labourers and those who are skilled labourers. Using the Odds ratio test.

Table 48-4 Relationship between occupation of the H/H and Arm circumference/Age of the children. No. of H/H = 62. No. of students = 62

Occupation of H/H	No.	Arm Circum./Age of Children 60-90% No.	91% > No.
Unskilled labour	42	19	23
Skilled labour	20	8	12

Using the chi square test, there is no significant difference between the children of household heads employed in the unskilled labour and those employed in skilled labour, in the arm circumference for age of children.

Table 49-1 Relationship between Education level of the H/H and Weight/Age of the children. No. of H/H = 62 No. of children = 62

Education of H/H	No.	Weight/Age of children 70-90% No.	91%> No.
Nil	23	10	13
Some	39	11	28

There is a significant difference in weight for age of children of those household heads who have had no formal education and those who have had some formal education. $0.01 > p < 0.025$ ($x^2 = 5.7$).

Table 49-2 Relationship between education level of the H/H and Height/Age of children. No. of H/H =62. No. of children = 62

Education of H/H	No.	Height/Age of children 80-100% No.	100%> No.
Nil	23	18	5
Some	39	24	15

There is a difference in height for age of children whose fathers have had no formal education and of the fathers who have had some education. Using a chi square test.

Table 49-3 Relationship between education of the H/H and weight/height of children. No. of H/H = 62. No. of children= 62.

Education of H/H	No.	Weight/Height of children 70-90%	91% >
Nil	23	1	22
Some	39	3	36

Using the chi square test and the odds ratio test there is no significant difference between the children whose fathers have had no formal education and those whose fathers have had some formal education in weight for height.

Table 49-4 Relationship between education of the H/H and Arm circum/age of children. No. of H/H = 62. No. of children = 62.

Education of H/H	No.	Arm Circum./Age of children 60-90%	91% >
Nil	23	11	12
Some	39	15	24

Using the chi square test, there is no difference in arm circumference for age between children whose fathers had had no formal education and those whose fathers had had some formal education.

Table 50-1 Relationship between size of family and weight/age of the children. No. of families = 62. No. of children 62.

Size of Family (members)	No.	Weight/Age of children 70-90%	91%
5-12	48	15	33
13+	14	6	8

Using the chi square test, there is no difference in weight for age between the children who come from medium sized families and those who come from large families.

Table 50-2 Relationship between size of family and Height/Age of the children. No. of families = 62. No. of children = 62.

Size of family (members)	No.	Height/Age of children 80-100% No.	101% No.
5-12	48	32	16
13+	14	10	4

Using the odds ratio test and the chi square test (Yates Correction) there is no difference in height for age between children who come from medium sized families and those who come from large families.

Table 50-3 Relationship between size of family and weight/Height of the children. No. of families = 62, No. of children= 62.

Size of family (members)	No.	Weight/Height of children 70-90%	91% >
5-12	48	3	45
13+	14	1	13

Using the odds ratio test, there is no significant difference in weight for height between those children who come from medium sized families and large sized families.

Table 50-4 Relationship between size of family and Arm Circum./Age of the children. No. of families = 62 No. of children = 62.

Size of family (members)	No.	Arm Circum./Age of children 60-90%	91% >
5-12	48	25	23
13+	14	3	11

Using the Odds ratio test (> 2) and the chi square test Yates Correction ($0.25 > p > 0.05$), there is a significant difference in arm circumference for age between children who come from medium sized families (5-12 members) and those who come from large families (13+ members).

Table 51-1 Relationship between type of housing and weight/age of the children. No. of houses = 62, No. of children = 62.

Type of Housing	No.	Weight/Age of the children 70-90% No.	91% > No.
Temporary	30	10	20
Semi-permanent and permanent	32	11	21

Using the chi square test, there is no significant difference in weight for age between children living in temporary houses and those living in semi permanent and permanent houses.

Table 51-2 Relationship between type of housing and Height/Age of the children. No. of houses = 62, No. of children = 62.

Type of Housing	No.	Height/Age of the children 80-100% No.	101% No.
Temporary	30	27	3
Semi permanent & permanent	32	15	17

Odds Ratio Test - significant $x^2 = 13.4$ significant

Using the odds ratio test (>2) and the chi square test (Yates Correction, ($x^2 = 13.4$, $P < 0.005$), there is a significant difference in height for age between those children living in temporary houses and those who live in permanent and semi-permanent houses.

