NUTRITIONAL EVALUATION OF IMPROVED LOCAL DIETS BASED ON RAGI AND RICE ON PRESCHOOL CHILDREN

By

Kalpana, R.

A Thesis Submitted to the University of Madras
in Partial Fulfilment of the Requirements
for the Degree of Master of Science,
April, 1977.

A C K N O W L E D G E M E N T

The author wishes to express her deepfelt gratitude and sincere thanks to Dr.(Tmt.) Rajammal, P.Devadas, M.A.,M.Sc., Ph.D., (Ohio State), Principal, Sri Avinashilingam Home Science College for Women, Coimbatore, for her guidance and valuable suggestions throughout the study. She expresses her thanks and gratitude to Miss.N.Bhooma, M.Sc., (Madras), Lecturer in Foods and Nutrition, Sri Avinashilingam Home Science College for Women, for her continuous help, suggestions and guidance during the study. Her thanks are due to Dr.S.N.Jagannathan,M.B.B.S., M.Sc., (Applied Nutrition) for his assistance in clinical examination of the children. A special word of thanks to the children who participated in the feeding programme and their parents for their kind co-operation.

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

I INTRODUCTION

One of the most formidable tasks India faces is helping its millions of chronically underfed, specially children reach a healthy nutritional level (Devadas, 1977).

Out of 500 million children under the age of five years, 400 millions live in the developing countries and it is in this section that 97 per cent of all deaths in that age group occurs (Morley, 1973). Children below five years constitute in our country fifteen per cent of our population. Roughly 50 per cent of the preschool population suffers from under nutrition and malnutrition which are pre-eminent handicaps (Gopalan, 1973; Nutrition, 1973; Brown, 1973; Luthra, 1973 and Devadas, 1977). Nagarajan (1977) speaking about the nutrition profile of vulnerable segments of Indian population records with a disheartening note that the chances of preschool child's survival have not yet shown encouraging trends.

Malnutrition is a global health problem and is mainly due to ignorance, false beliefs, traditions, customs and faulty food habits (Pascual, 1972; Mathur et al 1974; Bailey, 1973; Gopalan, 1973; Ramalingaswami, 1973 and Devadas, 1976, 1977). Malnutrition in the first years of life "distorts the normal symmetry of size and body", leads

"to a perversion of development", "creates a disproportionate child" or is responsible for "lack of balanced growth" (Bengoa, 1974).

The immediate consequences of malnutrition at this age are, high morbidity and mortality, while the long term consequences are chronic under nutrition, retarded growth and mental development, stunted adult status, apathy, inertia, slow minds and low levels of production (Jelliffe, 1968; Read, 1968; Mayer, 1970; Dume, 1971; Berg, 1973; Mc Namara, 1973; Pasricha, 1973; Kymal, 1973; Brown, 1975; PAG, 1975; Rajalakshmi, 1976; Stewart, 1976 and Devadas, 1977). The problems of malnutrition and under nutrition pose a serious threat to the growth and development of children and in turn that of the country. Hence preschool children are given high priority in all nutrition programmes (Nutrition, 1973; Swasth Hind, 1974 and Cool, 1975).

Several supplementary feeding programmes have been launched and are in operation under the auspices of the central and state governments and voluntary agencies throughout India (Devadas, 1976 and 1977). Any feeding programme to be successful should have a builtin integral health and nutrition education scheme. Most of the feeding programmes in operation in India are at present aided by

agencies from other countries and supplies, food materials as donations. Once the agency ceases to supply the food materials, the feeding programme will lose its impetus. It is in this vein that the present day nutrition experts speak about the utilisation of low cost, locally available foods which have been an element of self generation and self-reliance (Gopalan 1973; Pasricha et al 1973 and Devadas et al 1976).

Apart from the benefits outlined above, improvement on local dietaries has an advantage of being woven around the traditional food habits and cultural dietary patterns of the society and hence inspite of feeding programmes being withdrawn, has the possibility and feasibility of continuance by the families themselves if they are given proper nutrition education. Costing such improved dietaries to suit the common man's purse along with proper education in nutrition and availability of foods would gain momentum in its follow up by the common population.

Devadas and coworkers (1972) have developed many a low cost indigenous dietary combinations based on local diets of which two have been selected for human feeding trial for their superior protein quality, calcium availability and carotene utilisation as judged on experimental animals.

The present investigation was an attempt to evaluate the impact of these two low cost, locally available rural diets based on ragi and rice on preschool children between the age of two and a half to three and a half years. A balanced diet with ragi or rice as the basic food, pulses, green leafy vegetables, roots and tubers, other vegetables, nuts and oilseeds, fruits, jaggery and milk products were used in the feeding trial to meet two thirds of the daily Recommended Allowances for foods. The nutritional benefits of these diets were studied through changes in the anthropometric measurements, biochemical parameters and clinical picture of the preschool children over a period of six months.

II REVIEW OF LITERATURE

The literature pertaining to this study on nutritional evaluation of improved local diets based on ragi and rice on preschool children is reviewed under the following heads:

A. Nutritional profile of preschoolers in India

B. Indigenous food combinations as a strategy to combat malnutrition

C. Methods of assessing the nutritional status of preschool children and

D. Feeding programmes as a measure to alleviate malnutrition among preschool children.

A. Nutritional profile of preschoolers in India:

The world's population was edging towards four billion by the middle of 1975, and increasing by nearly two per cent a year. This rate of increase means that the earth's population would double in the early years of next century (United Nations, 1977). It has been estimated that at least 460 million people now suffered from a severe degree of protein energy malnutrition (UNICEF, 1975). Out of 500 million children under the age of five years, 400 million live in the developing countries, and it is in this section that 97 per cent of all deaths in that age group occur (Morley, 1973). Children below five years constitute in our country 15 per cent of the population (Gopalan, 1973

and Luthra, 1975). Roughly 50 per cent of the preschool population suffers from under-nutrition and malnutrition which are pre-eminent handicaps (Morley, 1973; UNICEF, 1975; Luthra, 1975 and Prasannappa et al 1976).

Every child has a future and it is determined by what and how often do we feed him-whether he will be healthy or diseased, intelligent of retarded, clever or dull (Mehta, 1974). The impact of undernourishment is not always limited to death during the early years of human life. Experiments have shown that severe malnutrition during the formative years results in emotional problems and difficulty in adapting to changes later on. Protein, crucial for children's mental development, is often lacking in the diets of pregnant women. The infant, unable to get enough nutrition in the fetus during critical stages of development, may never recover (Devadas, 1970; Srikantia and Sastry, 1972; Brown, 1975; Swaminathan, 1971 and Udani et al 1976). The effects of diseases and malnutrition are also frequently more serious during the formative years and prevent children from attaining the full genetic potential for development (Cravioto et al 1969; Behar, 1975; Luthra, 1975 and Udani et al 1976).

Malnutrition is an important cause of infant and child mortality, stunted physical growth, slow minds, low

work out put, premature ageing and reduced life span in the developing countries. (Read, 1968; Jelliffe, 1968; Mayer, 1970; Dumo, 1971; Berg, 1973; McNamara, 1973; Brown, 1975; PAG 1975; Stewart, 1976 and Devadas, 1977). Malnutrition is invariably associated with infections and infestations. While malnutrition increases the susceptibility to infection, infection aggravates malnutrition (Scrimshaw et al 1968; Datta Banik et al 1971; McCance, 1971; Scrimshaw, 1972; Devadas, 1972; Gopalan, 1973; Srikantia, 1974 and Jelliffe, 1976).

Good nutrition and malnutrition are the end results of many interacting factors operating simultaneously and concurrently on the individual in the physical, ecological and cultural environment (Devadas, 1972 and Gopalan, 1973). The nutrition and diet surveys carried out in the different parts of our country under the auspices of the Indian Council of Medical Research have shown that the diets of poor people are composed predominantly of cereals and are deficient in protective foods, such as egg, meat, milk, vegetables and fruits (Pandit, 1964; Rao, 1968 and Desai et al 1970).

The pattern of growth and physical status, though genetically determined is strongly influenced by several socio-economic factors of which, diet is important. Children belonging to different socio-economic groups and different

income levels have been shown to have significant differences in their growth pattern and nutritional status. Rao and Sathyanarayana, (1976), Devadas and Easwaran (1967) and Thimmayamma et al (1974) also opine that income appeared to have a decisive influence on the food intake. The diets consumed by the weaned infants and preschool children belonging to the low income groups of the population in India are lacking in general, in protective foods. (Devadas et al 1967; Champakam and Balasubramaniam,1968; Balasubramaniam, 1969; Bagchi,1970 and Gopalan and Vijayaraghavan, 1971).

The primary bottle neck in the dietaries of preschoolers belonging to the poor socio-economic class as indicated in several studies (Rao, N.P. et al 1969; Rao,B.S.N et al 1969; Gopalan, 1969; NIN, 1972; Sundararaj, 1972; Srikantia, 1973 and Pasricha, 1973) point out the existence of a calorie gap or food gap. The intake of iron, thiamine and niacin were adequate, while the amount of Vitamin A, riboflavin, ascorbic acid and calcium in the diets of the preschoolers were found to be markedly deficient (Sundararaj, 1972).

As Gopalan (1973) points out, the ultimate nutritional upliftment of our communities can only be achieved through educating the village communities to effectively utilise locally available foods for better nutrition.

B. Indigenous food combinations as a strategy to combat malnutrition:

In most of the developing countries, the diets consumed by a great majority contain negligible amounts of good quality proteins. These proteins are costly to purchase and are beyond the reach of the poor (Devadas et al 1974). The strategy suggested by Sukhatme (1972) for alleviating protein malnutrition is the production of semi conventional, inexpensive, locally available protein rich foods.

One of the most important reasons for using locally available foods in any supplementary feeding programme, is that it introduces an element of self generation (Pasricha et al 1973). Rajalakshmi, (1976) feels it is appropriate to emphasize that diets or supplements based on ordinarily available foods can eradicate the deficiency symptoms resulting from malnutrition and that we need not place our dependence on processed high protein foods. According to Seman et al (1974), the need for local foods to meet the nutritional requirements of people is more than ever urgent in the present context of accent on self reliance, for self sufficiency alone can combat malnutrition and pave the way to success, warns Gopalan (1973).

Kymal (1973) feels that the acute shortage and high cost of conventional high protein rich foods such as

milk, meat; eggs etc. have necessitated the development of nutritious processed food formulations based on readily and locally available cereals, fortified with high protein edible oilseed meals and also pulses.

Modern science and technology has made possible the production of various processed protein foods as a measure to meet the protein deficiency. Some of the protein rich foods developed in India are the multipurpose food, malt foods, vegetable milk, cotton seed meal, vegetable protein mixtures, fish protein concentrates and leaf protein (Mathrani, 1972 and Devadas et al 1974). Research efforts in several countries have helped to develop high protein mixtures of locally available plant material that approach or equal the results obtained with milk proteins. The main protein sources for such combinations are cereals, legumes, oilseeds and meals and isolated plant proteins (Register et al 1967). Several workers in India have reported on the development of supplementary foods based on the locally available protein rich foods of vegetable origin, suitable for supplementing the diets of vulnerable sections of the populations (Subramanyan et al 1960 and Devadas and Radhabai, 1966).

Bains et al (1960) reported that CFTRI had developed palatable protein rich foods designed as nutro food comprising

nutro biscuits, nutro macaroni, nutro breakfast and nutro protein foods.

Parthasarathy et al (1962) found that supplementing a rice based diet with 50g. of edible ground nut flour, fortified with vitamins and minerals has a significantly higher nitrogen retention than rice diet.

Rao et al (1965) demonstrated that Multipurpose food containing groundnut flour and Bengalgram flour was one of the good sources of vegetable protein for preschool children.

The supplementary relations between the proteins of rice and ragi and Bengal gram fed in the ratio of 7:3 have been studied and a feeding trial was conducted on weaned infants by Daniel et al (1967) with low cost balanced feeds based on blends of ragi or maize, groundnut, bengal gram, soya and sesame flour, and fortified with limiting amino acids.

Radhakrishnan et al (1967) studied the effect of the wheat based and rice based diets on the growth of preschoolers. There was greater increase in height in group consuming rice-based diets.

Chandrasekhara et al (1972) report that spray-dried preparations containing ground nut protein in combination with milk-solids and small amounts of enzymatically

treated wheat and barley have been efficient in the feeding of young infants. These contain 26 per cent protein.

Periera et al (1968) found that an infant food based on peanut, flour, containing only 25 per cent skimmed milk with solids, was as adequate as whole milk.

Swaminathan et al (1968) studied a diet based on ragi, supplemented with protein foods based on groundnut, sesame, Bengal gram and soya flour or skim milk powder. The same study with maize showed that the growth promoting value of the maize diet was noted only when the supplement provided ten per cent extra proteins. The effect of replacement of 25 per cent of the cereals in poor Indian diets with a low cost mixture containing 19.3 per cent protein based on a blend of ragi 65 per cent, peanut flour 25 per cent and chick pea flour 10 per cent fortified with calcium, phosphate and vitamins, on the overall value of the diets resulted in significant increases in growth of children (Kurian et al, 1970)

Narayanaswamy et al (1972) observed a significantly higher nitrogen retention in children whose poor rice diet was supplemented with low cost protein food (based on wheat and soy bean) or chick pea or skim milk powder. This provided an extra protein of 5g. to 10g. to their diet.

A supplement in the form of laddoo made from wheat flour (30g), green gram (20g), groundnuts (8g) and sugar or

jaggery (20g) was enough for a child per day to bridge the calorie gap of 300 calories in preschool children (Swaminathan et al 1973 and Srikantia, 1973).

Balahar-a high protein, low cost well balanced food developed by the Central Food Technological Research Institute (CFTRI), Mysore, is a blend of wheat flour, groundnut flour, and Bengal gram flour fortified with vitamins and minerals. The protein content of Balahar now under preparation is between 22-24 per cent and gives 360 calories per 100 g. (Kymal, 1973).

Miltone is a vegetable toned milk. Instead of using imported skim milk powder for toning, protein isolate from groundnut has been used. The groundnut cake, a by-product of oil industry can be made use of for its preparation and it has high protein content also. It gives 4 per cent protein, 5 per cent carbohydrate and 150 I.U. vitamin A. The only drawback is its short shelf life like other pasteurised milk (Chandrasekhara, 1973).

Under CARE, Kerala Indigenous Food project developed an indigenous food for Kerala which consisted of tapioca flour, peanut flour, Bengal gram flour; wheat flour and Multipurpose food (Chick Pea flour and Bengal gram flour in the ratio of 3:1). This can be used in the form of uppuma, payasam or porridge. Its calorific value for 100 g. is

410 and the protein 15g. (Napier, 1973). Chandrasekhar et al (1976) evaluated the KIF Products evolving local recipes for school children and found them to be highly acceptable.

Devadas et al (1974) evaluated a weaning mixture based on locally available cereals and pulses such as maize, roasted Bengal gram dhal, roasted groundnut and jaggery. A significant increase was seen in the heights and weights of children in the experimental group.

C. Methods of assessing the nutritional status of preschool children:

In general, the objectives for which the nutritional status of populations and individuals need to be assessed as summarised by FAO/UNICEF/WHO (1976) are:

1. Diagnosis of the nature, extent and causes of nutritional problems;
2. Establishment of a baseline for a later evaluation of control measures, curative or preventive;
3. The screening of populations for individual health care;
4. The recognition (identification) of changes in nutritional status as trends or movements around trend;
5. The planning and monitoring of programmes and policies for food and nutrition; and
6. The establishment of an early warning system for a seriously deteriorating situation or a developing emergency.

Nutritional status of an individual or community could be assessed by various yard sticks, as dietary survey such as weighment or recall method, physical anthropometry, biophysical and bio-chemical tests and vital statistics (Jelliffe, 1969; Davidson et al 1973 and Swaminathan, 1974).

i. Anthropometry:

Anthropometry, consisting, primarily of the direct body measurements by means of the anthropometers is a technique used to express the form of body, quantitatively (Meyer, 1972 and Tan et al 1974). Anthropometric data offer a method for evaluating the ultimate product of growth for any community. The need for such data has been emphasized in the interest of tackling malnutrition. It has been generally agreed that nutritional anthropometry may be a useful tool in the assessment of the magnitude of malnutrition (Sastry and Vijayaraghavan, 1973; Gupta et al 1973 and deGwynn and Sanjur, 1974).

(a) Height:

Ronaghy et al (1968) believes that height is more significant, weight may vary from short term factors, but height once gained is not lost. Thus, Waterlow, (1963) says that stunting in height is perhaps an evidence of a long continued process, where as a weight deficit can of course be established in quite a short time.

(b) Weight:

Weight, the total measurement of body mass, is key to nutritional anthropometry. It is easy to measure and understand equally by doctors, nutritionists and mothers and mothers and presents practical form of nutrition education (Jelliffe, 1968).

Watson and Lowery (1967) suggest that, of a group of body measurements, body weight is the best index of nutrition and growth.

(c) Head circumference and chest circumference:

Head circumference is related mainly to the brain size and growth and to a small extent to the thickness of scalp tissue and skull. The head circumference may be used as a rough additional guide in age assessment (Jelliffe, 1966; Parekh et al 1970 and Wakhlu, 1972). At birth, the head circumference is larger than the chest circumference. In Indian children (both boys and girls), the crossing over of chest and head circumference takes place around two years whereas in American male infants this takes place by about nine months. This indicates the growth retardation in Indian children due to poor nutritional status (Gopalan and Vijayaraghavan, 1971).