Table 51-3 Relationship between type of housing and weight/height of children. No. of houses = 62. No. of children=62.

Type of Housing	No.	Weight/Height of children 70-90% No.	91% > No.
Temporary	30	4	30
Semi permanent & permanent	32	-	28

Using the Odd ratio test (> 2) and the chi square test Yates Correction (P< 0.005), there is a significant difference between children living in temporary houses and those living in permanent or semi-permanent houses.

Table 51-4 Relationship between type of housing and arm circum./age of children. No. of houses = 62, No. of children = 62.

Type of Housing	No.	Arm Circum/.Age 60-90% No.	91% > No.
Temporary	30	12	18
Semi-permanent & Permanent	32	15	17

Using the chi square test, there is no significant difference between those children living in temporary houses and those living in permanent or semi permanent houses.

Table 52-1 Relationship between marital status of the mothers and weight/age of the children. No. of mothers = 62, No. of children = 62.

Marital Status of mothers	No.	Weight/Age of children 70-90% No.	91% > No.
Married	58	20	38
Widow	4	1	2

Using the Odds ratio test, there is no significant difference in weight for age in children of the married mothers and the children of widowed mothers.

Table 52-2 Relationship between marital status of the mothers and height/age of the children. No. of mothers = 62 No. of children = 62

Marital Status of mothers	No.	Height/Age of children 80-100% No.	101% > No.
Married	58	38	20
Widow	4	4	-

Using the Odds ratio test there is no significant ratio in height for age between the children of married mothers and those of widowed mothers.

Table 52-3 Relationship between marital status of mothers and weight/height of children. No. of mothers = 62
No. of children = 62

Marital Status of mothers	No.	Weight/Height of Children 70-90% No.	91% > No.
Married	58	4	54
Widow	4	-	4

Using Odds ratio test, there was no significant difference in weight for height between children of married mothers and those of widowed mothers.

Table 52-4 Relationship between marital status of mothers and arm circumference/age of children. No. of mothers = 62
No. of children = 62

Marital Status of mothers	No.	Arm Circumference/ age of children 60-90%	91% >
Married	58	27	31
Widow	4	-	4

Using the Odds test (>2) and the chi square test Yates Correction ($P<0.005$) there is a significant difference in the arm circumference for age between children of married mothers and those of widowed mothers.

According to Jelliffe (1966), a presence of 3 or more clinical signs is a sign of malnutrition. In this section, those who have 3 or more clinical signs are placed as malnourished and those with less than 3 signs are regarded as well nourished children. They are then related to the socio economic data collected in the study. The following are the results of this relationship.

Table 53-1 Relationship between occupation of the H/H and presence of clinical signs of the children. No. of H.H. = 62
No. of children = 62

Occupation of H/H	No.	Clinical Signs Less than 3 No.	3+ No.
Unskilled labour	42	40	2
Skilled labour	20	16	4

Using the Odds ratio test (> 2), there is a significant difference in clinical signs between the children of fathers who are unskilled labourers, and those whose fathers are skilled labourers. The chi square test however showed no significant difference.

Table 53-2 Relationship between education of H/H and the presence of clinical signs of the children. No. of H/H = 62
No. of children = 62

Education of H/H	No.	Clinical Signs Less than 3 No.	3+ No.
Nil	23	22	1
Some	39	34	5

Using the Odds ratio test (>2) there is a significant difference in clinical signs between the children of fathers who had had no formal education and those whose fathers have had some education. The chi square test however showed no significant difference between the two.

Table 53-3 Relationship between size of the family and clinical signs of the children. No. of families = 62
No. of children = 62

Size of family (members)	No.	Clinical Signs Less than 3 No.	3+ No.
5 - 12	48	42	6
13 +	14	14	-

Using the Odds ratio test, there is a significant difference in clinical signs between children coming from medium sized families (5-12 members) and large families (13+ members).

Table 53-4 Relationship between the type of housing and the clinical signs of the children. No. of houses = 62
No. of children = 62.

Type of Housing	No.	Clinical Signs Less than 3 No.	3+ No.
Temporary	30	27	3
Semi-permanent & permanent	32	26	5

Using the Odds ratio test, there is no significant difference in clinical signs between children living in temporary houses, and those living in permanent or semi permanent houses.

Table 53-5 Relationship between marital status of the mothers and the clinical signs of the students. No. of mothers = 62
No. of children = 62

Marital status of mothers	No.	Clinical Signs Less than 3 No.	3+ No.
Married	58	53	5
Widow	4	3	1

Using the Odds ratio test (>2) the test was significant. The chi square test however showed no difference . In addition the presence of parasites in the students was related to the hygienic practices in their homes, to see whether there is any relationship between the two.

Table 54 Relationship between the presence of parasites in the children and hygienic practices in the homes. No. of children = 62. No. of homes = 62.

Hygienic Practices	Presence of Parasites No.	%
Latrine		
Present and used	6	100.0
Water source		
River	1	16.7
Spring	1	16.7
Well	4	66.6

Presence or absence of latrine at home has no effect on the presence of parasites in the children, whereas there is a relationship between the source of water supply and the presence of parasites in children. All those children whose homes were visited, who had parasites, get water from unhygienic sources.

Conclusion

Level of education of father might affect the type of occupation a father can do, thus affect the income and expenditure in the household. Of the 62 homesteads visited 23(37%) of the fathers had had no education and of these 14 were farmers and 6 were employed a unskilled labourers. Low income means poor housing conditions and poor diets. Thus housing conditions were examined, and most of the housing conditions protrayed a low level of living conditions.

Education of the mother might affect her knowledge of nutrition, and thus influence food/nutrient intake of the family. It will also affect hygienic practices, since she will insist on the uses of the latrine, proper storage of food and water and where to fetch water. All these practices indirectly or directly affect the nutrition and health of the family members.

When socio economic factors are related to the anthropometric findings of the children and the clinical signs found in the

children, the following were found to be significant:

1. Relationship in height for age of children and occupation of household heads. Unskilled labourers having more malnourished children than skilled labourers.

2. Relationship between level of education of the household head and weight for age of children. More underweight children belonged to fathers who had had no formal education.

3. Relationship between type of housing and height for age of the children. More malnourished children were found to be living in temporary houses.

4. Relationship between type of housing and weight for height of children. More malnourished children lived in temporary houses than permanent or semi-permanent houses.

5. Relationship between family size and arm circumference of the children. More malnourished children were found in the medium sized families (5-12 members) than in large families (13+).

6. Relationship between marital status of mothers and arm circumference for age of the children. There were more cases of malnourished children of married mothers than the widowed mothers.

7. Relationship between occupation of household head and presence of clinical signs in children. There were more malnourished children of skilled labourers than of unskilled labourers.

8. Relationship between education of the household head and presence of clinical signs in children. There were more malnourished children of fathers who had had some education than of fathers who had had no formal education.

9. Relationship between marital status of the mothers and the clinical signs of the students. There were more malnourished children of widowed mothers than of married mothers.

From these observations we can see that there is a slight difference in nutritional status between those children who live in

better socio-economic conditions and those whose parents have received formal education than among those who are less privileged.

CHAPTER 7

DISCUSSION

7.1. Growth and Maturity

A cross-sectional growth study of the secondary school children in Machakos District (Kenya) has revealed that of the children between 15 to 18 years, a number of the boys are still in their pubertal spurt. Some have not yet even reached this stage. In girls the average age of menarche has been estimated to be 14.25 years. This can be compared to the Indian girls of Durban which is 13.56 years (Kark 1957), Baganda girls which is 13.4 years (Burgess and Burgess 1964), Bundi girls of the New Guinea which is 17.4 years (Malcolm 1970). In American White girls from 1940-55, age of menarche was given to be between 12.5 and 13.0 years, and in South England between 1950-60 the average age of menarche was given to be 13.2 years (Tanner 1962).

Tanner (1962) and Sinclair (1973) give the ages of the pubertal spurt to be 12.5-15 years for boys and 10.5-13 years for the girls.