(d) Mid upper arm circumference:

Between one and four years of age arm circumference shows little increase and is therefore relatively age

independent. Arm circumference related to height has been used as an indicator in relief operations in Nigeria and Bangladesh for a quick classification of malnourished children (Florentino & picar, 1975 and FAO/UNICEF/WHO, 1976).

Studies conducted at National Institute of Nutrition (ICMR, 1976) Hyderabad, show that both arm circumference and body weights were significantly lower in children with signs of protein-energy malnutrition as compared to apparently normal children. Though arm circumference is significantly associated with all other measurements (weight, height, chest circumference, head circumference, calf circumference, fat folds at triceps and calf), a considerable proportion of variation exists in measurements reflective of skeletal development, muscle and fat components of the body. Arm circumference alone may not provide reliable information regarding protein energy malnutrition, but together with other measurements like height and weight will be of use for the assessment of nutritional status.

2. Biochemical methods:

The most objective means for assessing the nutritional status and to evolve some normal patterns of deficiency, will be based on biochemical analysis of materials such as blood and urine that can be sampled easily (Rao et al 1969 and Whitehead, 1969). The methods found useful as for

diagnosis of protein deficiency include, estimation of plasma protein concentration, free amineacids in serum, albumin and creatinine excretion or urea/creatinine ratio in the urine (McLaren et al 1965; Jones and Schendal, 1966 and Swaminathan, 1969).

A situation of insufficient protein intake results in a decrease in the protein mass of the body. Therefore, the detection of this deerdase would be a direct indication of protein depletion. The excretion of urinary creatinine per unit of time is recognised as an indirect indicator of muscle mass. (Arroyave and Wilson, 1961). Creatinine height index has been proposed as a simple quantitative expression of the extent of depletion (Viteri et al 1966). The index is the ratio of the amount of creatinine excreted per unit of time by the children under study to that excreted by the normal children of the same height regardless of age. A ratio of one would be course indicate a fully developed muscle mass for the subjects being assessed. Ratios lower than 0.9 are interpreted as indicative of proportionally depleted protein mass (Arroyave, 1969).

Aneamia is a common problem in pediatric practice. It has been observed that the regeneration of haemoglobin does not keep pace with the disappearance of oedema on high protein diet nor with the restoration of plasma protein. (Rao and Sandosi, 1970).

3. Clinical examination:

Gopalan and Rao, (1961) states that signs of frank deficiency are so widespread that clinical assessment of malnutrition gains particular importance in India. Krehl and Hedges, (1965) consider the clinical method as the most commonly used method of assessing the nutritional status.

The clinical examination adopted in nutritional studies, is a careful physical examination including medical history, with special attention given to various symptoms and signs that are more or less associated with nutritional deficiencies (Swaminathan, 1969 and Nelson, 1965). The superficial epithelial tissues, especially the skin, eyes, hair and buccalmucosa or organs near the surface of the body, such as paretids and the thyroids are examined. This method has been found to be relatively inexpensive, rapid and not requiring elaborate field equipment or a costly laboratory (Jelliffe, 1969). The common nutritional deficiency signs that are looked for are pale conjunctiva, Bitot's spot, angular stomatitis, retarded growth and skin changes, bleeding spongy gums, pigeon chest, bowlegs, knock knees, changes in the tongue etc. (Mathur et al 1974).

The limitations, however are that trined physicians are needed to examine the groups and that the same group must be examined periodically to detect improvement or worsening.

4. Dietary surveys:

Dietary surveys are carried out to obtain information on dietary intake to determine in large measure, the nutritional level and health of its people, and to identify groups and individuals suffering from malnutrition and rectify the effects of ill balanced diets (Martin, 1963; Sjolin, 1969 and Davidson et al, 1973).

D. Importance of preschool feeding programmes:

As outlined by Devadas, (1975), preschool feeding programmes should aim at comprehensiveness, use of local foods, local participation, good organisation and integration with other health services. They have a twin role to play, namely, 1. the improvement of the nutritional status of the children and 2. nutrition education with the feeding programme serving as a culturally acceptable and practicable teaching aid to motivate and convince the community, towards desirable changes in food behaviour and habits.

In all developing countries, nutrition of the pre-school and school children has been engaging considerable attention. The prevalence of malnutrition in this age group has been estimated to be as high as 50 per cent and special nutrition programmes and midday meal school feeding programmes have been undertaken in different countries for the past several years (Sukhatme, 1967 and Kothari, 1973).

One of the important aspects of supplementary feeding programmes is the nature of the food supplement, which needs to be given.

The food supplements advocated in these programmes have varied on the basis of available raw materials and convenience of using them. Several blends based on cereals and oil seed flour have been used by Governmental agencies under aided programmes (Swaminathan et al 1972).

Fuller et al (1972) and Bhattacharya et al (1972) point out that the criterion for the selection of supplementary foods is that they are locally available, relatively inexpensive and commonly used by the population. To be fully effective, the supplement has to be so formulated that it will bridge the gap between Recommended Allowances of all nutrients for optimal health and the level of nutrients supplied by the existing habitual diets (Srikantia, 1975).

Some of the feeding programmes in action in the country are:

a. Special Nutrition Programme (SNP)

It is a direct attempt at reducing and checking the ill-effects of malnutrition. It provides supplementary nutrition to children below six years as well as to pregnant and lactating mothers. Two specific groups of population-the urban slum dwellers and tribal population-are benefitted by the

programme. The supplement received by children of 1-3 years gives 300 calories and 10-15g protein. Apart from supplementary feeding, periodic health check-up and immunisation are also carried out. Improvement in the appearance of the children and their body weight is assessed and blood tests are carried out (Nutrition, 1973).

b. Integrated Child Development Services (ICDS)

As a pilot project, the Central Government has started this in 33 blocks (17 rural, 10 tribal and 4, in urban areas). The aim of the scheme is to provide a package of services which are essential to ensure the healthy development of preschool children. The services consist of: supplementary nutrition, immunization, health check up, referral services, nutrition and health education and non formal preschool education (Social Welfare Newsletter, 1975).

c. Applied Nutrition Programme(ANP)

This was started by the Department of Rural Development basically educational in character, aims at stimulating selfhelp activities for the optimum use of food resources available in the rural areas. It is designed to make the community more conscious of nutrition to impart nutrition education to children and mothers and to bring about a change in the food and dietary habits through local production, demonstration cooking and feeding (Barooah, 1976).

d. Balwadi Feeding Programme:

The Department of Social Welfare operates more than 1,700 balwadies for preschool children in the 3-5½ years age group. They provide a daily cooked midday lunch for the children in these balwadies. Food is provided either by the CARE organisation (C.S.M. and oil) or is locally purchased and the meal is cooked at the feeding centre (Kothari, 1975).

A Comparison of the two kinds of feeding programmes, namely, "On the spot feeding" and "Take home system" was attempted by Devadas, (1975). It was found that the "take home food" approach could be economical and feasible than "on the spot feeding". Similar observations has been reported by Grewal et al (1974) and Gopaldas, (1976), in their studies on the adhoc project Poshak sponsored by CARE as a pilot scheme to improve the nutritional status of women and children.

III EXPERIMENTAL PROCEDURE

The specific aim of this investigation was to evaluate nutritionally the impact of two improved rural diets, based on ragi and rice on preschool children. The procedure involved in the conduct of this investigation consisted of the following steps.

A. Selection of the villages, and setting-up of the preschool

B. Selection of the preschool children

C. Planning and standardisation of the meal pattern for the two preschools

D. Conducting the feeding programme and

E. Evaluation of the outcomes of the feeding programme.

A. <u>Selection of the villages and setting up of the preschool:</u>

Two villages, namely, Gevanoor and Gudalur Koundam-palayam of the Perianaicken Palayam block were selected as the venue for setting-up the two preschool feeding centres. These centres were selected because of the co-operation evidenced by the local leaders, panchayat officials and because these two areas were not covered by any other feeding programme.

The preschools in Gevanoor and Gudalur, Koundam Palayam were set-up in local buildings provided by local leaders and were to serve as feeding centers for rice based and ragi

based diets respectively. The necessary equipment like vessels, stering equipment, toys and educational materials were procured by aid from the Avinashilingam Trust Institutions.

B. Selection of the preschool children:

Twenty five children each from low socio-economic group in the two villages between the age range of two and a half to three and a half years were selected to serve as the experimental group in the investigation. Apart from the economic status of the parents, willingness and co-operation of the parents to participate in the programme over a long period was also the criteria in the selection. A third group of twenty five children from an adjoining locality and belonging to the same socio-economic back ground but not participating in any feeding programme was selected as control group.

C. Planning and standardisation of the meal pattern for the two preschools:

Based on their investigations with local rural diets of Coimbatore district Devadas and Coworkers (1973) had enhanced the nutritive value of ragi based and rice based diets with low-cost, locally available foods like sweet potato (root vegetable), horse gram (pulse), sesame and ground nut flour (oil seeds) and amaranthus (green leafy vegetable)

Their results in evaluating biologically the protein quality of the above combinations on albino rats indicated the potentiality of a rice based mixture which had horse gram, sesame and groundnut flour and a ragi based mixture which had groundnut flour and cotton seed flour as their components apart from legumes, root vegetables and green leafy vegetables in promoting growth, nitrogen, calcium and vitamin A retention. Subsequently based on their earlier recommendations Devadas and co-workers (1976) as a prelude to a longitudinal human feeding trial to test the efficacy of the two ragi based and rice based mixtures had translated these mixtures into suitable recipes and meal patterns. In this investigation an effort has been made to study the nutritional impact of the above mentioned rice based and ragi based mixtures on a group of preschool children over a period of six months.

In formulating the meals to be served in the preschools, the percentage composition of the ragi based and rice based mixtures (Devadas and Coworkers 1973) and the ICMR recommended allowances for food for preschool children were taken into consideration. The aim was to provide 2/3 of the requirements of preschool children through the preschool feeding. Quantities thus formulated using the above criteria for the ragi based and rice based diets are given in Table 1.

TABLE I

FORMULATED COMPOSITION OF THE RICE AND RAGI BASED DIETS TO MEET TWO-THIRDS OF THE DAILY RECOMMENDED ALLOWANCES FOR PRESCHOOL CHILDREN

FOODS	Percentage composition of Rice based diet	2/3rds of the daily requirements computed from the ICMR Recommended Allowances for Preschool children (g)	Percentage composition of ragi based diet	2/3rds of the daily requirements computed from the ICMR Recommended Allowances for Preschool children (g)
Rice (Parboiled & milled) /Ragi	35.84	170.80	38.84	185.14
Sweet Potato	4.50	21.50	5.00	25.10
Horsegram	13.50	64.36	11.00	52.43
Sesame	5.00	25.10	5.00	25.10
Amaranthus	5.50	25.21	4.00	19.06
Groundnut	4.50	21.45	5.00	25.10
Other Ingredients:				
Redgramdhal	7.46	35.55	7.46	35.55
Drumstickleaves	3.09	14.73	3.09	14.73
Potato	4.22	20.11	4.22	20.11
Brinjal	4.87	23.20	4.87	23.20
Banana	1.52	7.24	1.52	7.24
Milk	7.88	37.55	7.88	37.55
Jaggery	1.29	6.15	1.29	6.15
Groundnut oil	0.89	3.95	0.83	3.95

Taking into consideration the local dietary habits and meal patterns gathered from the bench mark socio-economic cum dietary survey, the raw foods as outlined in Table I were translated into practicable recipes and distributed into the three meals of the day as given in Table II. A model menu for a day in both ragi based and rice based diets is also presented in Fig. 1.

TABLE II

MEAL PATTERN FOLLOWED IN THE TWO PRESCHOOLS

RAGI BASED DIET

S.No.	Breakfast (8.00 a.m.)	Lunch (12.45 p.m.)	Tea (4.30 p.m.)
1.	Ragi pittu, Horsegram podi, Banana	Ragi Kali, Brinjal + Sweet potato + potato poriyal, Amaranthus massial, Horsegram thokku, Butter milk	Horsegram sundal, Roasted groundnut, Jaggery + sesame ball
2.	Ragi + Horsegram + Red gram dhal adai, Greens + Red gram dhal massial, Horsegram podi, Banana	Ragi kali, Horsegram thokku, Brinjal Sambar, Sweet potato + Potato poriyal, Buttermilk	Horsegram sundal, Roasted groundnut Jaggery + sesame ball
3.	Ragi uppuma, Horsegram + Red gramdhal Brinjal kootu, Banana	Ragi kali, Red gram dhal + Greens kootu, Sweet potato + Potato poriyal, Horsegram thokku, Butter milk	Horsegram sundal, Roasted groundnut Jaggery + sesame ball
4.	Ragi + Horsegram Dosai, Horsegram podi, Red gram dhal + Brinjal kootu, Banana	Ragi kali, Red gram dhal + Greens poriyal, Sweet potato + Potato Sambar Buttermilk	Horsegram sundal, Roasted groundnut, Jaggery + Sesame ball.
5.	Ragi + Red gram dhal + Horsegram dosai, Horsegram + Brinjal kootu, Banana	Ragi leaf cake (Horsegram + Red gram dhal stuffing) Greens + Sweet potato + Potato poriyal, Buttermilk	Horsegram sundal, Roasted Groundnut, Jaggery + sesame ball.
6.	Ragi kali, Horsegram + Brinjal thokku, Banana	Ragi + Horsegram + Red gram dhal dosai, Greens + dhal kootu, Sweet potato + potato poriyal, Buttermilk	Horsegram sundal, Roasted groundnut, Jaggery + sesame ball.
7.	Ragi + Horsegram + Red gram dhal adai, Horsegram podi, Banana	Ragi kali, Greens + Dhal massial Brinjal + Sweet potato + Potato poriyal, Buttermilk	Horsegram sundal, Roasted groundnut, Jaggery + sesame ball.

RICE BASED DIET

S.No	Breakfast (8.00 a.m.)	Lunch (12.45 p.m.)	Tea (4.30 p.m.)
1.	Horsegram + Rice dosai, Podi, Banana	Horsegram Rice, Sweet potato + potato and Brinjal sambar, Redgram dhal + Greens massial, buttermilk	Horsegram Sundal, Roasted groundnut, Jaggery + sesame ball
2.	Rice uppuma, Horsegram + Brinjal Kootu, Horsegram podi, Banana	Dhal + Greens rice, sweet potato + potato poriyal, Horsegram thokku, buttermilk	Sesame groundnut ball
3.	Rice Pittu, Groundnut chutney, Banana	Brinjal rice, Sweet potato + potato poriyal, Red gram dhal + Greens massial, Horsegram thokku, Buttermilk	Horsegram Sundal, Jaggery + Sesame ball
4.	Rice + Horsegram + Red gram Dhal adai, Horsegram + Brinjal kootu, Banana	Rice, Greens massial, Sweet potato + potato poriyal, Buttermilk	Horsegram Sundal, Roasted groundnut, Jaggery + sesame ball
5.	Dhal rice, Horsegram + Sweet potato + potato poriyal, Banana	Rice, Horsegram + Brinjal sambar, Greens + Redgram dhal massial, Buttermilk	Horsegram sundal, Roasted groundnut, Jaggery + sesame ball
6.	Red Gram dhal + Horsegram + rice adai, Horsegram podi, Banana	Greens poriyal, Red gram dhal + Sweet potato + Potato + Brinjal rice, Butter milk	Horsegram sundal, Roasted groundnut, Jaggery + sesame ball
7.	Rice + Red gram dhal + Horsegram kozhukattai, Horsegram chutney, Banana	Sweet potato + Potato + Greens + Rice, Brinjal sambar, Buttermilk	Horsegram Sundal, Roasted groundnut, Jaggery + sesame ball

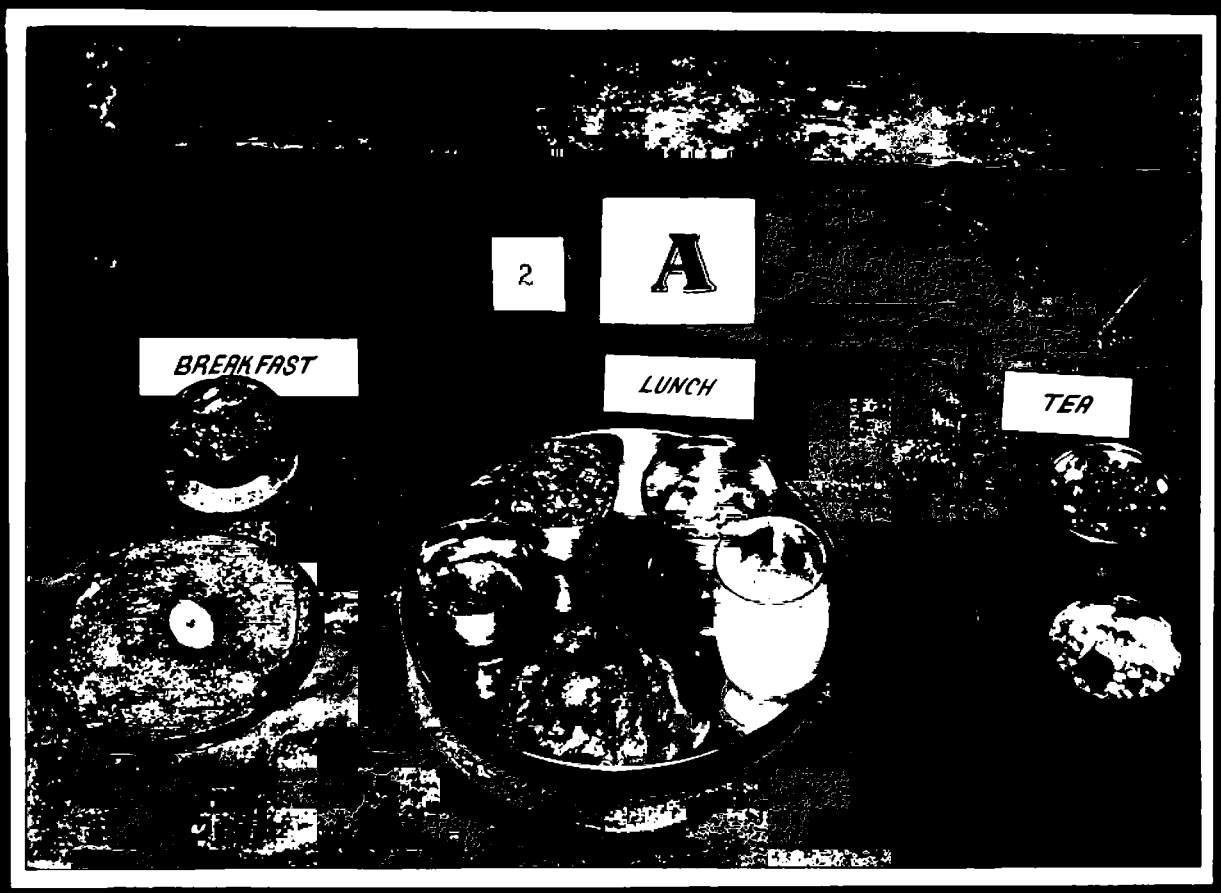

FIG. 1. RAGI BASED MODEL MEAL FOR A DAY

FIG. 1. RICE BASED MODEL MEAL FOR A DAY

These menus were standardised for their adequacy and acceptability (Devadas and coworkers, 1973) on a small sample under similar Socio-economic cum cultural conditions. Using the standard measures, the feeds for each meal were dolled out according to the menu pattern as outlined in Table II, in both the feeding centres. These measures ensured the adequacy of feeding each day the quantities prescribed for pre school children for both the diets to meet 2/3 of their daily food requirements.