The late maturity in the boys and girls in Machakos District can be said to be caused by socio-economic and environmental factors and poor diets. Tanner (1962) also states that malnutrition during childhood delays growth. Previous studies in Machakos District have revealed quite a high number of cases of early childhood malnutrition.

7.2. Anthropometry

In both girls and boys the mean weight and upper arm circumference increase with age. On the average girls are heavier than boys. Similar findings were reported on the weight of Baganda girls (Burgess and Burgess 1964), Bundi boys and girls of New Guinea (Malcolm 1970), Edinburgh children (Provis and Ellis 1970) of the same ages. However the Edinburgh girls are lighter than the Machakos girls and the Edinburgh boys heavier than Machakos boys. An increase in height is observed in all ages studied of the Machakos boys, Bundi (of New Guinea) school children.

Baganda girls and Edinburgh school children. The boys being taller than the girls. This shows that there is still growth by age 18 in both boys and girls. The Edinburgh boys and girls are however taller than the Machakos boys and girls.

Although genetic factors play a role in determining e heights of people, environmental and socio-economic factors also play a big role towards the growth of individuals (Tanner 1962). It can thus be said that since Edinburgh children come from better living conditions they are taller than the Machakos children. The fact that Machakos girls are heavier than Edinburgh girls, is probably due to a higher caloric intake.

When the weight for height percentage level is observed, it can be seen that most of the girls and boys are of either normal standard or above, again this may point towards an excess intake of calories.

Anthropometric assessment according to the standards of reference gives us an idea of cases of those malnourished. In this study only international standards were used as there are no local ones available in Kenya.

Since there were no birth certificates to confirm the ages of those children, reference in this section will be entirely based on the weight for height levels of the standards as these should be more reliable than the other anthropometric measures. Using this as a measure for the children's state of health we find that most of the girls and boys are of either normal standard or above, this may point towards an excess of calories. Only 2.1% and 1.7% of the day boys and day girls respectively are below the standard in weight for height.

7.3. Biochemistry, Laboratory and Diet

The mean haemoglobin values is satisfactory in both girls and boys in all ages. Only 9(9%) were found to be anaemic. Physical examination revealed 30(29%) cases of pallor (conjunctivae, nail bed and tongue). Parasitic infestations have been regarded as one of the causes of anaemia and 39(25.5%) of those examined were infested with parasites. The main intestinal parasites found were hookworm, ascaris, trichuris trichura and schistosomiais mansoni without any anaemia. It should also be noted

here that only 10(26%) cases of those infested had pallor or anaemia. This may be due to the fact that the diet of the boarding school pupils contained more iron than the required. The high altitude may also have played a part. The parasitic infestation does not seem to affect most of the students. No information on egg count was available.

There was also a low intake of calories in the diet of the boarders. Spauve and Dodds (1965) had a similar finding on subjects of Virgin Islands, especially the girls. The adequacy of the caloric intake of the day scholars is not known thus overweight as found in the day scholars could be either because of a high intake of calories, or because of lack of exercise. However, it should be noted that overweight in these girls is of a milder form.

Bowes (1955) cited calcium as being a nutrient most lacking in the diets of children between ages 4 and 20. Wharton (1963), Spauve and Dodds (1965), Hinton et al (1963) all show a low intake of calcium in the

teenagers' diets. The Machakos students also show a low intake of calcium in their diet. Considering that milk is part of the traditional Akamba diet this should not have been the case with Machakos students.

Carotene intakes of teenagers were deficient according to Hinton et al (1963), and Schorr et al (1972) found that this was due to a dislike of vegetables. Bohdal (1966-68) showed that there was an insufficient intake of vitamin A. Although there is also a very low intake of vitamin A of the boarding school girls and boys in Machakos District this is due to the planning and preparation of the meals. A look at meal pattern of the day students also shows that vegetables are not popular.

A high number of the subjects are observed with cheilosis of the lips, a deficiency caused by deficiency of riboflavin in the diet. A look at the diet of the boarders shows that riboflavin is actually inadequate.

The occurrence of goitre (mostly of minor form) especially amongst girls, can probably be explained by a low intake of iodine accentuated by accelerated growth (spurt).

7.4. Environmental Factors

The boarders spend most of their time in schools. On the other hand the day scholars also spend quite a time at school. The secondary school child is quite matured to be able to notice and follow up things. If the teachers and administrators introduce good hygienic habits in the school, the children will follow first consciously and finally habits are formed which are good and beneficial to them. Also with the cultural changes, where the elders can afford to sit and listen to the educated young, the young can have quite an influence on their elders and families and introducing good and healthy habits.

All the four schools were neat and had sufficient latrines (lavatories), and two of the schools (boarding) had good sources of water supply from a tap or borehole. Machakos Girls' School diet is a bit varied on Sundays, but still more variation could be introduced in the

diet, and a few new foods such as fish be introduced in the diet, in order to take into consideration other nutrients which are deficient and widen the girls' knowledge on food habits and nutrition. Only one school teaches nutrition as a subject. This subject should be introduced in all schools. Or if health subjects were introduced to all schools, a section on Nutrition should be included. This will improve the nutritional knowledge of all students which in turn will be communicated to their families in their homes.

Discussion of Objectives and Hypotheses

This study was set up to investigate factors affecting the nutritional status and health of the secondary school children in Machakos District.

Through home visiting, observations were made and questionnaires were filled by parents in which the economic status of family based by occupation rather than income were assessed. As the incomes filled by most of the families was rather vague and looked suspicious, this section was left out. Information on education

level of the families, sizes of the families, housing facilities and marital status and food availability was obtained. Information on schools, and school facilities and meal patterns of the boarders was obtained through visiting the schools and questionnaires to the heads of the schools (Appendix 6). Anthropometric measurements of the students were taken, clinical examinations, blood and stool samples were collected and tested for Hb levels and parasites respectively.

A slight difference was seen in the nutritional status, between the boys and girls and between the boarding girls and day girls and the boarding boys and day boys. But these differences were not very significant as such. Boys' nutritional status being slightly better than the girls', and day girls having a better nutritional status than boarding girls.

Girls have more clinical signs, showing more pallor of conjunctivae, pallor of nail bed,

goitre and obesity, whereas boys have only one sign of decayed teeth. Boys have higher Hb levels than girls. Of the anthropometric measurements girls show signs of being heavier than the boys; more boys are found to be malnourished than girls. More boarding boys are found to be underweight than day boys. More boarding girls have intestinal parasites than day girls.

Although there is an increase in iron requirement in girls after puberty, there was no significant difference between presence of anaemia in girls and boys as shown by Hb levels. However judging from the presence of palor, we find that a significant difference exists between pallor of the nail bed and pallor of Conjunctivae.

But since we are comparing mean of Hb level and percentages of Hb the two are not comparable and therefore no meaningful conclusion can be drawn from these.

Measurements of body weights were taken only twice, once at an end ofthe term and once at the beginning of term. No significant

differences were shown in the two weights. For this hypotheses to be proved, more weights should be taken probably more than twice at the end of terms and more than twice at the beginning of terms.

When the socio-economic factors are related to the anthropometric findings, and the clinical findings, a slight difference is found in nutritional status between those children who live in better socio-economic conditions and those whose parents have received formal education than among those who are less privileged.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

Changing social conditions, demographic and types of behaviour are producing new social and health needs in all parts of the world. Adolescents in particular are assuming an increasingly significant role and, in most developing societies, are beginning to constitute a strong social and economic component.

In the past, many of the health needs of this age group were neglected. Little was known about them and little was done for them. It has gradually been realized that their needs are considerable, and are not only physical, but also mental (emotional) and social. It is important therefore that the needs of adolescents and their significance be acknowledged in a changing world. It is equally important that mechanisms should be developed to foresee these problems and to allow appropriate programmes to be developed to prevent them.

"The school is one of the most important gathering places for a large section of the population and as it is a progressive part of the

community, it might be the easiest place in which to introduce new ideas on nutrition and hygiene with some hope of acceptance and spread and continuation to the next generation." (Bennett and Lutwama, 1966). Other programmes however should be organized to meet the needs of the adolescents who have not been lucky enough to be in schools.

The recommendations put forward in this chapter are those given by various authors who have had the adolescents in mind in their researches. They are then considered against the findings of the present research.