D. Conducting the feeding programme:

The raw ingredients for the feeding were bought in bulk every month and dolled out as per the standardised quantities given in Table I every previous evening. The meal pattern as outlined in Table II were followed and the three meals of the day were prepared and since the bulk had to be distributed for preschool children, snacks like sesame balls were given at intermittent feedings around 11.a.m. and / or before leaving the feeding centre. This ensured totality in consumption for this age group of children. In both the feeding centres the above pattern was adhered to and care was taken to see that children consumed the meals served without wastage. Meal time thus was an enjoyable period for the children, as is evident from Fig.2. Regular records of attendance at feeding was maintained and reasons for absenteeism

FIG. 2. CHILDREN ENJOYING THE MEAL

if any recorded. Since the children were in the preschool from the morning till evening, a routine education programme for preschoolers has been initiated after preliminary adjustments by the children. Accordingly readiness activities has been started after four months. Nutritional themes has been introduced into the songs and stories taught to these children as part of their pre-school educational activity from the beginning. Facilities for indoor and outdoor play and all possible help and attention to capture the interest of the preschool children and their parents and to sustain their interest in participating in the feeding programme has been provided. Such educational cum nutritional benefits has impressed the parents of the preschool children and the activities of the preschool has attracted the children resulting in the success of the conduct of the feeding programme.

E. Evaluation of the outcomes of the feeding programme:

The criteria of evaluation to judge the nutritional impacts of the feeding programme for the preschool children included;

1. Anthropometric measurements
2. Biochemical estimations
3. Clinical picture and
4. Food intake

1. Anthropometric measurements:

Body measurement is more realiable than sub-clinical assessment because physical growth, though genetically determined, is strongly influenced by food intake. (Topps et al 1970 and Linares et al 1972) In this investigation body measurements of children to include height, weight, arm circumference and chest circumference were taken using the procedures outlined by Jelliffe (1966) and taking care of all the usual precautions.

Heights and weights of all the children of both the control and the experimental groups were recorded every month. Heights were recorded to the nearest 0.1 cm. and weight recorded to the nearest 0.5 K.g. The balance was checked and standardised using standard weights, before taking the weights every month.

The chest circumference was taken using a non-elastic fibre glass tape in the bare body to the nearest 0.1 cm and the mid arm cicumference of the left hand to the nearest 0.1 cm. Using the above measurements of heights and weights as related to the age of the preschool childreh, weight-height ratio has been calculated.

2. Biochemical estimations:

Biochemical indices like haemoglobin level, urinary creatinine, serum protiens and serum vitamin A levels are sensitive indicators reflecting the quality of food protein.

Haemoglobin level of all the children was determined once in three months using the cyanmethaemoglobin method (ICNND, 1967).

In order to estimate the urinary creatinine levels, samples of urine from all the preschool children were collected every three months, using the proceedure outlined in NIN manual (1971).

For the purpose of estimating total protein, serum albumin globulin values and serum vitamin A levels, a total of five ml of blood was required and hence five-most co-operative preschool children from each group were selected. Using the standardised proceedure of Varley (1969) total serum proteins, albumin and globulin were estimated by the Biuret method.

Serum Vitamin A (retinol) values were determined spectrophotometrically using the proceedure as outlined by NIN (1971).

3. Clinical examinations:

Clinical examination was conducted with guidance from a trained physician for all the children using the ICMR schedule and prevalence of nutritional deficiency symptoms noted, during the beginning and towards the end of the investigation period. A record of attendance kept in the preschool and close follow up of the causes of absenteeism

helped evaluate the incidence of sickness among the preschool children in this study.

4. Food and nutrient intake:

Records of food and nutrient intake as obtained from one day recall method was maintained and this helped to estimate the total food and nutrient intake per day for the preschool children.

IV RESULTS AND DISCUSSION

The present investigation was planned to evaluate the nutritional impact of two improved rural diets based on ragi and rice on preschool children. Accordingly two pre-school feeding centres with 25 preschool children each of the age group 2½ to 3½ years for ragi based and rice based diets were set up. The impact of these diets on the nutritional status of the preschool children as against a control group of 25 preschool children not participating in any feeding programme was evaluated over a period of six months. The results obtained is discussed under the following headings:

A. Food consumption pattern of the preschool children

B. Nutritional status of the preschool children

1. Anthropometric measurements
2. Biochemical estimations
3. Clinical picture
4. Attendance and incidence of sickness

A. Food consumption pattern of the preschool children:

Food consumption pattern of all the children both in the experimental and control group were computed from the information gathered using the recall method of diet survey. The children in the experimental group had all their meals except dinner in the preschool, whereas children in the control

group had all their meals at home. The average food intake of the three groups compared with that of the Indian Council of Medical Research, Recommended Allowances (ICMR, 1976) is given in Table III.

TABLE III

MEAN FOOD INTAKE OF CHILDREN IN THE THREE GROUPS (g per DAY)

S.No	Foods	Ragi based diet group			Rice based diet group			Control group	RDA*
		Home diet	Supplement	Total	Home diet	Supplement	Total	Total feed intake (Home diet)	
1.	Cereals	45.40	185.14	230.54	63.60	170.80	233.40	141.5	150
2.	Pulses	8.00	87.98	95.98	10.20	99.91	110.11	19.9	50
3.	Milk and its products	22.45	37.55	60.00	27.60	37.55	65.15	152.0	300
4.	Roots and tubers and other vegetables	5.30	68.41	73.71	5.40	64.81	70.21	65.7	50
5.	Green leafy vegetables	-	33.79	33.79	0.80	40.94	41.74	1.8	50
6.	Oils and Fats	2.64	3.95	6.59	1.72	3.95	5.67	7.2	20
7.	Sugar and jaggery	4.00	6.15	10.15	3.20	6.15	9.35	10.9	30
8.	Nuts and oil-seeds	-	50.20	50.20	-	46.55	46.55	-	-
9.	Fruits	1.40	7.24	8.64	0.20	7.24	7.44	9.14	50
	Cost (Rs) +	0.15	0.77	0.92	0.18	0.80	0.98	0.90	

* RDA - Recommended Daily Allowances of ICMR (1976)
+ Calculated as per the prevailing prices at the rural cooperative society as in January 1977.

The intake of cereals and pulses in the diets of children both in the ragi and rice groups were above the recommended allowances which was mainly due to the supplements given. In the control group both these fell six and sixty per cent below the recommended allowance. Consumption of roots and tubers was found to be above the recommended allowance in all the groups and reflects the pattern of consumption of these foods in a low socio-economic group. Consumption of green leafy vegetables was negligible in the control group and the contribution of home diet was also negligible as far as green leafy vegetables was concerned for the experimental group. However, the intake of green leafy vegetables in the experimental group provided as planned two thirds of the recommended allowances. Intake of milk and milk products (78 to 80 per cent in experimental and sugar and 50 per cent in control group). Fats and oils and sugar and jaggery (65 to 66 per cent in all groups) and fruits (82 per cent in all groups), fell short of the Recommended Allowances. This was expected because the experimental diets were planned along the meal pattern of the community and the supplements selected to enhance the nutritive value were mainly low-cost, locally available foods like pulses, green leafy vegetables and nuts and oilseeds. Accordingly the consumption of nuts and oilseeds were 47-50 g in the experimental groups as against no consump-

tion in the control group. This pattern of food consumption depicts clearly the meal pattern followed in the rural low sócio economic group dietaries and is clearly seen in the intake pattern of control group. Enhancement of the intake of low cost, nutritious foods through supplementation has enhanced the diets of children in the experimental groups.

Food intakes reflect the consequent nutrient intakes. The calculated average intake of nutrients as compared to the Recommended Allowances of nutrients (ICMR, 1976) for the preschool children is given in Table IV. The percentage adequacy of some of the nutrients in comparison to the Recommended Allowances is also pictorially represented in Fig. 3.

TABLE IV

MEAN DAILY NUTRIENT INTAKE OF CHILDREN IN THE THREE GROUPS

S.No	Group		Protein (g)	Energy Kcal	Calcium (g)	Iron (mg)	Vita-min A (µg)	Thia-mine (mg)	Ribo-flavin (mg)	Ascorbic acid (mg)
1.	Ragi based diet group	Home diet	7	251	0.1	3	120	0.18	0.12	2
		Supplement	48	1367	1.4	29	2318	1.71	0.82	65
		Total	55	1618	1.5	32	2430	1.89	0.94	67
2.	Rice based diet group	Home diet	9	289	0.1	4	146	0.34	0.12	4
		Supplement	48	1367	0.9	27	2636	1.32	0.60	71
		Total	57	1656	1.0	31	2782	1.66	0.72	75
3.	Control group	Home diet	23	826	0.3	10	485	0.42	0.40	16
4.	RDA	ICMR (1976)	19	1200	0.4-0.5	15-20	1000	0.60	0.70	30-50

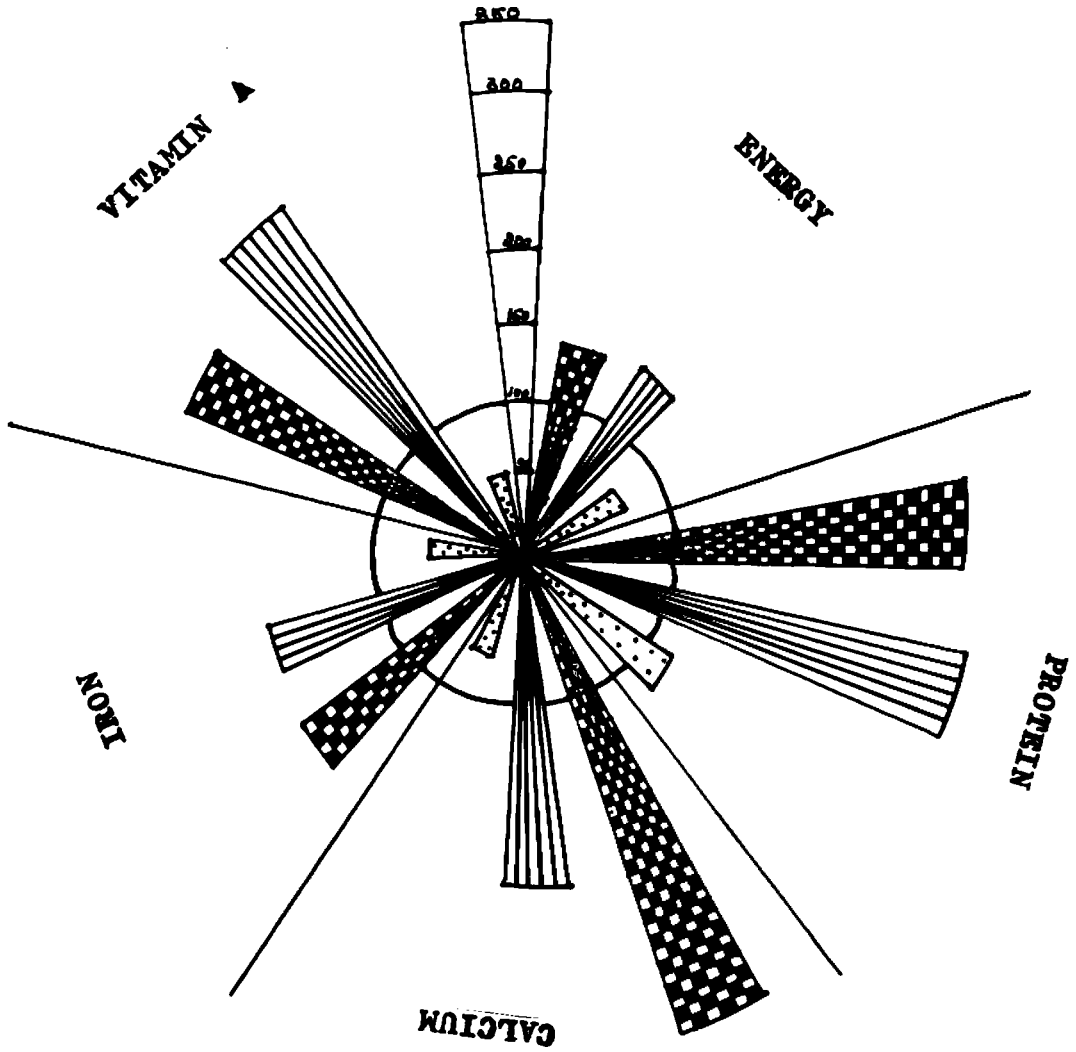

FIG.3. PERCENTAGE ADEQUACY OF SOME NUTRIENTS

SCALE:

1 cm. = 50 PER CENT OF RDA

KEY:

RAGI BASED DIET GROUP

RICE BASED DIET GROUP

CONTROL GROUP

Protein intake:

The total protein intake of children in both the experimental groups were 55g. and 57g respectively for ragi and rice based diets and 23g for the control group as against recommended allowance of 19g. Of this 48g. of protein were provided by the supplement in the experimental groups. These intakes were much above the recommended allowance and since even in the control group because of the higher intake of milk and milk products protein intake seems to be adequate. The introduction of higher amounts of pulses in the supplementary diets accounts for the higher amount of protein in these diets. Speaking in terms of the qualities of these proteins it may be recalled that several investigations in the literature has time and again pointed out the complementary value of pulse-protein to cereal-protein and cereal-protein and the higher biological value of the combined protein (Daniel et al 1977). The main purpose of this investigation being to evaluate the biological potency of low cost, locally available foods, inclusion of proteins of pulses like horsegram to the cereals like ragi and rice is justifiable. In the formulation of these diets, Devadas, et al (1972) had computed the amino acid pattern and found that these two supplementary diets had chemical scores of 81 and 71 respectively for ragi based and rice based diets,

ensuring a better essential amino acid patterns in these diets. In view of this intake of larger quantities of pulses and consequent protein is perceivable.

Calorie intake:

The calorie intake of children were 1618 (ragi based diet), 1656 (rice based diet) and 826 (control) respectively for the children in the three groups as against the recommended allowances of 1200 for this age group of children. It may be noted that in the experimental groups calorie adequacy was ensured with the supplement itself whereas a calorie gap of 374 was observed in the control group which was not given any supplement. This result is in agreement with the studies reported in the literature (Rao, N.P. et al 1969; Rao, B.S.N. et al 1969; Gopalan 1969; NIN, 1972; Sundararaj, 1972; Srikantia, 1973 and Pasricha, 1973), wherein a calorie gap of 300-400 for preschool children has been observed.

Calcium intake:

The supplement in the ragi-group provided 1.4g of calcium and that of rice diet 0.9g of calcium. Whereas the home diet contributed 0.1 g for both the groups, thus making the total intake 1.5 and 1.0g respectively for the ragi based and rice based diets. In the control group the intake was only 0.3g and hence was below the recommended allowance of

the ICMR (1976). In the experimental groups, however, because of the supplementation, adequacy of calcium intake was assured.

Iron intake:

Includion of green leafy vegetables in the experimental groups contributed a great deal to the iron intake of these children. While the intake of iron in the control group was only 10 mg., the total intake of iron in the ragi based and rice based diet groups were 32 and 31 mg respectively, out of which 29 and 27 mg were supplied by the supplement themselves. Its may however be pointed out that the iron content of these diets which are mainly cereal based has the problem of availability and percentage utilisation.

Vitamin A intake:

While the intake of Vitamin A in the control group, (485 µg) is only half the recommended allowance (1000 µg), the total intake of Vitamin A in the ragi based and rice based diets were 2430 and 2782 µg respectively. The adequacy of the intakes of Vitamin A in these two groups was mainly due to the includion of green leafy vegetables in supplemented diets.

Thiamine and Riboflavin intake:

The intake of both thiamine and riboflavin fell short of the requirement by 34-43 per cent in the control group.

On the other hand, in the experimental groups the supplements, themselves ensured adequacy of these nutrients thus making the total intake of thiamine and riboflavin as 1.89 mg and 0.94 mg respectively for ragi based diet and 1.66 mg and 0.72 mg respectively for the rice based diet.

Ascorbic Acid intake:

The ascorbic acid intake of the children on the ragi based and rice based diets were 67 and 76 mg respectively, out of which only 2 and 4 mg were contributed from the home diet. The intake of ascorbic acid for the control group of children was 16mg as against the requirement figure of 30-50 mg.

From the foregoing discussion it is evident that both rice based and ragi based improved diets provided all nutrients as compared to the recommended allowances of ICMR (1976) and was superior to the local home diet which fell short of all nutrients as is evident from the control group's diet. This enables us to speculate that from the nutritional and acceptability stand points the improved diets has good scope of substituting existing meal pattern without any detriment to the local customary dietary pattern and without any extra burden on the local population.

When viewed from the economic point (Table - III) it is evident that the cost of the improved ragi based and rice

based diet is 0.77 and 0.80 paise respectively and when one considers the cost of foods taken by children at home apart from the supplement, the total cost works out to be 0.92 paise and 0.98 paise respectively for children on the ragi based and rice based diets. On an average children in the control group spend 0.90 paise per day on their food. This implies that without much addition on the cost, adequacy of nutrient intake especially for calories and proteins could well be obtained using judicious combinations of low cost locally available foods to enhance the local diets.

B. Nutritional status of the preschool children:

1. Anthropometric measurements:

a. Increments in heights:

An increase in heights of children in both the experimental groups (ragi based and rice based diets) and control group was noted over the period of six months of the study and the individual monthly increments for each child is given in Appendix A.

The mean initial and final heights of the three groups along with the statistical analysis are given in Table V. Increments in height for the three groups is also evident from Fig. 4.

TABLE V

MEAN INCREASE IN HEIGHTS OF CHILDREN IN THE THREE GROUPS

S.No	Groups	Height in cm.			't' Values
		Initial	Final	Increase	
1.	RAGI-BASED DIET GROUP	86.46± 3.69	90.25± 3.79	3.89± 1.17	Ragi Vs Rice = 4.27**
2.	RICE-BASED DIET GROUP	89.41± 6.80	92.03± 6.54	2.62± 0.71	Ragi Vs Control = 6.04**
3.	CONTROL GROUP	87.25± 5.04	89.51± 4.20	2.26± 0.42	Rice Vs control = 2.00*

* Significant at five per cent level
** Significant at one per cent level
@ Standard deviation.

Children in the ragi based diet group registered the highest increase in height (3.89 cm), while children in the rice-based diet had increments of 2.62 cm and those in the control group 2.26 cm. Statistical analysis indicated that the increases in heights for children in the ragi group was significantly ($P < 0.01$) higher than that of the children in the rice group and that of the control group. Children on the rice group had increments in heights significantly higher than that of control group at five per cent level.

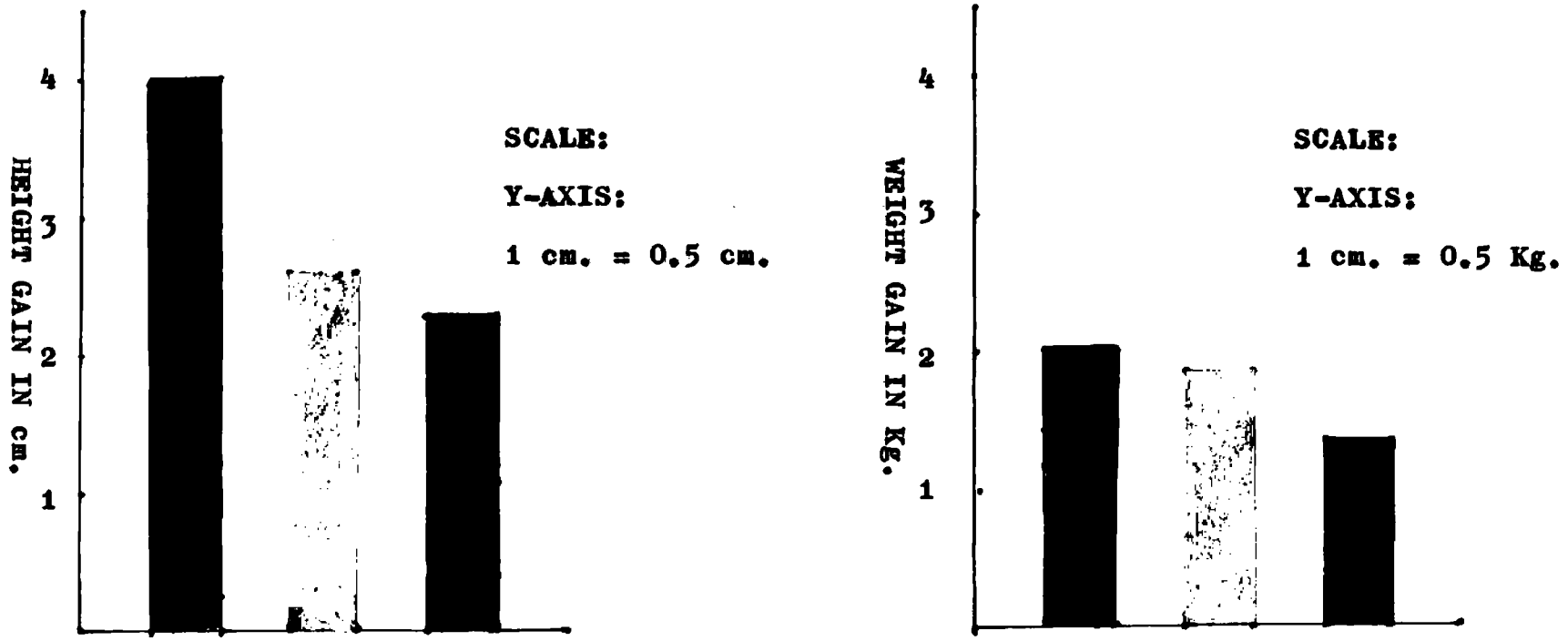

FIG. 4. HEIGHT AND WEIGHT INCREMENTS IN THE THREE GROUPS OF CHILDREN

KEY:

RAGI BASED DIET GROUP

RICE BASED DIET GROUP

CONTROL GROUP

These results suggest that provision of nutritional supplements at this crucial preschool age aids better growth and the results obtained in this investigation is on par with the studies reported by Kamalanathan et al (1970, 1975), Devadas et al (1974, 1974) who had studied the effect of supplementation as against a non supplemented group.

b. Increments in weights:

The mean, initial and final weights of the three groups of children along with the statistical analysis is given in table VI and the monthly increments for individual child is given in Appendix B. Fig 4. depicts the increments in weights exhibited by the three groups of children.

TABLE VI

MEAN INCREASE IN WEIGHTS OF CHILDREN IN THE THREE GROUPS

S.No	GROUPS	Weight in kg			't' Values
		Initial	Final	Increase	
1.	RAGI BASED DIET GROUP	10.58± 0.64	12.56± 0.28	1.98± 0.54	Ragi vs Rice = 0.80
2.	RICE BASED DIET GROUP	10.94± 1.98	12.80± 1.82	1.86± 0.17	Ragi vs Control = 4.93**
3.	CONTROL GROUP	10.76± 0.51	12.10± 0.44	1.34± 0.37	Rice vs Control = 8.33**

** Significant at 1 per cent level.

The mean increments in weight for children fed ragi based and rice based diets were 1.98 kg. and 1.86 kg. respectively as against 1.34kg. for children in the control group. The increments in weight between the two experimental groups were not significant whereas those between two experimental groups and control were significant at one per cent level. Weight increments in the control group is comparable to those of the values reported by Kamalanathan et al (1970, 1975) Devadas et al (1974) and reflects the growth trends of this age group. On the other hand, supplementation has increased the growth and consequently the gain in weight and the values in this study is again in close agreement with those reported in the literature.

Although, there was a slight difference in the height promoting quality of the ragi based diet which may be due to higher intakes of calcium by children in this age group. (Table IV) or may be due to the higher chemical score of this diet, but there was no significant difference in the weight promoting quality of the two experimental diets. It may be noted that the intake of calories and proteins were the same in both the groups and this might have resulted in equal weight gains. When these groups are compared with control which had a calorie gap, the nutritional outcome is evident.

C. Arm and chest circumference:

The mean increase in the arm circumference of the three groups of children and the statistical analysis for increments is given in Table VII and the individual values for each month is given in Appendix C.

TABLE VII

MEAN INCREASE IN ARM CIRCUMFERENCE OF CHILDREN IN THE THREE GROUPS

S.No.	GROUPS	Arm Circumference in Cm.			't' Values
		Initial	Final	Increase	
1.	RAGI-BASED DIET GROUP	13.69± 0.86	14.00± 0.97	0.31± 0.18	Ragi vs Rice = 0.30
2.	RICE-BASED	13.77± 0.81	14.02± 1.21	0.25± 0.89	Ragi vs Control=4.78**
3.	CONTROL GROUP	13.71± 0.78	13.82± 0.81	0.11± 0.07	Rice vs Control = 0.765

** Significant at one per cent level.

The mean difference in arm circumference between the two groups was found to be statistically insignificant. While children in the experimental group had higher increments in arm circumference when compared with children in the control group, statistically the increments between the ragi and control was significant at one per cent level while those

between rice and control was insignificant. The values for arm circumference obtained in this study is similar to those reported by Kamalanathan et al (1975) for both supplemented and not supplemented group. The values obtained for the control group is similar to those reported by Gopalan and Vijayaraghavan (1971) for Indian preschool children, and supplementation diffinitely seems to have had an impact.

The mean initial and final chest circumference of the three groups along with the statistical analysis are given in Table VIII and the individual values are presented in Appendix D.

TABLE VIII

MEAN INCREASE IN CHEST CIRCUMFERENCE OF CHILDREN IN THE THREE GROUPS

S.No.	Groups	Chest circumference in cm.			't' Values
		Initial	Final	Increase	
1.	RAGI-BASED DIET GROUP	48.36± 1.87	48.97± 1.93	0.61± 0.65	Ragi vs Rice = 0.813
2.	RICE-BASED DIET GROUP	48.36± 2.48	48.82± 2.13	0.46± 0.61	Ragi vs Control = 3.474**
3.	CONTROL GROUP	48.25± 2.85	48.38± 1.92	0.13± 0.13	Rice vs Control

** Significant at one per cent level

The values obtained for chest circumference for children in this investigation fell within the range of 45.0 to 48.0 cm as reported by Gopalan and Vijayaraghavan (1971) for Indian preschool children. Increments in the chest circumference for the control group (0.15cm) was significantly ($P < 0.01$) lower than that of the increments registered by children in the supplemented group and the value was similar to those reported by Kamalanathan et al (1975) for unsupplemented preschool children. The difference in increments registered by children in the ragi and rice diets were statistically insignificant.

d. Weight/Height ratio (Growth Index):

Table IX - depicts the mean weight/height ratio for each group of preschool children calculated from the individual height and weight of the children using the formula ($Weight/Height^2$) X 100 (Rao and Singh, 1970 and Sastry and Vijayaraghavan, 1973). This index was chosen to be calculated because as opined by NIN (1974) weight-height ratio is a more sensitive index to assess the degree of malnutrition among all other indices for preschool and was found to be independent of age and sex even in longitudinal studies.

TABLE IX

MEAN WEIGHT - HEIGHT RATIO FOR THREE GROUPS OF PRE-SCHOOL CHILDREN

S.No	Groups	Initial	Final	Increase
1.	RAGI BASED DIET GROUP	0.1419± 0.52	0.1552± 0.02	0.0132± 0.09
2.	RICE BASED DIET GROUP	0.1365± 0.68	0.1503± 0.74	0.0138± 0.08
3.	CONTROL GROUP	0.1410± 0.69	0.1507± 0.73	0.0097± 0.04

Gowrinath Sastry (1974) has reported 0.15 as a normal value for this index. The values for this weight/height ratio obtained in this study was 0.14 initially for all the groups, and ranged from 0.15 to 0.16 finally. With the ragi based diet group having an index of 0.16. The beneficial effect of supplementation is evident by the rate of increase in this ratio for the supplemented group as against the control group. Similar impacts of supplementation have been observed by Kamalanathan et al (1975) for groups of children fed supplement over that of unsupplemented group.

2. Biochemical estimations:

a. Hemoglobin level:

The mean increase in the haemoglobin levels in the children of the three groups along with the statistical

analysis is given in Table X and the individual values at the beginning and end of the study is given in the Appendix E.

TABLE X

MEAN INCREASE IN HEMOGLOBIN LEVELS OF CHILDREN IN THE THREE GROUPS

S.No.	Groups	Hemoglobin levels in g/100ml of blood			't' value
		Initial	Final	Difference	
1.	RAGI BASED DIET GROUP	8.05± 1.51	8.50± 1.57	0.45± 0.216	Ragi vs Rice = 0.52
2.	RICE BASED DIET GROUP	7.79± 1.69	8.27± 1.77	0.48± 0.179	Ragi vs control = 1.00
3.	CONTROL GROUP	7.62± 1.33	7.68± 1.32	0.06± 0.103	Rice vs control = 0.86

The mean increase in the hemoglobin level of the children fed ragi based and rice based diets were 0.45g per 100 ml and 0.48 g. per 100 ml respectively as against 0.06g. per 100 ml for the control group. These increments were however not statistically significant. May be, a larger experimental period in these children who have had lower hemoglobin levels to begin with is necessary to result in

higher and significant increments. The final hemoglobin values obtained in the present investigation for the control as well as the supplemented group compares well with those of the values reported by Kamalanathan et al (1975) and Devadas et al (1974, 1974).

b. Serum protein and serum vitamin A levels:

The serum proteins including albumin and globulin levels and the mean serum Vitamin A levels of the selected five preschool children from whom blood could be drawn without much difficulty and who were willing to cooperate is presented in Table XI.

TABLE XI

MEAN SERUM PROTEIN AND SERUM VITAMIN A LEVELS OF SELECTED PRESCHOOL CHILDREN

S.No	GROUPS	Levels of Protein in g./ 100ml. of serum			mg.of Vitamin A in 100 ml. of Serum
		Albumin	Globulin	Total Protein	
1.	RAGI BASED DIET GROUP	2.77	2.96	5.73	48.33
2.	RICE BASED DIET GROUP	3.32	1.30	4.62	40.50
3.	CONTROL GROUP	2.17	2.40	4.57	37.50
4.	ICNND (1966)				20-49 accepted value
5.	Sauberlich et al (1976)			⩾ 5.5 accepted value ⩽ 5.0 low	

The total protein in serum for the children in the ragi based diet was 5.73g per 100 ml as against 4.62 and 4.57 respectively for the rice based diet fed group and control group. Krishnamoorthy et al (1976) reported a range of values between 5.7-7.9g per 100 ml of total proteins and range of 2.9-4.1g/100ml for albumins and 2.7-3.9g/100ml for globulins in preschool children after a period of supplementation in an urban population. The values obtained for children in the three groups in the present study especially for total proteins approximates the range reported by Krishnamoorthy et al (1976). These values were in close aggreement with those reported by Periera et al (1969), Prasad et al (1969), Kothari et al (1971) and Vinodini Reddy, (1974) and are within the normally acceptable limits for Indian Children. Since the protein values were taken only once during the period of six months of study, it is recommended that a better picture might evolve if the impact of feeding a good protein diet to these highly malnourished children is prolonged over a longer period of time.

The values obtained for serum Vitamin A levels per 100ml. were 48.33Mg. for ragi based diet, 40.50 µg for rice based diet and 37.50 µg for control group. When the intake of β caretene (Table IV) for the three groups of children is correlated with that of the serum Vitamin A

levels and when the total protein quality of the diet is considered, there seems to be a relationship between the β caretene and the protein value of the diet and between the serum Vitamin A levels. Similar observations have been reported by Periera and Begum (1968), Vinodini Reddy, (1970) and Krishnamoorthy et al (1976). Krishnamoorthy et al (1976) have reported serum vitamin A levels of 29.2 µg per 100 ml.on a 1200 ug of dietary intake of B caretene and the values obtained in the present study with higher intakes of 2430ug to 2782ug is consequently higher. The values obtained in the present study is comparable to the accepted values reported in ICNND (1963) for preschool children.

c. Urinary creatinine:

The mean creatinine excretion in the beginning and at the end of the study as analysed from a 24-hour collection of the three groups of children is given in Table XII and the individual values are given in Appendix F.

TABLE XII

MEAN URINARY CREATININE EXCRETION FOR 24 HOURS OF THE THREE GROUPS OF CHILDREN

S.No.	Groups	Mean Urinary Creatinine Value in mg per 24 hours		
		Initial	Final	Increase
1.	RAGI BASED DIET GROUP	154.5± 60.4	159.0± 89.2	4.5± 33.8
2.	RICE BASED DIET GROUP	136.2± 29.6	157.0± 42.5	21.0± 34.0
3.	CONTROL GROUP	122.5± 43.4	124.0± 59.4	1.5± 52.8

The creatinine excretion for the control group was 122.5 mg and 124.0 mg in the beginning and at the end of the study. Children in the rice diet fed group had creatinine values of 136.2 mg. and 157.0 mg initially and finally where as children fed ragi diet had excretion levels of 154.5 mg. and 159.0 mg. respectively. Anusuya (1971) had reported that the creatinine excretion in normal Indian children to be 189.0 mg. for 24 hours sample. Values reported in the present study was lower than that of the above reported value but in the supplemented group, the value was similar to that reported by Devadas et al (1975).

d. Creatinine - Height Ratio:

According to Sauberlich et al (1976) the relationship of mg. of creatinine excreted/unit of time/cm. of body height (CHI) has been used in evaluating protein nutritional status in children. Uninary excreation of creatinine is determined principally by the lean body mass which is sacrificed during protein deprivation. Hence, children suffering from protein-calorie malnutrition have a lowered creatinine-height index.