1. The School Environment

Bennett and Lutwama (1966) recommended deep boreholes or other good sources of water in boarding schools, good ways of waste (excreta) disposal and sufficiently big and well ventilated classrooms. All the schools in the study seem to have been built with these views in mind. The exception is in the dormitories in the boarding schools which were rather crowded. Probably lack of funds has led to this situation where, the schools have

been forced to have a large intake, of students whereas the sleeping space has been the same.

2. Growth and development studies

Growth and development studies permit more effective planning of long range health care programmes for adolescents and should also yield further facts for improving medical teaching and for the assistance of those who plan educational and vocational programmes.

There is a need for standardization of methods of assessing growth and development, including criteria for making and analyzing measurements. Only when such standards exist can comparative cultural studies be really valid. Precise information on chronological age is essential for correct analysis and interpretation of growth data (WHO, 1965).

If a simple growth chart is kept on each student for each child right from the time he/she starts schooling, growth studies would have been done easily, local standards for measurements such as weights and heights can easily be established in the country by using such records. Cross-section studies cannot

provide enough information to set local standards. As it is, none of the schools in the study had any growth charts, and actually these charts do not exist in any school in Kenya.

It was therefore impossible to assess the growth pattern and standards of children from developed countries were used. Although the backgrounds of the two groups are completely different, these standards can still be used for comparative purposes.

3. The School Meals

In boarding schools trained cateresses should be employed to plan the meals for boarders. Diets should be reviwed periodically because it is very easy for some vital items to be omitted with subsequent deficiency diseases developing in children. These meals should provide an educational situation which children learn about (new) foods and nutritional values. (Bennett and Lutwama, 1966). For the day students arrangements should be made so that there is a school feeding programme in each secondary day school. The purpose of this programme should be to provide items

which might be lacking in home diet e.g. vitamins, proteins or minerals, and to provide calories to improve the child's performance during a long day. It should be noted that some of these children come to school without breakfast, and some do not have lunches at all and would be glad if a school lunch programme was provided.

A national policy of school meals could be established or this could be undertaken at the local school by interested parents and teachers. In addition to the setting of this programme, adequate thought should be given to food storage, the kitchen, the dining place, utensils, water supply, seasonal marketting difficulties, the staff required and budgetting.

The diets of both boarding schools examined, fell short of calories, some minerals and vitamins. Sprouting of beans for 2 to 3 days has been known to synthesize considerable amounts of ascorbic acid, and increase the amount of riboflavin and niacin.

This method if used in schools could be a cheap way of increasing the vitamins in the diet. Although trained cateresses are found in both schools, it should be noted that the diets were rather monotonous: introduction of a few new foods such as fish once in a while would have improved the diet considerably.

4. The teaching of Health Education

Adolescents must eventually assume adult responsibilities, among which is responsibility for their own health and of other people.

An adolescents' health education should not be taught as something isolated from his past. It starts in childhood with the example set by his parents with regard to their own health practices. Trained teachers, and health personnel should teach the subjects, and emphasis should be put on real existing problems such as hazards of smoking, excessive drinking of alcohol, the abuse of drugs, and prevention of accidents and venereal diseases (WHO 1965). Hygiene and nutrition should be included in the syllabus and be related to real life. This

subject should be taught in all schools for the benefit of the adolescents.

Amongst the schools in the study only one school teaches Health Science as a subject, two schools teach biology (which should include health science) and one girls' school teaches biology and home economics as health education subject. It should be noted that more health education is needed in all the schools in order to relate it with the students' living conditions. Most of these children in these schools come from very poor backgrounds where standards of hygiene are very low. Schools could help a lot in enforcing these aspects.

5. Extra Curricular Programmes

Besides the academic subjects in schools extra curricular programmes related to health, could be used very easily to increase the health education of the adolescents. Clubs such as the First Aid Club, the Four K Club or the Young Farmers Club, a school garden could be introduced where vegetables can be grown and used in the school. A Cookery Club where

foods and nutritional value of foods ban be stressed while at the same time the children are enjoying themselves in the cooking. All such clubs can increase the health awareness of the adolescents.

Once in a while doctors, home economists, family planning personnel, health workers in various fields could be invited to give talks on various interesting talks on health hazards, and how to prevent them.