In the present study the creatinine-height index for individual children was calculated using the formula-

$$\text{Creatinine-height index (CHI)} = \frac{\text{creatinine excretion by subject (mg/24hours)}}{\text{Creatinine excretion by normal child of same height (mg./24 hours)}}$$

and the individual values for each child is given in Appendix G. According to the standards prescribed by Sauberlich et al (1976) the creatinine height index of 0.9 and above is considered to be an acceptable value and values below 0.9 has been classified to be low with medium risk involved. The creatinine-height indexcalculated for the children in this study were grouped according to the above standard and the number of children classified accordingly as normal and below normal at the beginning and at the end of the study is presented in Table XIII.

TABLE XIII

MEAN CREATININE HEIGHT INDEX OF THE CHILDREN IN THE THREE GROUPS

S.No	Creatinine-Height index	Number of children					
		RAGI BASED DIET GROUP		RICE BASED DIET GROUP		CONTROL GROUP	
		Initial	Final	Initial	Final	Initial	Final
1.	< 0.9	13	8	8	4	14	10
2.	> 0.9	12	17	17	21	11	15

It is evident from the table that initially there were greater number of children in the below normal range in all the three groups which improved considerably in the supplemented group towards the end of the study. The improvement shown in the control group was not as conspicuous. As

outlined by Arroyave, (1969) and Sauberlich et al (1976) expressing creatinine in terms of height has the advantage of independency from age as creatinine excretion of normal children of the same height as that that of malnourished child is the criteria involved. If it is assumed that when evaluated with accuracy in urine collection it could be used as a sensitive index to assess recovery from malnutrition. It is possible to speculate that the improvements evidenced by greater number of children in the experimental groups may be due to the better quality of the diets supplemented and their nutritional adequacy. Evaluation over a longer period is recommended to further substantiate the above and bring out marked differences as height increments are slower but steadier especially for this age group of children.

3. Clinical picture:

Clinical assessment of all the children in the three groups was done at the beginning and end of the study period. An improvement in the general clinical picture of all the children was noted at the end of six months specially for children in the experimental group (Table XIV)

TABLE XIV

CLINICAL PICTURE OF CHILDREN IN THE THREE GROUPS

S.No	Clinical Symptoms	Percentage of children					
		Ragi Based Diet Group		Rice Based Diet Group		Control Group	
		Initial	Final	Initial	Final	Initial	Final
1.	HAIR:						
	Discoloured	-	-	8	4	12	12
2.	SKIN:						
	Follicular hyperkeratosis	8	-	-	-	4	4
3.	EYES:						
	Conjunctival-xerosis	20	12	20	12	32	32
4.	MOUTH:						
	Angular Stomatitis	44	16	60	20	64	60
	Papillae atrophy	-	-	20	8	28	24
	Caries	12	12	24	24	44	44
5.	Enlarged liver	-	-	8	-	12	4
6.	Marasmus	-	-	4	-	-	-

FIG. 5. A MARASMIC CHILD BEFORE AND AFTER SIX MONTHS OF THE STUDY

FIG. 6. AN ANGULAR STOMATITIS CASE BEFORE AND AFTER SIX MONTHS OF THE STUDY

In the experimental and control groups initially, there were nutritional deficiency symptoms, as discoloured hair, conjunctival xerosis, follicular hyperkeratosis, Bitot's Spots, angular stomatitis, caries and enlarged liver. But after six months of supplementation, the symptoms were reduced in both the experimental groups. The striking improvement in the clinical picture is clearly visible from Figures 5 and 6 wherein two children in the experimental group one a pathetic marasmic baby and the other a victim of severe angular stomatitis in the beginning of the study has shown marked improvements after six months. But the reduction of symptoms was not conspicuous in the control group. The fact that some of the symptoms like conjunctival xerosis and angular stomatitis still existed in the supplemented group points out the need for supplementation over a longer period of time.

4. Attendance and incidence of sickness:

The monthly incidence of sickness as recorded from the absenteeism to school and personal visits is presented in Table XV.

TABLE XV

PERCENTAGE OF ATTENDANCE AND INCIDENCE OF SICKNESS IN THE THREE GROUPS OF PRESCHOOL CHILDREN

S.No	Groups	Percentage of attendance	Reasons for absenteeism — Number of children				Number of children	
			Diarrhoea	Mumps	Chicken pox	Cold, cough & Fever	Liver troubles	Skin infections
1.	Ragi based diet group	88	1	-	-	2	-	-
2.	Rice based diet group	85	1	3	-	4	-	-
3.	Control group	66	1	-	6	4	2	2

On an average the duration of absenteeism were from 3 to 4 days for illness like cold, cough and diarrhoea whereas sicknesses like mumps, liver trouble, chicken pox persisted for 2 to 3 weeks.

As is evident from the table the percentage of attendance was the least in the control group and correlated with the incidence of sickness which was also higher for this group. In the supplemented group the attendance was improved and kind of sickness observed was varied and of less duration.

It is evident from the foregoing discussion that children who were given a supplement based on their customary dietary pattern but by enhancing the diet with the inclusion of locally available, low cost foods exhibited better trends in their growth pattern,

hemoglobin levels, serum protein and serum Vitamin A levels and clinical picture, as compared to their counter parts who did not receive any supplement. These two improved ragi based and rice based diets were well accepted by the children and was economically feasible for their families to adopt, thus enlightening the potentials of these improved diets for usage in the common dietaries of the rural population.

V SUMMARY AND CONCLUSION

The feasibility of adoption of two improved low cost rural diets based on ragi and rice in the dietaries of preschool children was investigated over a period of six months. Two improved diets based on ragi and rice which were enhanced by addition of low cost, locally available foods like sweet potato, horsegram, sesame and groundnut flour and amaranthus, suggested to possess potentials of greater nutritional impact by Devadas and coworkers (1963, 1976) formed the basic diets supplemented in this investigation. Using the dietary composition suggested by the above workers and having the food requirements of preschool children (ICMR, 1976) as the guideline, quantities of food to be supplied, each day to meet the 2/3rd of the food requirements of the preschool children were evolved. Subsequently menus and recipes tailored around the common food habits of the local preschool children were worked out. Two groups of 25 children each from two rural areas having similar socio economic background and within the age range of two and a half to three and half years were selected and supplemented with the ragi based and rice based diets respectively. A third group of 25 children comparable in age and socio economic background were selected from a nearby area and served as the unsupplemented control. The food consumption pattern of the children, changes in their

anthropometric measurements, changes in biochemical parameters, clinical picture and incidence of sickness over the period of six months formed the criteria of evaluation of the two improved diets.

The results revealed that;

The mean whole days' intake of cereals and pulses in the supplemented groups were above the recommended allowances and was mainly due to the supplement. Whereas six per cent deficit in cereals and 60 per cent deficit in pulses were found in the control group. Consumption of roots and tubers was above the recommended allowance while that of the green leafy vegetable was negligible in the control group and was enhanced in the experimental groups. Consumption of all other foods fell short of the recommended allowances but provision of nuts and oilseeds in the supplemented groups as envisaged, enhanced the nutritive value.

2. Comparison of the nutrient intake with that of the recommended allowances (ICMR-1976) indicated a high intake of protein in all the three groups and an adequacy of calories in the supplemented group with a caloric gap of 374 in the control group. Intake of calcium was 1.5g, 1.0g and 0.3g; iron 32mg, 31mg and 10mg; Vitamin A 2430µg, 2782µg and 485µg, Thiamine 1.89mg, 1.66 mg and 0.42mg; Riboflavin 0.94mg, 0.72mg and 0.40mg, and ascorbic acid 67 mg, 75 mg and 16mg respectively for the ragi based, rice based diets and control group. The intake of all these nutrients were adequate in the supplemented group but inadequate in the control group.

3. The mean increase in height of children in the ragi based diet was 3.89 cm as against 2.62 cm in the rice based diet and 2.26 cm in the control group. Statistically, the increase between the two supplemented groups were significantly higher than the control and those between ragi and rice was also significant.

4. The increments in weight registered by children in the ragi based diet, rice based diet and control were 1.98kg, 1.86kg and 1.34 kg respectively. Increases in weight between the two supplemented groups was not statistically significant while those between the experimental and control was significant at one per cent level.

5. Highest increment in arm circumference (0.31cm) was recorded by children in ragi based diet group, with rice based diet group (0.25) and control group (0.11cm) ranking next in the descending order. Statistically there was no significant difference in the increments between the two supplemented groups but those between ragi based diet and control was significant at one per cent level.

6. Increments in the chest circumference of children fed the ragi based and rice based diets were 0.61cm and 0.46cm, respectively and was not significantly different from each other but both were significantly higher at one per cent level than the control group (0.13 cm).

7. The values obtained for the weight-height ratio of the children in the three groups were below the normal values recommended for Indian children initially but were equal to higher than value of 0.15 towards the end of the study with greater efficacy in the supplemented groups.

8. The increments in the hemoglobin levels of the three groups of children were 0.45 g per 100 ml, 0.48g per 100ml and 0.06g per 100ml respectively and statistically the differences were insignificant.

9. The values obtained for total serum protein and serum vitamin A levels for the selected children ranged from 4.57 g per 100ml to 5.73g per 100ml and 37.50 ug per 100ml to 48.33ug per 100ml respectively and were within the accepted value reported in the literature. In this criteria also ragi based diet ranked to be the first, rice based and control coming next in the descending order.

10. Twenty four hour collection of urine sample revealed a higher excretion of urinary creatinine by children in the ragi based diet, rice based diet and control group ranking next in the decending order.

11. Clinical picture showed that there was an improvement in the general nutritional condition of the children in both the experimental group towards the end of the study while children in the control group did not exhibit much improvement. Incidence of sickness was also found to be higher in the control group than in the experimental group.

The two improved ragi based and rice based diets patterned around the rural dietaries thus investigated in this study possessed equal potentials in improving the nutritional picture of the children as against the control and the supplemented group. When judged through the parameters of anthropometric measurement, biochemical estimations and clinical picture, both ragi based and rice based improved diets evinced similar potentials in improving the nutritional status of the preschool children although insignificantly higher values except for height was registered by the ragi based diet. Inspite of the fact that both these diets virtually provided equal amounts of calories and protein and all the other nutrients, approximately in equal quantities, the fact that there was a difference in the calcium intake needs mentioning and is worth being correlated with the slightly higher nutritional picture exhibited by the ragi based diet fed children. This speculation is in line with the findings of Devadas et al (1975) who found a relationship between adequate amounts of calcium and growth rate of children.

In virtue of these evidences and because of the fact that these supplemented diets were nutritionally enhanced with low cost locally available foods, with practically no increase in their cost speaks well for their potency to be included in the dietaries of local populations without any

cultural and economic impediments. It also throws light on the possibility of including such nutritious supplements for various nutritional feeding programmes for the vulnerable sections of the population without any extra cost burden and dependence upon doles and aids from extranious sources.

Further research to evaluate longitudinally over the period of entire preschool age starting from conception is recommended and might throw more light on our knowledge about building a nutritionally sound generation solely by self reliance.

LITERATURE CITED

Annsuya, A.S and Narasinga Rao, B.S (1971) "Uninary hydroxy proline index and plasma amino acid ratio in undernourished children", Proceedings of the Nutrition Society of India, Hyderabad, pp.144-145.

Apte, S.V and Venkatachalam, P.S (1962) "Iron absorption in human volunteers using high phytate cereal diet" Indian Journal of Medical Research, Vol.27, p.400.

Arroyave, G and Wilson, D (1961) "Urinary Excretion of creatinine of children under different nutritional conditions", American Journal of Clinical Nutrition. Vol.9, p.170.

Bagchi, K (1970) "Malnutrition and food scarcity", Swasth Hind. Vol.14, pp.163-164.

Bailur, A (1972) "Food consumption patterns of preschool children in India", Proceedings of the First Asian Congress of Nutrition, National Institute of Nutrition, Hyderabad, p.256.

Bailey, K.V (1975) "Malnutrition in African Region" WHO Chronicle, Vol.29, pp.359-360.

Bains, G.S., Bhatia, D.S., and Subramanyam, V (1960) "Technology of protein rich Nutrofoods", Proceedings of the symposium on protein, pp.270-274.

Balasubramaniam, S.C (1969) "Malnutrition and disease" Vol.3, p.1 Nutrition.

Barooah, P.P (1976) "Reaching the Unreached" Yojana, Vol.20, No.19, p.3

Behar, M (1975) "The nutritionally critical periods of childhood" Assignment Children, No.30, pp.83-85.

Bengoa, J.M (1974) "Hunger and malnutrition" World Health, Feb-Mar, p.7

Berg, Alan (1973) "The Nutrition Factor", The Brooking's Institution, Washington D.C., p.8

Bibera S.B., Lopez H.G Rabuco. L.B., Sakdalan, Z.C Salvosa, C.B and Wadsworth, G.R (1976)	"The origins of malnutrition during childhood; A study of 2 cases in "Manila, Philippines", Philippine Journal of Nutrition, Vol.XXIX, No.3, p.105.
Brown, L.R (1975)	"Putting the brakes on population growth" Assignment children, . No.30 p.58.
Brown, L.R (1975)	"Death at an early age", UNICEF News Issue 85/1975/3, pp.3-9.
Champakam, S and Balasubramaniam, S.C (1968)	"Hazards of protein deficiency", Swasth Hind, Vol.12, p.180
Chandrasekhara, M.R Indira, K., Prasanna,H.A Ramanathan, G., Jagannath, K.S., Leela,N Srinivasan, K.S., Vaidehi, M. Murthy,A.S and Indira (1972)	"Nutritional studies with milk toned with peanut proteins-Miltone", The Nutrition Reports International, Vol.6, p.239.
Chandrasekhara, M.R (1973)	"Miltone-current position and future possibilities", Proceedings of the Nutrition Society of India, No.15, p.44.
Chandrasekhar, U Nandini, S., and Devadas, R.P (1976)	"Protein quality and acceptability of CARE's Kerala Indigenous Food", The Indian Journal of Nutrition and Dietetics, Vol.13, No.1, p.1-6
Cool, J (1975)	"Children in the Second India", Assignment Children, No.29, p.61.
Cravioto, J., Pinero,C Arroya, M., and Alcalde, E (1969)	"Mental performance of school children who suffered malnutrition in early age", Nutrition in preschool and school age. Proceedings of the Symposia of the Swedish Nutrition Foundation, Uppsala, p.85.

Daniel, V.A., Urs, S.R., Desai, B.L.M., Rao,S.V., Rajalakshmi, D Swaminathan, M and Parpia, H.A.B (1967) "Studies on low cost balanced foods suitable for feeding weaned infants in developing countries. The Protein Efficiency Ratio of low cost balanced foods based on ragi or maize, groundnut, bengalgram, soya and sesame flours and fortified with limiting amino acids", Journal of Nutrition and Dietetics, Vol.4, p.183.

Daniel, V.A., Rajan.P., Sanjeevarayappa, K.V Srinivasan, K.S and Swaminathan.M (1977) "Effect of insect infestation on the chemical composition and the protein efficiency ratio of the proteins of bengal gram and redgram", The Indian Journal of Nutrition and Dietetics, Vol. 14, pp.70-73.

Datta Banik, N.D Krishna, R., Mane, S.I.S and Liba Raj (1971) "A longitudinal study on Protein Calorie malnutrition in North Indian preschool children", The Indian Journal of Pediatrics, Vol.38, No.87, pp.147-152.

Davidson, S., Passmore, R and Brock, T.F (1973) "Human Nutrition and Dietetics", The English Language Book Society, Churchill, Livingstone, pp. 472-481

DeGwynn, E.R., and Sanjur, D (1974) "Nutritional Anthropometry: Diet and Health related correlates among preschool children in Bogota: Columbia", Ecology of Food and Nutrition, Vol.3, pp.273-291.

Desai, B.L.M., Daniel, V.A., Rao, S.V Swaminathan, M., and Parpia, H.A.B. (1970) "Supplementary value of low cost balanced foods based on cereals, cottonseed or peanut flour, and bengalgram flour to poor Indian diets," Indian Journal of Nutrition and Dietetics, Vol.7, p.21.

Devadas, R.P. and Radhabai, N (1966) "Effect of vegetable protein mixture in the treatment of kwashiorkor" The Journal of Nutrition and Dietetics, Vol.3, p.134.

Devadas, R.P., and Easwaran, P.P (1963) "Influence of socio economic factors on the nutritional status and food intake of preschool children in a rural community", Journal of Nutrition and Dietetics, Vol.4, p.156.

Devadas, R.P (1970) "Problems and prospects of ensuring nutritive food to children", Proceedings of the National Food Congress, FFHC and Government of India, p.3.

Devadas, R.P (1972) "Nutrition in Tamilnadu", Sangam Publishers, Madras, pp.1-5.

Devadas, R.P (1973) "Problems of nutrition of the child in the Tropics", Archives of Child Health, Vol.14, p.156.

Devadas, R.P (1973) "Take home system"vs, "On the spot feeding", Proceedings of the Nutrition Society of India, No.15, pp.68-69.

Devadas, R.P Chandrasekhar, U and Premakumari, S (1973) Report of the Project on "Nutritional evaluation of the supplementary value of low cost and locally available foods namely colocasia and sweet potato (root Vegetables), Horsegram, cowgram, field beans, sesame and amaranthus (leafy vegetables) to a poor rice or ragidiet", Sri Avinashilingam Home Science College for Women, Coimbatore.