As it appears that the number of pregnancies occurring in early adolescence is increasing, and there is evidence that the infants born of these pregnancies tend to have low birth weights and are subject to neglect and unfavourable feelings from immature mothers sex education programmes should be included in the curriculum of the secondary school children. These programmes should not be limited to information on reproductive physiology but should be designed to cover a far broader range of topics including contraception, family life and parenthood. They should also deal, as far

as possible, with questions of ethics in interpersonal relationships and responsibility in reproductive behaviour (WHO 1975). As it might be difficult to include these topics in an already tight school routine they could well be covered if personnel from the Family Life Education are invited every now and then to give talks in these areas.

From the observations made in the extra curricular activities of the schools in the studies, it seems that a lot has to be done in the area. What is being done is not adequate for the adolescents. This group needs special attention.

CHAPTER 9

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CHAPTER 10

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Appendix 1

SURVEY FORM FOR THE ADOLESCENT

To be helped by a medical doctor

No.:	Name:	
Sex:	Address:	
Birthday:	Age:	
Anthropometry		
Weight	Wt/Age	%
Height	Ht/Age	%
Arm Circumference	Wt/Ht	
Triceps Skin fold:	Arm Circum.	% level
	Skinfold	% level

Clinical Tests

Conjunctival wrinkling

Bitot's spots

Corneal Scarring

Pallor of Conjunctivae

Pallor of tongue

Pallor of nail bed

Angular Stomatitis

Cheilosis of lips

Spongy/bleeding gums

Goitre: 0 1 2 3

No. of decayed teeth:

No. of missing teeth:

Clinical Tests (contd.)

Mottling of teeth:

Obesity 0 1 2 3

Laboratory

Stool: Ascaris/Hookworm/Giardia

Others: (state)

Blood date

Haemoglobin

Appendix 2

QUESTIONNAIRE FOR GIRLS

Name of Child: ..... Date: .....

Age: .....

School: .....

1. Do you have your menstruation period?

Yes ☐ No ☐

2. If yes, when did you start the first period:

1970 1971 1972
1973 1974 1975
1976

3. When you started periods how often did you have them:

a) once every month
b) once after 2 months
c) once after 3 months
d) once after 4 months
e) once after 5 months
f) once after 6 months

4. When did you start having periods once every month?

1970 1971 1972 1973
1974 1975 1976

Appendix 3

QUESTIONNAIRE ON NUTRITIONAL KNOWLEDGE OF THE ADOLESCENT

1. Beans contain less protein than maize Yes/No
2. Fruits are a good source of vitamin C Yes/No
3. Tinned fruits and vegetables are more nutritious than fresh fruits and vegetables Yes/No
4. Anaemia may be due to a deficiency of one of the following:- Calcium; Iodine; Iron.
5. Kwashiorkor is a disease of young children brought about because of lack of calories in the diet: Yes/No
6. A lack of iodine in the diet could result in one of the following diseases:-
   anaemia, goitre, oedema
7. Breastfeeding alone does not provide sufficient nutrients for a baby aged 2 months and should therefore be supplemented with cow's milk, powdered milk or some other milk product Yes/No
8. Which of the following member of the family needs more protein relative to calorie intake:- Pre-school age child; school child; hard-worker; father; mother.
9. A balanced diet is a diet containing all the nutrients necessary for body building, energy giving and body protection. Yes/No
10. A pregnant woman needs more food intake than a non-pregnant woman. Yes/No

Appendix 4

QUESTIONNAIRE FOR MOTHERS

1. District: ..... Location: .....

2. Name of Father: .....

   Name of Mother: .....

3. Age of Father: ..... Age of Mother: .....

4. Marital Status of Mother:

   Married ☐ Divorced ☐

   Widow ☐ Single ☐

5. Educational level of the parents:

   Mother: ..... Father: .....

6. a) What is the importance of protein foods in the diet of children?

   Explain: .....

   .....

   .....

   b) Should children be given eggs?

   Yes ☐ No ☐

   c) If there was just a little money left for housekeeping, which of the following would you buy? And why?

   Sugar ☐

   Flour ☐

   Meat ☐

   Eggs ☐

   Bread ☐

   d) There is only a little meat left from yesterday's supper, to whom should you give the meat? And why?