Devadas, R.P., Jaya, M and Vasantha P. (1973) "Nutritional status and mental ability of children of 3½ - 5 years", Indian Journal of Home Science, Vol.7, p.27.

Devadas, R.P and Jamala, S (1974) "Nutritional evaluation of a maize based indigenous infant food' Kuzhandai Amuthu", The Indian Journal of Nutrition and Dietetics, Vol.11, pp. 257-258.

Devadas, R.P Chandrasekhar, U and Kusumlatha Dhody (1974) "Evaluation of a low-cost indigenous food supplement to the school lunch", The Indian Journal of Nutrition and Dietetics, Vol11, pp.127-133.

Devadas, R.P
Murthy, N.K. and
Roshan, A
(1974)

"Evaluation of a weaning mixture based on local foods" The Indian Journal of Nutrition and Dietetics, Vol.11, pp.209-212.

Devadas, R.P
(1975)

"Nutrition Programmes for Preschool children", paper presented at the 9th International Congress in Nutrition at Kyoto, Japan.

Devadas, R.P
Sarojini, K.S., and
Krishnamoorthy, N
(1975)

"Evaluation of calcium and iron supplements to preschool children", A thesis submitted to the University of Madras for the Degree of Master of Science, pp.62, 65.

Devadas, R.P
Yegammai, C and
Krishnamoorthy, N
(1975)

"Nitrogen retention in preschool children on Opaque-2 maize, Oridinary maize, and skim milk". A thesis submitted to the University of Madras for the Degree of Master of Science, pp.39-40

Devadas, R.P.,
Chandrasekhar, U
Bhooma, N. and
Kalavathy, S
(1976)

"Nutritional evaluation of a rural diet supplemented with low cost, locally available foods through human feeding trials". Annual Report-1975-1976.

Devadas, R.P
Eswaran, P.P. and
Usha Suri
(1976)

"Incidence of malnutrition among selected preschool children", The Indian Journal of Nutrition and Dietetics, Vol.13, Pp.95-100

Devadas, R.P
(1977)

"Strategies to overcome malnutrition in India", Abstract of the lecture delivered under the Programme of National lectures of U.G.C., 1976-1977.

Dumo, N.S
(1971)

"Evaluation of Applied Nutrition Project for combating protein calorie malnutrition", Abstracts, First Asian Congress of Nutrition, p.33.

FAO (1958) "Purpose and scope of school feeding programmes", Report of the FAO/UNICEF Regional School Feeding Seminar for Asia and Far East, Tokyo. FAO of the United Nations, Rome, P.8.

FAO (1970) Production Year Book, Vol. 23, FAO, Rome,

FAO/UNICEF/WHO (1976) "Methodology of Nutritional Surveillance", Report of a Joint FAO/UNICEF/WHO expert Committee Technical Report Series 593, WHO, Geneva.

Florentino, R.F and Picar, B.A (1975) "Report on the use of arm circumference for rapid screening of under nourished children". The Phillippine Journal of Nutrition, Vol. XXVII, No.1-2, pp. 12-14.

Fuller, B., Aletha Sanchez Albert, Yahiku, Y Paul and Hunter, C.C (1972) "The value of indigeneous supplements to diets composed of West African Staples. Preliminary studies" The Nutrition Reports International, Vol. 5, pp.293-294

Gopalan, C. and Rao, K.S (1961) "Clinical Nutrition Surveys", ICMR, Special Reports No. 56, ICMR, New Delhi, p.3.

Gopalan, C (1969) "Observations in some epidemiological factors and biochemical features of Protein Calorie Malnutrition", Protein calorie Malnutrition, Springer-Verlag Berlin, Heidelberg, pp.77-85.

Gopalan, C (1971) "The crux of the Asian nitrition situation" Nutrition, Vol.5, pp.2-9

Gopalan, B and Vijayaraghavan, K (1971) "Nutrition Atlas of India", National Institutes of Nutrition, Hyderabad pp.48-50.

Gopalan, C (1973) — General Objectives of and guidelines for supplementary feeding programmes", Proceedings of the Nutrition Society of India, No.15, p.4

Gopalan, C (1973) — "Malnutrition and its impact on National Development", Report of the Task force in Nutrition, Proceedings of the Nutrition Society of India, NIN, Hyderabad, pp.1-5

Gopalan, C (1973) — Key note address to the second Asian Congress of Nutrition, Manila, Philippines, 12th-17th January.

Gopalan, C (1975) — "Children in India, Nutrition and India's Children", Assignment children, No.29 , pp.57-58.

Gopaladas, T (1976) — "Project Poshak-Integrated health and nutrition large scale study for rural preschool children", P.A.G. Bulletin, Vol.6, No.2, pp.36-37.

Gowrinath Sastry, J and Vijayaraghavan, K (1973) — "Use of anthropometry in grading malnutrition in children" The Indian Journal of Medical Research, Vol.61, pp.1225-1232.

Grewal, T Gopaladas, T Gadre, V.J., Shrivastava, S.N Pranjpe, B.M Chatterjee, B.N. and Srinivasan, N (1974) — "Comparison of weightment and questionnaire dietary survey methods for rural preschool children", The Indian Journal of Nutrition and Dietetics, Vol.11, p.224-231.

Gupta, M., Agarwal, K.N.L. and Manwani, A.H (1973) — "Nutritional status of preschool children", Indian Pediatrics, Vol.X., p.81

ICMR (1976) — "Arm circumference as an indicator of Protein Calorie Malnutrition in preschool children". Annual Report of National Institute of nutrition (ICMR), Hyderabad, p.136.

I.C.N.N.D (1968) "Factor analysis of measure of nutritional status of preschool children", Manual for Nutrition Surveys, (2nd Edition), Washington Government, Printing Office, p.487

Jelliffe, D.B (1966) "The assessment of the nutritional status of the Community", WHO Monograph series No.53, World Health Organisation, Geneva, pp.50-78.

Jelliffe, D.B (1968) "Infant nutrition in the sub-tropics and tropics", World Health Organisation Monograph Series No.29, World Health Organisation, Geneva, pp.114-118.

Jelliffe, D.B and Jelliffe, E.F.P (1972) "Nutrition programmes for preschool children", The American Journal of Clinical Nutrition, Vol.25, No.6, p.595.

Jelliffe, D.B (1976) "World Trends in Infant Feedings", Proceedings of the Nutrition Society, of India, National Institute of Nutrition, Hyderabad, No.20, pp.1-16

Jones, R.C and Schendal, H.E (1966) "Nutritional Status of Selected Negro infants in Greenville country, South Carolina", American Journal of Clinical Nutrition, Vol.18, No.6, p.407.

Kamalanathan, G Gita Nalinakshi, and Devadas, R.P (1970) "Effect of a blend of protein foods on the nutritional status preschool children in a rural balwadi". The Indian Journal of Nutrition and Dietetics, Vol. 7, No.5, pp.288-292.

Kamalanathan, G Kalavathi, S.and Devadas, R.P (1975) "Effect of leaf protein supplementation on the growth of preschool children", A Thesis submitted to the University of Madras for the Degree of Master of Science, p.31, 38

Kamalanathan, G
Padma Karuppiah, and
Devadas, R.P
(1975)

"Supplementary value of leaf protein and ground nut meal in the diet of preschool children", The Indian Journal of Nutrition and Dietetics, Vol.12, pp.203, 205.

Kothari, L.K., Lal, K.B
Srivastava, D.K, and
Sharma, R
(1971)

"Correlation between plasma levels of Vitamin A and Proteins in children". The American Journal of Clinical Nutrition, Vol.27, pp.774-776.

Kothari, K.B
(1973)

"The Tamil Nadu Nutrition Study". Sidney M. Cantor Associates Incorporated, Pennsylvania, U.S.A. Vol.II, Section-D, Part-II, p.12.

Krishnamoorthy, N
Geetha, S., and
Devadas, R.P
(1976)

"Biological utilisation of P carotene from amaranath and leaf protein in preschool children, The Indian Journal of Nutrition and Dietetics, Vol.13, pp.293-295.

Krehl, W.A., and
Hodges, R.E
(1965)

The interpretation of nutrition survey data" The America Journal of Clinical Nutrition, Vol.17, p.191.

Kurien, P.P.,
Rao, M.N.,
Swaminathan, V., and
Subramaniyam, V
(1960)

"The metabolism of nitrogen, Calcium, phosphorus in undernourished children, The effect of replacement of rice poor vegetarian diets by Kaffir corn (Sorghum vulgare)", The British Journal of Nutrition, Vol.14, p.339.

Kymal, P.K.
(1973)

"Balahar-Present Experience and future projections" Proceedings of the Nutrition Society of India, No.15, p.32.

Linares, F.A.,
Sinisterra, L
Makay, A.C and Key, M.E
(1972)

"Anthropometric measurement in the assessment of nutritional status". Unpublished data.

Luthra, P.N (1975) — The child in India's Fifth Plan" Assignment children, No.29, p.34

Mahadevan, M (1975) — Children without childhood", Assignment Children, No.29, p.42.

Martin, E.A (1963) — "Robert's Nutrition Work with Children", The University of Chicago Press, Chicago, pp.18-55.

Mathrani, K.P (1972) — "Chairman's remarks efor the sympesium on Role of Food Technology in Combating malnutrition in Asia", Proceedings of the first Asian Congress of Nutrition, National Institute of Nutrition, Hyderabad, pp.422-426.

Mathur, J.S., Mehrotra, S.K. and Maheswari, B.B. (1974) — "Nutritional disorders among children below five years in a rural Community" Indian Journal of Pedictrics, vol.41, pp.184-192.

Mc Laren, D.S Kamel, W.W., Ayyoub, N (1965) — "Plasma Amino Acid and the detection of Protein calories Malnutrition", American Journal of clinical Nutrition, Vol.17, pp 152.

Mayer, Jean (1970) — Commentary, Journal of Nutrition Education, Vol.2, p.80

Mc Cance, R.A. (1971) — "The effect of malnutrition on growth, metabolism and final form", Proceedings of Nutrition Society, Vol.30, pp.123-128

Mc Namara, R.S (1973) — "The environmental dilemma", Span, Vol.14, p.30.

Mehta, M.L (1974) — "Feeding the preschool Child", Swasth Hind, Vol.XVIII, p.302.

Meyer, J (1972) "Human Nutrition-Its physiological Medical and social aspects", Charles, G. Thomas Publishers, Illinois, USA, pp.252-269.

Milton, M.L (1953) "School feeding-its contribution to child nutrition", FAO Nutritional Nations, Rome pp.8,9.

Morley, D (1973) "Pediatric priorities in the developing world", Butterworths & Co. (Publishers) Ltd., Great Britain. p.1,10.

Nagarajan, V (1977) "Food, agriculture and nutrition situation in India", Nutrition, Vol.11, pp.2-10.

Narayanaswamy, D Doraiswamy, T.R. Daniel, V.A Swaminathan, M and Parpia, H.A.B. (1972) "Effect of supplementing poor rice diet with low cost protein food, Chick pea or skim milk powder on nitrogen retention and N.P.U. in children", Nutrition Reports International, Vol.5, p.171.

Narayanaswamy, D Daniel V.A., Soma Kurien, Rajalakshmi, D, Swaminathan, M and Parpia, H.A.B. (1974) "Supplementary value of protein enriched cereal foods containing varying amounts of proteins to poor rice and ragi diets", The Indian Journal of Nutrition and Dietetics, Vol.11, pp.72-76.

Napier, W.G (1973) "The scope and possibilities for the use of the Kerala Indegeneours Food (K.I.F.)", Proceedings of the Nutrition Society of India, No.15, p.36.

Nelson, F.W (1963) "Text Book of Pediatrics", Philadelphia, London, pp.12-13. 39, 42.

N I N Manual (1971) "Creatine and creatinine in Urine", A manual of laboratory techniques, National Institute of Nutrition, (ICMR) Hyderabad, pp.286-287.

NIN (1972) "Effect of calorie Supplementation on the growth of preschool children", Annual Report, National Institute of Nutrition, (ICMR), Hyderabad p.174.

NIN, (1974) National Institute of Nutrition, Hyderabad, Annual Report, Indian Council of Medical Researeh pp.138-139, 150-152.

Nutrition (1973) "Supplementary feeding programmes", Nutrition, National Institute of Nutrition, Hyderabad, Vol. 7, No.4. pp.15-19.

P.A.G. (1975) "Place of infant and child Nutrition in the Government Food Policy", P&G Bulletin, Vol.5, p.27.

PAG (1976) "Mass Communication in Nutrition Improvement" PAG Bulletin, Vol.VI. p.1.

Parekh, U.C., Pherwani, A., Udani, P.M and Mukherji, S (1970) "Head circumference and brain size", Indian Journal of pediatries, Vol.37, p.4

Pascual, C.R (1972) "Social and cultural factors in malnutrition", Proceedings of the First Asian Congress of Nutrition, National Institute of Nutrition, Hyderabad, pp.560-569,

Pasricha, S (1973) "Possible calorie intake in young children fed cereal based diets", The Indian Journal of Nutrition and Dietetics, Vol. 10, pp.282-285.

Pasricha, S., Rau, P and Rao, D.H (1973) "Recipes from locally available foods suitable for home or village processing", Proceedings of the Nutrition Society of India, No.15, p.27.

Pereira, S.N and Begum, A (1968) "Studies in the prevention of Vitamin-A deficiency". Indian Journal of Medical Research, Vol.56, 362-369.

Pereira, S.N., Begum, A Sunderaraj, R and Dumm, M.E (1968) "Effect of dietary protein on serum amino acids", American Journal of clinical Nutrition, Vol.21, p.167.

Pereira, S.M., Begum, A Jesudian, G and Sundararaj, R (1969) "Lysine supplemented wheat and growth of preschool children" The American Journal of clinical Nutrition, Vol. 22, pp.606-611.

Parthasarathy, H.N Tasker, P.K., Doraiswamy, T.R Natarajan, N. and Subramanyam, V (1962) "Effect of supplement on ground nut flour fortified with vitamins and minerals of the retention of nitrogen, calcium and phosphorus in children subsisting on a rice diet". Food Science, Vol.2, pp.192.

Prasad, L.S.N. Rahman, R., Sen, D.K and Sinha, P (1969) "Some observations on serum proteins and amino aciduria in malnutrition", The Indian Journal of Pediatrics, Vol.6, p.73.

Prasannappa, G Chandrasekhara, H.N Padma Rani.R Srinivasan, K.S. and Chandrasekhara, M.R. (1976) "Supplementary feeds for preschool Children", Nutrition Reports International, Vol.13, pp.71-77

Radhakrishnan, N.V Ambegnokar, S.D Raj, H, and Shinde, V.O. (1967) "Studies on nutritive value of Food Stuffs-II Amino acid composition of certain leafy vegetables and millets", The Journal of Nutrition, Vol.2, p.16.

Rajalakshmi, R (1976) "Prevention and Prevalence of Malnutrition" The Baroda Journal of Nutrition, Vol.3, pp.1-39.

Ramalingaswami, V (1975) — "Medicine, Health and human development", IX Jawaharlal Nehru Memorial Lecture, New Delhi, November, Jawaharlal Nehru Memorial Fund, Teen Murthy House, New Delhi-11. p.4 (Unpublished).

Ranaghy, H.A Caughey, J.E and Halsted, J.A (1968) — "The study of growth in Iranian village", The American Journal of Clinical Nutrition, Vol.21, pp.438-494.

Rao, B.R.H. Benjamin, V., Jesudian, G and Mary, E., Dumm, (1965) — "Indian multripurpose food and low fat ground nut flour as supplements for school children", The Indian Journal of Pediatrics, Vol.32, pp.1-8.

Rao, G.P (1968) — "Possible approaches towards increasing food production", Proceedings of Nutrition Society of India, No.4, pp.214-215.

Rao, B.S.N., Rao, K.V and Naidu, A.N. (1969) — "Calorie-Protein adequacy of the dietaries of preschool children in India", Journal of Nutrition and Dietetics, Vol.6, p.238-243.

Rao, N.P., Singh, D and Swaminathan, M.C (1969) — "Nutritional status of pre-school children of rural communities near Hyderabad City". Indian Journal of Medical Research, Vol.57, pp.2132-2146.

Rao, P.T,and Sandozi, M.K (1970) — "Hermatological findings in Kwashiorkor", The Indian Journal of Pediatrics, Vol.37, p.255

Rao, D.H. and Sathyanarayana, K (1976) — Nutritional status of people of different socio economic groups in a rural area with special reference to preschool children", Ecology of Food and Nutrition, Vol.4, pp.237-242.

Read, M.S (1968) "Malnutrition and Mental retardation", CENTO, p.23.

Register, U.D., Inano Mitsuko, Thurston, C.E., Vyhmeister, E., Irma Dysinger, P.W., Blankenship, W.J and Herming,M.C. (1967) "Nitrogen balance studies in human subjects on various diets", The American Journal of Clinical Nutrition, Vol.20, pp.753-759.

Pandit, C.G (1964) "Diet Atlas of Indian", I.C.M.R., New Delhi, pp.18-20.

Sauberlich, H.E SKala, J.H and Dowdy, R.P (1976) "Laboratory Tests for the Assessment of Nutritional Status", CRC, Press, Inc., Ohio USA. pp.895-896.

Scrimshaw, N.S., Taylor, C.E and Gordon, J.E (1968) "Interactions of Nutrition and Infection", World Health Organisation Monograph Series, No.57., World Health Organisation, Geneva. p.9.

Scrimshaw, N.S (1972) "Nutrition and Infection" proceedings of the First Asian Congress of Nutrition, National Institute of Nutrition, Hyderabad, p.11, p.11, 571-580.

Sjolin, S (1969) "Food consumption surveys in children and adolescents", Nutrition in preschool and school age. Proceedings of the symposia of the Swedish Nutrition Foundation, Uppsala, p.68.

Srikantia, S.G and Yogandanda shastri (1971) "Observations of Malnutrition and Mental Development", Proceedings of Nutrition society of India, No.10, pp.216-220.

Srikantia, S.G and Sastri, C.Y (1972) "Effect of maternal attribute on malnutrition in children", Proceedings of the First Asian Congress of Nutrition, National Institute of Nutrition, Hyderabad, pp.584-590.

Srikantia, S.G (1973) "Scientific basis for supplementary feeding programmes for preschool children", Proceedings of the Nutrition Society of India, No.15, pp.6-8.

Srikantia, S.G (1974) "Nutrition and Infection", Proceedings of the Nutrition Society of India, No.16. pp.35-38.

Stewart, R.c (1976) "Twelve generations of marginal malnutrition", The Baroda Journal of Nutrition, Vol.3, p.145.

Social Welfare News letter. (1975) "News from the Centre", Social Welfare Newsletter, Government of India, Department of Social Welfare, New Delhi, Vol.1, No.3, p.1.

Soman, C.R., Das, V.L., Iyer, P. and Kutty, C.P.M (1974) "An evaluation of fish-cassava meal as a preschool supplementary feed", Proceedings of the Nutrition Society of India, No.18, p.24.

Sukhatme, P.V. (1967) "Population and food supplies Present picture in South East Asia", Symposium on population problems and Food Resources of South East Asia, Proceedings of the Nutrition Society of India, No.1, pp.1-36.

Sukhatma, P.V (1972) "India and the Protein Problem". Ecology of Food and Nutrition, Vol.2, pp.267-278.

Swaminathan, M (1969) "Assessment of Nutritional Status of the Community" Indian Journal of Nutrition and Dietetics, Vol.6 pp.122-148.

Sundararaj, R (1972) "Food intakes of rural preschool children (Tamil Nadu) ", The Indian Journal of Nutritionand Dietetics, Vol.9, pp.88-90.

Swaminathan, M.S (1971)	"Plant foods and intellectual dwarfing", Plant foods for Human Nutrition, Vol.2, pp.89-92
Swaminathan, M Daniel, V.A and Parpia, H.A.B. (1972)	"Protein enriched cereal feeds for overcoming malnutrition among preschool children in India and other countries", The Indian Journal of Nutrition and Dietetics, Vol.9, pp.22
Swaminathan, M.C Rao, D.H., Rao., K.V Narasimhan, M.V.V.L and Dumo, N.S (1973)	"Supplementary feeding programmes organised and operated by village community-Kuntloor experiences". The proceedings of the Nutrition Society of India, No.15, pp.52.
Swaminathan, M (1974)	"Essentials of Nutrition", Ganesh and Co., Madras-17. Vol.II, pp.5, 300-335, 566.
Swasth Hind (1974)	Swasth Hind, Vol.18, No.11, cover page.
Tan, R.H., deGuzmann, P.E., Lingao, A.L., Del Rosario, R.B and Cuaderno, F.C (1974)	"Weight, height and arm skinfold measurements of High School students in Metropolitan Manila", Philippine Journal of Nutrition, Vol.27, pp.27-31.
Thimmayamma, B.V.S., Sathyanarayan, K, Rau, K.P. and Swaminathan, M.C (1974)	"Effect of socio economic differences in the dietary intake of urban population in Hyderabad", Indian Journal of Nutrition and dietetics, Vol.10, pp.8-13.
Toppsp G., Look, J.Mallanch, W.W and Elliott, A (1970)	British Journal of Preventive Medicine, Vol.34, p.154
Udani, P.M., Bhat, U.S and Shah, B.P. (1976)	"Mental Development in severe protein calorie malnutrition" Indian Pediatrics, Vol.13, pp.507-516.

UNICEF, (1975) — World Food Conference, Assignment children, No.31

United Nations (1977) — "World population nearly 4 billion mid 1975", U.N. News letter, U.N. Information Centre, New Delhi, Vol.28. No.6, p.4.

USAID (1974) — War on Hunger, A Report from the Agency for International Development, Vol.VIII, No.12.

Varley, H (1969) — "The Plasma Proteins", Practical Clinical Biochemistry, The English Language Book Society, London, pp.230-246.

Venkatachalam, P.S and Rebello, L.M (1971) — "Nutrition for mother and child", ICMR Special Reports Series No.41, National Institute of Nutrition, (ICMR) Hyderabad, p.21.

Vinodini Reddy, and Srikantia, S.G (1966) — "Serum vitamin A in Kwashiorkor", The American Journal of clinical Nutrition, Vol.18, p.105.

Vinodini Reddy and Lala, V.R (1970) — "Absorption of B carotene from green leafy vegetables in under nourished children", The American Journal of clinical Nutrition, Vol.23, pp.110-113.

Vinodini, R and Gupta, C.P (1974) — "Treatment of Kwashiorkor with opaque-2 maize", The American Journal of Clinical Nutrition, Vol.27, pp.122-124.

Viteri, F.E., Arroyave.G and Behar.M (1966) — "Estimation of protein depletion in malnourished children by a creatinine Height index", VII International Congress of Nutrition, Hamburg, p.46.

Wakhlu, I (1972) — "Nutritional authropometry", Archives of child Health, Vol.14, p.72.

Waterlow, J.C (1965) "The assessment of Protein Malnutrition", Proceedings of the Nutrition Society, 22, p.8.

Watson, E.H., and Lowert, G.H., (1967) "Growth and Development of children", Chicago Year Book, Medical Publishers, Inc., As Referred by Wakhlu (1972) Archieves of child Health, Vol.14, p.72.

White head, R.G (1969) "The assessment of nutritional status in protein malnourished children", The Proceedings of the Nutrition Society, Cambridge University Press, London, Vol.28, pp.1-5.

APPENDICES

A P P E N D I X A

MONTHLY HEIGHT INCREMENTS OF THE PRE - SCHOOL CHILDREN IN THE THREE GROUPS

RAGI BASED DIET GROUP

S.No	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	88.0	88.4	88.9	89.3	89.8	90.2
2.	87.5	88.2	89.0	89.7	90.5	91.2
3.	82.6	83.6	84.6	85.7	86.3	87.0
4.	92.4	93.0	94.0	95.0	96.2	97.8
5.	84.8	85.9	87.0	88.2	89.5	91.0
6.	84.6	85.3	86.0	86.8	87.3	88.0
7.	85.4	86.0	86.6	87.2	88.6	89.4
8.	88.0	88.8	89.7	90.4	91.6	93.2
9.	89.8	90.5	91.2	92.0	93.2	94.2
10.	90.4	91.6	92.7	93.9	94.3	94.8
11.	76.7	77.5	78.3	79.1	79.5	81.0
12.	91.1	91.6	92.0	92.5	93.4	94.0
13.	80.8	81.3	81.9	82.5	83.0	83.8
14.	82.2	82.8	83.4	84.2	84.9	86.3
15.	89.0	89.7	90.5	91.2	91.9	93.2
16.	86.1	86.4	86.8	87.1	87.6	88.0
17.	73.2	73.5	73.9	74.5	74.9	75.3
18.	90.4	91.1	91.8	92.5	93.2	94.1
19.	92.6	93.3	94.0	94.7	95.4	96.0
20.	91.8	92.3	92.9	93.4	94.2	95.0
21.	85.6	86.3	87.0	87.8	88.7	89.5
22.	87.6	88.2	88.8	89.4	89.7	90.2
23.	86.6	87.1	87.6	88.1	88.4	89.0
24.	89.0	89.7	90.3	91.0	92.0	93.0
25.	85.2	86.2	87.4	88.6	89.6	91.0

RICE BASED DIET GROUP

S.No.	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	84.5	85.3	86.1	86.9	87.9	89.0
2.	99.0	99.5	99.9	100.4	100.9	101.4
3.	93.4	94.0	94.7	95.2	96.2	97.0
4.	89.4	89.9	90.5	91.0	91.6	92.2
5.	84.3	84.7	85.2	85.6	86.0	86.6
6.	100.7	101.2	101.7	102.1	102.7	103.2
7.	84.3	84.6	84.9	85.3	85.6	86.0
8.	93.0	93.6	94.1	94.6	95.2	96.0
9.	89.9	90.4	91.0	91.6	92.2	92.9
10.	93.1	93.6	94.2	94.7	95.3	96.0
11.	91.6	92.1	92.7	93.3	93.8	94.5
12.	81.6	82.1	82.7	83.2	83.8	84.6
13.	94.3	94.6	95.0	95.8	95.8	96.4
14.	88.1	88.4	88.6	89.0	89.5	90.0
15.	84.6	85.1	85.7	86.2	86.8	87.5
16.	74.4	74.8	75.1	75.5	75.9	76.2
17.	97.5	98.0	98.5	99.0	99.6	100.0
18.	89.7	90.1	90.6	91.0	91.7	92.2
19.	92.3	92.9	93.4	93.9	94.3	94.8
20.	89.7	90.0	90.3	90.7	91.2	91.7
21.	98.7	99.1	99.5	99.8	100.3	100.8
22.	74.4	75.0	75.7	76.3	77.2	78.0
23.	93.6	94.1	94.6	95.2	95.7	96.2
24.	88.4	88.7	89.0	89.3	90.0	90.4
25.	84.8	85.4	86.0	86.5	87.0	87.3

CONTROL GROUP

S.No	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	89.0	89.5	90.2	90.8	91.4	92.0
2.	88.5	88.9	89.3	89.8	90.3	91.0
3.	86.0	86.3	86.6	87.0	87.4	87.8
4.	83.3	83.7	84.0	84.5	85.0	85.4
5.	87.1	87.4	87.7	88.0	88.3	89.0
6.	96.0	96.3	96.9	97.3	97.6	98.0
7.	77.5	77.8	78.0	78.3	78.6	79.0
8.	86.1	86.5	86.9	87.3	87.8	88.4
9.	80.8	81.1	81.5	81.8	82.3	82.8
10.	83.4	83.7	84.0	84.4	84.7	85.5
11.	90.0	90.3	90.6	91.0	91.6	92.2
12.	86.4	86.7	87.0	87.4	88.0	88.5
13.	81.7	82.1	82.6	83.0	83.6	84.2
14.	86.0	86.5	87.0	87.5	88.4	89.0
15.	88.9	89.3	89.7	90.1	90.6	91.4
16.	90.1	90.7	91.2	91.8	92.5	93.2
17.	95.3	95.9	96.2	96.5	97.0	97.4
18.	91.0	91.5	92.0	92.6	93.0	94.0
19.	90.9	91.2	91.5	91.9	92.5	93.0
20.	88.2	88.5	89.0	89.5	89.6	90.2
21.	89.0	89.3	89.7	90.0	90.5	91.0
22.	85.6	86.0	86.5	87.0	87.5	88.1
23.	86.0	86.4	86.9	87.3	87.8	88.2
24.	90.6	90.8	91.0	91.3	91.8	92.1
25.	83.8	84.2	84.6	85.0	85.6	86.3

APPENDIX B

MONTHLY WEIGHT INCREMENTS OF THE PRESCHOOL CHILDREN IN THE THREE GROUPS

RAGI BASED DIET GROUP

MONTHS

S.No	1 (Kg)	2 (Kg)	3 (Kg)	4 (Kg)	5 (Kg)	6 (Kg)
1.	10.50	11.00	11.25	11.50	11.50	12.00
2.	10.00	10.50	11.25	11.50	11.75	12.00
3.	9.50	10.00	10.50	11.00	11.50	12.50
4.	13.00	13.50	14.00	14.75	15.00	15.50
5.	10.50	11.00	11.50	11.75	12.00	12.50
6.	10.00	10.25	10.50	10.75	11.00	11.00
7.	11.00	11.50	12.00	12.50	13.00	13.50
8.	12.00	12.50	13.00	13.25	13.75	14.00
9.	11.00	11.25	11.75	12.00	12.50	12.00
10.	11.50	12.00	12.25	12.75	12.00	13.50
11.	10.50	11.00	11.25	11.50	11.75	12.00
12.	11.00	11.50	11.75	12.00	12.25	12.25
13.	10.00	10.50	11.00	11.50	12.75	13.00
14.	9.00	99.25	9.50	9.75	10.00	10.00
15.	11,50	11.75	12.00	12.50	13.00	13.50
16.	10.00	10.50	11.00	11.50	11.75	12.50
17.	9.00	10.00	10.50	11.00	11.75	12.75
18.	11.00	11.25	11.50	11.75	12.00	12.00
19.	11.50	12.00	12.50	12.50	13.00	13.00
20.	10.50	11.00	11.25	11.75	12.00	12.50
21.	9.50	10.00	10.50	11.00	11.50	12.00
22.	11.00	11.25	11.75	12.00	12.50	12.50
23.	10.00	10.50	10.50	10.75	11.00	11.00
24.	11.00	12.00	12.25	12.50	12.50	13.00
25.	10.00	10.50	11.00	11.50	12.00	12.50

RICE BASED DIET GROUP

S.No	MONTHS 1 (Kg)	2 (Kg)	3 (Kg)	4 (Kg)	5 (Kg)	6 (Kg)
1.	10.00	10.25	10.50	11.00	11.50	12.00
2.	13.00	13.25	13.75	14.00	14.50	15.00
3.	12.00	12.50	12.75	13.00	13.25	14.00
4.	11.50	12.00	12.50	12.75	13.00	13.50
5.	10.00	10.50	11.00	11.25	11.50	11.50
6.	13.00	13.25	13.50	14.00	14.25	15.00
7.	9.50	9.75	10.00	10.25	10.75	11.00
8.	12.00	12.50	12.75	13.00	13.50	14.00
9.	11.50	11.75	12.00	12.50	12.75	13.00
10.	11.00	11.25	11.75	12.00	12.50	12.50
11.	10.50	11.00	11.25	11.50	11.50	12.00
12.	10.00	10.50	11.00	11.25	11.50	11.50
13.	13.00	13.50	13.75	14.00	14.50	15.00
14.	11.50	11.75	12.00	12.25	12.50	13.00
15.	10.50	11.00	11.50	12.00	12.50	12.50
16.	7.50	7.75	8.00	8.25	8.75	9.50
17.	12.50	13.00	13.50	14.00	14.75	15.00
18.	11.00	11.25	11.50	12.00	12.50	13.00
19.	12.50	13.00	13.25	13.75	14.25	14.50
20.	5.00	5.50	5.75	6.00	6.50	7.00
21.	12.00	12.50	13.00	13.50	14.00	14.50
22.	11.00	11.50	12.00	12.25	12.50	12.50
23.	10.00	10.50	11.00	11.25	12.00	12.00
24.	11.00	11.25	11.50	12.00	12.50	13.00
25.	12.00	12.25	12.75	13.00	13.50	13.50

CONTROL GROUP

S.No.	MONTHS 1 (Kg)	2 (Kg)	3 (Kg)	4 (Kg)	5 (Kg)	6 (kg)
1.	10.00	10.50	10.50	10.75	11.00	11.00
2.	11.00	11.25	11.50	12.00	12.50	12.50
3.	11.00	11.50	12.00	12.00	12.50	12.50
4.	12.00	12.25	12.50	12.50	13.00	13.00
5.	10.00	10.50	11.00	11.50	11.50	12.00
6.	13.50	13.50	14.00	14.50	14.50	15.00
7.	8.50	8.75	9.00	9.50	9.50	10.00
8.	9.50	10.00	10.00	10.25	10.50	10.50
9.	10.00	10.25	10.50	10.50	11.00	11.00
10.	10.00	10.25	10.50	10.50	11.00	11.00
11.	11.50	11.50	12.00	12.00	12.50	12.50
12.	11.00	11.25	11.50	11.50	12.00	12.00
13.	9.50	9.50	10.00	10.50	11.00	11.50
14.	10.50	11.00	11.25	11.25	11.50	11.50
15.	10.50	11.00	11.25	11.50	12.00	12.00
16.	11.00	11.50	12.00	12.50	13.00	13.00
17.	12.00	12.25	12.50	13.00	13.50	13.50
18.	11.00	11.50	12.00	12.25	12.50	12.50
19.	12.00	12.25	12.50	12.75	13.00	13.00
20.	11.50	11.50	11.75	12.00	12.00	12.00
21.	10.50	11.00	11.25	11.50	12.00	12.00
22.	10.00	10.25	10.50	10.75	11.00	11.00
23.	11.00	11.25	11.50	11.75	12.00	12.00
24.	12.00	12.50	13.00	13.25	13.50	13.50
25.	9.50	10.00	10.25	10.50	10.50	11.00

APPENDIX C

MONTHLY INCREMENTS IN ARM CIRCUMFERENCE OF THE PRE-SCHOOL CHILDREN IN THE THREE GROUPS

RAGI BASED DIET GROUP

S.No	MONTHS 1 (Cm)	2 (Cm)	3 (Cm)	4 (Cm)	5 (Cm)	6 (Cm)
1.	13.0	13.1	13.1	13.2	13.2	13.3
2.	12.6	12.7	12.8	12.8	12.9	13.0
3.	13.8	13.9	14.0	14.1	14.1	14.2
4.	15.8	15.8	15.8	15.9	15.9	15.9
5.	14.0	14.0	1 4.1	14.1	14.2	14.2
6.	13.2	13.3	13.3	13.4	13.4	13.5
7.	15.0	15.0	15.1	15.1	15.2	15.2
8.	14.5	14.5	14.6	14.6	14.7	14.7
9.	15.1	15.1	15.1	15.2	15.2	15.2
10.	13.8	13.9	14.0	14.2	14.3	14.6
11.	14.8	15.0	15.0	15.2	15.1	15.1
12.	12.4	12.4	12.5	12.5	12.5	12.5
13.	13.6	13.6	13.6	13.7	13.7	13.7
14.	13.0	13.0	13.1	13.1	13.2	13.2
15.	14.4	14.6	14.9	15.0	15.1	15.2
16.	12.6	12.7	12.8	12.8	12.9	12.9
17.	14.2	14.2	14.3	14.4	14.5	14.5
18.	13.8	13.8	13.8	13.9	13.9	13.9
19.	13.2	13.2	13.3	13.3	13.5	13.5
20.	13.0	13.2	13.3	13.3	13.4	13.5
21.	12.0	12.0	12.1	12.2	12.2	12.3
22.	14.0	14.1	14.3	14.5	14.5	14.6
23.	14.0	14.0	14.0	14.1	14.1	14.2
24.	14.0	14.0	14.1	14.1	14.2	14.2
25.	12.6	12.6	12.8	12.8	12.9	13.0

RICE BASED DIET

S.No	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	13.2	13.2	13.3	13.3	13.4	13.4
2.	13.2	13.4	13.5	13.5	13.6	13.7
3.	15.0	15.0	15.1	15.1	15.1	15.2
4.	14.2	14.3	14.5	14.5	14.6	14.7
5.	13.4	13.6	13.7	13.8	13.9	14.0
6.	14.3	14.3	14.3	14.4	14.4	14.4
7.	12.4	12.4	12.5	12.6	12.7	12.8
8.	14.6	14.6	14.7	14.7	14.7	14.7
9.	13.6	13.6	13.6	13.7	13.7	13.8
10.	13.5	13.5	13.6	13.6	13.7	13.8
11.	13.2	13.2	13.2	13.3	13.3	13.3
12.	14.4	14.4	14.4	14.4	14.5	14.5
13.	16.0	16.0	16.1	16.1	16.2	16.2
14.	15.0	15.0	15.1	15.1	15.1	15.2
15.	14.2	14.2	14.3	14.3	14.4	14.4
16.	12.5	12.5	12.6	12.6	12.7	12.8
17.	14.2	14.2	14.3	14.3	14.4	14.4
18.	14.4	14.4	14.5	14.5	14.6	14.6
19.	13.8	13.8	13.8	13.9	13.9	13.9
20.	14.2	14.2	14.3	14.3	14.4	14.4
21.	14.4	14.5	14.6	14.7	14.9	15.0
22.	9.0	9.1	9.2	9.2	9.3	9.4
23.	14.2	14.2	14.3	14.3	14.4	14.4
24.	14.0	14.0	14.1	14.2	14.2	14.2
25.	13.3	13.3	13.4	13.4	13.5	13.5

CONTROL GROUP

S.No	Months 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	13.1	13.1	13.1	13.1	13.2	13.2
2.	14.0	14.0	14.0	14.1	14.1	14.1
3.	14.6	14.6	14.6	14.7	14.7	14.7
4.	14.0	14.0	14.1	14.1	14.2	14.2
5.	12.7	12.7	12.8	12.8	12.8	12.8
6.	15.0	15.0	15.0	15.1	15.1	15.1
7.	13.7	13.7	13.7	13.8	13.8	13.8
8.	14.2	14.2	14.2	14.3	14.3	14.3
9.	13.2	13.2	13.3	13.3	13.4	13.4
10.	15.2	15.2	15.2	15.3	15.3	15.3
11.	13.2	13.2	13.3	13.3	13.4	13.4
12.	15.9	15.9	15.9	15.9	15.9	15.9
13.	13.3	13.3	13.3	13.4	13.4	13.4
14.	14.0	14.0	14.0	14.0	14.0	14.0
15.	13.0	13.0	13.0	13.1	13.1	13.1
16.	13.3	13.3	13.3	13.4	13.4	13.4
17.	13.0	13.0	13.1	13.1	13.2	13.2
18.	12.9	12.9	13.0	13.0	13.1	13.1
19.	12.8	12.8	12.8	12.8	12.8	12.8
20.	13.4	13.4	13.4	13.5	13.5	13.5
21.	14.1	14.1	14.1	14.2	14.2	14.2
22.	12.6	12.6	12.6	12.6	12.6	12.6
23.	13.3	13.3	13.3	13.4	13.4	13.4
24.	14.0	14.0	14.1	14.1	14.2	14.2
25.	14.2	14.2	14.3	14.3	14.4	14.4

APPENDIX D

MONTHLY CHEST CIRCUMFERENCE INCREMENTS OF THE PRE-SCHOOL CHILDREN IN THE THREE GROUPS

RAGI BASED DIET GROUP

S.No	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	48.2	48.2	48.3	48.3	48.4	48.5
2.	48.2	48.4	48.7	48.8	48.9	49.0
3.	47.0	47.0	47.0	47.1	47.2	47.2
4.	54.0	54.0	54.1	54.1	54.3	54.3
5.	46.0	46.0	46.1	46.2	46.2	46.4
6.	48.0	48.2	48.2	48.4	48.5	48.5
7.	49.0	49.2	49.3	49.3	49.5	49.5
8.	48.6	48.7	48.8	48.8	48.9	49.0
9.	49.0	49.0	49.1	49.3	49.3	49.4
10.	50.0	50.2	50.3	50.5	50.0	51.2
11.	47.0	47.2	47.3	47.4	47.4	47.6
12.	48.0	48.0	48.1	48.1	48.2	48.2
13.	46.0	46.4	47.0	48.0	48.5	49.0
14.	44.2	44.2	44.3	44.3	44.4	44.4
15.	51.4	51.4	51.5	51.5	51.6	51.6
16.	46.0	46.2	46.3	46.4	46.5	46.6
17.	46.0	46.2	46.4	46.6	46.6	46.8
18.	50.0	50.0	50.1	50.1	50.1	50.1
19.	49.0	49.1	49.2	49.2	49.4	49.4
20.	46.8	46.8	46.9	46.9	47.0	47.0
21.	46.2	46.2	46.3	46.3	46.3	46.3
22.	46.8	47.0	47.1	47.1	47.2	47.2
23.	47.6	47.6	47.7	47.7	47.8	47.8
24.	50.3	50.6	51.0	51.0	51.2	51.2
25.	46.0	46.6	47.6	47.6	48.0	48.2

RICE BASED DIET GROUP

S.No.	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	48.4	48.4	48.5	48.6	48.7	48.7
2.	52.8	52.8	52.9	52.9	53.0	53.0
3.	50.4	50.4	50.4	50.5	50.5	50.5
4.	47.2	47.3	47.3	47.4	47.4	47.5
5.	48.8	48.8	48.9	48.9	49.0	49.0
6.	51.6	51.6	51.6	51.7	51.7	51.7
7.	46.0	46.1	46.2	46.3	46.4	46.4
8.	48.8	48.8	49.0	49.2	49.3	49.4
9.	49.6	49.6	49.7	49.7	49.8	49.8
10.	47.6	47.7	47.8	47.8	47.9	47.9
11.	47.0	47.1	47.2	47.3	47.4	47.5
12.	46.4	46.5	46.5	46.6	46.6	46.7
13.	50.2	50.3	50.3	50.4	50.5	50.5
14.	49.0	49.3	49.5	49.8	50.0	50.2
15.	49.0	49.0	49.1	49.1	49.1	49.2
16.	45.6	45.6	45.6	45.7	45.7	45.7
17.	49.4	49.4	49.5	49.5	49.6	49.7
18.	47.4	47.4	47.5	47.5	47.6	47.6
19.	51.2	51.2	51.2	51.3	51.3	51.3
20.	51.0	51.0	51.0	51.1	51.1	51.2
21.	50.2	50.3	50.5	50.5	50.6	50.7
22.	40.6	41.1	41.6	42.3	42.8	43.6
23.	49.2	49.2	49.2	49.3	49.3	49.3
24.	45.6	45.8	46.0	46.3	46.6	47.0
25.	46.2	46.2	46.3	46.3	46.4	46.4

CONTROL GROUP

S.No	MONTHS 1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	6 (cm)
1.	45.8	45.8	45.9	45.9	46.0	46.0
2.	50.0	50.0	50.0	50.0	50.0	50.0
3.	49.6	49.6	49.6	49.7	49.7	49.7
4.	48.8	48.8	48.9	48.9	49.0	49.0
5.	51.0	51.0	51.0	51.0	51.0	51.0
6.	51.6	51.6	51.7	51.8	51.9	52.0
7.	44.2	44.2	44.2	44.3	44.3	44.3
8.	43.6	43.6	43.8	43.8	44.0	44.0
9.	47.0	47.0	47.1	47.1	47.1	47.1
10.	47.8	47.8	47.8	47.9	47.9	47.9
11.	48.0	48.0	48.0	48.1	48.1	48.1
12.	50.6	50.6	50.6	50.6	50.6	50.6
13.	49.0	49.0	49.0	49.0	49.0	49.0
14.	48.6	48.6	48.8	48.8	49.0	49.0
15.	47.6	47.6	47.8	47.8	48.0	48.0
16.	50.0	50.0	50.0	50.0	50.0	50.0
17.	50.0	50.0	50.0	50.0	50.0	50.0
18.	48.4	48.4	48.4	48.5	48.5	48.5
19.	48.6	48.6	48.6	48.6	48.6	48.6
20.	48.0	48.0	48.0	48.1	48.1	48.1
21.	48.0	48.0	48.0	48.0	48.0	48.0
22.	43.8	43.8	43.8	43.9	43.9	43.9
23.	48.8	48.8	48.8	48.9	48.9	49.0
24.	49.6	49.6	49.6	49.7	49.7	49.7
25.	47.8	47.8	47.8	47.9	47.9	47.9

APPENDIX E

HAEMOGLOBIN LEVELS OF THE PRESCHOOL CHILDREN IN THE THREE GROUPS AT THE BEGINNING AND AT THE END OF THE STUDY

RAGI BASED DIET GROUP

S.No	INITIAL Haemoglobin in g/100 ml of Blood	FINAL Haemoglobin in g/100ml of blood
1.	8.00	8.61
2.	8.00	8.25
3.	7.26	7.84
4.	10.75	11.75
5.	5.10	5.66
6.	9.15	9.58
7.	8.20	8.70
8.	7.24	7.84
9.	10.20	10.88
10.	6.20	6.96
11.	7.26	7.62
12.	7.26	7.62
13.	7.30	7.62
14.	6.00	6.14
15.	11.00	11.32
16.	9.00	9.23
17.	6.00	6.20
18.	8.00	8.23
19.	7.15	7.62
20.	7.00	7.40
21.	8.00	8.70
22.	8.00	8.70
23.	9.80	10.07
24.	9.85	10.10
25.	9.56	10.00

RICE BASED DIET GROUP

S.No.	INITIAL Haemoglobin in g/100ml of blood	FINAL Haemoglobin in g/100ml of blood
1.	7.50	7.83
2.	9.12	9.58
3.	10.26	10.88
4.	6.75	6.96
5.	8.25	8.70
6.	6.36	6.52
7.	6.27	6.52
8.	9.10	9.58
9.	8.00	8.70
10.	8.15	8.70
11.	8.25	8.70
12.	6.29	6.96
13.	8.20	8.70
14.	10.00	10.88
15.	4.10	4.79
16.	4.50	4.76
17.	7.28	7.83
18.	9.50	10.00
19.	7.13	7.83
20.	9.10	9.58
21.	8.70	9.14
22.	6.60	6.88
23.	6.26	6.52
24.	8.00	8.54
25.	11.15	11.76

CONTROL GROUP

S.No	INITIAL Haemoglobin in g/100ml of blood	FINAL Haemoglobin in g/100ml of blood
1.	6.00	6.00
2.	8.36	8.36
3.	8.24	8.28
4.	8.30	8.36
5.	10.68	10.70
6.	10.00	10.10
7.	6.89	7.00
8.	5.00	7.00
9.	6.89	6.91
10.	6.15	6.18
11.	7.20	7.50
12.	7.89	8.00
13.	6.85	7.31
14.	6.60	6.64
15.	8.28	8.30
16.	8.22	8.24
17.	8.24	8.24
18.	9.22	9.22
19.	7.15	8.25
20.	9.20	9.22
21.	7.50	7.50
22.	8.24	8.24
23.	6.25	6.30
24.	5.57	5.57
25.	7.60	7.62

APPENDIX F

URINARY CREATININE LEVELS OF THE PRESCHOOL CHILDREN IN THE THREE GROUPS AT THE BEGINNING AND AT THE END OF THE STUDY

RAGI BASED DIET GROUP

S.No	INITIAL Creatinine in mg/100ml of urine	FINAL Creatinine in mg/100ml of urine
1.	19.0	23.5
2.	20.0	28.0
3.	18.0	22.5
4.	16.0	25.6
5.	25.5	30.0
6.	30.0	21.0
7.	25.0	33.0
8.	22.0	26.0
9.	58.0	48.0
10.	30.0	31.5
11.	30.0	31.0
12.	31.5	21.0
13.	41.0	51.5
14.	27.5	30.0
15.	64.0	50.0
16.	44.0	40.0
17.	41.0	46.5
18.	30.0	37.5
19.	41.0	40.0
20.	30.0	21.5
21.	14.0	20.0
22.	36.5	36.0
23.	15.0	19.0
24.	12.5	15.0
25.	50.0	46.5

RICE BASED DIET GROUP

S.No.	INITIAL Creatinine in mg/100ml of urine	FINAL Creatinine in mg/100ml of urine
1.	40.0	44.0
2.	27.0	36.0
3.	36.5	47.5
4.	12.0	23.5
5.	18.0	23.5
6.	24.0	36.5
7.	26.5	30.0
8.	29.0	38.5
9.	42.0	33.0
10.	16.5	22.0
11.	19.5	20.0
12.	36.5	36.0
13.	20.0	24.5
14.	25.0	20.5
15.	30.0	38.0
16.	33.0	35.0
17.	35.0	53.0
18.	25.0	25.0
19.	21.0	30.0
20.	40.0	36.0
21.	24.0	29.5
22.	21.0	21.0
23.	35.0	22.0
24.	32.0	42.0
25.	12.5	17.0

CONTROL GROUP

S.No	INITIAL Creatinine in mg/100ml of urine	FINAL Creatinine in mg/100ml of urine
1.	20.0	22.0
2.	21.0	25.0
3.	20.0	20.0
4.	11.0	21.0
5.	13.5	15.5
6.	23.0	23.0
7.	42.5	37.5
8.	23.0	25.0
9.	26.0	30.5
10.	48.0	24.0
11.	9.5	18.5
12.	13.0	53.0
13.	14.0	14.5
14.	49.0	44.0
15.	37.5	13.5
16.	10.0	16.0
17.	13.0	24.5
18.	40.0	25.0
19.	21.0	19.0
20.	37.0	28.5
21.	25.0	23.0
22.	25.0	23.0
23.	25.0	12.5
24.	15.0	23.0
25.	30.0	27.5

A P P E N D I X G

CREATININE - HEIGHT RATIO OF THE PRESCHOOL CHILDREN IN THE THREE GROUPS AT THE BEGINNING AND AT THE END OF THE STUDY

RAGI BASED DIET GROUP

S.No	INITIAL	FINAL
1.	0.5	0.7
2.	0.5	0.6
3.	0.6	1.7
4.	0.8	1.2
5.	0.7	0.8
6.	0.7	0.5
7.	1.8	2.2
8.	0.9	0.5
9.	1.4	1.5
10.	0.7	1.1
11.	0.9	0.8
12.	0.7	1.1
13.	1.3	1.1
14.	0.9	0.9
15.	1.9	2.6
16.	1.5	1.9
17.	0.7	1.3
18.	0.8	1.9
19.	2.0	1.6
20.	1.5	0.7
21.	0.6	0.6
22.	1.6	1.5
23.	0.6	1.5
24.	0.2	0.9
25.	2.0	1.7

RICE BASED DIET GROUP

S.No	INITIAL	FINAL
1.	1.3	0.7
2.	1.1	1.8
3.	1.0	1.9
4.	1.0	1.1
5.	0.6	1.3
6.	0.8	1.0
7.	0.9	1.0
8.	0.8	1.2
9.	1.6	1.3
10.	0.6	0.9
11.	1.4	1.6
12.	2.6	1.2
13.	1.6	1.1
14.	0.8	0.6
15.	1.1	2.0
16.	1.6	1.2
17.	2.7	1.2
18.	2.1	1.1
19.	0.8	1.4
20.	1.6	1.8
21.	0.9	0.8
22.	0.6	0.7
23.	1.0	0.9
24.	0.9	1.1
25.	0.5	0.9

CONTROL GROUP

S.No	INITIAL	FINAL
1.	1.3	1.0
2.	0.8	0.9
3.	0.9	0.8
4.	1.2	0.8
5.	0.6	0.2
6.	0.6	0.9
7.	2.0	1.4
8.	0.8	0.6
9.	0.8	1.7
10.	0.9	1.2
11.	0.4	0.7
12.	0.4	1.0
13.	0.3	0.5
14.	3.9	2.3
15.	1.8	0.5
16.	0.5	0.6
17.	0.4	0.9
18.	0.9	1.7
19.	0.5	1.5
20.	1.6	0.8
21.	1.6	0.7
22.	1.5	0.9
23.	0.5	0.5
24.	0.5	1.1
25.	0.6	0.9