   The husband ☐ Yourself ☐

   Older children ☐ Younger children ☐

Appendix 5

QUESTIONNAIRE FOR PARENTS

District: ..... Location: .....

Sublocation: ..... H/H No.: .....

Date: .....

Socio-Economic Data

1. Name of Household Head(H.H.) .....
2. Occupation of H.H./husband: .....
3. Edication of H.H./husband: .....

   Years attended school: .....
4. No. of household members: .....
5. Kitchen separate from living room:

   Yes ☐ No ☐
6. No. of rooms excluding kitchen: .....
7. Type of roof:- Corrugated sheet ☐

   Flattened tins ☐ Thatch ☐

   Others ☐
8. Type of floor:- Cement ☐ Earth ☐

   Other: ☐
9. Latrine:- Present and used ☐

   Present not used ☐ Not present ☐
10. Water source:- Spring ☐ Well ☐

    Roof ☐ Catchment ☐ Other ☐
11. Fuel used for cooking: Kerosene ☐

    Charcoal ☐ Wood ☐ Other ☐
12. Lighting: explain type: .....

Appendix 5 (contd.)

13. Storage Facilities

Storage of food:

i) Cooked food .....

ii) Raw food .....

14. Types of food item bought (previous week)

	1. Food	Cost
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

(If more foods continue overlead)

15. Size of the family:

Name	Age	Sex

(If more names continue overleaf)

Appendix 5 (contd.)

16. Types of foods produced by the family:

1	7
2	8
3	9
4	10
5	11
6	12

Appendix 6

DATA ON SCHOOL FACTORS

QUESTIONNAIRES TO HEADMASTERS/TEACHERS

Name of the School:

Size of the School:

No. of Boys:

No. of Girls:

No. of hostels (if boarding)

No. in each hostel:

Size of each hostel:

No. & type of beds:

Sanitary Facilities in School:

Latrine (lavatories):

Laundry facilities:

Disposal of waste (dirty water and rubbish)

General Appearance of school Healthy ☐

Unhealthy ☐

CATERING FACILITIES

1. For day scholars Yes ☐ No ☐
2. For boarders Yes ☐ No ☐
3. Cateress/Matron Present ☐ Absent ☐
   (a) If 3 present trained Yes ☐ No ☐
   (b) If 3 absent who plans meals:-
4. No. of cooks:
5. Size of kitchen:

Appendix 6 (contd.)

6. Equipment:

7. Cooking stoves:

8. Storage of food:

9. Storage of equipment:

10. Transportation of food to school:

11. General impression on catering (kitchen premises) Healthy Yes ☐ No ☐

12. Availal'lity of canteen for day scholars?

Yes ☐ No ☐

OTHER INFORMATION ON HEALTH

1. Teaching of Home Economics in School:

Yes ☐ No ☐

If Yes, which subjects:-

If Yes, facilities: Good ☐ Fair ☐
Poor ☐ Below Standard ☐

(Collect syllabus if possible)

2. Other Health Education Subjects Yes ☐ No ☐

If yes which? (Name)

If yes facilities for subject: Good ☐

Fair ☐ Poor ☐ Below standard ☐

(Collect syllabus if possible)

3. Any dispensary in the school: Yes ☐ No ☐

Appendix 6 (contd.)

4. Presence of Doctor, Nurse, Matron in school ☐ ☐ ☐

   If not other trained staff: Name

5. (a) Dispensary/Health Centre near School
   Yes ☐ No ☐

   (b) Distance from school:

6. Visiting Doctor in the School: Yes ☐ No ☐

7. School Counsellor: Yes ☐ No ☐

   (a) If present, trained: Yes ☐ No ☐

   (b) If absent, any other person acting as counsellor

8. Any other method used on Counselling/Guidance/ Health talks/talks from social worker, etc.

CHILDREN'S PERFORMANCE (IN GENERAL)

Collect results on EACE for last 3 years.

Good ☐ Satisfactory ☐ Poor ☐
Very Poor ☐

EXTRA CURRICULAR ACTIVITIES

Radio: Present ☐ Absent ☐

T.V. : Present ☐ Absent ☐

Newspapers for children: Yes ☐ No ☐

School clubs Yes ☐ No ☐

If yes, any related to health: