NUTRITIONAL STATUS AND DIETARY HABITS OF IRULAS OF ATTAPPADY

BY

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DECLARATION

I hereby declare that this thesis entitled **Nutritional Status and Dietary Habits of Irulas of Attappady** is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **Nutritional Status and Dietary Habits of Irulas of Attappady** is a record of research work done independently by Smt. V. Indira under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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EXTERNAL EXAMINER

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INTRODUCTION

1. INTRODUCTION

Tribal communities form a small but an important and ancient group of our population. Tribes have been the original autochthonous inhabitants of the country, who were driven from the fertile plains to the more inaccessible, remote, inhospitable slopes, hills and forests by successive waves of invaders (Singh, 1983). Tribes are integral components of forest life and they are seen in forests, hills, plateaus and in naturally isolated regions (Singh, 1990).

Tribal communities belong to different ethnological groups, profess diverse faith and are at varied levels of socio-economic development and constitute an important segment of the population (Sahni and Xirasagar, 1990). Inspite of the fact that the country has made rapid progress and development, tribes have by and large remained primitive and under developed technologically and economically because of their secluded habitat (Rao <u>et</u> <u>al</u>., 1983).

The tribal areas of India are broadly divided into six groups viz., central tribal region, western tribal region, north-eastern tribal region, north-western tribal region, southern tribal pockets and oceanic groups (Sahni and Xirasagar, 1990). There are 427 tribal communities in India with a population ranging from 18 (Great Andamanese Tribe) to 3 to 4 million (Gonds, Bhils and Santhals). India has perhaps the highest tribal population among the countries whose major population is non-tribal (Chattopadhyaya, 1978; Thakur, 1986; Gunasekaran and Ramaswamy, 1988). The scheduled tribe population of India is 5.16 crores (Census, 1981) constituting about 7.53 per cent of the country's total population.

The scheduled tribe population of Kerala is 2.61 lakhs (Census, 1981) and constitutes 1.03 per cent of the total population of the state. Being isolated from the mainstream of people, they are one of the most underdeveloped and underprivileged lots of the State (Prakash and Kunju, 1988).

More than 77 per cent of the scheduled tribes of 35 distinct communities are concentrated in Wayanad, Palakkad, Kannur and Idukki districts (Government of Kerala, 1992). Attappady valley in Palakkad district is an important tribal settlement in the state and Irulas, Mudugas and Kurumbas are the three tribal communities residing in this valley. Among these, the Irulas constitute the bulk forming as much as 82 per cent of the total population.

Tribal population which constituted 90 per cent of the total population of Attappady in 1951 has been reduced to 33 per cent by 1981 (Muraleedharan and Sankar, 1991). Palakkad area formed part of the erstwhile Malabar district of Madras Presidency. With the reorganization of Indian States in 1956, Malabar district formed part of Kerala State. Since then, there has been sizable immigration of population to this area from other parts of the State. It is this massive influx of settlers which reduced the proportion of tribal population in Attappady. This has had very serious socio-economic consequences and it appears that a process of marginalisation of the local population (tribes) has been set in motion. Massive deforestation, land acquisition by settlers and progressive acculturisation have played a significant role in tribal land degradation and marginalisation at Attappady.

To find out the dietary habits and nutritional problems faced by the tribes in the changed scenario and to formulate and implement appropriate developmental programmes for their welfare, a comprehensive and systematic study on the prevailing dietary habits and nutritional status among tribes is necessary. Hence the present study on the dietary habits and nutritional status among the Irula tribes of Attappady was conducted with the following specific objectives.

1. To assess the socio-economic and dietary habits of the tribes.

2. To identify the magnitude of the health problems prevalent among the tribes with special reference to school children in the age group of 5 to 15 years.

3. To assess the factors contributing to the nutritional status of tribes with special reference to school children in the age group of 5 to 15 years, and

4. To find out the attitude of tribes towards the programmes implemented for their welfare.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

In this chapter an attempt has been made to review the literature relevant to the study on nutritional status and dietary habits of Irulas of Attappady. The review has been done in seven sections as indicated below.

2.1. Situation of tribes in India

2.2. Food consumption pattern of different tribal communities

2.3. Dietary habits of different tribal communities

2.4. Prevalence of malnutrition with special reference to children

2.5. Factors influencing the nutritional status of tribal children

2.6. Genetic disorders among the Indian tribes

2.7. Impact of developmental programmes in tribal areas.

2.1. Situation of tribes in India

A tribe is defined as a social group, usually with a definite area, dialect, cultural homogeneity and unifying social organization (Bhowmik, 1971). According to Friedl (1976), a tribe can be generally defined as a confederation of groups who recognizes a relationship with one another, usually in the form of common ethnic origin, common language, or a strong pattern of interaction based on intermarriage of presumed kinship. According to Chandrasekhar and Chitra (1990), a tribe is a collection of families bearing a common name, speaking a common dialect, occupying or professing to occupy a common territory.

Tribal populations in India are found scattered in different parts of the country and are segregated physically culturally and economically from the general population (Shukla, 1982).

On the basis of geographical distribution, ethnic characteristics and linguistic affiliations of the tribal groups they can be divided into distinct zones which are North-eastern, Central and Southern (Prasad, 1988). According to the author these diverse tribes are found to live in plain areas and hilly and forest tracts stretching from the foot hills of Himalayas to the hill tracts of Kerala.

Shah (1986) and Thakur (1986) had pointed out that the tribes constituted an important element in India's population and belonged to varying and different stages of development and contributed variety and richness of culture to the country with a distinct style of life and cultural ethos. The tribes have also been observed to suffer from various forms of economic exploitation, social discrimination and political isolation by the same authors. Mohankumar (1990) reported that tribes in India are a neglected lot, vastly discriminated against in terms of income distribution and social status. Sethia and Joshi (1990) observed that most of the tribal population of India live in remote hilly and forest areas and are at a lower level of technological development because of their relative backwardness, illiteracy, poverty and complex problems. According to Rajyalakshmi (1992) the process of industrialization-urbanization have significantly affected the lives of the tribal population in India.

According to Rao and Satyanarayana (1987) India had a variety of tribal population reflecting its great ethnic diversity. Demographically there are about 250 scheduled tribes with several subgroups speaking around 100 languages/dialects (Mukhopadhyay and Mukhopadhay, 1989).

The total tribal population
forming 7.53 per cent of the total
Though the concentration of tribal people in Kerala is not so considerable, they are numerically significant and constitute 1.03 per cent of the State's population.

According to the Bureau of Economics and Statistics (1979) the tribal population in Kerala constituted a weaker section of the community and are subjected to various types of exploitation for the past several generations. Their life style consequently has been characterised by servitude, poverty and misery. The various tribal communities differ from one another in racial traits, language, social organization, economy, religion, belief, custom and manner and are under the clutches of tradition.

Attappady is a forest region situated in the Mannarghat taluk of Palakkad district. The tribal population of this region is 20659 (Census, 1981) and consisted of Irulas, Mudugas and Kurumbas.

Attappady offers a typical example of unplanned human settlements in a forested area which had turned the 'green hill' to a 'red desert' (Kerala Forest Research Institute, 1989). The area was fully forested till the dawn of the century and the tribes had developed a system which was in harmony with nature. Excepting the high rainfall areas in the western sector, today the Attappady valley represents a totally degraded landscape, where basic resources like water, vegetation and soil have been irreparably damaged.

According to Muraleedharan and Sankar (1991) land degradation and marginalisation are threatening the entire life support system of tribal communities in Attappady. At present due to land alienation, tribes are being forced to exist on marginal lands on steep slopes and carry out subsistence farming. Better tribal land alienated to settlers are more under cash crops.

The economic organization of most tribal people in India is complex and formed a combination of agricultural, pastoral and hunting activities (Gupta, 1983).

According to Mathur and Nair (1983) and Mukhopadhyay and Mukhopadhay (1989) the economy of tribal people have a varied nature starting from food gatherer, hunter, shifting cultivators, farm labourers and settled plough cultivators with primitive technology and are devoid of most of the skills required for a modern life for their economy. Shah (1986) pointed out that the main source of sustenance of tribes is the forest and the primitive agriculture occupies only a secondary place in the tribal economy. According to Prasad (1988) tribes and forests are ecologically and economically inseparable.

According to Rao (1971) the Todas are a pastoral tribe and their main occupation is cattle rearing. Chitre *et al.* (1976) pointed out that the Santhals of Bihar work as labourers especially on the site of building projects. The economy of Juangs of Keonjhar Hills, a tribe which had to cope with severe scarcity of food, is shifting cultivation and selling of timber and fuel collected from forests (Bose, 1972). According to Chakrabarti (1979) Kadars of Palghat and Trichur districts of Kerala are found in three distinct stages of economic activities as collectors of forest produce, forest labourers and regular employees in the forest department.

Agriculture is the main occupation of the Khonds of Orissa (Roy, 1976), tribal people of Madhya Pradesh (Yadav, 1983), Kinwat in Marathwada region (Pawar and Ingle, 1982), Bhil families in Jhabua district and Gond households in Bastar district of Madhya Pradesh (Rao et al., 1983), tribes of Gujarat (Gopaldas, 1987), Kotas of Tamil Nadu (Chandrasekhar and Chitra, 1990), Santhals and Pahariyas of Bihar (Moitra and Choudhary, 1991) and Kudubis of Karnataka (Rao, 1991).

Natarajan (1982) reported that Abujmarias of Madhya Pradesh are shifting cultivators and Tharus of Bihar engage in subsistence agriculture. According to Bhat (1985) the only craft of Koragas of South Kanara is basket making. Birhor, Chenchus and Cholanaickans practise hunting and food gathering (Mathur, 1983b; Eshwariah, 1986).

Thakur (1986) reported that tribal people of Bihar, Orissa, Andhra Pradesh and parts of Madhya Pradesh practised shifting cultivation. He also pointed out that the Todas of Nilgiris followed a pastoral economy, the Bhutias of North Uttar Pradesh and parts of West Bengal followed a mixed agricultural and pastoral economy, the Gujjars and Gaddis of Himachal Pradesh and Punjab entirely depended on goats, sheep and buffaloes for their livelihood. According to Thakur (1986) the Nagas, the Khonds, the Mishmis, the Abors, the Khamptis, the Kacharis and the Mompas of North Eastern Frontier are among those known for their skill in handlooms and handicrafts and the Baigas and Gonds of Madhya Pradesh are found to be good in carving of wooden door.

From a study among the Irula tribes of Nilgiri Hills of South India by Maurya (1987) it was revealed that most of the tribes are estate labourers in plantations, and only few have their own land where they grow coffee, guava or jack fruit. The main occupation of the tribal people of Kerala consists of collection of minor forest produce and agriculture (Viswambharan and Aravindakshan, 1987).

A comprehensive nutrition survey of the Konda Reddis in Andhra Pradesh, Jenu Kurubas of Karnataka, Maria Gonda of Maharashtra and Lanjia Saoras of Orissa indicated that tribal economy is dependent on primitive agriculture and manual labour (National Institute of Nutrition, 1988-89).

According to Rao et al. (1989) the Onge tribe of Little Andamans are primarily a hunting, food gathering and fishing tribe. Danda (1991) reported that forest is the home, principal resource base as well as a means of subsistence for Korwa tribes residing in the tri-junction of Madhya Pradesh, Bihar and Uttar Pradesh. Traditionally, Andamanese are hunters and fish catchers and are good at sea diving. Currently they are mostly engaged in the collection of coconuts from plantations raised exclusively for them (National Institute of Nutrition, 1989-90). 'Subsistence farming' is the main stay of economy among Thangkul and Marring of Manipur and Angami and Konyak of Nagaland (National Institute of Nutrition, 1990-91). According to Kailash (1993) land and forest are the two major locally available resources of Baigas of Madhya Pradesh.

According to Mathur (1977) the tribal people of Kerala are not able to make both ends meet with what they earn and indebtedness among them is a chronic malady. A survey conducted by the author to ascertain the quantum of indebtedness among Irulas of Nakkupathy in Attappady revealed that one of the worst forms of exploitation to which these tribes are exposed is through traditional money lending. This study on indebtedness revealed that the utilization of loan for social and religious ceremonies is highest among the Irulas.

Despite the constitutional protection promised to the tribes of India, even after four decades of independence, they are the most backward ethnic group of India on the basis of the major indicators of development, viz. income, literacy and health (Singh, 1988).

Although the tribal population had attracted many sociologists and anthropologists, information on their living condition especially on their food habits is meagre (Gore et al., 1977). According to Swaminathan (1983) if health is considered as an important part of development and progress, and if nutrition is considered as a measure of health, it is necessary for planners to understand the situation regarding food and nutrition and health among tribal people.

Bhattacharya (1987) had reported that our vast tribal population concentrated in the most underdeveloped regions in the country are suffering from malnutrition. Ali (1987) pointed out that for the effective utilization of developmental inputs and to solve the health and nutritional problems faced by the tribes, a systematic study on health and nutritional status of different tribal group is necessary.

2.2. Food consumption pattern of different tribal communities

In most tribal areas the food availability and pattern of consumption depended on either local or natural resources or on the production by the population which invariably was based on subsistence farming with poor agricultural technology (Swaminathan, 1983).

Belavady et al. (1959) observed that the food habits of Todas, Kotas, Irulas and Kurumbas of Nilgiris were similar to that of the low socio-economic group of South India.

Rice is the major cereal taken by the Santhals of Bihar (Chitre et al., 1976; Thakur, 1986), Cholanaickans of Kerala (Mathur, 1977), Muthuvans of Kerala (Sengupta, 1980), Tharu tribes of Uttar Pradesh (Usha, 1983), Hill Bhuinyas of Orissa (Ali, 1983), Gond tribe of Bhoolandabri village (Mishra, 1983), tribes of Pottumavu in Trivandrum district (Prema, 1983), Uralies of Idukki district (Kattakayam, 1983), Manne tribes of Andhra Pradesh (Pingle, 1987), Khasis of Meghalaya (Easwaran and Goswani, 1989), Kotas and Kadars of Tamil Nadu (Chandrasekhar and Chitra, 1990) and Marrings and Thangkuls of Manipur (Rao et al., 1991).

Mathur (1977) had observed that the staple food of the Kurumbas of Kerala was ragi supplemented with chama, edible roots, fruits and tubers of different creepers. 'Adivasis' of Thane district of Maharashtra also consumed ragi as the staple food (Pore,1985).

Maize was found to be the staple food of the tribes of Rajasthan (Vyas, 1983) and Udaipur (Goyal and Mathew, 1987). Shahu (1987) reported that most of the tribes of Orissa used millet as the staple food item, and ragi is most popular followed by millets.

Cereal or millet based diets were preferred by the Khonds of Orissa (Roy, 1976), the tribes of Kinwat area in Marathwada region (Pawar and Ingle, 1982; Ingle et al., 1983); Lanjia Saoras of Orissa (Ali, 1987), Konda Reddis of Andhra Pradesh, Jenu Kurubas of Karnataka, Maria Gonda of Maharashtra (National Institute of Nutrition, 1988-89) and Santhals and Pahariyas of Bihar (Moitra and Choudhary,1991).

Sengupta (1980) found that Kanikkars, Uralies and Malapandarams of Kerala used tapioca as the staple food item and consumed few vegetables and fish. The Kanikkar tribes of Amboori area of Trivandrum district consumed roots and tubers especially tapioca as the staple food item and other foods like cereals, pulses, vegetables, milk and milk products were included in negligible amounts (Thomas, 1989_1). Fruits, millets, flowers, leaves, roots and tubers were the major food sources for the Baigas of Madhya Pradesh (Kailash, 1993).

Todas of Nilgiris were lacto-vegetarians and consumed more milk and milk products (Chattopadhyaya, 1978; Eshwariah, 1986). Milk and milk products formed an important part in the diet of Kotas of Tamil Nadu also (Chandrasekhar and Chitra, 1990).

Milk was conspicuously absent in the diet of Murias of Bastar district (Roy and Rao, 1957), Santhals of Bihar (Chitre et al., 1976), tribes of Udaipur (Goyal and Mathew, 1987) and Kadars of Tamil Nadu (Chandrasekhar and Chitra, 1990). The diet of Khonds of Koraput district (Roy, 1976) and Phulbani district (Patel, 1983) was poor in quality and quantity and did not include milk at all.

The diet of Murias of Bastar district was monotonous and consisted mainly rice, pulses and some vegetables (Roy and Rao, 1957). In a survey conducted by National Institute of Nutrition (1967) it was revealed that the Mompas of NEFA regularly consumed green leafy vegetables, milk products chiefly as cheese, fish, flesh of pigs, goat and sheep while the use of pulses were not common among these tribes. Dietary investigations of Nicobarese and Shompens of Great Nicobar by Roy and Roy (1969) had revealed that their foods were rich in variety and basically different from those of the main land of India.

According to Vyas (1983) the tribes of Rajasthan consumed wheat and rice on special occasions and more frequently if belonging to higher economic strata. The consumption of food stuffs except cereals and millets were especially ignored by the tribes of Kinwat region (Pawar and Ingle, 1982; Ingle *et al*., 1983). The intake of pulses, vegetables, oils and fats were low in the diets of the Kondhs of Orissa (Patel, 1983). The tribes of Pottumavu in Kerala supplemented the rice diet with locally available roots and tubers, while pulses and vegetables were consumed only occasionally (Prema, 1983). The intake of all food items including cereals was much below the Recommended Dietary Allowances for pre-school children in Mandla district (Gupta and Rajput, 1983). Mahanta *et al*. (1989) reported that the intake of all foods except roots and tubers and leafy vegetables was deficient in the diets of Kachari tribes of Kamrup district of Assam. According to Moitra and Choudhary (1991), Santhals of Bihar though non-vegetarians, subsisted mainly on regular vegetarian foods.

Rao *et al*. (1983) and Lakshmi and Rao (1988) reported that tribes subsisting on forest had a better economic and nutritional status compared to those depending on primitive cultivation. As per a report published by Food and Agricultural Organization (1989) the impact of the declining consumption of forest foods have led to a poorer quality diet; most notably diets are becoming less diverse as people rely mostly on purchased foods.

Chakrabarti (1979) had reported that the Kadar families of Palghat and Trichur districts in Kerala collected roots and tubers from forest for their direct consumption. Roots and tubers, green leafy vegetables and a variety of seasonal fruits collected from the forest were consumed by the Savaras of Andhra Pradesh (Rao and Satyanarayana, 1987). The Marrings and Thangkuls of Manipur consumed yam, tender shoots of bamboo, varieties of wild orchids and wild tomatoes gathered from forest (Rao *et al.*, 1991).

Ali (1983) reported that the food habits of Hill Bhuinyas of Orissa was not monotonous since it varied with the seasonal availability of food. Edible roots, tubers, flowers, vegetables, mushrooms and fruits were found to supplement their diet especially during lean months. Asha (1988) reported that plain mahua flower was the only food for the Raj Gond families during off seasons. Kotas of Tamil Nadu consumed a variety of greens and fruits available in the hills and Kadars subsisted entirely on roots and tubers available in the jungle during lean months (Chandrasekhar and Chitra, 1990).

Singh (1983) reported that the Gond tribe occasionally consumed fowl, beef, pork, crocodiles, certain kinds of sea snakes, lizards, tortoises, rats, cats, red ants, jackals and monkeys. Ali (1983) opined that the Hill Bhuinyas of Orissa viewed hunting and fishing as a sport than as a source of food. Uralies of Kerala relished wild flesh of deer, jungle sheep and goat (Kattakayam, 1983). Easwaran and Goswani (1989) reported that Khasis of Meghalaya consumed rats, tadpoles and ants' eggs apart from the common non-vegetarian foods. Small fishes, pigs, turtles, snakes, birds, fresh water snails and bivalves when available found a place in the diet of Santhals and Pahariyas of Bihar (Moitra and Choudhary, 1991). Tribes of Manipur (Rao et al., 1991) consumed domestic animals also in addition to most of the wild animals hunted. According to Rao (1991), Kudubis of Karnataka did not consume the flesh of reared animals like fowl, sheep, and goat and consumed wild pig or hares hunted from forest.

Lanjia Saoras of Orissa, according to Ali (1987) consumed chicken, mutton, beef and buffalo meat in a decreased quantity. The daily consumption of animal foods among the tribes of Ranchi district was less than one per cent even though many families had chickens and milch animals (Singh et al., 1987a).

The main drink consumed by the Khonds of Koraput district in Orissa is 'mahua mada' a liquor made through distillation of fermented mahua flowers and fermented juice of sago palm (Roy, 1976). Thakur (1986) observed that the Santhals were in the habit of drinking 'handi', a home made wine, prepared from rice. The Gond tribe of Maharashtra consume mahua liquor daily (Chaudhari and Mane, 1987; Asha, 1988). The Thangkul of Manipur consume beer locally called as 'Zu' flavoured with different forest herbs (Rao et al., 1991).

2.3. Dietary habits of different tribal communities

Literature on dietary habits of tribal communities are reviewed here covering different aspects such as nutritional quality of the tribal diet, cooking, storage and preservation practices, food taboos, infant feeding practices and foods included and avoided during special conditions.

Belavady et al. (1959) showed that calorie and protein intake of Irulas and Kurumbas of Nilgiri hills were deficient whereas the calorie intake of Todas and Kotas was satisfactory with slight protein insufficiency. Roy and Rao (1962) studied the diet pattern of eighteen Indian tribes of North-Eastern, Central, South and South-western zones of India and found that the diets were grossly deficient in calcium, riboflavin, animal protein and vitamins A and C.

The authors also reported that the diets of most of the South Indian tribes were very much deficient in calories and total proteins. Rao (1971) observed that the diets of the Indian tribes in general were grossly deficient in vitamins and minerals.

The diet of Nicobarese and Shompens was found to be remarkably rich in animal protein and high in fat content and much of the food energy was obtained from fat and protein (Roy and Roy, 1969; Rao, 1971). Gore et al. (1977) in a study on the dietary pattern, nutrient intake and health of tribes of Orissa, Madhya Pradesh and Maharashtra revealed that the tribal diets were deficient in calories but not in essential amino acids.

The diet of Agathi and Minicoy tribes was found to be rich in animal protein though 25 per cent of the population consumed inadequate energy (Roy et al., 1978). Sengupta (1980) studied the consumption and nutrition of 31 Regional Tribes of India and reported that 47 per cent of the tribes were well fed and in satisfactory nutritional status, 23 per cent living in utmost poverty with grossly deficient nutrient intake resulting in a state of physical degeneration and nutritional depletion. The author also reported that the deits of Kanikkar, Urali and Malapandaram tribes of Travancore were deficient in nutrients.

Singh and Sidhu (1980) indicated that calorie intake of Gaddi Rajput boys aged 4 to 20 years was lower at all ages than the Recommended Daily Allowances of Indian boys by about 250-350 calories while their protein intake was higher than Recommended Daily Allowances.

Ali (1980a) reported undernutrition with vitamin and iron deficiencies among the Kutia Kondhs of Orissa. The Bhuinya diet and Lanjia Saora diet were found to be deficient both in quantity and quality as compared to accepted standards (Ali, 1983; 1987).

Ingle et al. (1983) revealed that the average daily intake of protein and calories per consumption unit were less by 4.4 per cent and 10.6 per cent respectively as compared to Recommended Daily Allowances among the Kinwat tribes. They also reported a deficient intake of vitamin A, riboflavin and ascorbic acid among these tribes. The diet of Mahadeo Koli tribes from Khireshwar was deficient in fat, meeting only 4 to 5 per cent of total calories and very bulky with high fibre content (Chitre et al., 1983). Sarupriya and Mathew (1988) indicated inadequacy in all nutrients except protein among the tribal adolescents of Gogunda of Rajasthan. In a report published by Nutrition Foundation of India (1988) it was found that only 12 per cent of the tribes of Orissa had adequate energy intake.

According to Rao *et al*. (1988) 56 per cent of tribes had inadequate intake of required nutrition as compared with 42 per cent of the general population and 53 per cent of scheduled caste. The diets of Konda Reddis, Jenu Kurubas, Maria Gonda and Lanjia Saoras were inadequate in many nutrients (National Institute of Nutrition, 1988-89). Khasis of Meghalaya used to give increased amount of milk for pre-school and school going children (Easwaran and Goswani, 1989).

According to Yadav (1983) Adivasis of Madhya Pradesh used to take three meals a day during agricultural seasons, and during off season, the timings were relaxed. The dietary pattern of Tharu tribes of Uttar Pradesh was found to be enhanced from two rice based main meals to three during the harvest period (Usha, 1983). Though Uralies of Idukki district take three meals a day, majority get satisfied with one meal a day due to poverty (Kattakayam, 1983). Gond tribe of Maharashtra also take three meals a day (Chaudhari and Mane, 1987).

Prema (1983) had pointed out that the tribes of Pottumavu practised boiling as the common method of cooking. Cooking methods familiar to the tribes of Mandla block were boiling and shallow frying (Gupta and Rajput, 1983). Yadav (1983) had reported that the Adivasis of Madhya Pradesh cooked food normally by boiling, drying or baking.

Cooking utensils made of bamboo used by Cholanaickans of Nilambur valley were being replaced by earthen pots and aluminium utensils while only earthen pots were used for cooking by the Kurumbas of Attappady (Mathur, 1977) and by the tribes of Mandla block (Gupta and Rajput, 1983). The adivasis of Madhya Pradesh use earthen and wooden utensils for cooking and these tribes use leaf plates and cups for serving meals (Yadav, 1983).

Ali (1983) observed that Bhuinyas of Orissa did not wash rice before cooking and never discarded the surplus water. It was either consumed after the meal or was added to dal or to meat curry. Eshwariah (1986) reported that Lakhers did not wash cereals before cooking which they believe preserves vitamins.

The Kurumbas of Attappady (Mathur, 1977) and the tribes of Pottumavu area (Prema, 1983) used bamboo baskets for storing food stuffs. The tribes of Pottumavu area used earthenwares also for this purpose. Kadars of Tamil Nadu used to store 'moongil rice' in hollow bamboo cylinders for one to two years (Chandrasekhar and Chitra, 1990).

According to Prema (1983) 31 per cent of the tribal families of Pottumavu were aware of the methods of preserving mango and cassava when available in plenty.

Tharu tribes were in the habit of preserving fish by sundrying (Usha, 1983). According to Chandrasekhar and Chitra (1990) Kadars of Tamil Nadu preserved gooseberries by sundrying and used them in cooking as a substitute for tamarind. They also processed the 'moongil rice' by putting it in a cow-dung smeared pit, pounding it with iron pestle and winnowing to remove the husk to improve keeping quality.

Food beliefs, fads and fallacies are the major factors influencing the food consumption pattern of any community. According to Vijayakhader (1990a) the faulty food habits are contributing factors to the wide prevalence of malnutrition among the uneducated classes in the developing countries.

Gupta (1983) stated that the tribal diet is limited by the traditional regulations of that society. According to Ali (1983) social roles played a vital role in determining the food habits of Hill Bhuinyas. He had further stated that very often traditions coupled with their irrational thinking deprived the Bhuinyas from taking foodstuffs with high nutritional value.

The Todas were reported to be flesh eaters and yet the flesh of a female cattle is a taboo as the cow yields milk (Chattopadhyaya, 1978). Patel (1983) reviewed the food habits of Kondhs and found that milk and eggs are prohibited from the diet of young women of that community. According to Rao et al. (1991) consumption of goat meat is a taboo among Thangkuls of Manipur and pregnant women are forbidden from eating the flesh of animals dying of natural death. The authors also reported that female members of Marrings of Manipur are forbidden from consuming the flesh of animals that are sacrificed to ward off illness.

As in many parts of the world, among tribal communities also, there are strong beliefs with regard to hot, cold, light and heavy foods. The tribes of Jabalpur believed that maize, wheat, kodo, kutki and gram are heat producing while rice and dal are cold inducing (Mudgal et al., 1979). According to Patel (1983) the Kondhs of Phulbani district consider wheat, jaggery, meat, fish, egg, tea, ginger, spices, and jack fruit as hot foods while rice, curd and juicy fruits are cold foods. Khasis of Meghalaya consider fruits and vegetable like cucumber as cold foods while beverages like coffee and tea and flesh food as hot foods (Easwaran and Goswani, 1989). Irulas of Attappady and Lambas of Katchuvadi believe that jackfruit and sesame seeds are hot foods (Chandrasekhar et al., 1990).

Swain (1985) reported that from time immemorial the tribes, living in isolated pockets in the mountaneous areas have been practising distinctive ways of infant feeding. According to Chandrasekhar et al. (1990) infant feeding and weaning practices are strongly associated with the culture of a society.

Belavady et al. (1959) reported that 60 per cent of the Toda mothers of Nilgiris started breast feeding soon after delivery while Kotas, Irulas and Kurumbas discarded colostrum and started feeding after the third day. Early initiation of breast feeding and acceptance of colostrum was adopted by the tribes of Madhya Pradesh (Mudgal et al., 1979; Mudugal and Kaul, 1983), Bhil and Gond tribe (Rao et al., 1983), Santhal tribes (Swain, 1985), tribes of Andhra Pradesh (Vimala and Ratnaprabha, 1987) and Kachari tribes of Assam (Mahanta et al., 1989).

Colostrum is discarded by a number of tribes of Rajasthan, Maharashtra, Madhya Pradesh, Bihar and Uttar Pradesh (Vyas, 1983; Mane and Bantey, 1987; Gopaldas, 1987; Singh et al., 1987a; Nutrition Foundation of India, 1988).

The Nilgiri hill tribes (Belavady et al., 1959), Koya tribes of Orissa (Roy and Roy, 1971), tribes of Madhya Pradesh (Mudgal et al., 1979), Kondhs of Phulbani district (Patel, 1983). Tharu tribes of Nainital (Usha, 1983), Bhil and Gond tribes of Madhya Pradesh (Rao et al., 1983), tribes of Maredumilli block of East Godavari district (Pushpamma et al., 1983), tribes and harijans of Banda district of

Uttar Pradesh (Mishra _et al_., 1985) and tribes of Amaravati, Maharashtra (Mane and Bantey, 1987) adopted prolonged breast feeding.

A study conducted among the Nigerian Igbo tribe (Kazimi and Kazimi, 1979) revealed that 94 per cent of the mothers surveyed breastfed their infants for at least six months and the duration was longer among non-educated mothers.

Ingle _et al_. (1983) reported that tribal women of Kinwat region of Maharashtra are in the habit of breast feeding their babies till 16 to 20 months. Gupta and Rajput (1983) observed that tribes of Mandla block breastfed their infants at least upto six months and sometimes even upto two years. The mean period of breast feeding among Tharu tribes as reported by Usha (1983) is thirty months ranging from 15 months to four and a half years. The tribes of Chittorgarh district in Rajasthan (Choudhry and Khimesara, 1986) continue breast feeding upto 18 months.

The infants are permitted to suckle till the next pregnancy among the Bhuinyas of Orissa (Ali, 1983), tribes of Rajasthan (Vyas, 1983), Kondhs of Orissa (Patel, 1983), Santhal tribes (Swain, 1985), tribes of Udaipur (Dave, 1985) and Kanikkars of Amboori area (Thomas, 1989_1).

The life of Bhil children of Gujarat and Rajasthan (Chattopadhyaya, 1978) is marked by many rites starting with the sucking of milk, when the child is ceremonially put to the breast by an elderly women two days after birth. Till then a foster mother feeds the baby.

Most of the tribes of Madhya Pradesh believe in breast feeding even during maternal illness (Mudgal et al., 1979). On the contrary tribes of Ranchi district consider that such mother should not feed her child since it may cause harm to the child (Singh et al., 1987b).

Weaning is a process in which an infant is gradually introduced to a variety of liquid, semi-solid and solid foods to effect a smooth shift to the adult or family food pattern (Geervani, 1983). According to Vijayakhader (1990b) the process of weaning should normally begin by third and fourth month and completely weaned by the tenth and eleventh month.

Belavady et al. (1959) have reported that poor quality rice based supplements were started invariably by the Todas, Kotas, Irulas and Kurumbas of Nilgiris in the early half of the first year.

According to Roy and Roy (1971) supplementary foods like gruels of rice or millets are introduced in the infants' diet among the Koya tribes of Orissa at 5 to 8 months and solid foods at 12 to 18 months. Alcoholic beverages except those prepared by distillation of Mahua flowers are given to infants and children by these tribes.

A study conducted by Bhattacharya et al. (1972) among Kharwas of Palamau district in Bihar revealed that infants at weaning age were principally fed on gruel made from maize powder.

Though the tribes of Madhya Pradesh introduced semi solids within six months of age (Mudgal et al., 1979) much of the possible nutritional benefits were lost because of their cereal character and due to lack of preference of the tribal women for top milk as an essential food for the children.

Roy et al. (1978) had found that supplementary feeding among the tribes of Agathi started at three months and in Minicoy around the seventh month. Arrow root preparation known as bimbi or kuddush were introduced first to the infant followed by rice gruel, tender coconut kernel and whole milk powder and after one year adult food with substantial amounts of sea fish was given.

Kazimi and Kazimi (1979) had reported that 80 per cent of mothers of Nigerian Igbo tribe gave supplementary food for their babies between 3 to 7 months of age. The authors had also observed that the prevalence of diarrhoea, malnutrition and death among these tribes could be attributed to their early introduction of supplementary foods under insanitary conditions and ignorance of the mothers about weaning food.

The weaning practices of urban, rural and tribal mothers of Udaipur district was studied by Chandrasekaran and Awasthy (1982) who reported that a higher percentage of the infants were weaned at the age of 10 to 12 months.

Tharu tribes of Uttar Pradesh fed the same family food in a mashed and diluted form to infants between 6 to 15 months of age (Usha, 1983). The tribes of Rajasthan provide supplementary food to the baby around the nineth month and all children are normally weaned before attaining the fourth year (Vyas, 1983). The weaning foods of these tribes normally consist of broken wheat cooked in the form of porridge by adding goat's milk, jaggery or buttermilk. Swain (1985) reported that santhal tribes start supplementary feeding after seventh month and use soft rice, gruel and pulses as a major supplementary food.

In Mandla block the tribes introduced supplementary foods in the form of cooked rice called 'Pej' to six-month old-babies (Gupta and Rajput, 1983). Mishra (1983) had reported that cereal was introduced to the infant's diet after the age of 5 or 6 months along with breast milk by the Gond tribe of Bhoolandabri village. Patel (1983) had stated that the Kondhs of Orissa supplemented milk diet with a little watery rice, red gram and vegetables from nine months onwards. The supplementary foods selected by Bhuinyas of Orissa are semi liquid foods like gruel made of minor millets and the infants are gradually introduced to family foods (Ali, 1983).

A study on the infant feeding practices of Dubla and Kokni tribes of Gujarat indicated that Dubla tribes introduced soft rice gruel to the infants after 6 months while Kokni infants were weaned with biscuit powder, fruit and rice by ten months and were introduced with rice gruel at the age of one year (Bhattacharya et al., 1983).

Except breast milk, no other supplementary food was given to the tribal children of Maredumilli block of East Godavari district (Pushpamma et al., 1983). The tribes and harijans of Uttar Pradesh (Mishra et al., 1985) and the tribes of Chotanaghpur (Singh et al., 1987b) were unaware of the necessity of supplementary food to the infant. According to Maurya (1987), the Irulas of Nilgiris commenced weaning as early as the third month and adopt a method of gradual weaning. Tribes of Chittorgarh district in Rajasthan weaned the children directly to the adult diet (Choudhry and Khimesara, 1986). Tribal mothers of Andhra Pradesh also believed in introducing all types of food to infant by one year (Vimala and Ratnaprabha 1987). The quality and type of food consumed by the Lanjia Saora children of Orissa was found to be similar to that of adults and were not receiving any special foods (Ali, 1987). Gopaldas (1987) reported that for most of the children of Lanjia Saora of Madhya Pradesh, breast milk was the major source of food supplemented with small amounts of diluted milk.

According to Mane and Bantey (1987) the tribal infants of Maharashtra were fed with cow's milk, buffaloe's milk or tea as a liquid supplement at the age of 10 to 12 months. Manne tribes of Andhra Pradesh introduced soft rice in the child's diet between the ages of 8 month to 1 year (Yayathi, 1987). In a report released by Nutrition Foundation of India (1988) it has been indicated that the Kols and Harijans of Uttar Pradesh started top milk only after six months and semi solids were introduced between sixth and nineth month.

The Khasis of Meghalaya (Easwaran and Goswani, 1989) included weaning foods like mashed cereals, vegetables and fruits from third month onwards, and for Kotas of Nilgiri hills pop seeds of Amaranth with water and sugar formed an important weaning food (Chandrasekhar and Chitra, 1990). According to Chandrasekhar et al. (1990) Irulas of Attappady and Lambas of Katchuvadi hills gave only home made weaning foods to the infants from four to six month onwards.

No special foods or food combinations were given during childhood, pregnancy or lactation by the tribes of pottumavu (Prema, 1983) and Tharu tribes of Uttar Pradesh (Usha, 1983). The tribes of Rajasthan according to Vyas (1983) believed that special diets were essential for the health of nursing mothers and gave importance to special diets during lactation. They also believed that milk production was facilitated by drinking buttermilk during lactation. These tribes prohibit chillies, tamarind, meat, fish, brinjal, rice, liquor, garlic, papaya and wines from the pregnant women's diet since these are considered as heat producing and cause abortion. According to Eshwariah (1986) among Bastar tribes, lactating women consumed more pulse, ghee and jaggery to improve health and quantity of breast milk. The author also reported that Onge mothers considered tubers and honey as good for health; Toda mothers do not consume milk for three months after delivery.

Pregnant mothers do not receive any special attention except for the increased intake of the normal adult woman's diet among Khasis of Meghalaya (Easwaran and Goswani, 1989).

According to Chandrasekhar and Chitra (1990) Kota tribes of Tamil Nadu include an extract of green leafy vegetable called pulichakeerai during lactation which enhances milk secretion and kadars give chilli-salt paste to the delivered women in order to clean the uterus and to enhance milk production. During lactation they avoid mango, jack fruit, ayana kizhangu and honey and believed that these are not good for the infant. Irulas of Attappady and Lambas of Katchuvadi include ragi kali, fruits, egg and milk specially during pregnancy and believed that green leafy vegetables had galactogenic properties (Chandrasekhar et al., 1990).

During conditions of illness and infection, certain foods and food combinations are specially given or withheld by the Tharu tribes (Usha, 1983). Fruits are not consumed normally by the tribal children of Mandla block except during measles, jaundice, fever or diarrhoea (Gupta and Rajput, 1983). Onges avoid fatty pork during diarrhoea and illness and include carbohydrate rich tubers (Eshwariah, 1986). Maurya (1987) reported that the Irula tribes of Nilgiris included cereal kanji, cow's milk and breast milk in the child's diet during fever and avoided normal diet. During measles they avoided oily foods and chillies and included fruits and tender coconut.

Khasis of Meghalaya used to give bland diets during fever, diarrhoea and chickenpox, and for flatulence, indigestion and stomach pain they avoided greens, milk and spices (Easwaran and Goswani, 1989). The authors also revealed that the Khasis included garlic in the dietaries of cardiovascular patients and restrict the intake of salt, fats and oils and flesh foods. Kadars and Kotas of Tamil Nadu during illness like chickenpox gave rice kanji and liquid foods to cool the body, and for stomach disorders, Kotas gave the extract of the plant namely 'Peimuh' as medicine while the Kadars gave extracts of special roots like 'Kathari manjal' and 'koovai kizhangu' to stop diarrhoea (Chandrasekhar and Chitra, 1990). Irulas of Attappady and Lambas of Katchuvadi include curds, fruits, milk, buttermilk and tender coconut during chickenpox and avoid salt, oil, mango and jackfruit. During fever they avoid all foods except rice and sesame (Chandrasekhar et al., 1990). According to the authors these tribes include curd rice during diarrhoea and avoid pulses, roots and tubers.

2.4. Prevalence of malnutrition with special reference to children

The school going age is a dynamic period of physical growth and development when the children undergo mental, emotional and social changes (Koshi et al.,1970). According to the authors, the school children being a vulnerable section of the population, are in need of health promotion, health appraisal and health restoration. Puri _et al_. (1984) reported that children constitute the most precious resource of a country and utmost care must be exercised to promote their health and protect them from diseases. Gopaldas and Kanani (1987) opined that the school-age population forms one-fifth of the country's population and will form the manpower of the country after a decade.

Swaminathan _et al_. (1971) reported that the Onge children have higher weights without the manifestation of nutritional deficiency signs except vitamin A. A study on the nutritional status of four major tribal groups in Andhra Pradesh viz., Chenchus, Gonds, Koya Doras and Konda Reddis conducted by National Institute of Nutrition (1973) revealed high incidence of malnutrition among their children.

The nutritional survey of tribal and non-tribal rural pre-school children around Udaipur revealed widespread malnutrition (Gupta and Bhandari, 1973).

A study conducted by Rao and Satyanarayana (1974) among pre-school children of seven major tribes in Andhra Pradesh viz. Gonds, Koya Doras, Konda Reddis, Jatapur, Savaras, Yanadis and the Chenchus had revealed that the prevalence of protein calorie malnutrition was higher among the Chenchus and the Gonds while vitamin A and B complex deficiencies were found to be much lower in these tribes than the rural

Hyderabad children, mainly due to the inclusion of green leafy vegetables and millets in the former's diets.

Mammi (1977) had reported spongy hypertrophied gum with or without bleeding (75%), conjunctival xerosis (50%), anaemia (50%) and phrynoderma (45%) among tribal children of Kerala.

Mathur (1977) observed that many kurumba children suffer from malnutrition, vitamin deficiency and skin diseases. Gore et al. (1977) found that 40 per cent of the tribal children in the Indravati river basin were underweight while no child was found to be below the critical limit for height. Chopdar and Samal (1979) had revealed that 57.8 per cent of the child beneficiaries of Subdega tribal ICDS project in Orissa were malnourished. Ali (1980b) detected malnutrition with typical clinical signs in 14.4 per cent of tribal Pauri Bhuinya children upto 14 years of age. According to Chopdar and Mishra (1980) the common causes of morbidity among tribal school children in Western Orissa were deficiencies of vitamin A and B, anaemia, upper respiratory tract infection and gastro-intestinal disorders.

In a baseline survey of the Integrated Child Development Services in India, Tandon et al. (1981a) recorded moderate and severe malnutrition among 21.3 per cent and 19.4 per cent tribal children. In a survey conducted among the hill tribal population of Manipur by Luwang and Singh (1981) it was revealed that 43 per cent of the children below five years had protein energy malnutrition, the intensity of which was the highest in the second year and the lowest in the first six months of age.

Malnutrition was observed among majority of Tharu tribal pre-school children (Usha, 1983), Bhuinya children and infants (Ali, 1983), pre-school children of Rajasthan (Vyas, 1983) and among the children of Kinwat region (Ingle et al., 1983).

Different grades of malnutrition without sex variation was observed among 87 per cent of the tribal children between 1 to 3 years of age, in Chittorgarh district in Rajasthan by Choudhry and Khimesara (1986). Eshwariah (1986) reported goitre among the tribes of Sub-Himalayan region, Arunachal Pradesh and Madhya Pradesh. More than 70 per cent of children in a tribal area of Udaipur are reported to be suffering from one or other nutritional problems (Goyal and Mathew, 1987). Ali (1987) reported high incidence of malnutrition among the Lanjia Saora children. Singh et al. (1987a) had found that 44 per cent of the children in two tribal blocks of Ranchi district have severe malnutrition, the prevalence being more among girls.

Goitre is found to be common among 50 per cent of adults, adolescents and school-aged children in tribal areas of Andhra Pradesh (Rao et al., 1987). Sankhla (1987) observed that about 90 per cent of tribal children of Udaipur between 5 to 14 years are malnourished. Devan (1988) reported that most of the Adivasis of Wayanad were malnourished. The common nutritional deficiencies among the pre-school tribal children of Andhra Pradesh, Karnataka, Maharashtra and Orissa are protein energy malnutrition, anaemia, vitamin A deficiency and B complex deficiencies (National Institute of Nutrition, 1988-89).

Among the school boys of the Bhil tribe in the age group of 5 to 11 years in Madhya Pradesh, stunted growth (50%), wasting (75%), anaemia (70%) and vitamin A deficiency (33%) were observed as major nutritional disorders along with high incidence of parasitic infestation (Taneja et al., 1989). According to Phadke et al. (1990) protein energy malnutrition is a common problem among the tribal children of Maharashtra. Protein energy malnutrition and vitamin A deficiencies are not present among the tribal children of Manipur and Nagaland. However the prevalence of goitre is high among these tribes (National Institute of Nutrition (1990-91).

Gadra *et al*. (1973) had revealed that tribal children of Madhya Pradesh compared equally with non-tribal children in weight, head and mid arm circumference and had smaller heights and greater chest circumference. A comparative study of the weight pattern of pre-school children of Tangkhul Naga tribes in the hilly area and Meetei and Muslim in the valley of Manipur revealed a significantly higher mean weight for the tribal children than others probably because of higher consumption of flesh food (Luwang, 1981). Chandrasekaran and Awasthy (1982) compared the nutritional status of urban, rural and tribal pre-school children in Udaipur and found that malnutrition was more or less uniform among females whereas there was a distinct difference among males because of the maternal preference. According to the authors the percentage of children below 30 per cent of the Harward Standards for their mean weight and height was more in tribal areas than in rural and urban.

According to Lakshmi and Rao (1988) non-tribal children had better nutritional status than the tribal children of Maredumilli block of Andhra Pradesh. The study further revealed that the prevalence of frank cases of deficiencies were rare in both groups due to the consumption of fresh fruits and vegetables.

2.5. Factors influencing the nutritional status of tribal children

Prolonged breast feeding, delayed and faulty weaning, poor maternal health, recurrent infection, lack of medical facilities, health, education and other beneficiary programmes are found to be responsible for the occurrence of protein energy malnutrition among tribal children (Gupta and Bhandari, 1973). Dhingra et al. (1977) had observed that a malnourished child is at risk mainly because of poverty coupled with illiteracy and ignorance.

Chopdar (1979) had attributed the incidence of vitamin A deficiency signs among the tribal pre-school children in Western Orissa, due to poor socio-economic conditions coupled with poor sense of nutrition and health education. Poor socio-economic conditions, lack of health and nutrition education, failure of lactation in nursing mothers who fed their babies with a diluted milk formula of plain barley water and repeated pregnancies were reported to be the pertinent causes of malnutrition among the tribal pre-school children of Western Orissa (Chopdar and Samal, 1979). Patwari et al. (1979) indicated that the problem of malnutrition which has assumed alarming proportion among children in the poor socio-economic group are due to inadequate diet, poor environmental hygiene, parental illiteracy and large family size.

Chopdar and Mishra (1980) had reported that high incidence of morbidity among tribal school children in a rural area in Western Orissa was due to poor socio-economic condition of the tribal people. According to Rao (1980) non-formal education programme in tune with local customs, traditions and environment play a vital role to bridge the wide gap between tribes and non-tribes in their socio-economic conditions.

Luwang and Singh (1981) observed that infection has a significant influence in the causation of protein energy malnutrition among the underfives of a hill tribal population of Manipur. A study conducted by Chandrasekaran and Awasthy (1982) among tribal, urban and rural pre-school children of Udaipur district revealed that an increase in family size and reduction in per capita income increases the prevalence of malnutrition. The literacy level of the head of the family also had an impact on the malnutrition. The authors also reported that the percentage of malnourished children was found to decrease when breast fed for a longer time.

According to Shukla (1982), the reason behind the prevalence of nutritional deficiencies among tribal people are said to be inaccessability and segregation, overall poverty due to lack of resources and ignorance, lack of cultivable land and high energy requirements imposed by living conditions.

Unavailability of food, ignorance, infections, infestations, deep rooted cultural beliefs and customs are the major causes of malnutrition among tribes (Gupta and Rajput, 1983). According to these authors, malnutrition in Mandla tribal children had a relationship to family size and literacy status of the head of the family.

According to Ali (1983) the common diseases affecting the Hill Bhuinyas are mainly due to unsanitary conditions, lack of knowledge and health education.

Mathur (1983a) viewed the level of education as an indicator of the progress of any community and this is particularly true in the case of scheduled tribes and scheduled castes. According to the author poor educational progress among tribal people is a major handicap in their development.

Low nutritional status of Tharu pre-school children was due to an interplay of macro-micro-social and maternal environmental factors (Usha, 1983). The maternal environmental factors mainly encompass inadequate child care, high proportion of work time of the mother, irregular feeding pattern from early infancy, inadequate weaning practices, lack of knowledge of the needs and care of sick children and lack of knowledge and utilization of available health services.

Among the tribes of Rajasthan, economic conditions, customs, beliefs and prejudices appeared to be some of the chief causes of poverty and malnutrition (Vyas, 1983). Patel (1983) pointed that the weaker sections like tribes are the victims of chronic malnutrition mainly due to ignorance and poverty. The author revealed that improper food distribution system within the family was probably responsible for continuing the cycle of malnutrition through the women to children among the Kondhs of Orissa.

Gracey (1986) had reported that generally low standards of housing and hygiene of Aborigines had an important impact on nutritional standards, especially in infants and young children among whom malnutrition is widespread. Unsatisfactory nutrition is also common in pregnant and nursing mothers and influences outcomes of their pregnancies and the nutrition of their children in the first few years of life. Devan (1988) had pointed out that the contributory factors for malnutrition, gastroenteritis and scabies among the Adivasis of Wayanad of Kerala were unhygienic conditions such as lack of pure dirnking water and untidy premises. The at risk status of tribal and rural pregnant women of

Panchmahal district of Gujarat as reported by Christian et al. (1988) revealed that more than 70 per cent of the women were at risk with low birth weight, premature delivery, still births and various other obstetric complications. They further reported that with an increase in the order of pregnancy, the nutritional status of the women deteriorated. Since, tribes in forests had an easy access to natural food especially to fruits, vegetables, roots and animal food, they are likely to have better nutritional status compared to others (Lakshmi and Rao, 1988). Von and Haimendorf (1988) opined that the vulnerability of tribal population to exploitation can largely be traced to their illiteracy and general ignorance. Prasad (1988) concluded that for scheduled tribes, education is an input not only for their economic development, but also for promoting in them self-confidence and inner strength to face new challenges.

2.6. Genetic disorders among the Indian tribes

Sickle cell disease is a unique haematological abnormality of genetic origin, the control and cure of which still elude clinicians, research workers and social scientists (Reynolds and Natta, 1985; Feroze et al., 1989).

According to Lehmann and Cutbush (1952), haemoglobin structural abnormalities had geographic and ethnic variations. Mouzan et al. (1989) reported that the variability of sickle cell disease in early childhood is more likely related to genetic than to environmental factors.

Sickle cell trait among individuals belonging to Badagas, Todas and Irulas of Southern India was reported by Lehmann and Cutbush (1952). Khandelwal and Paithankar (1961) have reported sickle-cell anaemia in children belonging to Mahar caste. Pande et al. (1970) observ-- the highest incidence of abnormal haemoglobins in Mahar soldiers. The authors had also reported haemoglobin E disease in the Hazong tribe from Garo Hill area of Assam.

Mehta et al. (1972) observed beta thalassaemia trait and glucose-6-phosphate dehydrogenase deficiency (G-6-P-D) among Cutchhi Bhanushali community. Frequency of haemoglobin S in Kurmi community in Madhya Pradesh is reported by Ghatge et al. (1977) and the authors found that the overall frequency of positive sicklers is 25.2 per cent. The incidence of sickle cell disorder is found to be significant among the aboriginal tribes of Chotanagpur (Karan et al., 1978) and the genetic pattern revealed an inheritance of this disease by the siblings. Ali (1979) has observed quite high incidence of sickle cell disease and G-6-P-D deficiency among Kutia Kondh of Belgarh area of Phulbani district.

Jain *et al*. (1981) had reported sickle cell trait, beta thalassaemia and glucose-6-phosphate dehydrogenase deficiency among 4.2, 2.9 and 16.3 per cent of Bhil tribes of Southern Rajasthan respectively. Among tribes very high frequency of sickle cell abnormal haemoglobin is found among Pardhan of Andhra Pradesh, Mullu Kurumba, Paniyan and Irula tribes of Tamil Nadu, Adiyan of Kerala, Gamit of Gujarat, Gonds, Bhattra and Halba of Madhya Pradesh (Basu, 1982). He had also observed G-6-P-D deficiency among Irula and Kurumba of Nilgiri hills,Koya Dora of Andhra Pradesh, Kunbis of Wardha, Santhals of West Bengal, Mahar of Nagpur and Angami Nagas of Nagaland.

Jain *et al*. (1983a) found sickle cell trait among Bhil (5.7%), Mina (4.4%), and Adivsai (3.5%), Garasia (1.1%) and in Gameti (0.6%) tribes of Rajasthan. The authors had also observed higher frequency of thalassaemic gene among Damor tribal population. Jain *et al*. (1983b) also reported sickle cell haemoglobin in the form of trait (Hb-As) among the Mina tribal population of Udaipur district.

Abnormal haemoglobins among scheduled castes of Udaipur was reported by Choubisa *et al*. (1984). Ramalingaswami (1986) has reported the incidence of haemoglobinopathy traits in tribal areas and among scheduled castes of India in the range of 3 to 6 per cent in Central India and 1 to 2 per cent in South India.

According to Feroze *et al*. (1989) 25.8 per cent of the tribal subjects and 38.9 per cent of the non-tribal Chetties of Wayanad district had incidence of sickle cell gene while none of the non-tribal settlers reacted positively for sickling test. Phadke *et al*. (1990) observed sickle cell anaemia among the tribal children of Maharashtra.

Balpande *et al*. (1987) have observed iron deficiency among homozygous sickle cell anaemic cases. In a study on the iron status of children with sickle cell disease in Western Nigeria by Jeyakumar *et al*. (1987), it was found that the mean values of plasma iron and the percentage saturation of plasma transferrin were lower in sicklers than in non-sicklers.

According to Basu (1982) the course of G-6-P-D deficiency disease is influenced by diseases like malaria, viral and bacterial infections, hookworm infestation and iron and folic acid deficiencies. According to Jain *et al*. (1983a) malarial endemicity might be responsible for a high frequency of sickle cell and thalassaemic genes among the tribal population of Rajasthan.

2.7. Impact of developmental programmes in tribal areas

In a study conducted by Rao *et al*. (1975) it was revealed that Special Nutrition Programme had a good impact on the tribal areas of Andhra Pradesh since very few beneficiaries are affected by milder forms of protein calorie malnutrition. The beneficiaries have better growth status than that of non beneficiaries.

Bhandari et al. (1981) in a study conducted with regard to the outcome of children with severe grades of protein energy malnutrition in the Integrated Child Development Services of Garhi tribal block reported improvement of nutritional status in 62.35 per cent of child beneficiaries and concluded that effective monitoring of severe grades of protein energy malnutrition cases made significant impact with regard to the improvement in nutritional status as well as reduction in morbidity and mortality.

In a follow up study of the Integrated Child Development Services in rural, tribal and urban project areas in India, considerable improvement in nutritional status among pre-school children, pregnant women and nursing mothers were observed (Tandon et al., 1981b).

The evaluation of training programmes in Agriculture conducted for the benefit of the tribal people of Pottumavu in Trivandrum district had indicated improvement in the quality of their diet (Prema, 1983). Prabha (1986) in a study on the impact of governmental programmes of health among tribal women of Paderu block of Andhra Pradesh reported that though they are not getting any benefit from these programmes they are aware about the programmes especially the development and health programmes.

In a report published by Nutrition Foundation of India (1988) it was revealed that various development programmes in the rural communities comprised of scheduled castes and scheduled tribes of Karnataka, failed to improve the economic status of the households resulting in inadequate food intake and reduced body weights of the population. The Integrated Rural Development Project at Banda district of Uttar Pradesh also did not improve the nutritional status of its beneficiaries (Nutrition Foundation of India, 1988).

Pingle (1989) carried out a study to assess the impact of horticulture on diet and nutritional status among the tribal children of two villages of Andhra Pradesh. It was observed that children of Chitapoor were better off in all socio-economic and nutritional parameters as compared to those of Mailaram, a remote and backward village lying on the fringe of this horticultural development programme. Despite major developmental projects being undertaken in the tribal regions of the country, majority of the tribes have not benefited from these and the process of modernization has simply bypassed them (Rajyalakshmi, 1992). The impact of Integrated Rural Development Project among tribal beneficiaries of Rajasthan showed a substantial increase of 27.96 per cent in their income (Mehta and Joshi, 1993). Rayappa (1993) also observed some progress in the direction of providing basic needs such as drinking water, electricity, schooling, health and nutrition through the developmental programmes in Dakshina Kannada district of Karnataka.

Immunization programmes are one of the best and most effective investments which any government can make towards the health of its citizens (Goud _et al_., 1980).

Bhandari _et al_. (1975) had ascertained the impact of an immunization programme on the tribal children of Udaipur and revealed that the immunization status of children was not at all satisfactory. Only 31 per cent had been immunized against small pox and tuberculosis and hardly ten children out of 839 had the privilege of getting triple antigen and oral polio vaccine. Chopdar and Mishra (1980) reported 100 per cent immunization coverage for primary small pox and 69.5 per cent coverage for BCG among the tribal school children in a rural area of Western Orissa. A study conducted by Ingle _et al_. (1983) had revealed that tribal children of Nanded district of Maharashtra were not immunized which resulted in major health problems and extensive growth retardation.

Similar results were reported from Bihar where Singh _et al_. (1987a) had found that less than 8 per cent of the tribal children in Ranchi district were immunized. In an evaluation of nutritional and immunization services of the Integrated Child Development Services in a tribal block of Rajasthan it was observed that except for BCG the vaccination coverage was improved (Bhandari _et al_., 1989).

MATERIALS AND METHODS

3. MATERIALS AND METHODS

This study on 'Nutritional Status and Dietary Habits of Irulas of Attappady' is an attempt to ascertain the dietary habits and nutritional status of Irulas and to investigate the various factors which may influence the nutritional status. This chapter presents the details in respect of the locale of the study, sample and sampling procedure, variables and their measurements, data collection and statistical procedures used in the analysis of the data. The details are presented under six sections as indicated below.

3.1. Selection of the tribal area

3.2. Selection of the sample

3.3. Plan of study

3.4. Methods adopted for the study

3.5. Development of tools and conduct of study

3.6. Analysis of data.

3.1. Selection of the tribal area

Attappady valley is an important tribal area and one of the most backward areas of Kerala with maximum number of Irula tribal population. Hence Attappady was purposively selected for the present study.

Attappady valley is situated in the Western Ghats between 10°55' and 11°14' N latitude and 76°27' and 76°48' E longitude and covers an area of 765 square kilometers. The elevation of the valley ranges from 1200 ft to 3000 ft above sea level and bounded on the north by the Nilgiris, on the east by Coimbatore district, on the south by Palghat district and on the west by thick forests of which the Silent Valley Reserve is one of the virgin stretches of forests. The area can be approached by an all weather road which connects Mannarghat and Coimbatore (Fig. 1).

There are 52,421 households with scheduled tribe members in Kerala, out of which 6577 are in Palghat district (Census, 1981). Among the five taluks of this district Mannarghat taluk has the maximum number of scheduled tribe households (4797). In this taluk, Agali, Pudur and Sholayur Panchayats have the majority of tribal households (4716), which constitute the Attappady area having a tribal population of 20,659. Hence the study was concentrated in these three Panchayats.

3.2. Selection of the sample

Irulas, Mudugas and Kurumbas are the three dominant tribes residing in the 137 hamlets of Attappady, out of which 99 hamlets are inhabited by Irulas. Irulas are one among the notified tribal communities, numerically dominant and relatively acculturated among the tribal communities of Attappady. Hence the Irula tribal community was taken for the present study.

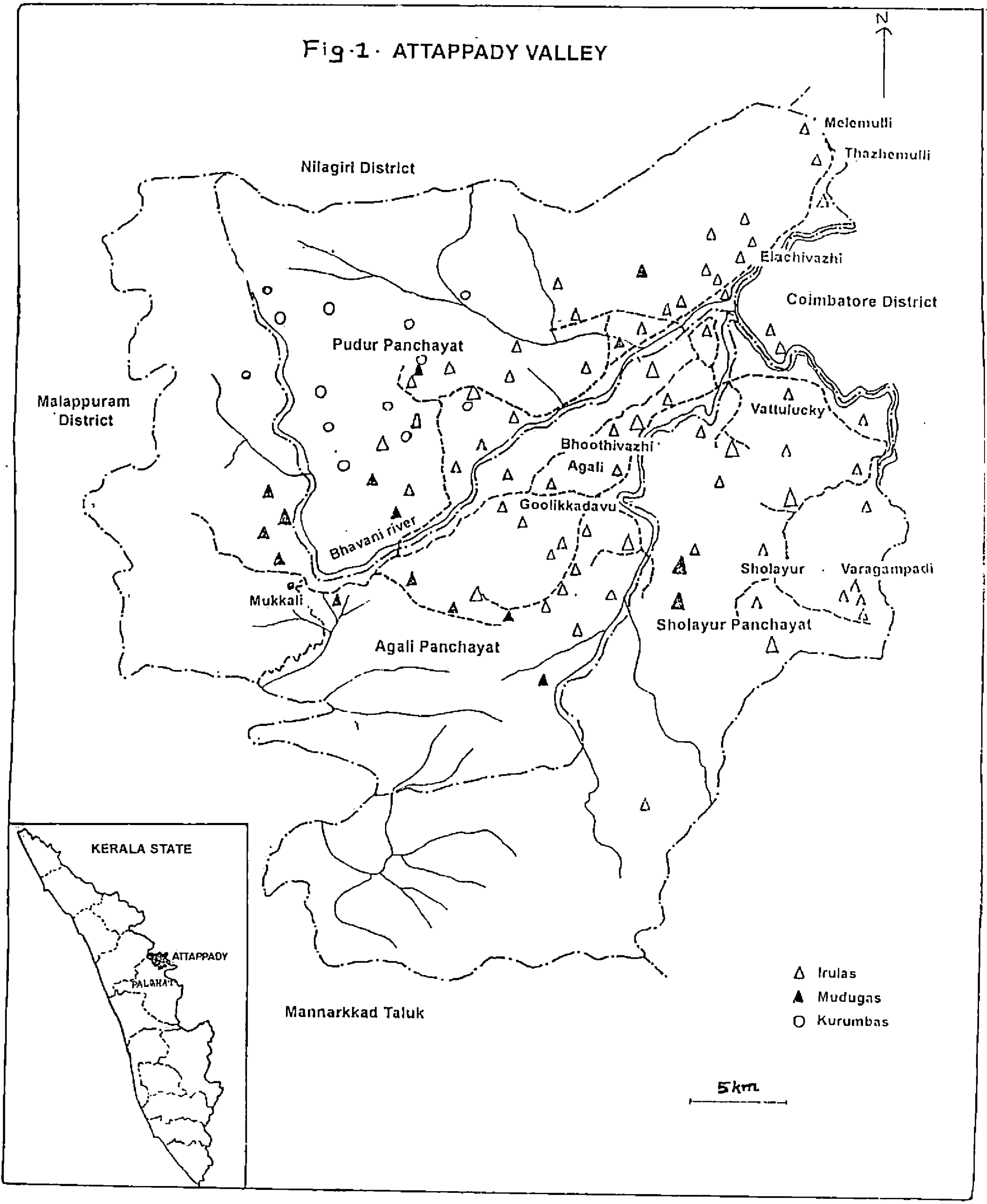
Fig.1. ATTAPPADY VALLEY
N
Nilagiri District
Melemulli
Thazhemulli
Elachivazhi
Coimbatore District
Pudur Panchayat
Malappuram District
Vattulucky
Bhoothivazhi
Agali
Goolikkadavu
Bhavani river
Sholayur
Varagampadi
Mukkali
Sholayur Panchayat
Agali Panchayat
KERALA STATE
ATTAPPADY
PALAKAT
Mannarkkad Taluk
Irulas
Mudugas
Kurumbas
5km

Out of the 99 Irula hamlets, 9 hamlets were selected equally and randomly from the three Panchayats of Attappady namely Agali, Pudur and Sholayur (3 hamlets each). Twenty households from each hamlet were selected at random comprising 180 households as the total sample. The total number of houses and families in the selected nine hamlets and the sample size selected for the study are presented in Table 1. The difference in the number of houses and the number of families in the hamlets was due to the sharing of the houses by two families.

Table 1. Details of selected hamlets

Name of the hamlets in each panchayat	No. of houses	No. of families	No. of families selected
Agali Panchayat			
Agali	34	42	20
Bhoothivazhi	79	91	20
Goolikadavu	37	41	20
Pudur Panchayat			
Thazhe Mully	27	27	20
Mele Mully	50	59	20
Elalchivazhy	43	46	20
Sholayur Panchayat			
Sholayur	95	99	20
Vattulucki	57	67	20
Varagampadi	64	66	20
TOTAL	486	538	180

The socio-economic and dietary surveys were conducted among these 180 families. The attitude towards developmental programmes implemented in the hamlets and nutritional awareness were also ascertained from the 180 respondents.

Out of the 180 families surveyed, children between 5 to 15 years were present only in 125 families and out of this 120 most co-operative families were selected to assess the nutritional status of children. The study was conducted among 135 boys and 109 girls (Table 2).

To investigate the incidence of sickle cell anaemia and malarial parasites, 76 boys and 66 girls who co-operated with the investigator to give blood samples were selected (Table 3).

Out of the 9 hamlets surveyed, 2 hamlets namely Agali and Thazhe Mully were selected randomly for indepth studies. Twenty boys and 18 girls in the age group of 5 to 15 years were selected to conduct the food weighment survey (Table 4). For biochemical estimations 7 boys and 3 girls from these 38 children were selected based upon their willingness to give blood samples.

Table 2. Distribution of children selected for the assessment of nutritional status

Name of hamlet	No. of households with children between 5-15 years	Number of children between 5-15 years		No. of households selected	Age in years									
					5 - 6		7 - 9		10 - 12		13 - 15		Total	
		B	G		B	G	B	G	B	G	B	G	B	G
Agali	16	19	11	16	5	-	5	1	4	8	4	2	18	11
Bhoothivazhi	12	14	9	12	2	2	3	1	5	3	4	1	14	7
Goolikadavu	9	8	7	9	-	1	4	2	2	4	2	-	8	7
Thazhe Mully	16	23	18	16	4	3	10	6	6	3	3	5	23	17
Mele Mully	17	22	16	17	7	7	8	3	2	5	-	-	17	15
Elachivazhy	11	10	11	10	1	2	4	1	3	2	1	2	9	7
Sholayur	13	21	15	12	4	1	6	5	6	6	2	1	18	13
Vattulucki	15	16	19	14	4	7	4	3	5	7	1	1	14	18
Varagampadi	16	20	16	14	3	4	3	4	4	6	4	-	14	14
Total	125	153	122	120	30	27	47	26	37	44	21	12	135	109

B - Boys G - Girls

Table 3. Distribution of children selected to investigate the prevalence of sickle cell anaemia and malarial parasites

Name of hamlet	No. of households selected	Age in years									
		5-6		7-9		10-12		13-15		Total	
		B	G	B	G	B	G	B	G	B	G
Agali	11	2	-	4	1	1	8	1	2	8	11
Bhoothivazhi	8	2	2	2	1	3	2	-	-	7	5
Goolikadavu	4	-	-	2	-	-	3	1	-	3	3
Thazhe Mully	13	4	1	7	5	5	-	2	1	18	7
Mele Mully	8	5	1	4	2	1	1	-	-	10	4
Elachivazhy	7	1	1	3	-	-	2	-	2	4	5
Sholayur	8	2	1	3	3	1	4	1	1	7	9
Vattulucki	11	3	5	4	2	3	4	-	-	10	11
Varagampadi	13	2	4	2	3	1	4	4	-	9	11
Total	83	21	15	31	17	15	28	9	6	76	66

B - Boys G - Girls

Table 4. Distributin of children selected for indepth studies.

Name of hamlet	No. of households with children between 5-15 years	No. of households selected	Age in years									
			5-6		7-9		10-12		13-15		Total	
			B	G	B	G	B	G	B	G	B	G
Agali	16	9	4	-	2	1	1	5	2	1	9	7
Thazhe Mully	16	8	2	3	4	4	4	-	1	4	11	11
Total	32	17	6	3	6	5	5	5	3	5	20	18

B - Boys G - Girls

3.3. Plan of study

Based on the objectives, plan of study was designed. The study comprises

1. A baseline survey to monitor the socio-economic status.
2. A survey to assess the food consumption and dietary habits.
3. Assessing the nutritional status of children through
   - i. Anthropometric measurements viz. height, weight, mid upper arm circumference and skinfold thickness
   - ii. Clinical examination
   - iii. Food weighment survey to assess the actual food intake
   - iv. Study on the general profile of blood with response to haemoglobin, packed cell volume, RBC count, total count and differential count, serum iron, serum protein and serum albumin.
   - v. Examination of stool samples to determine worm infestation.
4. Prevalence of sickle cell anaemia and malarial parasites among children.

5. Nutritional awareness of the respondents.

6. Attitude of the respondents towards developmental programmes.

3.4. Methods adopted for the study

3.4.1. General methods

Interview method consists of face to face verbal inter change by which the interviewer attempts to elicit information or expression of opinion or belief from another person (Lindzey, 1954). According to Sundararaj (1972) interview method is generally considered as a less laborious way of collecting the required informations. Moreover interview method is the suitable way to collect data as it proceeds systematically and enables to record the collected informations quickly (Devadas and Kulandaivel, 1975; Bass *et al*., 1979).

Because of the above reasons, in the present study, interview method through house visit, was selected to collect the required informations on socio-economic and dietary habits of the families and also to assess the nutritional awareness of the respondents.

3.4.2. Specific methods

3.4.2.1. Assessing the nutritional status

According to Aebi (1983) anthropometric indices, presence of clinical deficiency signs, dietary assessment, actual food intake and various biochemical estimations are widely used as direct parameters of nutritional status. For assessing the nutritional status of children between 5 to 15 years of age, following methods were employed.

i. Recording anthropometric measurements
ii. Conducting clinical examination
iii. Monitoring actual food intake and
iv. Biochemical estimations

i. Recording anthropometric measurements

Anthropometric indices are useful, sensitive, practical, accurate and reliable as indicators of nutritional status of a community (World Health Organization, 1965). These indices were used extensively over the past several decades to assess the nutritional status of children in developing countries (Cooper and William, 1982). The importance of anthropometric measurements as a simple, useful, practical and as the accepted method to study the nutritional status of individuals has been reported by several authors (Jelliffee, 1966; Hamill et al., 1979; McLaren et al., 1984; Vijayaraghavan, 1987; Sharma and Kalia, 1990).

The commonly employed anthropometric measurements used in nutrition surveys are weight, height, sitting height, skinfold thickness and arm, chest and head circumferences (Rao and Singh, 1970). Measurements of heights and weights were reported to be important and useful indicators in the evaluation of nutritional status (Easwaran et al., 1972). In a report published by Nutrition Foundation of India (1988) weight and arm circumferences are considered as being 'sensitive' indicators, since they respond quickly to nutritional deprivation of even short durations.

Weight/height^2 is a reliable age independent index and since it takes into consideration weight in relation to height, the index is considered to have advantages over using either height or weight singly as an index of growth (Rao and Singh, 1970; Babu and Chuttani, 1979). Gupta et al. (1979) opined that weight for age is the most sensitive index to evaluate nutritional status of growing children and weight/height^2 ratio is simple, practical and composite anthropometric index of malnutrition in growing children. According to Sen et al. (1980) weight/height^2 ratio is 83.3 per cent sensitive and 80 per cent specific.

Mid upper arm circumference is a useful indicator for assessing protein calorie malnutrition of early childhood (Jelliffee, 1966; Kamath, 1986). It is considered as a useful and simple method to assess the nutritional status of children (Zerfas, 1975; Voorhoea, 1983).

Skinfold thickness is the only means of measuring subcutaneous fat and therefore body composition (Swaminathan, 1974). According to Roy (1978), the most frequently chosen site in nutritional investigation is the skinfold at the back of the upper arm over the tricep muscle at a point mid way between the tip of the acronial process of the scapula and the tip of elbow and meets all the criteria for selection of the best site for the purpose.

In the present study the anthropometric indices like weight for age, height for age and weight/height^2 ratio, mid upper arm circumference, and skinfold thickness over triceps were used to assess the nutritional status of children between 5 to 15 years.

ii. Conducting clinical examination

Clinical examination is of value for the identification of characteristic nutritional syndromes (Shimazono, 1970). It is an important, practical, sound and simplest means of assessing the nutritional status of a community (Jelliffee 1966; Gupta et al., 1978; Kamath, 1986). According to Swaminathan (1986) clinical assessment is the most important part of nutritional assessment which gives direct information of signs and symptoms of dietary deficiencies in an individual.

In the present study clinical examination of children between 5 to 15 years was conducted to assess the signs and symptoms of nutritional deficiencies.

iii. Monitoring actual food intake

Diet surveys constitute an essential part of any complete study of nutritional status of individual or groups, and provides essential information on nutrient intake levels, source of nutrients, food habits and attitudes (Gopaldas and Seshadri, 1987).

Among the different methods of diet surveys, weighment method is considered to be the most reliable, since the actual foods taken by the individuals are weighed (Rau et al., 1972; Tilve, 1978). According to Gore et al. (1977) only weighment method can give reasonably accurate values of dietary intakes of tribes.

Among diet survey methods commonly employed, the conventional seven day weighment method is the most reliable, since it takes care of daily variations in food intake (Swaminathan et al., 1967). On the contrary, Rao (1975) had reported that any single day or two day weighment method would be as efficient a tool as that of seven days. However, Guthrie and Crocetti (1985) were of the opinion that one day food records alone were of limited value in estimating nutrient adequacy of an individual's diet. For the estimation of overall food and nutrient intake a 3-day dietary record is recommended by Bingham (1987).

Hence, in the present study, a three day weighment survey was conducted among 20 boys and 18 girls in the age group of 5 to 15 years to determine their actual food intake.

iv. Biochemical estimations

Variations in the intake of different nutrients in the diet are reflected by changes of the concentration of the corresponding nutrients in blood, tissues and in urine (Jelliffee, 1966; Davidson et al., 1973). Shimazono (1970) had stated that biochemical data in nutritional surveys are specific and quantitative.

The results of the biochemical tests can reflect a defective imbalanced supply of nutrients, or a subsequent metabolic upset well before recognizable physical lesions appear, and provide information on the immediate past and the present as well as a prediction for the immediate future (Burgess, 1976). According to Underwood and Stekel (1984) laboratory measurements of the nutrient adequacy of body fluids or tissues can provide objective, specific and sensitive indicators of nutritional status.

In the present study the following biochemical investigations were carried out among children between 5 to 15 years.

i. Haemoglobin estimation of blood among 135 boys and 109 girls

ii. The following investigations were carried out among the selected sub samples constituting 7 boys and 3 girls.

1. Serum iron
2. Packed cell volume
3. Serum protein
4. Serum albumin
5. RBC count
6. Total count
7. Differential count
8. Worm infestations

iii. Prevalence of sickle cell anaemia and malaria among 76 boys and 66 girls.

food intake is given in Appendix V. The nutrients available from the food consumed was computed using the food composition tables (Gopalan et al., 1989).

Haemoglobin level of blood of the children was determined by cyanmethaemoglobin method (NIN, 1983).

The following procedures were adopted for other biochemical estimations.

1. Serum iron - Wong's method (NIN, 1983)
2. Packed cell volume - Wintrobes method (Sood, 1990)
3. Serum protein - Biuret method (NIN, 1983)
4. Serum albumin - NIN (1983)
5. RBC count - (NIN, 1983)
6. Total count - NIN (1983)
7. Differential count - NIN (1983)
8. Worm infestations - Concentration method

The method suggested by Schneider et al. (1967) was adopted to find out the incidence of sickle cell anaemia, and for malarial parasites the blood smears were stained with Leishman's stain and looked for parasites in red blood cells.

The procedures adopted for the above estimations are given in Appendix VI.

3.4.2.2. Attitude towards developmental programmes

Thurstone (1946) defined attitude as the degree of positive or negative effect associated with psychological object towards which people can differ in varying degrees. Sharma (1972) defined attitude as a personal disposition which impels an individual to react to some objects or situations. According to Mehrabian (1973), attitude is the degree of liking, positive evaluations and/or preference of one person for another.

To assess the attitude of the respondents towards the developmental programmes implemented in the locality direct questioning method suggested by Edwards (1969) was used.

3.5. Development of tools and conduct of study

To elicit informations on the socio-economic and personal characteristics of the Irulas of Attappady, a questionnaire was developed. The schedule comprised informations on type and size of family, composition of the family, marital status, dowry system, educational and occupational status, monthly income, monthly expenditure pattern, possession of land, domestic animals, housing conditions, personal hygiene, treatment followed, details about immunization and family planning measures.

Another schedule was prepared to collect informations on dietary habits and food consumption pattern of the families. The schedule included details about the staple food, food expenditure pattern, frequency of use of food, cooking devices, cooking methods, meal pattern, storage and preservation practices, infant feeding practices, foods included and avoided during special conditions and illness, epidemics prevalent in the locality, details about the handicapped persons and knowledge about basic nutrition.

The above two questionnaires were pretested before field application and the details are presented in Appendix I and II respectively.

Anthropometric measurements of 135 boys and 109 girls between 5 to 15 years of age were taken as suggested by Jelliffee (1966). The details of the procedure adopted are given in Appendix III.

Clinical examination of children was conducted with the help of a qualified physician. Schedule used for the purpose is given in Appendix IV.

Three day weighment survey was conducted among 20 boys and 18 girls and the schedule adopted to monitor the actual food intake is given in Appendix V. The nutrients available from the food consumed was computed using the food composition tables (Gopalan et al., 1989).

Haemoglobin level of blood of the children was determined by cyanmethaemoglobin method (NIN, 1983).

The following procedures were adopted for other biochemical estimations.

1. Serum iron - Wong's method (NIN, 1983)
2. Packed cell volume - Wintrobes method (Sood, 1990)
3. Serum protein - Biuret method (NIN, 1983)
4. Serum albumin - NIN (1983)
5. RBC count - (NIN, 1983)
6. Total count - NIN (1983)
7. Differential count - NIN (1983)
8. Worm infestations - Concentration method

The method suggested by Schneider et al. (1967) was adopted to find out the incidence of sickle cell anaemia, and for malarial parasites the blood smears were stained with Leishman's stain and looked for parasites in red blood cells.

The procedures adopted for the above estimations are given in Appendix VI.

3.6. Analysis of data

3.6.1. Per capita food requirement

For conversion of per capita norm into per capita requirements for the tribal area, proportion of sample population belonging to different age group was estimated and multiplied by Aykroyd's coefficient. (Government of Kerala, 1982). The details are presented below:

Age group (years)	Aykroyd's coefficient
0-4	0.45
5-9	0.65
10-14	0.90
15-19	1.0
>20	1.0 (male) 0.9 (female)

Conversion ------

$$Cc = \frac{c_1f_1 + c_2f_2 + c_3f_3 + c_4f_4 + c_5f_5}{f_1 + f_2 + f_3 + f_4 + f_5}$$

$$Cc = \frac{\Sigma c_1f_1}{\Sigma f_1}$$ where

f_1 to f_5 = Proportion of population in the age group (frequency)

c = Aykroyd's coefficient for each age group

Cc = Coefficient of conversion

3.6.2. Calculation of food use frequency

Based on the frequency of use of different food groups in the daily diet of the surveyed families, food use frequency scores were calculated as suggested by Reaburn *et al*. (1979). The formula used for the calculation is given below.

$$\text{Percentage of total score} = \frac{R_1S_1 + R_2S_2 + \dots\dots + R_nS_n}{n}$$

S_n = Scale of rating

R_n = Percentage of respondents selecting a rating

n = Maximum scale rating

3.6.3. Nutritional status index of the children

Anthropometric measurements like height, weight, midupper arm circumference and skinfold thickness and other parameters like haemoglobin values and clinical scores obtained were used to compute the nutritional status index of 135 boys and 109 girls between the age group of 5 to 15 years as described below.

Suppose X_{ij} be the observation corresponding to j^{th} variable for the i^{th} sample, $W_j = 1/\sigma_j^2$, the weight assigned to the observation corresponding to j^{th} variable, the nutritional status of i^{th} individual is defined as

$Ni = \sum K_{Wi} X_{ij}, \quad i = 1, 2, \ldots\ldots\ldots, N$

N = Number of respondents

K = Number of variables

The index was calculated for each age group varying from 5 to 15 years and classified into low, medium and high based on measures of quartile deviation, viz. Less than Q_1 = low; between Q_1 to Q_3 = medium and above Q_3 = high, where Q_1 and Q_3 are quartile deviations with respect to first and third quartiles.

3.6.4. Nutritional awareness of the respondents

Nutritional awareness of the respondents was ascertained by assessing their knowledge about health, infant feeding practices and cooking practices. Different questions were formulated and the details are given in Appendix VII. On the basis of total scores the nutritional awareness of the respondents were classified into three classes, Low = <Mean-SE, Medium = Mean$\pm$SE, High = >Mean+SE.

3.6.5. Relationship between different variables and expenditure incurred for food

Following independent variables were selected to find out the association with the food expenditure pattern of the family.

1. Type of family
2. Family size
3. Income of the family
4. Per capita income of the family
5. Education of father
6. Education of mother
7. Occupation of father
8. Occupation of mother
9. Number of persons employed
10. Availability of land

3.6.6. Relationship between selec nutritional status index of chi

Following independent variables out the association with the nutritional status index of boys and girls.

1. Family size
2. Family income
3. Education of father
4. Education of mother
5. Occupation of father
6. Occupation of mother
7. Education of children
8. Food expenditure
9. Amount spent for vices.

10. Number of children
11. Birth order of children
12. Birth spacing from older child
13. Birth spacing from younger child
14. Personal hygiene (adults)
15. Personal hygiene (children)
16. Health facilities in the locality
17. Housing conditions
18. Morbidity status of children
19. Nutritional awareness of the respondent
20. Participation of children in feeding programmes

3.6.7. Relationship between different variables and nutritional awareness of the respondents

Following independent variables were selected to fin out the association with the nutritional awareness of th respondents.

1. Age of the respondent
2. Family size
3. Income of the family
4. Education of the respondent
5. Occupation of the respondent
6. Housing conditions
7. Exposure to mass media
8. Urban contact of the respondent
9. Land holdings

RESULTS

To find out the associations (3.6.5 to 3.6.7) correlation analysis was carried out for quantified variables and chi-square test was administered for non-quantified variables.

3.6.8. Test of significance

The anthropometric measurements and haemoglobin values were compared with the standard values by Student's 't' test where

$$t_{n-1} = \frac{/ \bar{x} - a /}{S / \sqrt{n - 1}}$$

Where $\bar{x}$ = Observed mean measurement

a = Standard measurement

n = Sample size

S = Sample standard deviation

Mean food intake and nutrient intake of the children were compared with the Recommended Dietary Allowances (RDA) suggested by Gopalan et al. (1981) and Recommended Dietary Allowances for nutrients (Indian Council of Medical Research, 1991) and bio chemical values with standard values. Students 't' test was used to analyse the difference with the Recommended Dietary Allowances for food and nutrients. The same formula explained above was applied in this respect.

Nutritional status index for boys and girls at different ages were compared by 't' test where

$$t_{n_1 + n_2 - 2} = \frac{/ \bar{x}_1 - \bar{x}_2 /}{SE\ (\bar{x}_1 - \bar{x}_2)}$$

3.6.9. <u>Analysis of variance (Anova)</u>

Analysis of variance was carried out to compare the nutritional status index of children at different age groups.

3.6.10. <u>Path analysis</u>

Path analysis was carried out to find the direct and indirect effects of different nutrients on nutritional status index of the subsample constituting 20 boys and 18 girls.

RESULTS

4. RESULTS

The results of the study on the assessment of nutritional status and dietary habits of Irulas of Attappady are presented under the following headings.

4.1. Socio-economic profile of the tribal families.

4.2. Food consumption and dietary pattern of the tribal families.

4.3. Nutritional status of the tribal children and factors influencing the nutritional status.

4.4. Prevalence of sickle cell anaemia and malaria among tribal children.

4.5. Nutritional awareness of the tribal people and factors influencing nutritional awareness.

4.6. Attitude of the tribal people towards developmental programmes implemented in the locality.

4.7. Direct and indirect effects of nutrients contributing to the nutritional status of children.

4.1. Socio-economic profile of the tribal families

The Socio-economic profile of the Irula tribal families was studied with special reference to their religion, head of family, type of family, family system, details of marriage, family size, composition of the family, educational status, occupational status, monthly income, land holdings, domestication of animals, monthly expenditure pattern, unhealthy habits, details on loan, housing conditions, personal hygiene, treatment followed, mortality status and immunization status of children.

There was predominance of nuclear type families which constituted 93.88 per cent and the remaining was joint families. All the families belonged to the Hindu community and followed patriarchal system. The respondents of the survey were predominantly female members (94.44%). Among the families, 92.22 per cent were headed by male members and the rest by female members, either due to the expiry of the husband or due to divorce.

4.1.1. Marital status of the members

Table 5 presents the details regarding the marital status of the family members. The table shows that difference existed in the marital age of male and female members of the surveyed families. Male members (68.33 %) in general entered into marital life between the age of 19 to 24 years while in the case of female members (76.11 %), the marital life started even before the age of 19. Marriage after 30 years was observed in very few male members only.

Among the families surveyed 89.44 per cent entered into marriage alliance within the tribal community while the remaining had inter-caste marriages.

Table 5. Marital status of family members

Age in (years)	Marital age		Type of marriage		Details of dowry	
	A Number of families	B Number of families	Particulars	Number of families	Particulars	Number of families
< 19	10 (5.56)	137 (76.11)	Married within the caste	161 (89.44)	Received dowry	161 (89.44)
19-24	123 (68.33)	37 (20.56)	Intercaste marriage	19 (10.56)	No dowry	19 (10.56)
25-30	41 (22.78)	6 (3.33)				
31-36	5 (2.77)					
> 36	1 (0.56)					
Total	180 (100)	180 (100)	Total	180 (100)	Total	180 (100)

A - Husband; B - Wife
Number in parenthesis indicates percentage

Among the Irulas of Attappady, eventhough formal dowry system was not prevalent, bridegroom has to give Rs. 101.25 for the bride as bride-price at the time of marriage as per the prevailing custom. Among the families surveyed except those who married from other castes all others (89.44%) received bride-price in this manner.

4.1.2. Family size

Table 6 indicates the size of the 180 tribal families. As much as 65 per cent of the families was in the size group of 3 to 5 and 27.22 per cent in the size group of 6 to 8. Only less than 2 per cent of the families had more than eight members.

Table 6. Details of family size

No. of family members	Number of families	Per cent
< 3	11	6.11
3-5	117	65.00
6-8	49	27.22
> 8	3	1.67
Total	180	100.00

4.1.3. Composition of the families

Table 7 shows family composition. Sex ratio was found to be 967. As much as 50.82 per cent of the population was in the age group of 16 to 55 years and comprised of 24.60 male and 26.22 per cent female members. The percentage of people above 55 years was 3.98 per cent and the percentage of children below 16 years was 45.20. The two groups together constituted 49.18 per cent of the total population.

Table 7. Composition of the families

Age (years)	Male (Number)	Female (Number)	Total
> 55	20 (2.34)	14 (1.64)	34 (3.98)
19-55	181 (21.20)	204 (23.88)	385 (45.08)
16-18	29 (3.40)	20 (2.34)	49 (5.74)
13-15	28 (3.28)	17 (1.99)	45 (5.27)
10-12	47 (5.50)	49 (5.74)	96 (11.24)
7-9	47 (5.50	28 (3.28)	75 (8.78)
5-6	31 (3.63,	28 (3.28)	59 (6.91)
1-4	39 (4.56)	49 (5.74)	88 (10.30)
Infants (< 1)	12 (1.41)	11 (1.29)	23 (2.70)
Total	434 (50.82)	420 (49.18)	854 (100)

Number in parenthesis indicates percentage

Children between 5 to 15 years constituted 32.20 per cent of the total population, of which 10-to 12-year-old children constituted 11.24 per cent, 7-to 9-year-old 8.78 per cent, and 5-to 6-year-old 6.91 per cent of the total population. Children below 5 years constituted 13 per cent of the total population. Among children, below 15 years female members were more in the age group of 1 to 4 (5.74%) and 10 to 12 years (5.74%).

4.1.4. Educational status of adolescent and adult members

The educational status of the adolescent and adult members of the families is presented in Table 8. The adolescent and adult members of the families were composed of 230 male and 238 female members. Compared to men the educational status of the female members were found to be lower. In this group, 68.26 per cent of the male and 86.13 per cent of the female members were illiterate. It can be seen that the percentage of illiterates increased with increase in age group and in the highest age group of above 55 years all were illiterate. About 11.74 per cent male members and 4.62 per cent female members had studied upto lower primary level and 10.44 per cent male and 4.62 per cent female members had attained education upto high school level. However, 7 tribal men and 2 tribal women had received college level education.

4.1.5. Educational status of children

Table 9 indicates the details regarding the educational status of the children between 5 to 15 years. Among the children between 5 to 15 years of age 53.59 per cent of boys and 42.62 per cent of girls had studied upto lower primary level whereas 18.96 per cent boys and 24.59 per cent girls had upper primary level of education. Illiteracy was found among 11.77 per cent boys and only 9.84 per cent girls.

Table 8. Educational status of adolescents and adults

Educational status	Age in years							
	16-18		19-55		Above 55		Total	
	M	F	M	F	M	F	M	F
Lower primary	3 (10.34)	3 (15.00)	24 (13.26)	8 (3.92)	-	-	27 (11.74)	11 (4.62)
Upper Primary	5 (17.24)	3 (15.00)	10 (5.52)	6 (2.94)	-	-	15 (6.52)	9 (3.79)
High School	5 (17.24)	3 (15.00)	19 (10.50)	8 (3.92)	-	-	24 (10.44)	11 (4.62)
College	2 (6.90)	-	5 (2.76)	2 (0.98)	-	-	7 (3.04)	2 (0.84)
Illiterate	14 (48.28)	11 (55.00)	123 (67.96)	180 (88.24)	20 (100)	14 (100)	157 (68.26)	205 (86.13)
Total	29 (100)	20 (100)	181 (100)	204 (100)	20 (100)	14 (100)	230 (100)	238 (100)

M = Male
F = Female
Number in parenthesis indicates percentage

Table 9. Educational status of children in the age group of 5 to 15 years.

Educational status	Age in years									
	5-6		7-9		10-12		13-15		Total	
	B	G	B	G	B	G	B	G	B	G
Balwadi/ Nursery	15 (48.39)	19 (67.86)	-	-	-	-	-	-	15 (9.80)	19 (15.57)
Lower Primary	11 (35.48)	8 (28.57)	43 (91.49)	22 (18.57)	27 (57.45)	20 (40.82)	1 (3.57)	2 (11.77)	82 (53.59)	52 (42.62)
Upper primary	-	-	-	2 (7.14)	17 (36.17)	22 (44.90)	12 (42.86)	6 (35.29)	29 (18.96)	30 (24.59)
High School	-	-	-	-	-	-	9 (32.14)	9 (52.94)	9 (5.88)	9 (7.38)
Illiterate	5 (16.13)	1 (3.57)	4 (8.51)	4 (14.29)	3 (6.38)	7 (14.28)	6 (21.43)	-	18 (11.77)	12 (9.84)
Total	31 (100)	28 (100)	47 (100)	28 (100)	47 (100)	49 (100)	28 (100)	17 (100)	153 (100)	122 (100)
Continuing education	26 (100)	27 (100)	43 (100)	23 (95.83)	34 (77.27)	36 (85.71)	15 (68.18)	15 (88.24)	118 (87.41)	101 (91.82)
Dropouts	-	-	-	1 (4.17)	10 (22.73)	6 (14.29)	7 (31.82)	2 (11.76)	17 (12.59)	9 (8.18)
Total	26 (100)	27 (100)	43 (100)	24 (100)	44 (100)	42 (100)	22 (100)	17 (100)	135 (100)	110 (100)

B = Boys
G = Girls
Number in parenthesis indicates percentage

Since all the school going children are getting aid from the government for their education, equal opportunities were given for boys and girls for education by the tribal families.

It can also be seen that among the 135 boys and 110 girls who were literate, a predominant percentage of boys (87.41%) and girls (91.82 %) were continuing their education and the percentage of dropout was around 11 per cent. Among different age groups higher percentage of dropout was found among 13-to 15-year-old boys (31.82 %) followed by 10-to 12-year-old boys (22.73 %).

Majority of the respondents revealed that the reason for illiteracy or dropout among children was either poverty (60% boys and 55% girls) or their living in the forest far away from schools (26.67% boys and 10% girls). While 13.33 per cent of the respondents did not attribute any particular reason for the illiteracy or discontinuation of education of their children, a few girls discontinued either to look after their younger siblings or to attend to other household duties.

4.1.6. Occupational status of adolescent and adult members

The occupational status of the adolescent and adult members of the families are presented in Table 10. Out of the total population above 15 years, 57.05 per cent was

Table 10. Occupational status of adolescents and adults.

Occupation	Age in years								Grand total
	16-18		19-55		Above 55		Total		
	M	F	M	F	M	F	M	F	
Coolie	19 (65.52)	14 (70.00)	120 (66.30)	108 (52.94)	4 (20.00)	2 (14.29)	143 (62.17)	124 (52.10)	267 (57.05)
Coolie and agriculture	1 (3.45)	-	23 (12.71)	14 (6.86)	1 (5.00)	-	25 (10.87)	14 (5.88)	39 (8.83)
Agriculture	-	-	13 (7.18)	13 (6.38)	3 (15.00)	-	16 (6.96)	13 (5.47)	29 (6.20)
Private job	-	-	8 (4.42)	2 (0.98)	-	-	8 (3.48)	2 (0.84)	10 (2.14)
Government job	-	-	3 (1.66)	8 (3.92)	-	-	3 (1.30)	8 (3.36)	11 (2.35)
No work	4 (13.79)	5 (25.00)	14 (7.73)	57 (27.94)	12 (60.00)	12 (85.71)	30 (13.05)	74 (31.09)	104 (22.22)
Continuing education	5 (17.24)	1 (5.00)	-	2 (0.98)	-	-	5 (2.17)	3 (1.26)	8 (1.71)
Total	29 (100)	20 (100)	181 (100)	204 (100)	20 (100)	14 (100)	230 (100)	238 (100)	468 (100)

M = Male
F = Female
Number in parenthesis indicates percentage

working as coolies, particularly as agricultural labourers. Sex wise, 62.17 per cent of male and 52.10 per cent of female members were engaged in such type of occupation. More than 22 per cent did not have any work while this was only 13.05 per cent among men and 31.09 per cent among women.

Only in the age group of 19 to 55 years, 1.66 per cent male and 3.92 per cent female members were engaged in government job and 4.42 per cent male and 0.98 per cent female members in private job. Majority of the male (60%) and female members (85.71 %) above 55 years of age was not engaged in any work. In the age group of 16 to 18 years (adolescent) the percentage of working girls was higher than that of working boys. However, in the case of 19 to 55 years and above 55 years, the percentage of working men were more than the percentage of working women.

4.1.7. <u>Details of children engaged in labour</u>

Table 11 depicts the details of children between 5 to 15 years of age engaged in labour. Though majority of the children (79.64%) between 5 to 15 years of age were continuing their education, a few children became the bread winners of the Irula families. It is evident from Table 11 that out of the total boys, 6.54 per cent were engaged in cattle rearing, 5.23 per cent working as coolies and 11.11

Table 11. Children between 5 to 15 years engaged in labour

Occupation	Age in years: 5-6 B	5-6 G	7-9 B	7-9 G	10-12 B	10-12 G	13-15 B	13-15 G	Total B	Total G	Grand total
Coolie	-	-	-	-	4 (8.51)	4 (8.16)	4 (14.29)	1 (5.88)	8 (5.23)	5 (4.09)	13 (4.73)
Cattle rearing	-	-	2 (4.26)	1 (3.57)	5 (10.64)	-	3 (10.71)	-	10 (6.54)	1 (0.82)	11 (4.0)
Household work	-	-	-	2 (7.14)	-	6 (12.25)	-	1 (5.88)	-	9 (7.38)	9 (3.27)
Rearing of young children	-	-	-	2 (7.14)	-	1 (2.04)	-	-	-	3 (2.46)	3 (1.09)
No work	5 (16.13)	1 (3.57)	2 (4.26)	-	4 (8.51)	2 (4.08)	6 (21.43)	-	17 (11.11)	3 (2.46)	20 (7.27)
Continuing education	26 (83.87)	27 (96.43)	43 (91.48)	23 (82.15)	34 (72.34)	36 (73.47)	15 (53.57)	15 (88.24)	118 (77.12)	101 (82.79)	219 (79.64)
Total	31 (100)	28 (100)	47 (100)	28 (100)	47 (100)	49 (100)	28 (100)	17 (100)	153 (100)	122 (100)	275 (100)

B = Boys
G = Girls
Number in parenthesis indicates percentage.

per cent were idling without any specific occupation. Among girls 7.38 per cent were engaged in household work, 4.09 per cent working outside the house as coolies and 2.46 per cent were entrusted in taking care of younger siblings.

4.1.8. Number of persons employed

Details of the number of persons employed in a family are given in Table 12. As shown in the table, 54.44 per cent families were found to have two members employed outside their home, usually the male members and their spouses, while in 26.67 per cent of the families only one member was employed. In 18.89 per cent of families more than two members of the family went for work.

Table 12. Distribution of families as per the number of persons employed.

No. of persons employed	Number of families	Per cent
1	48	26.67
2	98	54.44
> 3	34	18.89
Total	180	100.00

4.1.9. Monthly income and per capita income

In Table 13, the details regarding the monthly income and per capita income of the families are presented.

Only 4.44 per cent of the families had above Rs 1000, 6.11 per cent had between Rs 801 to Rs 1000 and 11.67 per cent had between Rs 601 to Rs 800 as monthly income. The income ranged between Rs 401 to Rs 600 in 39.45 per cent of the families, and 33.33 per cent families had an income between Rs 201 to Rs 400 per month and the remaining 5 per cent had an income below Rs 200.

The table also shows that the per capita income of 47.22 per cent of the families was between Rs 51 to Rs 100 and 28.89 per cent had Rs 101 to Rs 150 as per capita income. Only 3.89 per cent had a per capita income above Rs 250, 5 per cent had Rs 201 to Rs 250, 8.89 per cent of the families had Rs 151 to Rs 200 and the rest (6.11 %) had below Rs 50 as per capita income.

4.1.10. Availability of land

Details on the availability of land and the way it was received are given in Table 14. Most of the respondents (75 %) owned land ranging from 1 to 9 acres and very few had (1.67 %) above 10 acres of land. About 86 per cent of the families inherited the land from their parents while 10.15

Table 13. Monthly total income and per capita income.

Monthly income (Rs)	No. of families	Per cent	Per capita income (Rs)	No. of families	Per cent
≤ 200	9	5.00	≤ 50	11	6.11
201-400	60	33.33	51-100	85	47.22
401-600	71	39.45	101-150	52	28.89
601-800	21	11.67	151-200	16	8.89
801-1000	11	6.11	201-250	9	5.00
> 1000	8	4.44	> 250	7	3.89
Total	180	100.00	Total	180	100.00

per cent possessed forest land and 3.62 per cent got it from government. About 90 per cent of the respondents who had land, cultivated different crops. Majority cultivated mainly ragi (94.4 %) and others cultivated cholam, pulses and keerai and no body was able to give the exact quantity of crops produced because the quantity produced used to vary according to the climatic changes. About 78 per cent of the families utilised the whole produce at home while the rest sold half of the produce.

Table 14. Details on the availability of land

Area (Acre)	Number of families	Way it was received	
		Particulars	Number of families
Nil	42 (23.33)	Inherited	118 (85.50)
1-3	87 (48.34)	Forest land	14 (10.15)
4-6	42 (23.33)	Government	5 (3.62)
7-9	6 (3.33)	Purchased	1 (0.73)
$\geq$ 10	3 (1.67)		
Total	180 (100)	Total	138 (100)

Number in parenthesis indicates percentage

4.1.11. Domestication of animals

About 61 per cent of the families had domestic animals like cattle and poultry. Among these families 91 per cent purchased the domestic animals and 7 per cent got these from government agencies free of cost and the rest received from their parents. About 88 per cent of these families grazed the animals in open space and the rest used the agricultural waste also for feeding. Most of the respondents (93 %) got milk, dung, chicks or meat from these animals while 61 per cent of the families sold all such produce, 10.18 per cent used them for family consumption and the rest utilised the produce partially at home and partially for sale.

4.1.12. Monthly expenditure pattern of the families

Details regarding the expenditure for various items like food, clothing, personal expenditure, recreation, fuel, education, shelter, health, electricity, transportation and savings are presented in Table 15. It can be seen from the table that 73.89 per cent of the families spent above 70 per cent of their monthly income for food and 18.33 per cent spent 60 to 70 per cent while 7.78 per cent spent 40 to 60 per cent of their monthly income for food.

It was also observed that on an average all the families spent upto 5 per cent of their monthly income for

Table 15. Monthly expenditure pattern of the families on different items

Expenditure (per cent)	Food	Clothing	Personal expenditure	Recreation	Fuel	Education	Shelter	Health	Electricity	Transport	Savings
No expenditure	-	-	3 (1.67)	106 (58.89)	16 (8.89)	174 (96.67)	179 (99.44)	178 (98.89)	157 (87.22)	173 (96.11)	173 (96.11)
< 10	-	180 (100)	28 (15.55)	74 (41.11)	164 (91.11)	6 (3.33)	1 (0.56)	2 (1.11)	23 (12.78)	6 (3.33)	6 (3.33)
10-20	-	-	94 (52.22)	-	-	-	-	-	-	1 (0.56)	1 (0.56)
20-30	-	-	39 (21.67)	-	-	-	-	-	-	-	-
30-40	-	-	13 (7.22)	-	-	-	-	-	-	-	-
40-50	2 (1.11)	-	3 (1.67)	-	-	-	-	-	-	-	-
50-60	12 (6.67)	-	-	-	-	-	-	-	-	-	-
60-70	33 (18.33)	-	-	-	-	-	-	-	-	-	-
70-80	69 (38.33)	-	-	-	-	-	-	-	-	-	-
> 80	64 (35.56)	-	-	-	-	-	-	-	-	-	-
Total	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)

Number in parenthesis indicates percentage

clothing. Regarding personal expenditure, except 1.67 per cent of the families, all others spent money for the purchase of tobacco, beedi, narcotics, alcohol or cigarettes. Majority of the tribal families did not spend money towards recreation (58.89 %), education (96.67 %), shelter (99.44 %), health (98.89 %), electricity (87.22 %) and transportation (96.11 %).

Regarding savings, no saving was reported by many families (96.11 %), upto 10 per cent of the income as savings was reported by 3.33 per cent and only one family (0.56 %) saved 10 to 20 per cent of the monthly income. Among the families who saved money for future use, three had joined savings scheme in the bank, two kept money in their houses separately and two families saved money through the employer.

4.1.13. Unhealthy habits prevalent among adults

Out of the 168 families in which adult male members were present 92.26 per cent had members with the habit of smoking either beedi or cigarette and most of them used beedi (Table 16). A few females (2.78 % families) had occasional smoking habits and they used only beedi. Majority (69.64 %) of the families also had male members with the habit of drinking arrack and 8.93 per cent used narcotics also while none of the families had females with

Table 16. Unhealthy habits prevalent among adults in the families

Particulars	Smoking: Beedi	Smoking: Cigarette	Smoking: Both	Alcohol (arrack)	Narcotics (Ganja)	Tobacco	Total
Adult male							
With habits	152 (90.48)	3 (1.79)	155 (92.26)	117 (69.64)	15 (8.93)	143 (85.12)	164 (97.62)
Without habits	16 (9.52)	165 (98.21)	13 (7.74)	51 (30.36)	153 (91.07)	25 (14.88)	4 (2.38)
Total	168 (100)	168 (100)	168 (100)	168 (100)	168 (100)	168 (100)	168 (100)
Female							
With habit	5 (2.78)	-	5 (2.78)	-	-	157 (87.22)	157 (87.22)
Without habits	175 (97.22)	180 (100)	175 (97.22)	180 (100)	180 (100)	23 (12.78)	23 (12.78)
Total	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)	180 (100)

Number in parenthesis indicates percentage

these habits. Men from about 85 per cent of the families and women from 87 per cent of the families used tobacco also. In general men from about 98 per cent families and women from 87 per cent families had one or another of these undesirable habits. None of the families prepared alcoholic drinks at home.

4.1.14. Indebtedness

Regarding the indebtedness of the families it was found that 56.67 per cent of the families borrowed money on loan basis from government or government agencies like bank. The details of the source, purpose and amount of loan received by the families are presented in Table 17.

It was found that out of the 102 families who took loan, 50.98 per cent received it through IRDP while 30.39 per cent and 15.69 per cent got from Girijan Society and bank respectively. Most of the families (81.37 %) took loan to purchase cattle and 12.75 per cent used the money for farming. Rest of the families took money for poultry rearing (2.94 %), business (1.96 %) and house construction (0.98 %). About 83 per cent of the families received an amount ranging from Rs 1001 to Rs 5000 with a subsidy of 50 per cent.

Table 17. Details of loan taken by the families

Source of loan	Number of families	Purpose of loan	Number of families	Amount of loan (Rs)	Number of families
IRDP	52 (50.98)	Cattle	83 (81.37)	≤ 1000	7 (6.87)
Girijan Society	31 (30.39)	Agriculture	13 (12.75)	1001-2000	34 (33.33)
Bank	16 (15.69)	Poultry	3 (2.94)	2001-3000	32 (31.37)
DWCRA	3 (2.94)	Business	2 (1.96)	3001-4000	8 (7.84)
		House construction	1 (0.98)	4001-5000	11 (10.78)
Total	102 (100)	Total	102 (100)	> 5000	7 (6.87)
				Not yet received the amount	3 (2.94)
				Total	102 (100)

Number in parenthesis indicates percentage

4.1.15. Housing conditions

Details of the housing conditions of the tribal families are presented in Tables 18 to 20. It was found that as many as 178 out of the 180 families surveyed (99%) had their own houses. Of the remaining two, one lived in a rented house and the other lived with relatives.

It was found that 66.11 per cent of the houses were built with the help of the government aid (Table 18) and the rest were constructed by the families themselves without any financial aid from other agencies.

Out of the 180 families surveyed 69.44 per cent were residing in Pukka houses made of bricks or granite as the wall material and tiles or concrete as the roofing material. The rest of the houses (30.56 %) were huts made of stumps and mud as the wall materials and straw as the roofing material.

Most of the families (88.33 %) used mud as the plastering material for floor while the rest plastered the floor with cement. About 78 per cent of the houses had two rooms, 13 per cent had only one room and the rest had three rooms. All the pukka houses had 1 to 3 windows where as the huts had no windows. About 77 per cent of the houses had separate kitchen, however all the families cooked their food inside the houses itself.

Table 18. Housing conditions of the families

Facilities	Number of families	Percent
1. Details of house		
Government built	119	66.11
Own house built by the family	59	32.77
Rented house	1	0.56
Residing with a relative	1	0.56
2. Type of wall		
Brick	78	43.33
Granite	47	26.11
Stump and Mud	55	30.56
3. Flooring material		
Mud	159	88.33
Cement	21	11.67
4. Roofing material		
Tiles	106	58.89
Concrete	19	10.55
Straw	55	30.56
5. Number of rooms		
1	24	13.33
2	141	78.34
3	15	8.33

Contd...

Table 18 contd...

6. No. of windows		
Nil	55	30.56
1	31	17.22
2	83	46.11
3	11	6.11
7. Kitchen facilities		
Separate kitchen present	139	77.22
No separate kitchen	41	22.78
8. Bathroom facilities		
Separate bathroom present	2	1.11
No separate bathroom	178	98.89
9. Latrine facilities		
Separate latrine present	0	0
No separate latrine	180	100.00
10 Drainage facitities		
Present	0	0
Absent	180	100.00

Most of the families (98.89 %) had no bath room in their house. Though two families had bath rooms adjacent to their houses, they were used only for minor calls of nature and they preferred to take bath in the stream or river. Regarding the facilities for major calls of nature it was observed that none of the families had their own latrine attached either to their houses or to the hamlet and none of the houses had proper drainage facilities too.

The details on the source of lighting facilities for the families are presented in Table 19.

Out of the 180 families,as much as 87.78 per cent used kerosene lamps and only 12.22 per cent used electricity as the source of light. Though 58 houses (32.22 %) were electrified, 62.07 per cent of those families in which electric connections were available used kerosene lamp because the fuse had been disconnected due to the non-payment of monthly electric charges.

Table 19. Source of lighting facilities for the families

Source	Electrified houses	Non-electrified houses	Total
Kerosene	36 (62.07)	122 (100.0)	158 (87.78)
Electricity	22 (37.93)	-	22 (12.22)
Total	58 (100)	122 (100)	180 (100)

Number in parenthesis indicates percentage.

The details regarding the source of water for drinking and other household purposes are given in Table 20.

It was found that about 36 per cent of the families used pipe water for drinking and cleaning of utensils and 26 per cent used stream water for these purposes. About 21 per cent and 22 per cent used water from bore well for drinking and cleaning purposes respectively.

Table 20. Source of water for drinking and other household purposes for the families

Source of water	Drinking	Bath	Cleaning of utensils	Washing Clothes
Pipe	65 (36.11)	-	65 (36.11)	-
Strea	47 (26.11)	153 (85.00)	46 (25.56)	153 (85.00)
Borewell	38 (21.11)	-	40 (22.22)	-
Pipe and borewell	27 (15.00)	-	27 (15.00)	-
Borewell and stream	1 (0.56)	-	-	-
Pit water	2 (1.11)	-	2 (1.11)	-
River	-	27 (15.00)	-	27 (15.00)
Total	180 (100)	180 (100)	180 (100)	180 (100)

Number in parenthesis indicates percentage.

It was also observed that the Irula tribes preferred to take bath either from the river or stream. Eighty five per cent used stream water and 15 per cent used river water for these purposes.

4.1.16 Possession of physical assets

Details on the possession of physical assets like radio, utensils and furniture in the families are presented in Table 21.

Table 21. Possession of physical assets in the families

Particulars	Radio	Steel,copper or brass utensil	Wooden furniture
Present	29 (16.11)	151 (83.89)	11 (6.11)
Absent	151 (83.89)	29 (16.11)	169 (93.89)
Total	180 (100)	180 (100)	180 (100)

Number in parenthesis indicates percentage.

It was found that only 16.11 per cent of the families possessed radio, purchased by themselves and used regularly. Most of the families (68.97 %) were interested in all the radio programmes, 13.79 per cent in music and news, 10.34 per cent only in music and 6.90 per cent were interested in music and drama. It was evident that 83.89 per cent of the families possessed steel, copper or brass utensils. About 94 per cent had no furniture in their houses and the rest possessed wooden furniture like cot, chair, table or bench.

4.1.17. Details of fuel collection

It was observed that all the families used wood as the sole source of fuel and 96.67 per cent of the families collected this from the forest and the rest purchased from others. The details regarding the frequency and quantity of firewood collection and the distance travelled for this purpose are presented in Table 22.

Table 22. Details of fuel collection for household purposes

Frequency of fuel collection		Distance travelled		Quantity collected	
Frequency	Number of families	Distance (Km)	Number of families	Quantity (Kg)	Number of families
Once in a week	100 (57.47)	1-3	85 (48.86)	Small quantity	11 (6.32)
Twice in a week	40 (22.99)	4-6	56 (32.18)	less than 10	10 (5.75)
Thrice in a week	17 (9.77)	7-9	5 (2.87)	10-20	94 (54.02)
Daily	17 (9.77)	10 & above	28 (16.09)	above 20	59 (33.91)
Total	174 (100)		174 (100)		174 (100)

Number in parenthesis indicates percentage

It was found that out of the total families who collected fire wood from the forest almost 90 per cent of the families collected one to three times in a week and the rest collected daily. All the family members especially husband, wife and in some houses children also actively participated in collecting wood from the forest. About 49 per cent of the families travelled a distance of 1 to 3 kilometers to collect the fuel while 32.18 per cent travelled 4 to 6 kilometers and 16.09 per cent had to travel above 10 kilometers for this purpose. Regarding the quantity of fuel collected it was revealed that about 54 per cent of the families collected 10 to 20 kilograms of fire wood at a time and 33.91 per cent collected even above 20 kilograms.

4.1.18. Personal hygiene

Details on the personal hygiene of the adults and children below 15 years are presented in Table 23.

It was evident from the table that majority of the children (60.25 %) took bath daily where as only 22.78 per cent of the adults had the habit of bathing daily. All the respondents cleaned their teeth daily and about 89 per cent insisted their children to clean their teeth daily. It was found that 51.11 per cent of the adults changed their clothes weekly twice and only 6.11 per cent changed daily; 11.18 per cent of the respondents insisted their children to

Table 23. Personal hygiene of the adults and children below 15 years in the families

Particulars	Adults					Children					
	Once in a week	Twice in a week	Thrice in a week	Daily	Total	As they wish	Once in a week	Twice in a week	Thrice in a week	Daily	Total
Bath	36 (20.00)	71 (39.44)	32 (17.78)	41 (22.78)	180 (100)	21 (13.04)	2 (1.24)	8 (4.97)	33 (20.50)	97 (60.25)	161 (100)
Cleaning teeth	–	–	–	180 (100)	180 (100)	–	–	–	–	143 (88.82)*	143 (88.82)*
Changing clothes	22 (12.22)	92 (51.11)	55 (30.56)	11 (6.11)	180 (100)	–	6 (3.73)	45 (27.95)	92 (57.14)	18 (11.18)	161 (100)
Washing clothes	33 (18.33)	84 (46.67)	52 (28.89)	11 (6.11)	180 (100)	–	10 (6.21)	56 (34.78)	82 (50.93)	13 (8.08)	161 (100)

* Rest of the families had very small children
Number in parenthesis indicates percentage

change clothes daily and majority (57.14 %) changed three times in a week. It was also observed that about 94 per cent of the adults washed their clothes one to three times per week and the rest washed daily. In the case of children also only 8.08 per cent of the respondents washed their children's dresses daily while others washed them once, twice or thrice in a week.

Footwear was used only by 13.89 per cent of the adults regularly whereas the rest did not use footwear mainly due to lack of money. Only the children from 17.39 per cent of the families used chappals and the rest of the families did not purchase footwear for children mainly due to lack of money.

When the reasons for the lack of proper personal hygiene was analysed it was found that majority (61.15 %) did not reveal any reason for not taking bath daily whereas 22.30 per cent stated that it was due to lack of time, 14.39 per cent mentioned that the streams were too far away from their home. In the case of children also, 28.12 per cent of the respondents revealed that the reason for not insisting their children to take bath daily was water scarcity and for 6.25 per cent it was due to lack of time and the rest did not reveal any reason.

Almost all the adults and children used soap for bathing. All the members applied oil to their head before taking bath. Coconut oil was used by most of the adults (90 %) and children (83.23 %) whereas castor oil or gingelly oil were used by rest of them. While most of the respondents (93.79 %) did not reveal any reason for the use of any particular oil for children, about 6 per cent felt that castor oil is good for children's health.

Regarding the combing of hair, generally all the adults and most of their children combed the hair daily.

Out of the 180 families studied majority (87.22 %) used charcoal for cleaning teeth. About 7 per cent used tooth powder and 3 per cent used tooth paste; however, very few families used tooth brush.

It was revealed from the study that majority of Irula tribes (68.89 %) had good eating habit of washing their hands before meals. But with regard to children, only 42.86 per cent of the mothers insisted their children to wash their hands before meals.

Regarding the use of soap for washing after defecation almost all the respondents revealed that neither did they use nor did they insist their children to use soap for washing.

4.1.19. Urban contact

Out of the total houses surveyed the female members of 30 per cent of the houses visited towns. Among these families also about 90 per cent went only to the nearest town of Agali and the rest went to Mannarghat, Palghat and even upto Calicut. It was revealed that female members of about 35 per cent of the houses went to the town daily others only occasionally. Most of them (72.22 %) went -- purchase household articles and 11.11 per cent went for their work. The rest went to town to see their children residing in hostels, to consult doctors or to see their relatives. Among the families who went to town, only 37.04 per cent used transport facilities.

4.1.20. Treatment followed

It was revealed from the study that 62.77 per cent of the tribal families followed allopathic mode of treatment whereas 11.66 per cent gave homeo medicines. About 17 per cent of the families followed either allopathic or homeopathic treatment. It was interesting to note that though majority of the tribes were illiterate only two families depended solely on mantra and three families on traditional medicines for treatments. The details are presented in Table 24.

Table 24. Mode of treatment followed by the families

Mode of treatment	Number of families	percent of families
Allopathy	113	62.77
Homeopathy	21	11.66
Allopathy and homeopathy	30	16.67
Ayurveda and homeopathy	1	0.56
Allopathy and manthra	1	0.56
Homeopathy and manthra	7	3.89
Manthra	2	1.11
Traditional medicine	3	1.67
Allopathy and traditional medicine	2	1.11
Total	180	100.00

Most of the resondents (75 %) revealed that allopathic way of treatment is effective for curing illness whereas for 10 per cent homeo medicines were effective and about 8 per cent followed homeopathic mode of treatment due to easy approach. Mantra and traditional medicines were found to be effective only for those who followed such treatments.

It was found that except those who depended solely on mantra and traditional medicines for curing ailments all the others gave the medicines prescribed by the doctors truthfully.

When the use of traditional medicines for curing certain specific diseases by the Irulas were analysed it was revealed that though they depended mainly on allopathic and homeopathic ways of treatments, 15 per cent of the families still practised traditional ways of curing diseases like fever, stomach pain, diarrhoea, snake bite and fear.

It was revealed that except for the visit of a homeo doctor from a voluntary organization in three of the nine hamlets, no other physicians visited the hamlets regularly. However doctors used to visit the hamlets during medical camps conducted once in a while. Para medical personnel like Auxillary Nurse Midwives occasionally visited most of the hamlets surveyed.

4.1.21. Details on mortality

The details on pre-natal and child mortality in the families are presented in Table 25. Only very few mothers reported still births (2.22 %) and 1 to 2 abortions (4.45%) No child death was reported by most (72.22 %) whereas one child death was reported by 18.89 per cent of the families.

Table 25. Distribution of families as per prenatal and child mortality

Number of occurences	Abortion	Premature birth	Still birth	Child death
1	5 (2.78)	1 (0.56)	4 (2.22)	34 (18.89)
2	3 (1.67)	-	-	10 (5.55)
3	-	-	-	5 (2.78)
⩾ 4	-	-	-	1 (0.56)
Nil	172 (95.55)	179 (99.44)	176 (97.78)	130 (72.22)
Total	180 (100)	180 (100)	180 (100)	180 (100)

Number in parenthesis indicates percentage

It was found from Table 26 that out of the total 75 children died in fifty families, 46.67 per cent died during the infant stage itself and 37.33 per cent died before the age of five years and the rest after 5 years. Mortality was highest among the second birth order children (29.33 %) followed by the first birth order children (25.33 %) and the mortality was found to decrease after the second delivery. It was noticed that the exact reason for the mortality of majority (60 %) of the children was unknown to the respondents while others died due to different diseases like fever, chicken pox, asthma, diarrhoea etc.

Table 26. Mortality status of children

Age (year)	Number of children	Birth order	No. of children
Below 1	35 (46.67)	1	19 (25.33)
1	8 (10.67)	2	22 (29.33)
2	10 (13.33)	3	14 (18.67)
3	6 (8.00)	4	9 (12.00)
4	4 (5.33)	5	8 (10.67)
5	12 (16.0)	> 5	3 (4.00)
> 5	12 (16.00)		
Total	75 (100)	Total	75 (100)

Number in parenthesis indicates percentage

4.1.22. Family Planning measures

It was revealed that only 40.56 per cent of the families adopted certain birth control measures; majority adopted sterilization. Among the total families who adopted family planning, except the family who used traditional medicine all others accepted it according to the advice of the doctors.

When the mothers were interviewed to elicit information on the use of traditional medicines to terminate unwanted pregnancies only two mothers willingly revealed that they used certain unknown medicines prescribed by the elders to terminate unwanted pregnancies while others were silent.

4.1.23. Immunization status of children

The details on the immunization status of children are presented in Table 27.

Table 27. Immunization status of children below 15 years.

Particulars of immunization	No. of children n = 386	per cent
Tuberculosis	105	27.20
DPT and Polio	111	28.76
Measles	6	1.55
Not immunized	202	52.33
Immunized but no idea against which disease	73	18.91

n = Total number of children below 15 years

As revealed in the table, among the total child population of 386 below 15 years of age, 52.33 per cent were not immunized against any diseases while 18.91 per cent were immunized against some diseases but parents were unaware of the name of the disease to which the child had been immunized. With the help of the local health and anganwadi workers, it was able to collect some informations and the results revealed that out of the child population, 28.76 per cent were immunized against DPT and Polio, 27.20 per cent against tuberculosis, 1.55 per cent against measles.

4.2. Food consumption and dietary pattern of the tribal families

Food consumption and dietary pattern of the tribal families were assessed with regard to the food requirements, food expenditure, frequency of use of different foods, meal frequency, cooking practices, cooking methods followed, storage practices, processing practices, foods given and avoided during illness and special conditions, food beliefs and infant feeding practices.

4.2.1. Food requirement for the tribal population surveyed

Total population of the sample families was 854, consisting of 419 adults and 435 children. This composition will indirectly influence the food requirement. The requirements of different food groups calculated on the basis of Aykroyd's coefficient for this particular tribal population under study are presented in Table 28.

Table 28. Balanced diet requirement of the tribal population for a day

Name of food item	Réquirement (g)	R.D.A* (g)
Cereals	431.60	520
Pulses	20.75	25
Green leafy vegetables	33.20	40
Other vegetables	58.10	70
Roots and tubers	49.80	60
Milk and milk products	166.00	200
Meat, fish or egg	24.90	30
Fats and oils	41.50	50
Sugar or jaggery	29.05	35

*R.D.A. - Recommended Dietary Allowances - ICMR (1984)

The results revealed that the requirements of various foods by the tribal population were below the Recommended Dietary Allowances suggested by Indian Council of Medical Research (1984) for an adult man engaged in moderate activity.

Among the families surveyed as much as 98.33 per cent were non-vegetarians while the rest consumed only vegetarian foods.

4.2.2. Staple food

It was found that 52.77 per cent of the families consumed rice as the staple food while for 41.67 per cent of the families, the staple food was ragi. Only very few families (5.56 %) used cholam as the staple food item. Majority of the families got the staple food item such as rice and ragi throughout the year and those who used cholam did not get it throughout the year. During scarcity of the staple food item, it was substituted with other cereals or millets.

4.2.3. Food expenditure pattern

Food expenditure is an important factor influencing the dietary habits of a community. Details of monthly expenditure pattern of the families on different food items are presented in Table 29.

As shown in the table upto 30 to 80 per cent of the money spent for food was incurred for the purchase of cereals by the tribal families. It can be seen that only an insignificant proportion of the families spent money for the purchase of fruits, milk and milk products, and nuts and oilseeds.

Table 29. Monthly expenditure pattern of the families on different food items

Food items	Expenditure (per cent)					
	Nil	Upto 10	10-20	20-30	30-80	Total
Cereals	-	-	-	-	180 (100)	180 (100)
Pulses	-	167 (92.78)	13 (7.22)	-	-	180 (100)
Vegetables	3 (1.67)	138 (76.66)	38 (21.11)	1 (0.56)	-	180 (100)
Fruits	177 (98.33)	3 (1.67)	-	-	-	180 (100)
Milk and milk products	170 (94.44)	10 (5.56)				180 (100)
Fats and oils	-	173 (96.11)	7 (3.89)	-	-	180 (100)
Flesh foods	55 (30.55)	104 (57.78)	20 (11.11)	1 (0.56)	-	180 (100)
Sugar	64 (35.56)	116 (64.44)	-	-	-	180 (100)
Spices	-	179 (99.44)	1 (0.56)	-	-	180 (100)
Nuts and oil seeds	147 (81.67)	33 (18.33)	-	-	-	180 (100)
Beverages	9 (5.00)	112 (62.22)	56 (31.11)	3 (1.67)	-	180 (100)
Prepared food	94 (52.22)	85 (47.22)	1 (0.56)	-	-	180 (100)

Number in parenthesis indicates percentage

The results revealed a significant positive correlation between the different variables and food expenditure pattern of the families.

Association between independent variables like educational status of father and mother, occupational status of father and mother and type of family indicated that the food expenditure pattern of the families was significantly associated (P = 0.01) only with the occupational status of father and mother (Table 31).

4.2.4. <u>Frequency of use of various food articles</u>

The economic status of a family and the availability of food articles locally are the two important factors which may influence frequency of use of various foods.

Table 32 pertains to the frequency of use of various food items by the families.

It was found that only cereals, fats and oils and spices and condiments were included in the daily diet of the families. About 46 to 95 per cent of the families included pulses, sugar or jaggery and beverages in the daily diet. Most of the families never included fruits (63.89 %), milk and milk products (87.22 %) and nuts and oil seeds (81.66 %) in their diet. Though majority of the families were non-vegetarians only 1.67 per cent included flesh foods like meat, fish or egg in their daily diet. Prepared foods like

Table 31. Association between independent variables (non-quantified) and food expenditure

Sl. No.	Variables	Food expenditure Low	Medium	High	χ^2		Coefficient of association
1.	Occupation of father						
	Labour class	79	9	38			
	Cultivator	-	4	14			
	Job (Govt./Pvt.)	-	-	4	χ^2_4	31.24**	0.38
	No work	17	5	10			
2.	Occupation of mother						
	Labour class	42	3	13			
	Cultivator	1	2	1			
	Job (Govt./Pvt.)	1	1	5	χ^2_4	18.47**	0.31
	No work	52	12	47			
3.	Education of father						
	Illiterate	73	14	49			
	Lower primary	14	2	3			
	Upper primary and above	9	2	14	χ^2_4	7.85	-
4.	Education of mother						
	Illiterate	87	17	62			
	Lower primary	4	-	-			
	Upper primary and above	5	1	4	χ^2_2	0.74	-
5.	Type of family						
	Joint family	4	-	7			
	Nuclear family	92	18	59	χ^2_2	4.14	-

** Significant at 1 per cent level

Table 32. Frequency of use of different food items by the families

Food items	Daily	Thrice in a week	Twice in a week	Once in a week	Occasion-ally	Never	Total
Cereals	180 (100)	-	-	-	-	-	180 (100)
Pulses	83 (46.11)	38 (21.11)	31 (17.22)	26 (14.45)	2 (1.11)	-	180 (100)
Green leafy vegetables	63 (35.00)	33 (18.33)	7 (3.89)	58 (32.22)	19 (10.56)	-	180 (100)
Other vegetables	55 (30.55)	66 (36.67)	31 (17.22)	19 (10.56)	9 (5.0)	-	180 (100)
Roots and tubers	29 (16.11)	91 (50.56)	32 (17.78)	15 (8.33)	13 (7.22)	-	180 (100)
Fruits	2 (1.11)	2 (1.11)	-	4 (2.22)	57 (31.67)	115 (63.89)	180 (100)
Milk and milk products	13 (7.22)	-	-	-	10 (5.56)	157 (87.22)	180 (100)
Nuts and oil seeds	23 (12.78)	-	-	-	10 (5.56)	147 (81.66)	180 (100)
Fats and oils	180 (100)	-	-	-	-	-	180 (100)
Flesh foods	3 (1.67)	-	-	14 (7.77)	160 (80.89)	3 (1.67)	180 (100)
Sugar or jaggery	113 (62.77)	-	-	-	3 (1.67)	64 (35.56)	180 (100)
Spices and condiments	180 (100)	-	-	-	-	-	180 (100)
Prepared foods	55 (30.56)	5 (2.78)	-	10 (5.56)	16 (8.88)	94 (52.22)	180 (100)
Beverages (Tea or coffee)	170 (94.44)	-	-	-	1 (9.56)	9 (5.0)	180 (100)

Number in parenthesis indicates percentage

iddli, biscuit, bread or bun purchased from the local shops were included in the daily diet of 30.56 per cent of the families.

The frequency of use of different food items among the tribal families was assessed by the formula suggested by Reaburn _et_ _al_. (1979). The findings indicated that the maximum score of 100 per cent was obtained for cereals, fats and oils and spices and condiments (Table 33). The

Table 33. Frequency score (%) on different food items

Food item	Scores
Cereals	100.00
Pulses	79.33
Green leafy vegetables	66.99
Other vegetables	75.45
Roots and tubers	72.00
Fruits	9.22
Milk and milk products	8.33
Nuts and oilseeds	13.89
Fats and oils	100.00
Flesh foods	22.55
Sugar or jaggery	63.10
Spices and condiments	100.00
Prepared foods	36.78
Beverages (tea or coffee)	94.56

percentage food frequency scores obtained for beverages, pulses, other vegetables, roots and tubers were 94.56, 79.33, 75.45 and 72.00 respectively and the lowest percentage score was obtained for milk and milk products (8.33).

Based on the percentage frequency scores obtained for different food items, the foods were classified into three groups viz. most frequently used (percentage score above 75), medium frequently used (percentage score 50-75) and less frequently used foods (percentage score below 50).

Table 34 gives the frequency of use of different foods among the tribal families on the basis of the percentage score.

Table 34. Frequency of use of different food items on the basis of percentage score.

Most frequently used foods (Scores above 75%)	Medium frequently used foods (scores 50-75%)	Less frequently used foods (below 50%)
Cereals	Green leafy vegetables	Fruits
Pulses	Roots and tubers	Nuts and oilseeds
Other vegetables	Sugar or jaggery	Milk and milk products
Fats and oils		Flesh foods
Spices and condiments		Prepared foods
Beverages		

The most frequently used food items were cereals, pulses, other vegetables, fats and oils, spices and condiments and beverages like tea or coffee. Green leafy vegetables, roots and tubers, and sugar or jaggery were the medium frequently used food items while fruits, nuts and oil seeds, milk and milk products, flesh foods and locally purchased prepared foods were used to a lesser extent by the tribal families.

The details about the habits of catching or hunting of birds or animals by the Irula tribes revealed that 88.33 per cent of the families did not go for hunting, though it was a common practice among their forefathers. The male members of the rest of the families went for hunting occasionally and used to catch rabbits, rats, birds or deer.

4.2.5. Meal pattern

Meal pattern of a family indirectly indicates their dietary habits. The analysis of the meal pattern of the tribal families revealed that none of the families did any meal planning in advance and the daily meal pattern had no variety. In almost all the families rice or ragi kali were the main items included in the daily diet. None of the families were found to be aware of keeping accounts for food expenditure and most of the families (99.44 %) did not keep any specific time schedule for taking meals.

Regarding the use of left over foods it was found that 88.89 per cent of the families used such type of foods for next day's breakfast if available. Among these families, 62.5 per cent used only rice, 33.12 per cent used all items while the rest (4.38 %) used rice as well as ragi for the next day. Majority of the families (97.50 %) used the left over as such while others used it either after boiling or mixing with onion and salt.

4.2.6. Other culinary practices

Culinary practices include the daily cooking pattern, preliminary treatments of food prior to cooking, cooking methods and type of chulah and utensils used. It was observed from the study that most of the families cooked (93.89 %) and consumed (83.33 %) the food two times a day (Table 35). Only 3.33 per cent cooked three times and 2.78 per cent cooked only once. It was found that only 16.11 per cent of the families had a three meal pattern.

It was observed that 93.89 per cent of the families washed cereals and pulses just before cooking without winnowing while the rest washed these items after winnowing/cleaning. Majority of the families (75.56 %) washed cereals thrice whereas 24.44 per cent washed only twice. In contrast to this, 75 per cent washed pulses twice and 20 per cent only once, 5 per cent washed thrice and one family did not wash the pulses before cooking. Only 3.89 per cent of the families soaked pulses before cooking and the rest did not soak the pulses.

Table 35. Frequency of cooking and consumption of foods.

Frequency	Cooking	Consumption
	Number of families	Number of families
Once	5 (2.78)	-
Twice	169 (93.89)	150 (83.33)
Thrice	6 (3.33)	29 (16.11)
> 3 times	-	1 (0.56)
Total	180 (100)	180 (100)

Number in parenthesis indicates percentage.

Majority of the housewives washed green leafy vegetables (65 %) roots and tubers (92.78 %) and other vegetables (92.78 %) after cutting (Table 36).

Regarding the cutting of vegetables adopted by the tribal families, 86.67 per cent did not adopt any specific criteria, while 2.78 per cent, cut according to the type of preparation and 9.45 per cent, into small pieces. All the housewives cut vegetables just prior to cooking.

Table 36. Preparation of vegetables for cooking

Particulars	Green leafy vegetables (Number of families)	Roots and tubers (Number of families)	Other vegetables (Number of families)
Washed before cutting	62 (34.44)	13 (7.22)	13 (7.22)
Washed after cutting	117 (65.00)	167 (92.78)	167 (92.78)
According to convenience	1 (0.56)	-	-
Total	180 (100)	180 (100)	180 (100)

Number in parenthesis indicates percentage

Majority of the families (96.66 %) did not eat any raw foods while the rest consumed tomato, papaya, cucumber or roots and tubers.

Among the various cooking methods adopted by the tribes boiling was found to be predominant. All the families surveyed adopted this method for cooking pulses and other vegetables while for cereals, boiling in excess water and then straining was the method adopted by all the families. About 78 per cent boiled roots and tubers whereas the rest followed boiling as well as grilling. For cooking flesh foods like meat and fish 73.45 per cent adopted only boiling and the rest used boiling and also grilling. About 86 per cent followed absorption method for cooking green leafy vegetables while the rest used boiling and then straining the excess water. Among the families who used milk, all of them boiled it before use. The details of cooking methods adopted by the tribes for cooking different items are presented in Table 37.

It was found that most of the families (98.89 %) were in the habit of drinking water without boiling.

It was found that majority of the families used the excess water left after cooking especially kanji water for different purposes, as a drink (45.39 %), cattlefeed (13.82 %) drink and cattle feed (25 %) and a medium for cooking pulses (3.75 %) and the rest used it as a drink and for cooking.

A substantial proportion of the families (92.78 %) used ordinary hearth for cooking. Though the rest of the houses had smokeless chulah, 5 per cent did not have the outside pipe attached to the chulah. These respondents revealed that they had removed the pipe, because the chulah was not constructed properly, and during rainy season the rain water used to enter the kitchen.

Table 37. Cooking methods for different food items

Food items	Cooking methods				
	Boiling	Boiling and straining	Absorption	Boiling and grilling	Total
	Number of families	Number of families	Number of families	Number of families	Number of families
Cereals	-	180 100)	-	-	180 (100)
Pulses	180 (100)	-	-	-	180 (100)
Green leafy vegetables	-	25 (13.89)	155 (86.11)	-	180 (100)
Roots and tubers	140 (77.78)	-	-	40 (22.22)	180 (100)
Other vegetables	180 (100)	-	-	-	180 (100)
Flesh foods	130 (73.45)	-	-	47 (26.55)	177 (100)
Milk	23 (100)	-	-	-	23 (100)

Number in parenthesis indicates percentage

About 32 per cent of the families used only earthen pots, whereas about 36 per cent used aluminium utensils and earthen pots and the rest used only aluminium vessels for cooking. In all families cooking was done by the female members.

4.2.7. Meal serving pattern

When the preference given for the family members for giving meals was analysed it was revealed that most of the families (93.33 %) did not give any preference to any of the family members while 5.56 per cent of the families gave the first preference to the children and 1.11 per cent to their husbands.

4.2.8. Storage practices

Storage practices adopted by the tribal families were ascertained and the results revealed that only 69.44 per cent stored foods like cereals and pulses produced in their lands. Out of this 63.2 per cent stored only ragi and 23.2 per cent stored ragi and cholam (Table 38). Gunny bag was used by 95.2 per cent of the families to store food grains and others stored either in mud pot (2.4 %) or in pits (2.4 %) lined with hay. About 95 per cent stored the foods for a period of 6 months to one year while 4 per cent stored for more than a year.

Table 38. Details regarding the storage of food items

Food items stored	Number of families	Methods employed	Number of families	Duration	Number of families
Ragi	79 (63.2)	Gunny bags	119 (95.2)	Few days	1 (0.8)
Ragi and Cholam	29 (23.2)	Mud pot	3 (2.4)	6 months to 1 year	119 (95.2)
Ragi and paddy	5 (4.0)	Pits lined with ragi hay	3 (2.4)	More than one year	5 (4.0)
Ragi and pulses	6 (4.8)				
Paddy	2 (1.6)				
Pulses	4 (3.2)				
Total	125 (100)	Total	125 (100)	Total	125 (100)

Number in parenthesis indicates percentage

Regarding pretreatments employed for storing foods, 98.4 per cent of the families did not employ any pretreatments except drying thoroughly in the sun while very few per cent mixed the grains with mud before drying to prevent the attack of pest.

4.2.9. Processing practices

The processing practices of the tribal families revealed that 98.88 per cent did not prepare any processed food items like vattals or pickles at home. Only one respondent prepared pickles and another one prepared both pickles and vattals at home. With regard to the purchase of processed foods about 96 per cent of the families did not purchase any processed foods, while the rest purchased pickles available in small packets from the local shops.

4.2.10. Foods given during illness

Tribes are found to be affected frequently by measles, chickenpox, diarrhoea and fever. Data collected on foods given during these conditions are given in Table 39.

As revealed in the table, 42.77 per cent included tender coconut water during an attack of measles and chickenpox.

Table 39. Foods given during illness by the families

Name of foods	Diseases			
	Measles and chickenpox	Diarrhoea	Fever	All diseases
Tender coconut water	77 (42.77)	-	-	-
Milk and tender coconut	18 (10.0)	-	-	-
Tender coconut, water and fruits	4 (2.27)	-	-	-
Fruits, milk and kanji	3 (1.67)			
Curds and fruits	2 (1.11)	-	-	-
kanji water with salt and bun	-	20 (11.11)	-	-
Made changes according to the advice of doctors	-	-	-	2 (1.11)
Milk and biscuit	-	-	1 (0.56)	-
No special foods	-	-	-	53 (29.44)

Number in parenthesis indicates percentage

Among the 127 families who included special foods during illness, 94.49 per cent did not know the reason for the inclusion of such foods and they gave it according to the advice of elders and the rest opined that inclusion of such foods are good for the health of the patient.

Regarding the foods avoided during illness 98.89 per cent revealed that they avoided oily foods during measles and chickenpox and the rest of the families made restrictions according to the advice of the doctor. All the mothers revealed that they avoided papaya during pregnancy as they considered that it may cause abortion. No special foods were included in the daily diet either during pregnancy or lactation. They were not in the habit of preparing special foods to children.

4.2.11. Food beliefs

Food beliefs are very common among the underdeveloped communities like tribes. Regarding the beliefs about foods among Irula tribes, it was found that all the families followed certain dietary pattern on the basis of religious beliefs. Accordingly, 99.44 per cent avoided beef and one family avoided beef as well as fish. None of the families included any special foods in their diet on the basis of religious beliefs.

It was also indicated from the study that the previous generation of all the surveyed families depended mainly on ragi and maize cultivated by themselves.

4.2.12. Infant feeding practices

The infant feeding practices adopted by the tribal families are presented in Table 40.

It was revealed that about 38 per cent of the mothers gave breast milk as the first food to the baby and all the respondents were of the opinion that it is good for baby's health. About 29 per cent and 26 per cent of the mothers gave honey and castor oil respectively as the first food. Others gave grape water, sugar water or boiled water for the baby. Most of the mothers who gave castor oil believed that it will clean the stomach and about 27 per cent gave specific foods according to the advice of the elders.

About 88 per cent of the mothers started feeding the baby from the first day of delivery itself and the rest gave breast milk after the third day. Thus it was revealed that majority of the Irulas fed colostrum to the baby. However, only 24.71 per cent of the mothers believed that colostrum is good for the health of the baby. Those who did not give colostrum believed that colostrum will produce stomach troubles.

All the mothers opined that breast milk is good for the health of the baby and most of the women (79.31 %) gave breast milk for more than two years while 16.67 per cent gave it till next pregnancy. Almost all the mothers (98.56 %) fed the baby as and when they cried and only the rest kept specific time for feeding the baby.

Table 40. Infant feeding practices

Sl. No.	Particulars	Number of families	Percentage of families
1.	First food given to the baby		
	Breast milk	66	37.93
	Honey	51	29.31
	Castor oil	45	25.86
	Others	12	6.90
2.	Initiation of breast feeding		
	First day	154	88.50
	After three or four days	20	11.50
3.	Opinion about giving colostrum		
	Good for baby's health	43	24.71
	Hard milk	20	11.50
	No idea	111	63.79
4.	Duration of breast feeding		
	More than two years	138	79.31
	Until next pregnancy	29	16.67
	1 to 2 years	7	4.02
5.	Age of weaning		
	3 to 5 months	31	17.81
	6 to 8 months	125	71.84
	9 to 12 months	15	8.62
	After one year	3	1.73

When the details regarding the weaning practices adopted by the mothers were ascertained, it was observed that majority (71.84 %) started weaning when the child was 6 to 8 months and 17.81 per cent started between 3 to 5 months and very few mothers (10.35 %) gave only breast milk even after 9 months. About 52 per cent of the mothers gave only ragi to their children as the weaning food and 11 per cent gave only rice. Only 8 per cent of the mothers introduced foods like fruits, biscuits, farex, cerelac or cow's milk along with ragi or rice during the weaning period and rest of the mothers gave rice as well as ragi to the young children. Only one mother gave tinned food to the baby. All the mothers fed the child with adult foods after the age of one year.

Only 3.53 per cent of the mothers opined that weaning at three months is good for the health of the baby, 92.94 per cent started weaning due to insufficient breast milk and the rest initiated weaning due to subsequent pregnancy.

Among the mothers who went for work outside, only 5.34 per cent carried the child also to the work place and the rest left the children with their parents, elder siblings or even with neighbours.

Table 41. Comparison of the mean height of boys (5-15 years) with the Indian and NCHS Standards

Age (Year)	Sample size	Height(cm) Mean±SE	Indian standard (cm)	Reduction from standard(cm)	't' value (comparison with the standard	NCHS standard (cm)	Reduction from standard(cm)	't'value(comparison with the standard)
5	17	98.59±1.07	113.51	14.92	14.02**	112.81	14.22	13.34**
6	13	107.18±1.45	118.90	11.72	8.08**	118.70	11.52	7.95**
7	19	107.79±1.75	123.32	15.53	8.85**	124.13	16.34	9.32**
8	16	117.24±1.63	127.86	10.62	6.53**	129.35	12.11	7.45**
9	12	119.73±1.89	133.63	13.90	7.36**	134.58	14.85	7.87**
10	21	128.55±1.34	138.45	9.90	7.40**	140.10	11.55	8.64**
11	6	129.00±0.80	143.35	14.35	17.94**	146.15	17.15	21.44**
12	10	141.86±2.64	148.91	7.05	2.67*	152.76	10.90	4.12**
13	7	137.97±4.66	154.94	16.97	3.64*	159.56	21.59	4.63**
14	7	142.10±1.57	161.70	19.60	12.46**	165.91	23.81	15.14**
15	7	153.09±1.76	165.33	12.24	6.96**	171.21	18.12	10.30**

** Significant at 1 per cent level
* Significant at 5 per cent level

SOURCE
Indian standard - (Vijayaraghavan et al., 1971)
NCHS standard - (WHO, 1983)

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4.2.13. Morbidity status of the tribal families

Regarding the morbidity condition in the hamlets for the three years it was found that in all the nine hamlets chickenpox and measles were prevalent. In Boothivazhi hamlet of Agali Panchayat, whooping cough was also found to be common whereas in Sholayur and Vattulucki hamlets of Sholayur Panchayat mumps had been detected along with chickenpox.

Among the families surveyed, 37.78 per cent families, members were affected with measless and in 11.11 per cent with measles and chickenpox. However in 43.34 per cent of the families, members were found to be free from diseases.

Seven physically handicapped persons were present in 3.89 per cent of the families and among these, four persons received monthly grant from the government.

Table 41. Comparison of the mean height of boys (5-15 years) with the Indian an
NCHS Standards

Age (Year)	Sample size	Height(cm) Mean±SE	Indian standard (cm)	Reduction from standard(cm)	't' value (comparison with the standard	NCHS standard (cm)	Reduction from standard(cm)	't'value(comparison with the standard)
5	17	98.59±1.07	113.51	14.92	14.02**	112.81	14.22	13.34**
6	13	107.18±1.45	118.90	11.72	8.08**	118.70	11.52	7.95**
7	19	107.79±1.75	123.32	15.53	8.85**	124.13	16.34	9.32**
8	16	117.24±1.63	127.86	10.62	6.53**	129.35	12.11	7.45**
9	12	119.73±1.89	133.63	13.90	7.36**	134.58	14.85	7.87**
10	21	128.55±1.34	138.45	9.90	7.40**	140.10	11.55	8.64**
11	6	129.00±0.80	143.35	14.35	17.94**	146.15	17.15	21.44**
12	10	141.86±2.64	148.91	7.05	2.67*	152.76	10.90	4.12**
13	7	137.97±4.66	154.94	16.97	3.64*	159.56	21.59	4.63**
14	7	142.10±1.57	161.70	19.60	12.46**	165.91	23.81	15.14**
15	7	153.09±1.76	165.33	12.24	6.96**	171.21	18.12	10.30**

** Significant at 1 per cent level
* Significant at 5 per cent level

SOURCE
Indian standard - (Vijayaraghavan et al., 1971)
NCHS standard - (WHO, 1983)

4.3. Nutritional Status of the tribal children and factors influencing the nutritional status

Nutritional status of children in the age group of 5 to 15 years was ascertained through anthropometric studies, clinical examination, actual food intake and biochemical estimations. A nutritional status index was developed through multivariate approach.

4.3.1. Anthropometric studies

The results of the anthropometric measurements like height, weight, mid upper arm circumference and skinfold thickness over triceps of 135 boys and 109 girls between 5 to 15 years of age are presented under

4.3.1.1. Height-for-age
4.3.1.2. Weight-for-age
4.3.1.3. Weight/height^2
4.3.1.4. Mid upper arm circumference, and
4.3.1.5. Skinfold thickness

4.3.1.1. Height-for-age

The mean height of boys and girls in comparison with Indian standards (Vijayaraghavan et al., 1971) and National Centre for Health Statistics (NCHS) standards (World Health Organization, 1983) and its statistical interpretations are presented in Tables 41 and 42.

Table 41. Comparison of the mean height of boys (5-15 years) with the Indian and NCHS Standards

Age (Year)	Sample size	Height(cm) Mean±SE	Indian standard (cm)	Reduction from standard(cm)	't' value (comparison with the standard	NCHS standard (cm)	Reduction from standard(cm)	't'value(comparison with the standard)
5	17	98.59±1.07	113.51	14.92	14.02**	112.81	14.22	13.34**
6	13	107.18±1.45	118.90	11.72	8.08**	118.70	11.52	7.95**
7	19	107.79±1.75	123.32	15.53	8.85**	124.13	16.34	9.32**
8	16	117.24±1.63	127.86	10.62	6.53**	129.35	12.11	7.45**
9	12	119.73±1.89	133.63	13.90	7.36**	134.58	14.85	7.87**
10	21	128.55±1.34	138.45	9.90	7.40**	140.10	11.55	8.64**
11	6	129.00±0.80	143.35	14.35	17.94**	146.15	17.15	21.44**
12	10	141.86±2.64	148.91	7.05	2.67*	152.76	10.90	4.12**
13	7	137.97±4.66	154.94	16.97	3.64*	159.56	21.59	4.63**
14	7	142.10±1.57	161.70	19.60	12.46**	165.91	23.81	15.14**
15	7	153.09±1.76	165.33	12.24	6.96**	171.21	18.12	10.30**

** Significant at 1 per cent level
* Significant at 5 per cent level

SOURCE
Indian standard - (Vijayaraghavan et al., 1971)
NCHS standard - (WHO, 1983)

Table 42. Comparison of the mean height of girls (5-15 years) with the Indian and NCHS Standards

Age (Year)	Sample size	Height(cm) Mean±SE	Indian standard (cm)	Reduction from standard(cm)	't' value (comparison with the standard)	NCHS standard (cm)	Reduction from standard(cm)	't'value(comparison with the standard)
5	15	102.87±1.78	112.24	9.37	5.26**	111.28	8.41	4.72**
6	12	104.73±1.19	117.73	13.00	10.94**	117.37	12.64	10.63**
7	8	110.18±2.46	122.65	12.47	5.07**	123.24	13.06	5.30**
8	9	115.00±2.22	127.22	12.22	5.51**	129.06	14.06	6.34**
9	9	116.71±3.54	133.08	16.37	4.62**	134.99	18.28	5.16**
10	19	126.47±1.77	138.90	12.43	7.03**	141.24	14.77	8.36**
11	5	125.60±4.54	145.00	19.40	4.28*	147.88	22.28	4.92**
12	20	133.28±1.85	150.98	17.70	9.56**	154.25	20.97	11.33**
13	4	142.00±2.44	153.44	11.44	4.67*	158.81	16.81	6.86**
14	5	147.00±3.14	155.04	8.04	2.56ns	161.13	14.13	4.50*
15	3	148.83±4.83	155.98	7.15	1.48ns	162.09	13.26	2.75ns

** Significant at 1 per cent level
* Significant at 5 per cent level
ns not significant

SOURCE:
Indian standard - (Vijayaraghavan et al., 1971)
NCHS standard - (WHO, 1983)

The mean height at different ages for both boys and girls were generally lower than the standard height of well to do Indian children. The reduction was found to vary from 7.05 cm (12-year-old) to 19.60 cm (14-year-old) in the case of boys and 7.15 cm (15-year-old) to 19.40 cm (11-year-old) in the case of girls. The statistical analysis of the data revealed that the height of boys at different ages were significantly lower than the standard values. In the case of girls also the mean height was found to be significantly lower than the standard height for all ages except for 14 and 15 years.

The mean height of boys and girls for all ages were significantly lower than the NCHS standards except for girls aged 15 years. The deviations from the standards were found to vary from 10.90 cm (12-year-old) to 23.81 cm (14-year-old) in the case of boys and 8.41 cm (5-year-old) to 22.28 cm (11-year-old) for girls. A comparison of the height among boys and girls revealed that deviations from Indian standards in the case of boys aged 5 years, 7 years and 13 to 15 years were more than those of girls. The comparison of the mean height of boys and girls with the Indian and NCHS standards are illustrated in Fig. 2 and 3 respectively.

The percentage of height of children calculated on the basis of the standard height for well-to-do Indian school children (Vijayaraghavan _et al_., 1971) were grouped, based

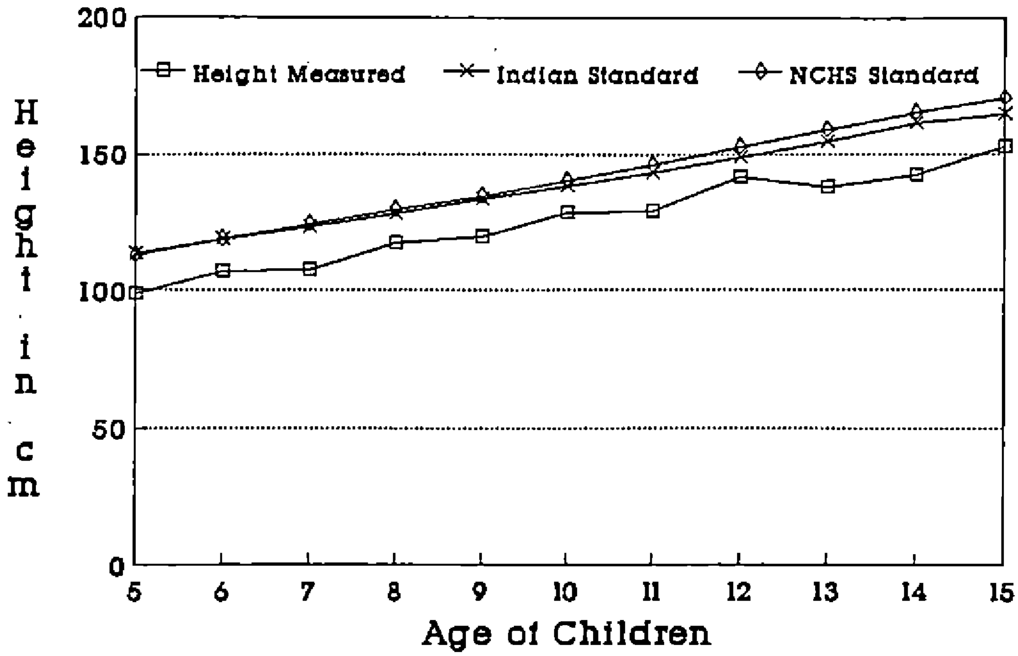


Fig. 2. Comparison of the mean height of boys with the Indian and NCHS Standards

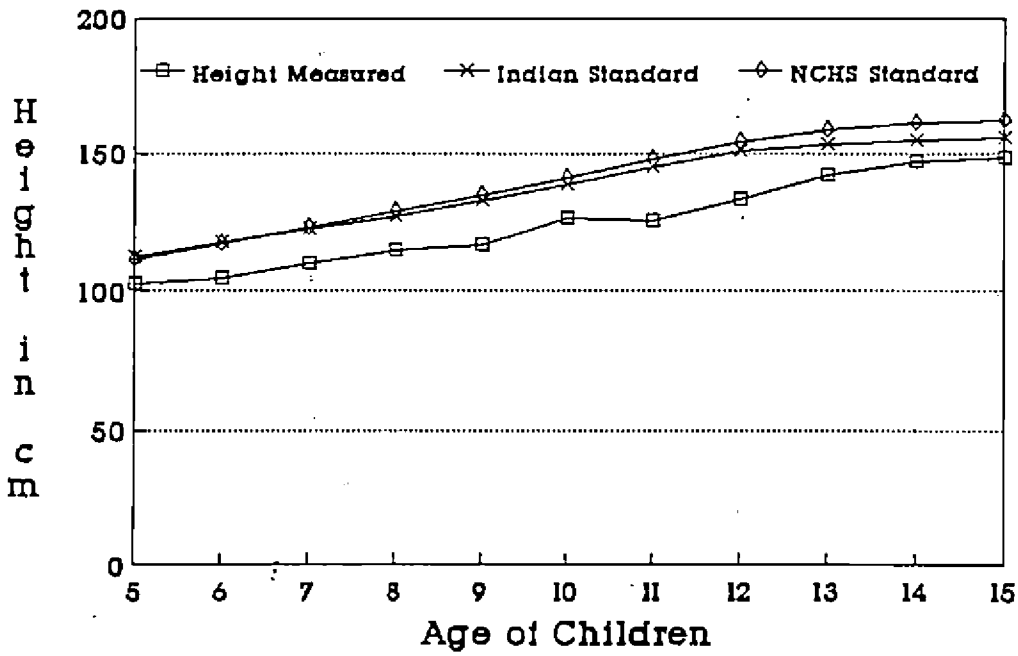


Fig. 3. Comparison of the mean height of girls with the Indian and NCHS Standards

on Waterlow's classification suggested by Gopaldas and Seshadri (1987).

The results (Table 43) revealed that majority of boys (81.48%) and girls (79.82 %) between 5 to 15 years of age were malnourished. It was found that 37.04 per cent boys and 39.45 per cent girls were moderately malnourished, while 16.29 per cent of boys and 15.60 per cent of girls were severely malnourished (Fig. 4). Among different age groups also, majority of boys and girls were found to have different grades of malnutrition. Higher percentage of normal children was found among girls aged 13 to 15 years (41.67 %) followed by boys aged 10 to 12 years (32.43 %). None of the girls aged 13 to 15 years was found to be severely malnourished (Fig. 5).

4.3.1.2. Weight-for-age

The results of the mean weight of boys and girls were compared with the Indian and NCHS standards and the results are given in Tables 44 and 45.

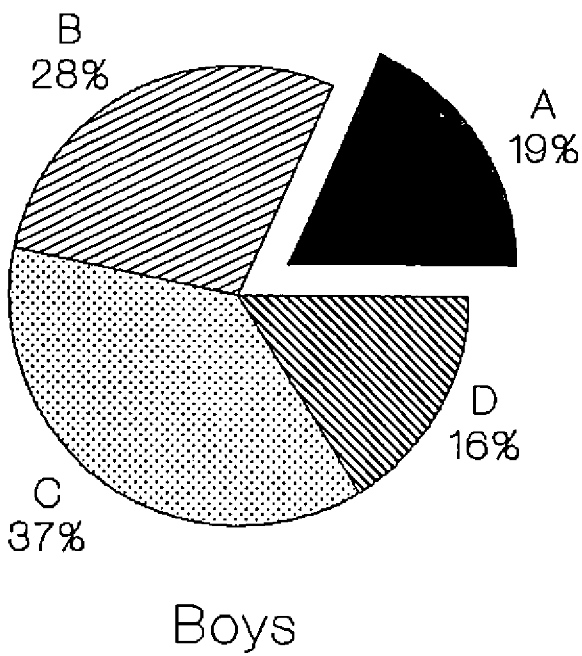
The statistical analysis of the data revealed that the mean weight of the tribal boys and girls were significantly lower than the standard weight suggested for well-to-do Indian children and NCHS standards except for girls aged 15 years where the results were found to be not significant.

Table 43. Height-for-age distribution of children based on Waterlow's classification.

Nutritional status	Expected height-for age (per cent of the standard)	Age in years 5 - 6		7 - 9		10 - 12		13 -15		Total	
		B	G	B	G	B	G	B	G	B	G
Normal	> 95	3 (10.00)	4 (14.81)	7 (14.89)	6 (23.08)	12 (32.43)	7 (15.91)	3 (14.29)	5 (41.67)	25 (18.52)	22 (20.18)
Marginal malnutrition	90-95	7 (23.33)	7 (25.93)	10 (21.28)	5 (19.23)	14 (37.84)	10 (22.73)	7 (33.33)	5 (41.67)	38 (28.15)	27 (24.77)
Moderate malnutrition	85-90	13 (43.34)	14 (51.85)	20 (42.55)	8 (30.77)	10 (27.03)	19 (43.18)	7 (33.33)	2 (16.66)	50 (37.04)	43 (39.45)
Severe malnutrition	< 85	7 (23.33)	2 (7.41)	10 (21.28)	7 (26.92)	1 (2.70)	8 (18.18)	4 (19.05)	-	22 (16.29)	17 (15.60)
Total		30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

B = Boys;
G = Girls
Number in parenthesis indicates percentage

Fig.4. Height-for-age distribution (percentage) of children (5-15 years) based on Waterlow's classification.



A - Normal   B - Marginal malnutrition   C - Moderate malnutrition

D - Severe malnutrition

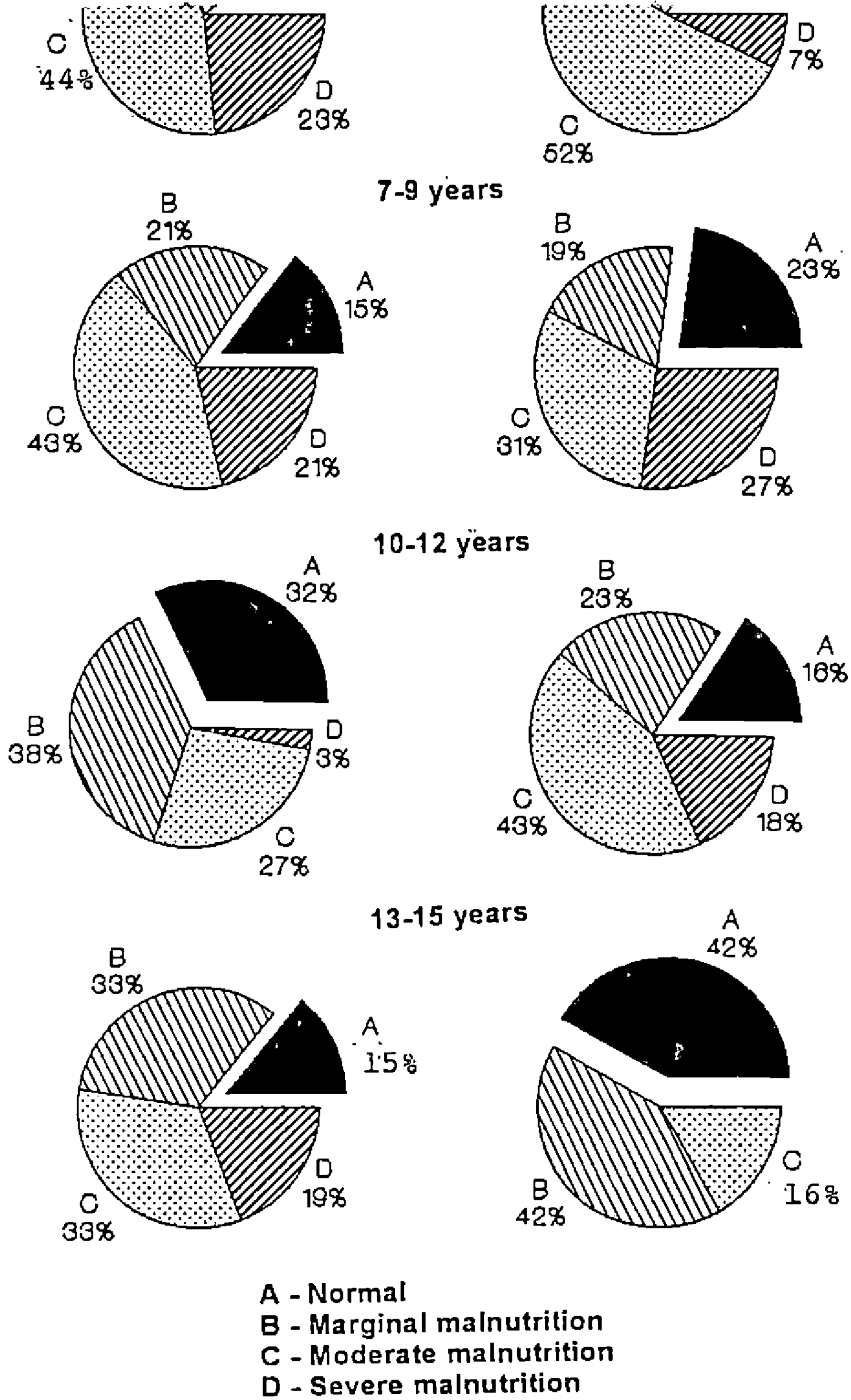


Fig. 5. Height-for-age distribution (percentage) of children (different age groups) based on Waterlow's classification

Table 44. Comparison of the mean weight of boys (5-15 years) with the Indian and NCHS Standards

Age (years)	Sample size	Weight (Kg) Mean±S.E.	Indian Standard (Kg)	Reduction from standard (Kg)	't' value (comparison with the standard)	NCHS standard (Kg)	Reduction from standard (Kg)	't' value (comparison with the standard)
5	17	13.15±0.46	19.33	6.18	13.80**	19.79	6.64	14.83**
6	13	15.53±0.60	22.14	6.61	11.07**	22.06	6.53	10.93**
7	19	15.47±0.60	24.46	8.99	15.02**	24.58	9.11	15.20**
8	16	18.13±0.49	26.42	8.29	17.13**	27.47	9.34	19.30**
9	12	19.46±0.43	30.00	10.54	24.06**	30.78	11.32	25.75**
10	21	22.52±0.62	32.39	9.87	15.76**	34.60	12.08	19.26**
11	6	24.08±0.41	35.26	11.18	27.24**	38.76	14.68	36.26**
12	10	30.85±1.46	38.78	7.93	5.43**	43.93	13.08	8.95**
13	7	27.64±1.99	42.88	15.24	7.64**	49.54	21.90	10.97**
14	7	29.86±1.62	48.26	18.40	11.34**	55.52	25.66	15.81**
15	7	35.71±2.46	52.15	16.44	6.68**	61.32	25.61	10.41**

** Significant at 1 per cent level.

SOURCE.
Indian standard -- (Vijayaraghavan et al., 1971)
NCHS standard - (WHO, 1983)

Table 45. Comparison of the mean weight of girls (5-15 years) with the Indian and NCHS Standards

Age (years)	Sample size	Weight (Kg) Mean±S.E.	Indian Standard (Kg)	Reduction from standard (Kg)	't' value (comparison with the standard)	NCHS standard (Kg)	Reduction from standard (Kg)	't' value (comparison with the standard)
5	15	14.23±0.39	18.67	4.44	11.35**	18.96	4.73	12.10**
6	12	14.38±0.58	21.56	7.18	12.33**	21.15	6.77	11.63**
7	8	15.88±0.66	24.45	8.57	12.98**	23.99	8.11	12.29**
8	9	17.94±0.96	25.97	8.03	8.38**	27.53	9.59	10.00**
9	9	19.06±1.08	29.82	10.76	9.99**	31.65	12.59	11.70**
10	19	22.32±0.63	33.58	11.26	17.88**	36.16	13.84	21.97**
11	5	22.30±0.49	37.17	14.87	30.51**	40.88	18.58	38.12**
12	20	26.65±1.28	42.97	16.32	12.73**	45.61	18.96	14.77**
13	4	30.75±0.55	44.54	13.79	24.95**	50.09	19.34	34.99**
14	5	32.40±2.57	46.70	14.30	5.58**	53.97	21.57	8.41**
15	3	37.83±4.56	48.75	10.92	2.39^{ns}	56.91	19.08	4.18^{ns}

** Significant at 1 per cent level
ns not significant

SOURCE
Indian standard – (Vijayaraghavan et al., 1971)
NCHS standard – (WHO, 1983)

The reduction of the mean weight from the Indian standard ranged from 6.18 kg (5-year-old) to 18.40 kg (14-year-old) in the case of boys and 4.44 kg (5-year-old) to 16.32 kg (12-year-old) in the case of girls. The deviations of mean weight from the NCHS standards for boys were found to be more than the deviations from the Indian standards for all ages except for 6 years. In respect of girls except for 6- and 7-year-old, the deviations from the NCHS standards were more than those from the Indian standards for all ages.

Fig. 6 and 7 represent the comparison of the mean weight with the Indian and NCHS standards for boys and girls.

To interpret the weight-for-age of children and to find out the grades of malnutrition among children between 5 to 15 years, the percentage of weight calculated on the basis of Indian Standard weight (Vijayaraghavan et al., 1971) were grouped on the basis of the classification of Indian Academy of Paediatrics suggested by Gopaldas and Seshadri (1987). The results are presented in Table 46.

The results indicated that among 135 boys, 11.85 per cent and among 109 girls, 9.17 per cent were nutritionally normal, and the rest fell under different grades of malnutrition. While 37.04 per cent of boys and 40.37 per cent of girls had Grade II malnutrition, 21.48 per cent of

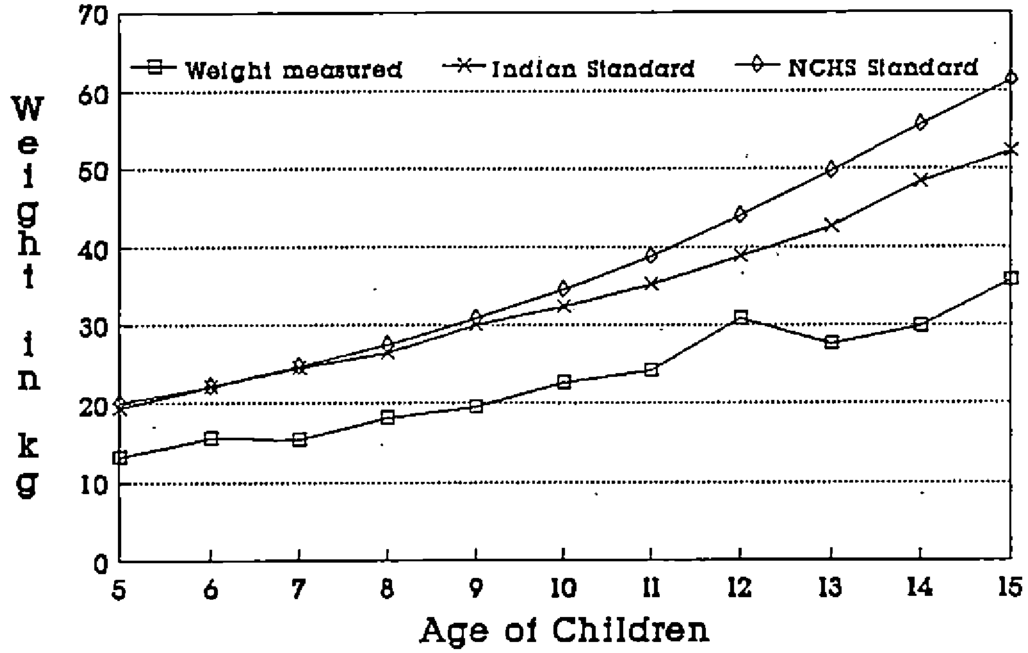


Fig. 6. Comparison of the mean weight of boys with the Indian and NCHS Standards

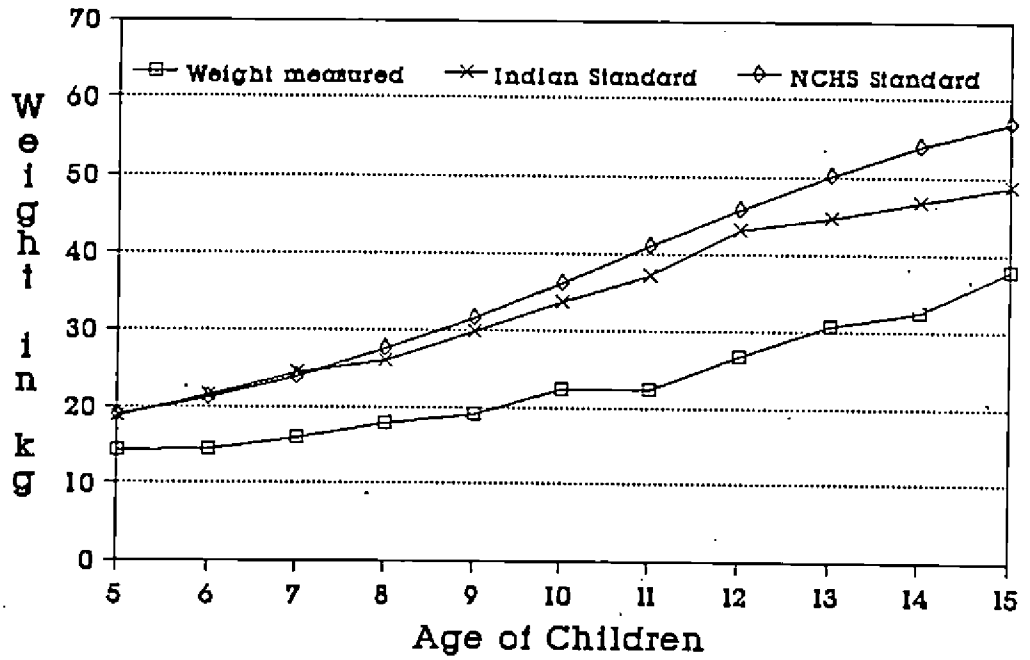


Fig. 7. Comparison of the mean weight of girls with the Indian and NCHS Standards

Table 46. Weight-for-age distribution of children based on the classification of Indian Academy of paediatrics

Nutritional status	Weight for-age (per cent of the standard)	Age in years 5 - 6 B	G	7 - 9 B	G	10 - 12 B	G	13 -15 B	G	Total B	G
Normal	> 80	5 (16.67)	2 (7.41)	1 (2.13)	2 (7.69)	8 (21.62)	4 (9.09)	2 (9.52)	2 (16.67)	16 (11.85)	10 (9.17)
Grade I malnutrition	71-80	7 (23.33)	12 (44.44)	11 (23.40)	3 (11.54)	15 (40.54)	5 (11.36)	3 (14.29)	3 (25.00)	36 (26.67)	23 (21.10)
Grade II malnutrition	61-70	11 (36.67)	10 (37.04)	20 (42.55)	11 (42.31)	9 (24.33)	17 (38.64)	10 (47.61)	6 (50.00)	50 (37.04)	44 (40.37)
Grade III malnutrition	51-60	7 (23.33)	2 (7.41)	14 (29.79)	10 (38.46)	5 (13.51)	15 (34.09)	3 (14.29)	1 (8.33)	29 (21.48)	28 (25.69)
Grade IV malnutrition	≤ 50	-	1 (3.70)	1 (2.13)	-	-	3 (6.82)	3 (14.29)	-	4 (2.96)	4 (3.67)
Total		30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

B = Boys
G = Girls
Number in parenthesis indicates percentage

boys and 25.69 per cent of girls had Grade III malnutrition (Fig. 8). Among the different age groups, the percentage of boys with normal nutrition ranged from 2.13 to 21.62 and for girls from 7.41 to 16.67. The rest of the boys and girls had different grades of malnutrition (Fig. 9).

4.3.1.3. Weight/height^2

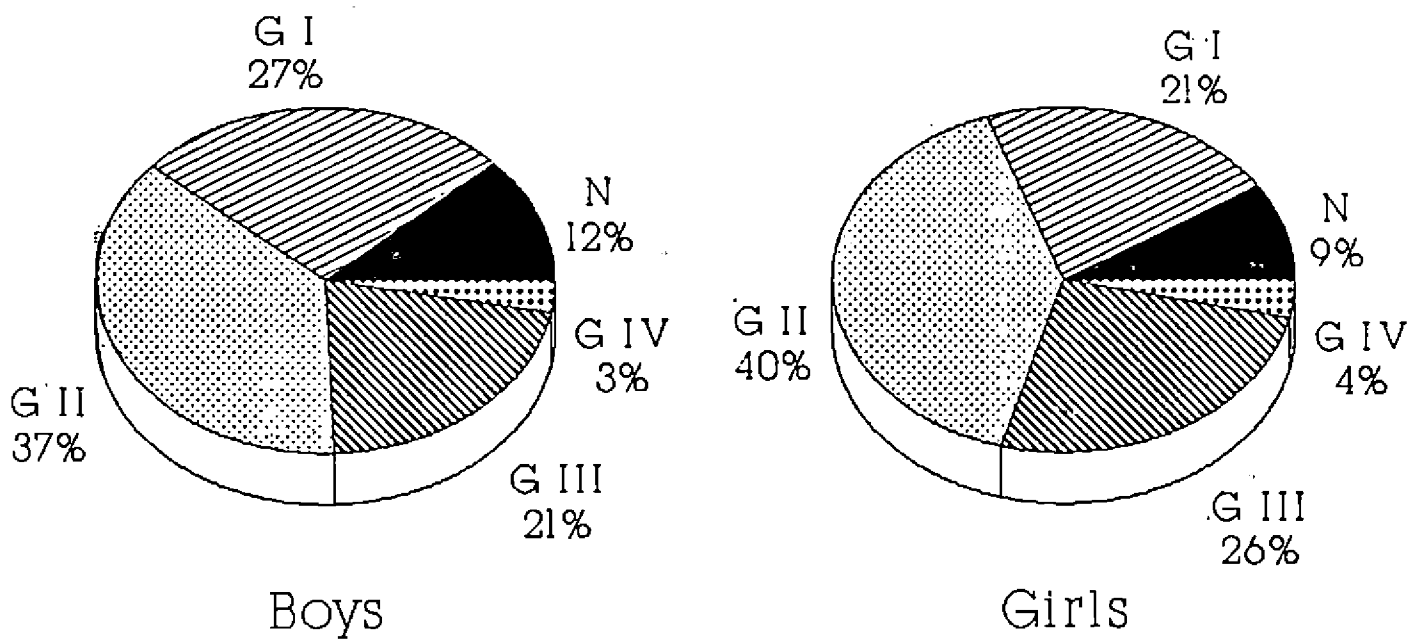
On the basis of weight/height^2 values, children were classified into normal, moderately malnourished and undernourished. Table 47 reveals the nutritional status of children based on weight/height^2 classification suggested by Rao and Singh as given in Gopaldas and Seshadri (1987).

It was found that only 21.48 per cent boys and 20.18 per cent girls between 5 to 15 years of age were nutritionally normal where as 51.11 per cent and 62.39 per cent boys and girls respectively were moderately malnourished and the rest were undernourished (Fig. 10). Among the different age groups, higher percentage of nutritionally normal children was found among 13-15 years (Fig. 11). However, majority of boys and girls between 5 to 15 years of age were malnourished on the basis of weight/height^2 ratio.

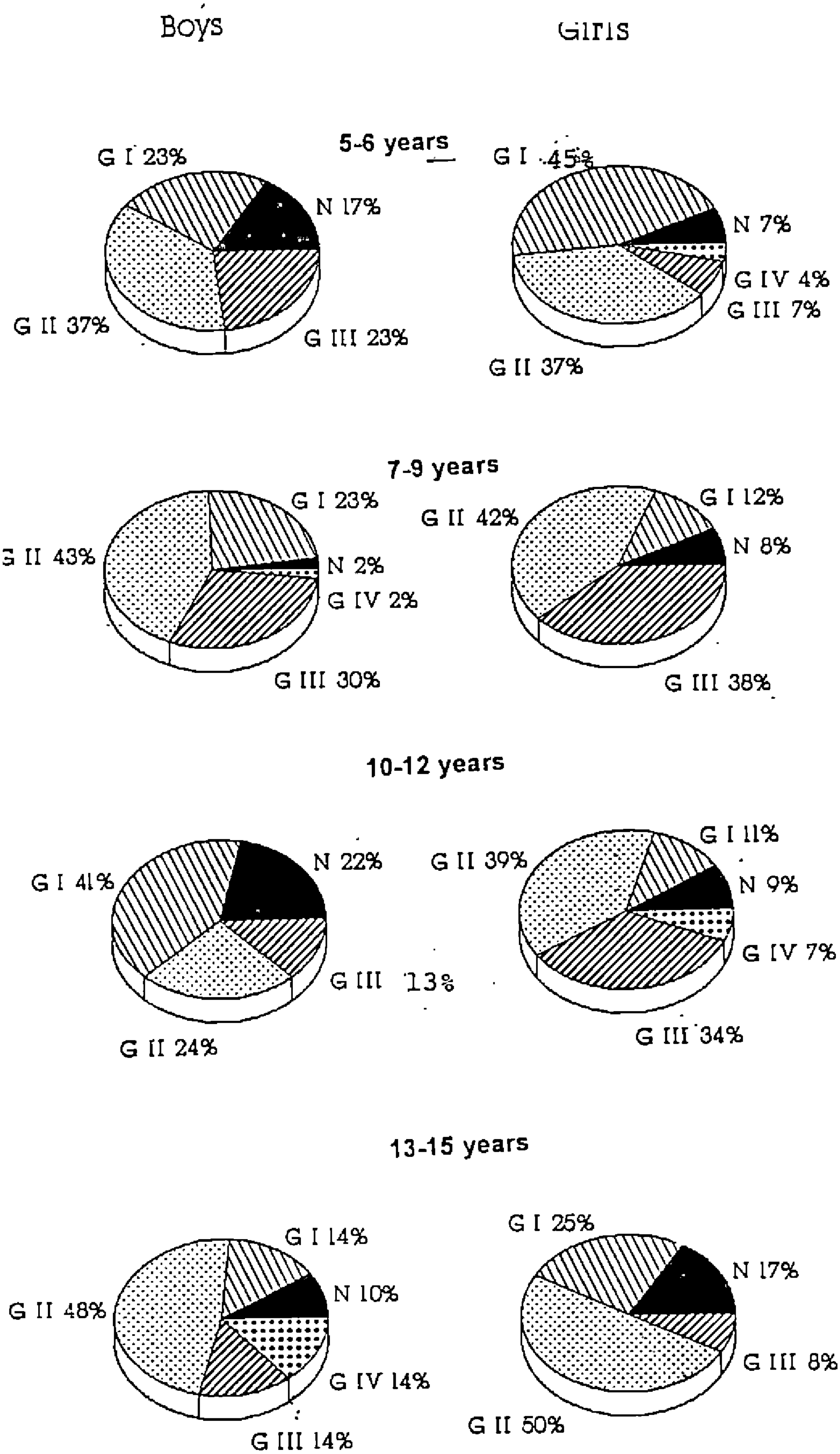
4.3.1.4. Mid upper arm circumference

The mean mid upper arm circumference of boys and girls were compared with the standards of well nourished Indian

Fig. 8. Weight-for-age distribution (percentage) of children (5-15 years) based on the classification of Indian Academy of Paediatrics



N - Normal G I - Grade I malnutrition G II - Grade II malnutrition
G III - Grade III malnutrition G IV - Grade IV malnutrition



N - Normal G I - Grade I malnutrition
G II - Grade II malnutrition G III - Grade III malnutrition
G IV - Grade IV malnutrition

Fig.9. Weight-for-age distribution (percentage) of children (different age groups) based on the classification of Indian Academy of Paediatrics

Table 47. Distribution of children based on weight/height^2

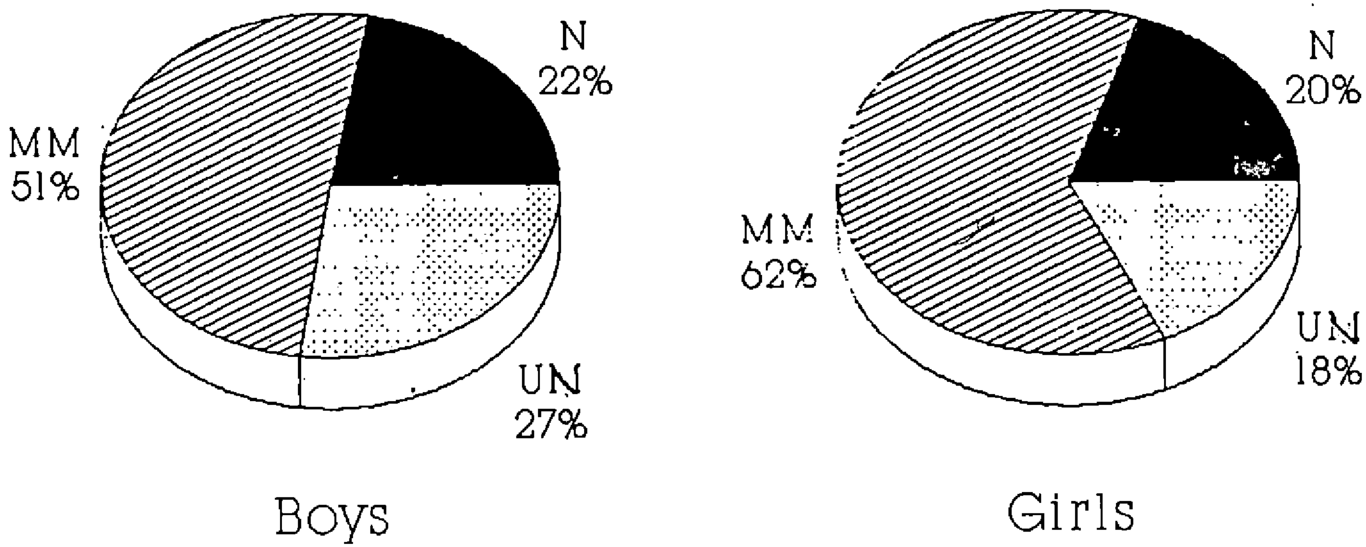
Nutritional status	Weight/height^2 (range)	Age in years									
		5 - 6		7 - 9		10 - 12		13 -15		Total	
		B	G	B	G	B	G	B	G	B	G
Normal	> 0.0015	3 (10.00)	2 (7.41)	4 (8.51)	2 (7.69)	11 (29.73)	11 (25.00)	11 (52.38)	7 (58.33)	29 (21.48)	22 (20.18)
Moderate Malnutrition	0.0013-0.0015	16 (53.33)	18 (66.67)	24 (51.06)	17 (65.39)	21 (56.76)	28 (63.64)	8 (38.10)	5 (41.67)	69 (51.11)	68 (62.39)
Under nutrition	< 0.0013	11 (36.67)	7 (25.92)	19 (40.43)	7 (26.92)	5 (13.51)	5 (11.36)	2 (9.52)	-	37 (27.41)	19 (17.43)
Total		30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

B = Boys

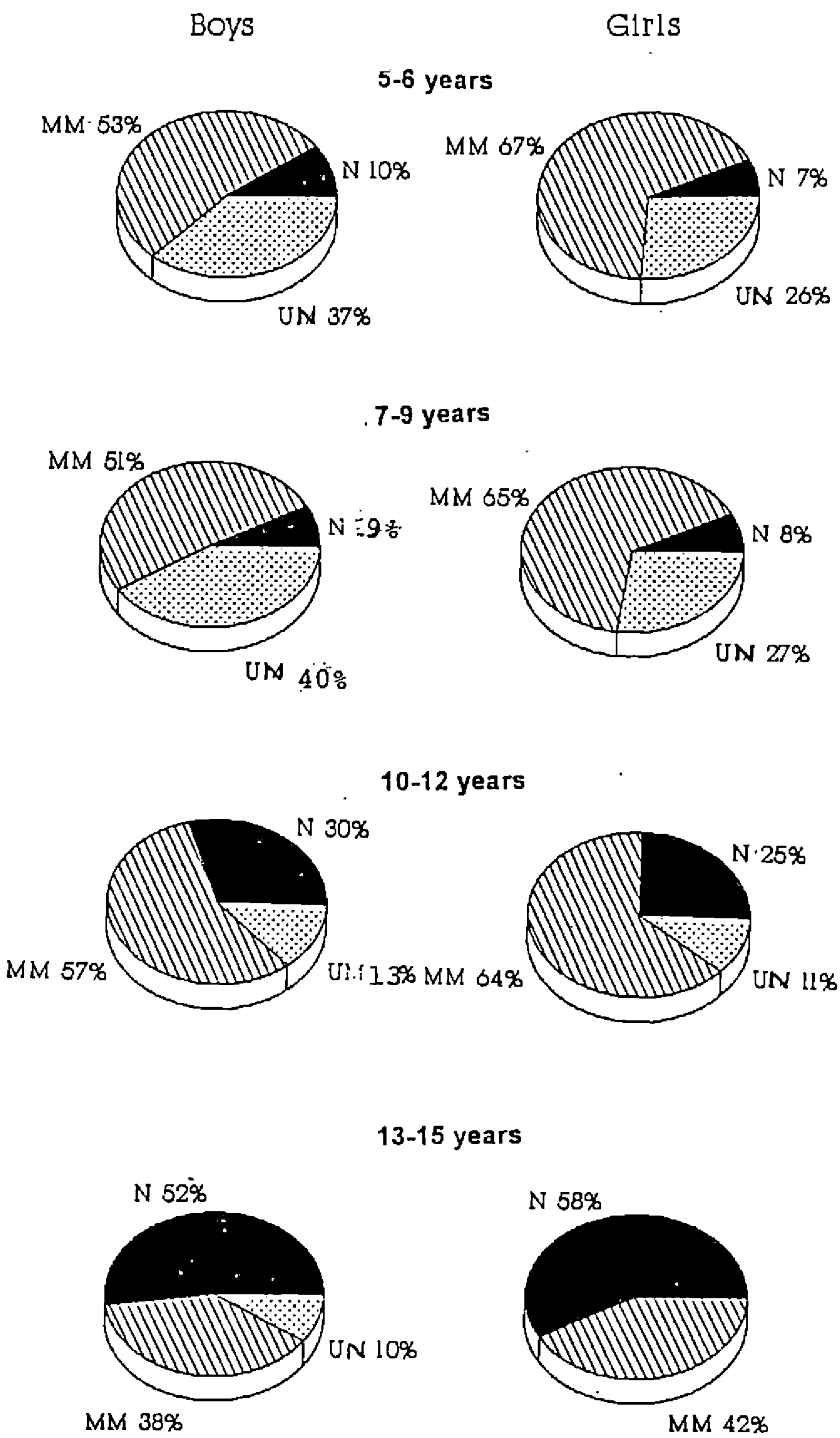
G = Girls

Number in parenthesis indicates percentage

Fig. 10. Percentage distribution of children (5-15 years) based on weight/height^2



N - Normal MM - Moderate Malnutrition UN - Under Nutrition



MM - Moderate malnutrition

trition

Fig. 11. Percentage distribution of children (different age groups) based on weight/height^2

school children suggested by Vijayaraghavan _et al_. (1974) and the results are presented in Table 48.

The results revealed that the mean values were lower than the standards for both sexes. The reduction of mean mid upper arm circumference ranged from 1.99 cm (6-year-old) to 4.00 cm (11-year-old) for boys and 0.95 cm (15-year-old) to 3.58 cm (9-year-old) in the case of girls. When the results were statistically analysed it was revealed that the mean mid upper arm circumference of boys were significantly lower than the standards for all ages while for girls the results were not significant for 13-year-old and 15-year-old girls.

The comparison of the mean mid upper arm circumferences of boys and girls with the Indian standards are illustrated in Fig. 12 and 13 respectively.

4.3.1.5. Skinfold thickness

The mean skinfold thickness over triceps of children and its comparison with the well-to-do Indian school children as suggested by Vijayaraghavan _et al_. (1974) are presented in Table 49.

The analysis of the data for boys and girls revealed that the values were significantly lower than the standard values (P = 0.01) for almost all ages in both sexes. In the

Table 48. Comparison of the mean mid upper arm circumference of boys and girls (5-15 years) with the Indian Standards

Age (years)	BOYS Sample size	MUAC (cm) Mean±S.E.	Indian standard	Reduction from the standard (cm)	't'value (comparison with the standard)	GIRLS Sample size	MUAC (cm) Mean±S.E.	Indian standard	Reduction from the standard (cm)	't'value (comparison with the standard)
5	17	14.26±0.29	16.42	2.16	7.52**	15	14.34±0.20	16.30	1.96	10.10**
6	13	14.69±0.22	16.68	1.99	9.17**	12	14.33±0.33	16.96	2.63	7.96**
7	19	14.16±0.19	17.36	3.20	16.62**	8	14.25±0.30	17.70	3.45	11.38**
8	16	15.16±0.25	17.72	2.56	10.33**	9	15.21±0.35	18.00	2.79	8.01**
9	12	15.27±0.25	18.55	3.28	13.20**	9	15.17±0.50	18.75	3.58	7.18**
10	21	15.93±0.22	18.98	3.05	13.77**	19	16.24±0.26	19.28	3.04	11.63**
11	6	15.58±0.70	19.58	4.00	5.72**	5	16.30±0.58	19.78	3.48	6.05**
12	10	18.00±0.38	20.29	2.29	5.95**	20	17.56±0.34	21.04	3.48	10.17**
13	7	17.29±0.80	21.09	3.80	4.77**	4	19.63±0.64	21.43	1.80	2.82 ns
14	7	18.79±0.48	22.29	3.50	7.10**	5	18.90±0.72	22.06	3.16	4.41*
15	7	19.47±0.68	23.22	3.75	5.55**	3	21.67±1.63	22.62	0.95	0.58 ns

** Significant at 1 per cent level
* Significant at 5 per cent level
ns not significant

SOURCE
Indian standard .. (Vijayaraghavan et al., 1974)

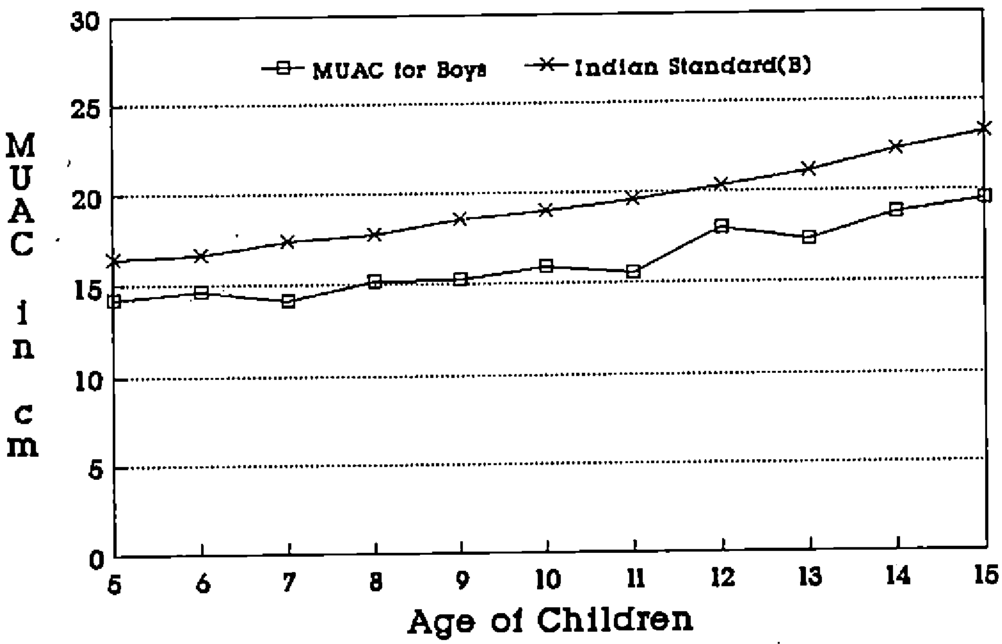


Fig. 12. Comparison of the mean mid upper arm circumference of boys with the Indian Standards

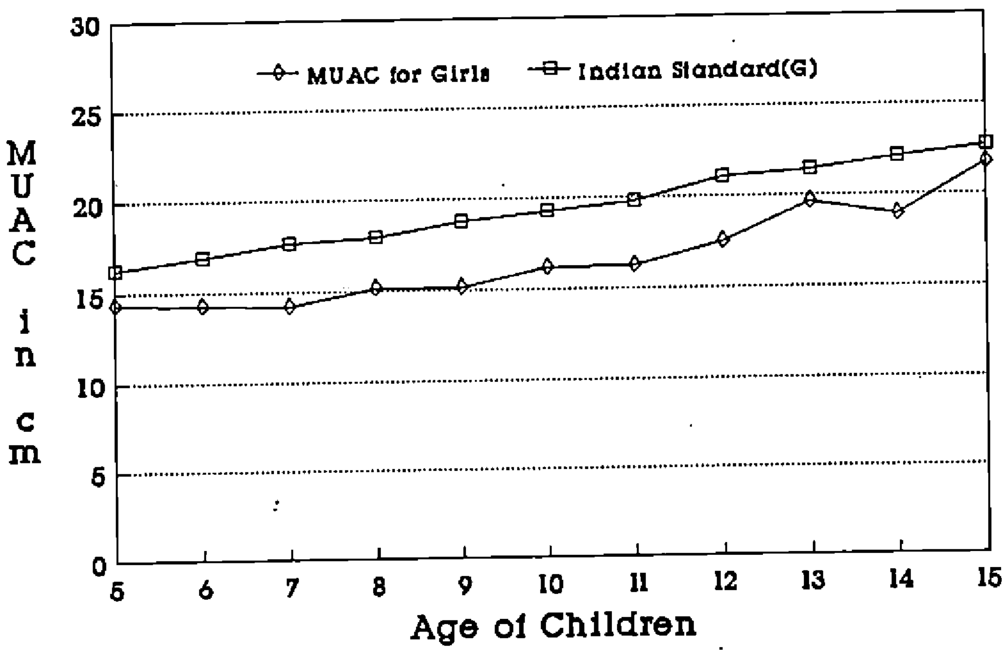


Fig. 13. Comparison of the mean mid upper arm circumference of girls with the Indian Standards

Table 49. Comparison of the mean skinfold thickness of boys and girls (5-15 years) with the Indian Standards

Age (years)	BOYS					GIRLS				
	Sample size	SFT (mm) Mean±S.E.	standard (mm)	Reduction from the standard (mm)	't'value (comparison with the standard)	Sample size	SFT (mm) Mean±S.E.	standard (mm)	Reduction from the standard (mm)	't'value (comparison with the standard)
5	17	5.76±0.47	7.56	1.80	3.87**	15	6.20±0.32	9.56	3.36	10.42**
6	13	5.62±0.65	8.14	2.52	3.88**	12	5.92±0.33	10.10	4.18	12.80**
7	19	5.47±0.23	8.74	3.27	14.37**	8	5.13±0.24	10.67	5.54	22.89**
8	16	6.25±0.24	8.66	2.41	10.03**	9	6.22±0.29	10.66	4.44	15.06**
9	12	6.25±0.19	9.22	2.97	15.85**	9	6.78±0.63	11.05	4.27	6.76**
10	21	7.00±0.18	9.50	2.50	13.36**	19	7.32±0.07	11.16	3.84	13.03**
11	6	7.00±0.40	9.58	2.58	6.45**	5	6.60±0.45	11.19	4.59	10.26**
12	10	7.60±0.28	9.84	2.24	7.97**	20	7.90±0.30	12.75	4.85	15.85**
13	7	6.57±0.40	9.49	2.92	7.33**	4	10.75±0.55	13.20	2.45	4.43*
14	7	7.00±0.24	9.08	2.08	8.82**	5	10.00±0.61	13.72	3.72	6.07**
15	7	8.86±0.36	9.03	0.17	0.47ns	3	9.00±0.71	14.08	5.08	7.18*

** Significant at 1 per cent level
* Significant at 5 per cent level
ns not significant

SOURCE
Indian standard - (Vijayaraghavan et al., 1974)

case of 15-year-old boys, the decrease in skinfold thickness from the standard was not significant while for girls it was significant only at 5 per cent level. The deviations from the standards ranged from 0.17 mm (15-year-old) to 3.27 mm (7-year-old) for boys and from 2.45 mm (13-year-old) to 5.54 mm (7-year-old) for girls.

The comparison of the mean skinfold thickness of tribal boys and girls with the Indian standards are illustrated in Figs. 14 and 15.

To interpret the nutritional status of children into different grades, the percentages of skinfold thickness calculated with reference to the Indian standards was classified into mild, moderate and severe malnutrition, and normal as suggested by Gopaldas and Seshadri (1987). The results are presented in table 50.

The data revealed that 89.63 per cent of boys and 98.16 per cent of girls were malnourished. It was found that 48.15 per cent of boys and 45.87 per cent of girls were moderately malnourished, while 20 per cent of boys and 44.95 per cent of girls were severely malnourished (Fig. 16). Among different age groups, higher percentage of children who were severely malnourished was found among 7-to 9-year-old girls (65.38 %) followed by 5-to 6-year-old girls, while lower percentage of severely malnourished was found among

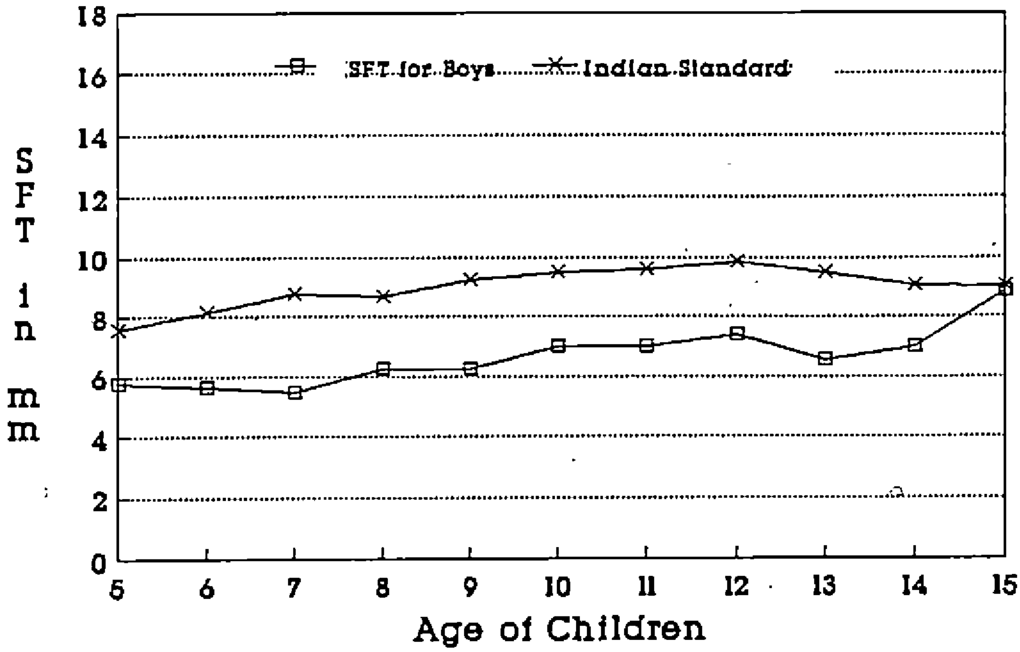


Fig. 14. Comparison of the mean skinfold thickness of boys with the Indian Standards

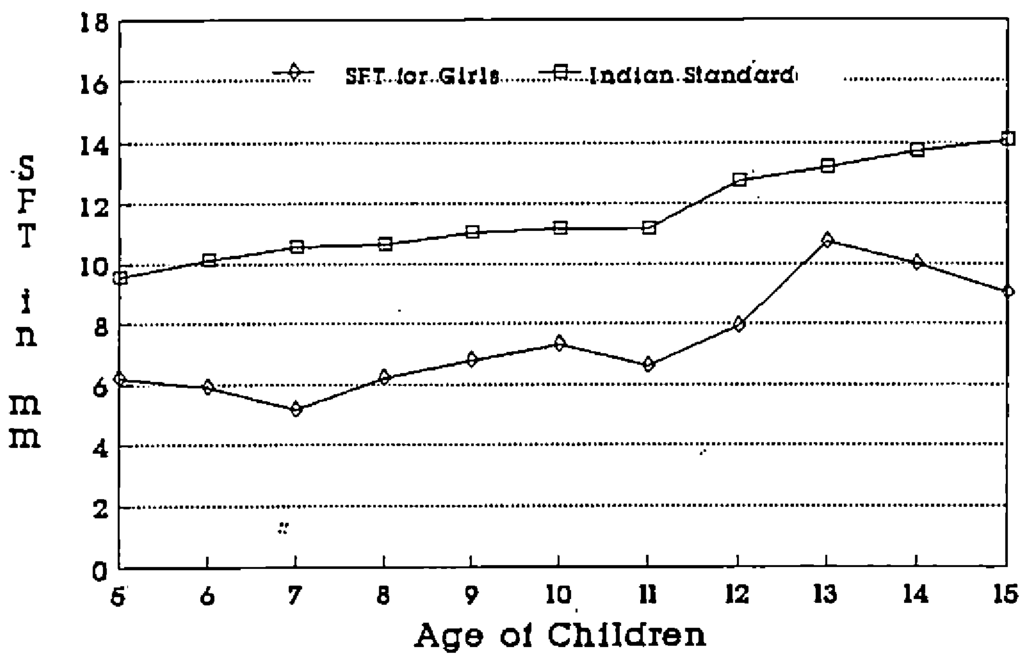


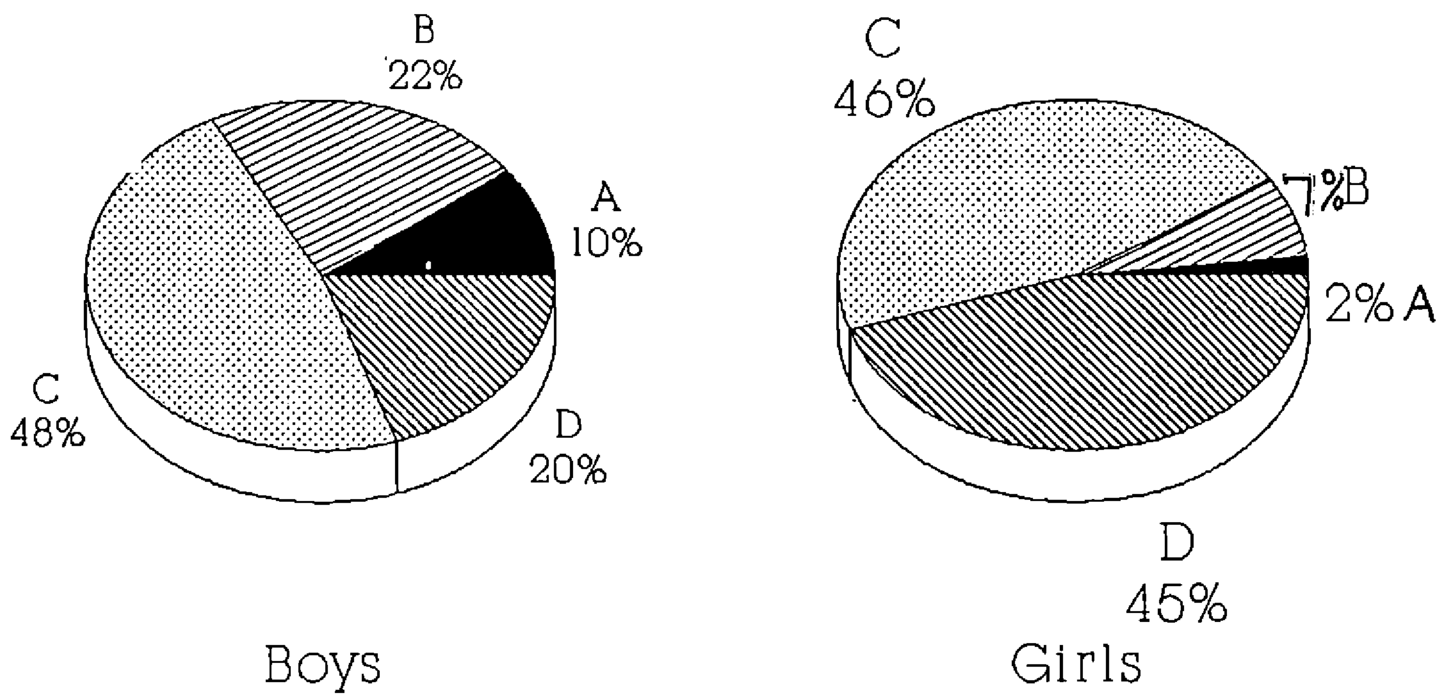
Fig. 15. Comparison of the mean skinfold thickness of girls with the Indian Standards

Table 50. Distribution of children based on skinfold thickness.

Nutritional status	SFT (per cent) of the standard	5 - 6 B	5 - 6 G	7 - 9 B	7 - 9 G	10 - 12 B	10 - 12 G	13 -15 B	13 -15 G	Total B	Total G
Normal	90-110	8 (26.67)	-	1 (2.13)	1 (3.85)	1 (2.70)	-	4 (19.05)	1 (8.33)	14 (10.37)	2 (1.84)
Mild malnutrition	80-90	2 (6.67)	2 (7.41)	9 (19.15)	-	13 (35.14)	4 (9.09)	5 (23.81)	2 (16.67)	29 (21.48)	8 (7.34)
Moderate malnutrition	60-80	10 (33.33)	12 (44.44)	22 (46.81)	8 (30.77)	22 (59.46)	22 (50.00)	11 (52.38)	8 (66.67)	65 (48.15)	50 (45.87)
Severe malnutrition	< 60	10 (33.33)	13 (48.15)	15 (31.91)	17 (65.38)	1 (2.70)	18 (40.91)	1 (4.76)	1 (8.33)	27 (20.00)	49 (44.95)
Total		30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

B = Boys;
G = Girls
Number in parenthesis indicates percentage

Fig. 16. Percentage distribution of children (5-15 years) based on skinfold thickness



A - Normal   B - Mild malnutrition   C - Moderate malnutrition

D - Severe malnutrition

10-to 12-year-old boys (2.70 %). It was also revealed that none of the girls between 5-to 6-year-old and 10-to 12-year-old had normal nutritional status on the basis of skinfold thickness over triceps (Fig. 17).

4.3.2. Clinical assessment

Incidence of clinical signs and symptoms observed among 135 boys and 109 girls are presented in Table 51.

It was found that among boys and girls between 5 to 15 years of age, 23.70 per cent boys and 45.87 per cent girls had pale tongue with anaemia, while 21.48 per cent and 28.44 per cent boys and girls respectively had dental caries. Xerosis of the conjunctiva, anaemia, dental caries and hair changes were noticed among boys and girls coming under the four different age groups. Among these symptoms, except boys and girls aged 10 to 12 years and girls aged 13 to 15 years pale tongue with anaemia was the most pronounced symptom among children in the other age groups. Night blindness, angular stomatitis, fluorosis and scabies were noticed only among a few children between 5 to 15 years of age.

Incidence of clinical signs and symptoms of the children were grouped under corresponding nutrients, the deficiency of which is the causative factor for the prevalence of the clinical symptoms and the results are presented in Table 52.

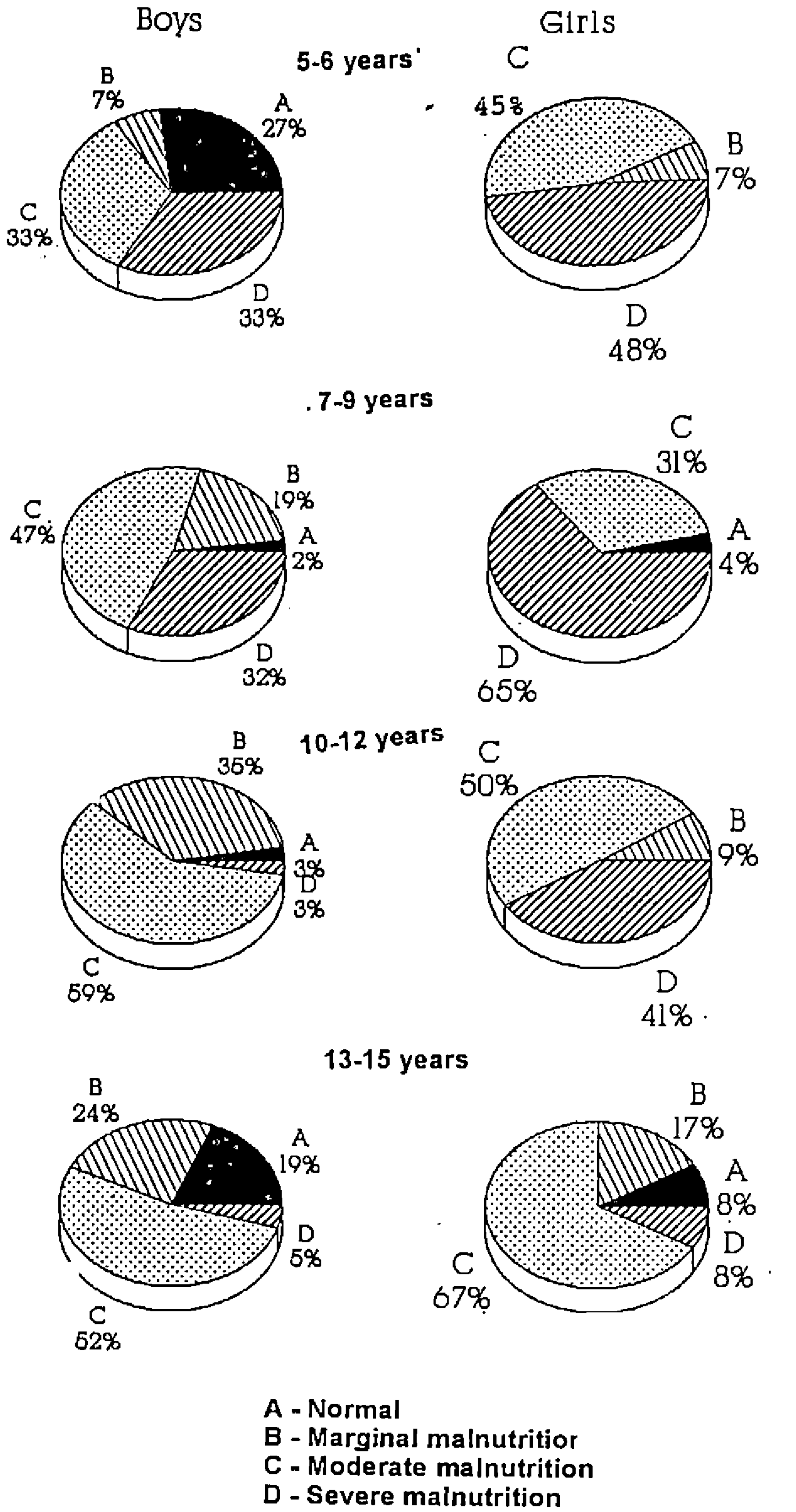


Fig. 17. Percentage distribution of children (different age groups) based on skinfold thickness

Table 51. Distribution of children with respect to clinical examination

Particulars	Age in years									
	5-6		7-9		10-12		13-15		Total	
	B n=30	G n=27	B n=47	G n=26	B n=37	G n=44	B n=21	G n=12	B n=135	G n=109
Good appearance	9 (30.00)	10 (37.04)	19 (40.43)	9 (34.62)	20 (54.05)	16 (36.36)	8 (38.09)	6 (50.00)	56 (41.48)	41 (37.61)
Xerosis of conjunctiva	4 (13.33)	5 (18.52)	8 (17.02)	4 (45.38)	13 (35.14)	8 (18.18)	6 (28.57)	1 (8.33)	31 (22.96)	18 (16.51)
Pigmentation of conjunctiva	1 (3.33)	-	3 (6.38)	-	2 (5.41)	-	-	-	6 (4.44)	-
Night blindness	-	-	1 (2.13)	-	-	-	-	-	1 (0.74)	-
Angular stomatitis	-	-	1 (2.13)	-	-	-	-	-	1 (0.74)	-
Pale tongue with anaemia	9 (30.00)	13 (48.15)	12 (25.53)	15 (57.69)	4 (10.81)	21 (47.73)	7 (33.33)	1 (8.33)	32 (23.70)	50 (45.87)
Red tongue	1 (3.33)	-	1 (2.13)	-	-	-	-	-	2 (1.48)	-
Hypertrophy of gums	1 (3.33)	-	1 (2.13)	-	-	-	1 (4.76)	1 (8.33)	3 (2.22)	1 (0.92)

(Contd.....)

(Table 51 Contd.....)

Fluorosis	-	-	-	-	-	2 (4.55)	-	-	-	2 (1.83)
Chalky teeth	2 (6.67)	4 (14.81)	5 (10.64)	2 (7.69)	5 (13.51)	4 (9.09)	-	-	12 (8.89)	10 (9.17)
Dental caries	4 (13.33)	10 (37.04)	11 (23.40)	4 (15.38)	11 (29.73)	16 (36.36)	3 (14.29)	1 (8.33)	29 (21.48)	31 (28.44)
Changes in hair	4 (13.33)	10 (37.04)	10 (21.28)	4 (15.38)	3 (8.11)	22 (50.00)	1 (4.76)	4 (33.33)	18 (13.33)	40 (36.69)
Skin changes	3 (10.00)	3 (11.11)	-	2 (7.69)	2 (5.41)	1 (2.27)	-	-	5 (3.70)	6 (5.50)
Scabies	-	-	1 (2.13)	-	2 (5.41)	-	2 (9.52)	-	5 (3.70)	-
Deficient adipose tissue	-	1 (3.70)	1 (2.13)	3 (11.54)	-	1 (2.27)	-	-	1 (0.74)	5 (4.59)
Change in bones	1 (3.33)	-	-	-	-	-	-	-	1 (0.74)	-
Palpable liver	4 (13.33)	-	1 (2.13)	-	-	-	-	-	5 (3.70)	-

n = Number of children
Number in parenthesis indicates percentage

Table 52. Incidence of clinical symptoms observed among the children

Deficiencies/ incidences	Symptoms	Age in years 5-6 B n=30	5-6 G n=27	7-9 B n=47	7-9 G n=26	10-12 B n=37	10-12 G n=44	13-15 B n=21	13-15 G n=12	Total B n=135	Total G n=109
<u>Nutritional</u>											
Anaemia	Pale tongue	9 (30.00)	13 (48.15)	12 (25.53)	15 (57.69)	4 (10.81)	21 (47.73)	7 (33.33)	1 (8.33)	32 (23.70)	50 (45.87)
Vitamin A	Xerosis of conjunctiva Night blindness	4 (13.33)	5 (18.52)	9 (19.15)	4 (15.38)	13 (35.14)	8 (18.18)	6 (28.57)	1 (8.33)	32 (23.70)	18 (16.51)
B complex	Angular stomatitis Red tongue	1 (3.33)	-	2 (4.26)	-	-	-	-	-	3 (2.22)	-
<u>Non-nutritional</u>											
Fluorosis	Mottled enamel	-	-	-	-	-	2 (4.55)	-	-	-	2 (1.83)
Dental caries	Dental caries	4 (13.33)	10 (37.04)	11 (23.40)	4 (15.38)	11 (29.73)	16 (36.36)	3 (14.29)	1 (8.33)	29 (21.48)	31 (28.44)
Scabies	Scabies	-	-	1 (2.13)	-	2 (5.41)	-	2 (9.52)	-	5 (3.70)	-

n = Number of children
Number in parenthesis indicates percentage

Among the various clinical manifestations 23.70 per cent boys and 45.87 per cent girls between 5 to 15 years of age were found to be suffering from anaemia. About 24 per cent boys and 17 per cent girls were observed to have vitamin A deficiency, while only 2.22 per cent boys had B complex deficiency symptoms.

Non-nutritional manifestations such as dental caries was seen in 21.48 per cent boys and 28.44 per cent girls. Fluorosis was seen only among girls (1.83 %) and scabies only among boys (3.70 %).

Nutritional deficiencies such as anaemia and vitamin A deficiencies and non-nutritional symptom like dental caries were present among the children irrespective of the age.

Table 53 depicts the percentage score obtained for the boys and girls of different age groups for clinical assessment. The maximum percentage score that can be obtained by an individual for the clinical assessment will be 100.

The table reveals that 47.41 per cent boys and 32.11 per cent girls were coming under the score range of 95 to 100 per cent and 42.96 per cent and 58.72 per cent boys and girls respectively attained the percentage score between 90 to 95 and the rest of the children had the percentage score between 85 to 90.

Table 53. Distribution of children on the basis of clinical score

Clinical score (per cent)	Age in years									
	5-6		7-9		10-12		13-15		Total	
	B	G	B	G	B	G	B	G	B	G
85 - 90	3 (10.00)	2 (7.41)	5 (10.64)	2 (7.69)	4 (10.81)	6 (13.64)	1 (4.76)	-	13 (9.63)	10 (9.17)
90 - 95	15 (50.00)	17 (62.96)	15 (31.91)	15 (57.69)	20 (54.05)	27 (61.36)	8 (38.10)	5 (41.67)	58 (42.96)	64 (58.72)
95 - 100	12 (40.00)	8 (29.63)	27 (57.45)	9 (34.62)	13 (35.14)	11 (25.00)	12 (57.14)	7 (58.33)	64 (47.41)	35 (32.11)
Total	30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

Number in parenthesis indicates percentage

Among the four different age groups also majority of the boys and girls attained the score above 90 per cent.

4.3.3. Actual food intake

An indepth study among 20 boys and 18 girls between 5 to 15 years of age was conducted by weighment method to determine their actual food intake and to assess the quantity of food consumed. The quantity of each food item was compared with the quantity specified for a balanced diet suggested by Gopalan et al. (1981) and were statistically examined.

The mean food intake of children aged 5 to 6 years (Table 54) indicated that the intake of all foods except cereals was significantly lower than the recommended levels for boys and girls. Fruits were not at all included in the diet of both boys and girls while the diet of girls was also lacking in meat, fish and egg. Though the cereal intake was higher than the recommended levels for both boys and girls, it was not statistically significant. The intake of green leafy vegetables, milk, fats and oils and sugar and jaggery was significantly lower than the recommended levels in the diet of boys and girls.

The percentage intake of different foodstuffs in comparison with the Recommended Dietary Allowances is illustrated in Fig. 18.

Table 54. Mean food intake of boys and girls (5-6 years) in comparison with RDA

Food groups	Boys n=6				Girls n=3			
	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Percentage of RDA	't'value (comparison with RDA)	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Percentage of RDA	't'value (comparison with RDA)
Cereals	221.42±33.59	200	110.71	0.64^{ns}	209.72±13.26	200	104.86	0.73^{ns}
Pulses	11.52±2.15	50	23.04	17.93**	24.49±6.94	50	48.98	3.68^{ns}
Green leafy Vegetables	2.66±1.42	75	3.55	50.98**	8.09±3.08	75	10.79	21.93**
Other vegetables, Roots and tubers	35.06±4.93	50	70.12	3.03*	16.72±9.37	50	33.44	3.55^{ns}
Fruits	-	50	-	-	-	50	-	-
Milk	13.61±5.74	200	6.81	32.45**	16.11±12.49	200	8.06	14.72**
Fats and oils	3.09±1.00	25	12.36	21.87**	3.28±0.74	25	13.12	29.24**
Meat and fish, eggs	5.72±3.26	30	19.07	7.44**	-	30	-	-
Sugar and jaggery	3.89±1.22	40	9.73	29.66**	4.44±2.96	40	11.10	11.99**

** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

The results of the mean food intake of children between 7 to 9 years of age (Table 55) revealed that as in the age group of 5 to 6 years, except cereals the intake of all the other food stuffs was below the recommended levels for boys and girls. Other vegetables, and roots and tubers were included in the diet of boys and girls to meet 64.7 per cent and 73.96 per cent of the recommended levels while fruits were not at all included in the diet of both groups. The results also showed that except other vegetables, and roots and tubers, the intake of all other food stuffs were significantly lower in the diet of both sexes. The intake of cereals was not significantly higher than the recommended quantity for both boys and girls. The percentage intake of foodstuffs in comparison with the Recommended Dietary Allowances is illustrated in Fig. 19.

It was found that among 10-to 12-year-old-boys and girls also intake of all other food stuffs except cereals was far below the prescribed levels. Fruits were absent in the diet of both boys and girls. Statistical analysis of the data showed that the intake of all food stuffs were significantly lower than the standard values for both sexes. The intake of cereals was not significantly higher than the prescribed levels for both boys and girls (Table 56).

Table 55. Mean food intake of boys and girls (7-9 years) in comparison with RDA

Food groups	Boys n=6				Girls n=5			
	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Percentage of RDA	't' value (comparison with RDA)	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Percentage of RDA	't' value (comparison with RDA)
Cereals	287.87±25.68	250	115.15	1.47^{ns}	259.74±20.69	250	103.90	0.47^{ns}
Pulses	22.87±5.61	60	38.12	6.62**	13.35±1.86	60	22.25	25.16**
Green leafy Vegetables	7.16±1.89	75	9.55	35.86**	8.18±2.30	75	10.91	29.08**
Other vegetables } Roots and tubers }	32.35±7.36	50	64.70	2.40^{ns}	36.98±5.18	50	73.96	2.52^{ns}
Fruits	-	50	-	-	-	50	-	-
Milk	11.94±6.24	200	5.97	30.13**	15.33±6.38	200	7.67	28.93**
Fats and oils	3.41±0.45	30	11.37	59.52**	2.70±1.28	30	9.00	21.43**
Meat and fish, eggs }	4.17±4.57	30	13.90	5.66**	3.04±3.41	30	10.13	7.92**
Sugar and jaggery	5.56±2.89	50	11.12	15.36**	7.21±2.99	50	14.42	14.31**

** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

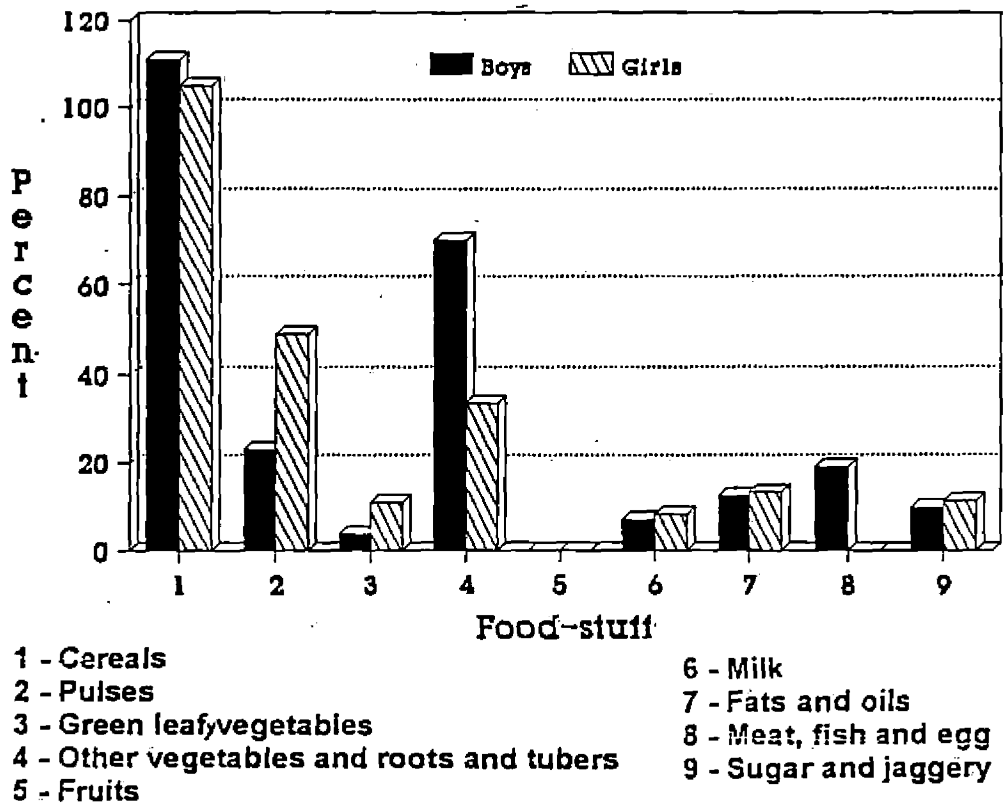


Fig. 18. Food intake of children (5-6 years) as percentage of RDA

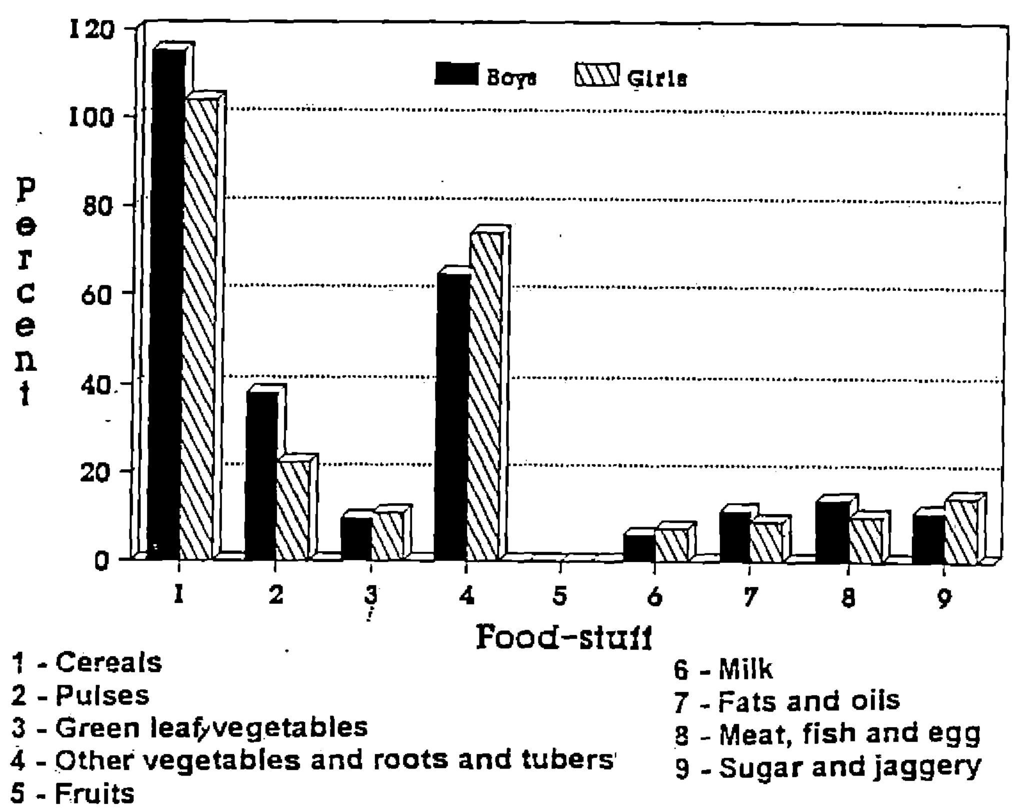


Fig. 19. Food intake of children (7-9 years) as percentage of RDA

Table 56. Mean food intake of boys and girls (10-12 years) in comparison with RDA

Food groups	Boys n=5				Girls n=5			
	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Per-cent age of RDA	't'value (comp-arison with RDA)	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Per-cent age of RDA	't'value (comp-arison with RDA)
Cereals	346.85±22.85	320	108.39	1.17^{ns}	332.92±37.95	320	104.0[illegible]	0.34^{ns}
Pulses	18.09±6.23	60	30.15	6.73**	13.65±2.35	60	22.75	19.73**
Green leafy Vegetables	10.09±1.42	100	10.09	63.40**	1.30±0.62	100	1.30	159.07**
Other vege-tables Roots and tubers	44.64±7.54	75	59.52	4.03*	37.62±6.43	75	50.16	5.81**
Fruits	-	50	-	-	-	50	-	-
Milk	14.00±6.37	200	7.00	29.23**	20.00±2.70	200	10.00	66.69**
Fats and oils	2.44±0.71	35	6.97	45.88**	4.05±1.41	35	11.57	22.01**
Meat and fish, eggs	4.00±4.47	30	13.33	5.81**	3.41±3.81	30	11.37	6.98**
Sugar and jaggery	8.67±3.61	50	17.34	11.47**	5.73±1.26	50	11.46	35.11**

** Significant at 1 per cent level
 * Significant at 5 per cent level
RDA Recommended Dietary Allowances

ns not significant
n number of children

The percentage intake of foodstuffs in comparison with the Recommended Dietary Allowances is illustrated in Fig. 20.

The actual food intake of children between 13 to 15 years of age as shown in Table 57 indicated that among the different foodstuffs, only the cereal intake of girls was higher than recommended levels which was found to be statistically insignfiicant. Fruits, meat, fish and eggs were not included in the family diet of both groups. Statistical interpretations indicated that intake of all other foodstuffs were significantly lower than the prescribed levels among both groups.

The percentage food intake of boys and girls between 13 to 15 years of age in comparison with the recommended balanced diet is presented in Fig. 21.

The nutrients present in the diet of tribal children of 5 to 15 years of age (20 boys and 18 girls) were calculated to find out the quality of the foods consumed using the food composition table (Gopalan et al., 1989). The results were compared with the 1989-Recommended Dietary Allowances (RDA) of nutrients for different age groups suggested by ICMR (1991) and the results were statistically analysed.

Table 57. Mean food intake of boys and girls (13-15 years) in comparison with RDA

Food groups	Boys n=3				Girls n=5			
	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Per-cent age of RDA	't'value (comp-arison with RDA)	Amount consumed Mean±SE (g)	Quantity (g) specified as per balanced diet (RDA)	Per-cent age of RDA	't'value (comp-arison with RDA)
Cereals	355.66±12.69	430	82.71	5.85*	357.28±18.62	350	102.08	0.39ns
Pulses	19.05±3.32	50	38.10	9.34*	15.08±2.37	50	30.16	14.75**
Green leafy Vegetables	2.22±1.80	100	2.22	54.31**	15.81±4.80	150	10.54	27.98**
Other vege-tables	25.49±3.46	75	33.99	14.28**	42.55±4.69	75	56.73	6.92*
Roots and tubers	7.83±1.79	75	10.44	37.56**	5.37±2.46	75	7.16	28.33**
Fruits	-	30	-	-	-	30	-	-
Milk	21.67±3.12	150	14.45	41.13**	12.00±3.51	150	8.00	39.36**
Fats and oils	3.31±0.52	40	8.28	69.83**	2.79±0.74	40	6.98	50.64**
Meat and fish	-	30	-	-	-	30	-	-
Eggs	-	30	-	-	-	30	-	-
Sugar and jaggery	11.11±1.36	30	37.03	13.89**	5.34±1.49	30	17.80	16.54**

** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

1. Cereals
2. Pulses
3. Green leafy vegetables
4. Other vegetables and roots and tubers
5. Fruits
6. Milk
7. Fats and oils
8. Meat,fish and egg
9. Sugar and jaggery

Fig. 2(

1. Cereals
2. Pulses
3. Green leafy vegetables
4. Other vegetables
5. Roots and tubers
6. Fruits
7. Milk
8. Fats and oils
9. Meat and fish
10. Egg
11. Sugar and jaggery

. 21. Food intake of children (13-15 years) as

The results of the study on the mean nutrient intake of boys and girls between 5 to 6 years of age revealed that the percentage intake of all nutrients were far below the RDA except for phosphorus where more than 97 per cent of the requirement was met by both the groups. More than 50 per cent of the requirements were met for protein, energy, thiamine and niacin by both boys and girls. The statistical interpretation of the data revealed that the intake of all nutrients except phosphorus and niacin were significantly lower than the RDA for boys whereas for girls except protein, phosphorus, niacin and vitamin C, all the other nutrients were significantly lower (Table 58).

The nutritional composition of the diets of boys and girls aged 5 to 6 years is presented in Fig. 22.

The mean nutrient intake of children between 7 to 9 years revealed that except for phosphorus the diet was deficient in all other nutrients (Table 59). Though phosphorus intake was in excess of the recommended levels for both the sexes, only for boys it was significantly higher than RDA. The intake of all the other nutrients except niacin was significantly lower than the recommended levels for boys whereas except calcium and vitamin C the intake of all other nutrients was significantly lower in the diet of girls.

Table 58. Mean nutrient intake of boys and girls (5-6 years) in comparison with RDA

Nutrient	Boys n=6				Girls n=3			
	Mean$\pm$SE	RDA	Per cent of RDA	't' value (comparison with RDA)	Mean$\pm$SE	RDA	Per cent of RDA	't' value (comparison with RDA)
Protein (g)	19.14$\pm$2.83	30	63.80	3.84*	21.70$\pm$1.69	30	72.33	4.01^{ns}
Fat (g)	6.11$\pm$2.15	25	24.44	8.79**	5.76$\pm$0.05	25	23.04	321.77**
Energy (Kcal)	893.03$\pm$133.23	1690	52.84	5.98**	881.76$\pm$50.78	1690	52.18	12.99**
Calcium (mg)	87.11$\pm$15.30	400	21.78	20.45**	118.45$\pm$27.30	400	29.61	8.42*
Phosphorus (mg)	397.04$\pm$62.06	400	99.26	0.05^{ns}	390.79$\pm$30.44	400	97.70	0.25^{ns}
Iron (mg)	4.63$\pm$1.33	18	25.72	10.07**	3.64$\pm$0.38	18	20.22	30.55**
Retinol (µg)	79.53$\pm$32.58	400	19.88	9.84**	154.03$\pm$44.05	400	38.51	4.56*
Thiamine (mg)	0.53$\pm$0.08	0.9	58.89	4.83**	0.54$\pm$0.04	0.9	60.00	7.36**
Riboflavin(mg)	0.19$\pm$0.04	1.0	19.00	23.99**	0.18$\pm$0.02	1.0	18.00	28.52**
Niacin (mg)	8.73$\pm$1.36	11	79.36	1.68^{ns}	7.89$\pm$0.50	11	71.73	2.19^{ns}
Vitamin C (mg)	15.14$\pm$3.78	40	37.85	6.57**	21.40$\pm$4.16	40	53.50	3.65^{ns}

** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

Table 59. Mean nutrient intake of boys and girls (7-9 years) in comparison with RDA

Nutrient	Boys n=6				Girls n=5			
	Mean±SE	RDA	Per cent of RDA	't' value (comparisoh with RDA)	Mean±SE	RDA	Per cent of RDA	't' value (comparison with RDA)
Protein (g)	26.51±1.26	41	64.66	11.52**	21.92±1.91	41	53.46	9.98**
Fat (g)	5.63±0.61	25	22.52	31.89**	6.29±2.46	25	25.16	7.62**
Energy(Kcal)	1203.33±46.82	1950	61.71	15.95**	1019.21±91.64	1950	52.27	10.16**
Calcium (mg)	109.72±16.35	400	27.43	17.75**	291.85±125.81	400	72.96	0.86^{ns}
Phosphorus (mg)	537.66±19.98	400	134.42	6.91**	533.37±66.28	400	133.34	2.08^{ns}
Iron (mg)	5.59±1.03	26	21.50	19.73**	6.89±1.19	26	26.50	16.08**
Retinol (µg)	140.26±38.33	600	23.38	11.99**	187.93±31.30	600	31.32	13.17**
Thiamine (mg)	0.76±0.03	1.0	76.00	7.83**	0.75±0.09	1.0	75.00	2.79*
Riboflavin(mg)	0.23±0.01	1.2	19.17	63.97**	0.28±0.05	1.2	23.33	17.80**
Niacin (mg)	12.32±0.67	13	94.77	1.03^{ns}	8.99±1.26	13	69.15	3.19*
Vitamin C (mg)	22.12±4.53	40	55.30	3.94*	28.73±4.56	40	71.83	2.47^{ns}

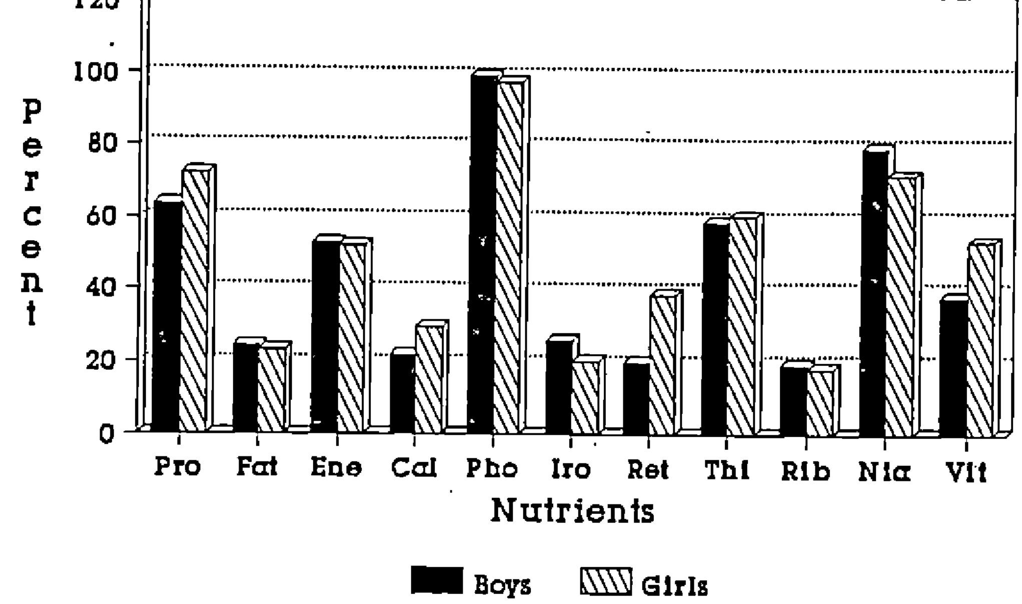
** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

The percentage nutrient intake of boys and girls in comparison with the Recommended Dietary Allowances is presented in Fig. 23.

The composition of nutrients in the diet of 10 to 12 year boys and girls (Table 60) revealed that except phosphorus intake of boys, and niacin intake of girls all the other nutrients were lower than the RDA. Statistical analysis indicated that the intake of nutrients like protein, fat, energy, retinol and riboflavin were significantly lower in the diet of boys and girls.

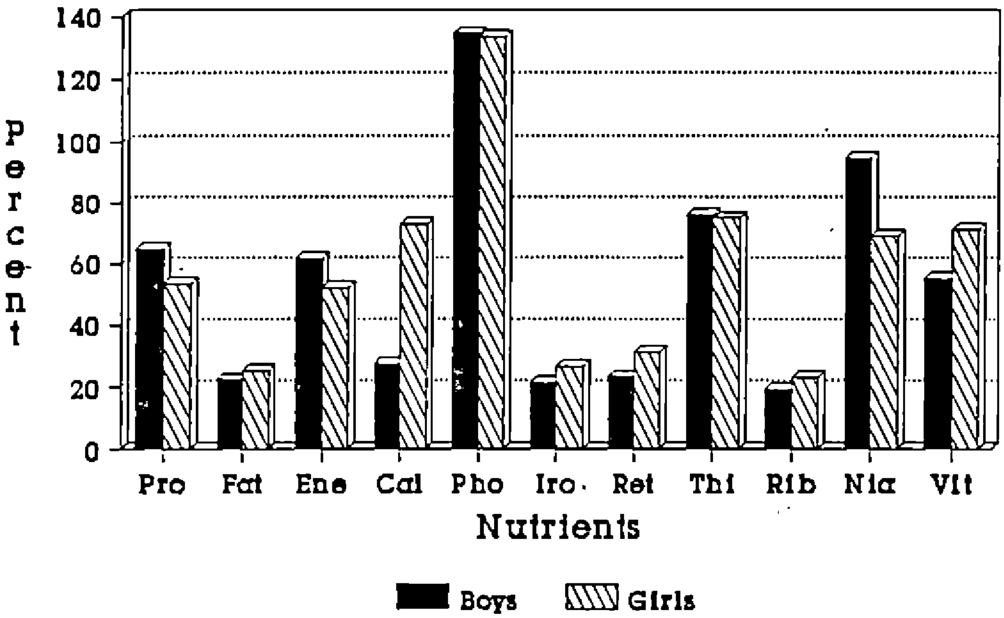
The comparison of the percentge nutrient intake of boys and girls between 10 to 12 years compared with the RDA is presented in Fig. 24.

The results of the mean nutrient intake of boys and girls between 13 to 15 years of age (Table 61) when compared with the Recommended Dietary Allowances of nutrients revealed that except phosphorus, the intake of all other nutrients was significantly lower in the diet of boys. For girls, the intake of protein, fat, energy, iron, retinol and riboflavin was significantly lower than the prescribed levels. It was found that though the mean intake of calcium, phosphorus, thiamine and vitamin C was higher in the diet of girls, they were not significantly higher ($P = 0.05$) than the recommended levels.



Pro - Protein
Fat - Fat
Ene - Energy
Cal - Calcium
Pho - Phosphorus
Iro - Iron
Ret - Retinol
Thi - Thiamine
Rib - Riboflavin.
Nia - Niacin
Vit - Vitamin C

Fig. 22. Nutrient intake of children (5-6 years) as percentage of RDA



Pro - Protein
Fat - Fat
Ene - Energy
Cal - Calcium
Pho - Phosphorus
Iro - Iron
Ret - Retinol
Thi - Thiamine
Rib - Riboflavin
Nia - Niacin
Vit - Vitamin C

Fig. 23. Nutrient intake of children (7-9 years) as percentage of RDA

Table 60. Mean nutrient intake of boys and girls (10-12 years) in comparison with RDA

Nutrient	Boys n=5				Girls n=5			
	Mean±SE	RDA	Per cent of RDA	't' value (comparison with RDA)	Mean±SE	RDA	Per cent of RDA	't' value (comparison with RDA)
Protein (g)	29.91±1.63	54	55.39	14.80**	26.25±3.12	57	46.05	9.88**
Fat (g)	5.79±0.58	22	26.32	27.93**	7.92±2.82	22	36.00	4.99**
Energy(Kcal)	1339.49±65.76	2190	61.16	12.93**	1296.94±148.54	1970	65.83	4.53**
Calcium (mg)	404.99±194.42	600	67.50	1.00^{ns}	93.07±17.42	600	15.51	29.11**
Phosphorus (mg)	669.75±95.13	600	111.63	0.73^{ns}	564.09±67.65	600	94.02	0.53^{ns}
Iron (mg)	18.88±12.65	34	55.53	1.19^{ns}	4.85±0.71	19	25.53	19.91**
Retinol (µg)	213.50±28.90	600	35.58	13.38**	71.75±25.52	600	11.96	20.70**
Thiamine (mg)	0.99±0.15	1.1	90.00	0.71^{ns}	0.79±0.08	1.0	79.00	2.56^{ns}
Riboflavin(mg)	0.39±0.09	1.3	30.00	10.05**	0.26±0.04	1.2	21.67	26.24**
Niaçin (mg)	11.50±1.31	15	76.67	2.69^{ns}	13.85±1.85	13	106.54	0.46^{ns}
Vitamin C (mg)	32.69±4.23	40	81.73	1.73^{ns}	16.58±4.42	40	41.45	5.29**

** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

Table 61. Mean nutrient intake of boys and girls (13-15 years) in comparison with RDA

Nutrient	Boys n=3				Girls n=5			
	Mean±SE	RDA	Per cent of RDA	't' value (comparison with RDA)	Mean±SE	RDA	Per cent of RDA	't' value (comparison with RDA)
Protein (g)	29.27±1.48	70	41.81	27.50**	30.20±1.60	65	46.46	21.77**
Fat (g)	6.12±0.52	22	27.82	30.59**	7.16±0.64	22	32.55	23.33**
Energy (Kcal)	1398.93±46.08	2450	57.10	22.81**	1347.55±5.17	2060	65.42	7.58**
Calcium (mg)	102.19±11.30	600	17.03	44.05**	678.24±261.10	600	113.04	0.29^{ns}
Phosphorus (mg)	601.00±16.33	600	100.17	0.06^{ns}	820.28±115.49	600	136.71	1.91^{ns}
Iron (mg)	5.05±0.31	41	12.32	116.50**	10.08±2.10	28	36.00	8.56**
Retinol (µg)	76.76±33.62	600	12.79	15.56**	323.61±82.23	600	53.94	3.36*
Thiamine (mg)	0.85±0.01	1.2	70.83	20.22**	1.18±0.17	1.0	118.00	1.08^{ns}
Riboflavin (mg)	0.27±0.01	1.5	18.00	98.28**	0.47±0.10	1.2	39.17	7.17**
Niacin (mg)	14.09±0.28	16	88.06	6.99*	10.11±1.70	14	72.21	2.30^{ns}
Vitamin C (mg)	10.89±2.02	40	27.23	14.41**	44.92±9.75	40	112.30	0.50^{ns}

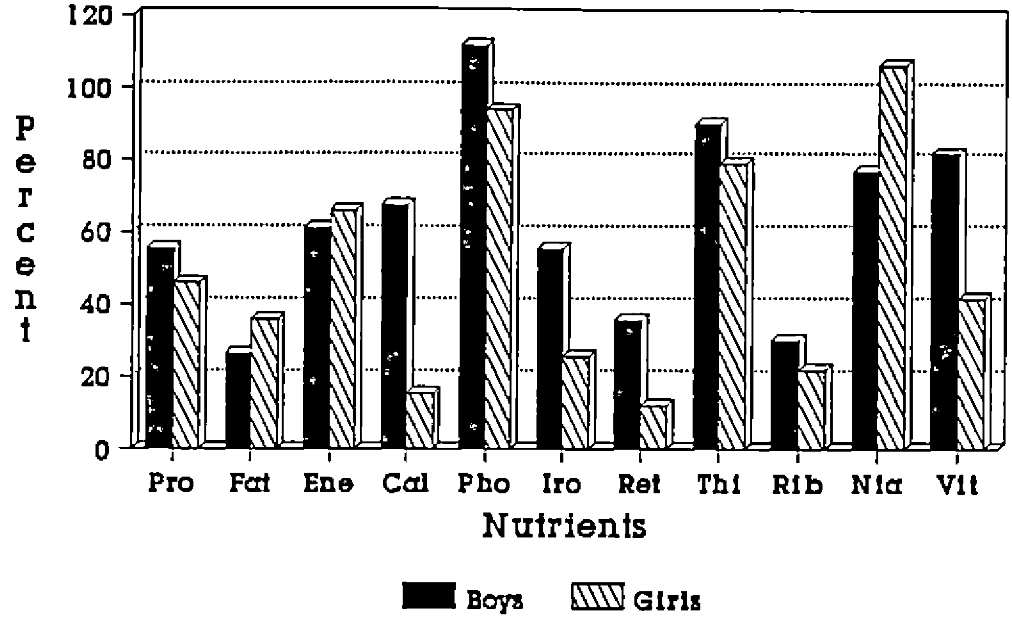
** Significant at 1 per cent level
* Significant at 5 per cent level
RDA Recommended Dietary Allowances
ns not significant
n number of children

The percentage intake of nutrients in comparison with the Recommended Dietary Allowances is illustrated in Fig. 25.

4.3.4. Biochemical estimation of blood

The blood haemoglobin was estimated in 135 boys and 109 girls aged 5 to 15 years and the mean haemoglobin values of different age groups were compared with the standard values suggested by World Health Organization as given in Gopaldas and Seshadri (1987) and the statistical interpretations are given in Table 62.

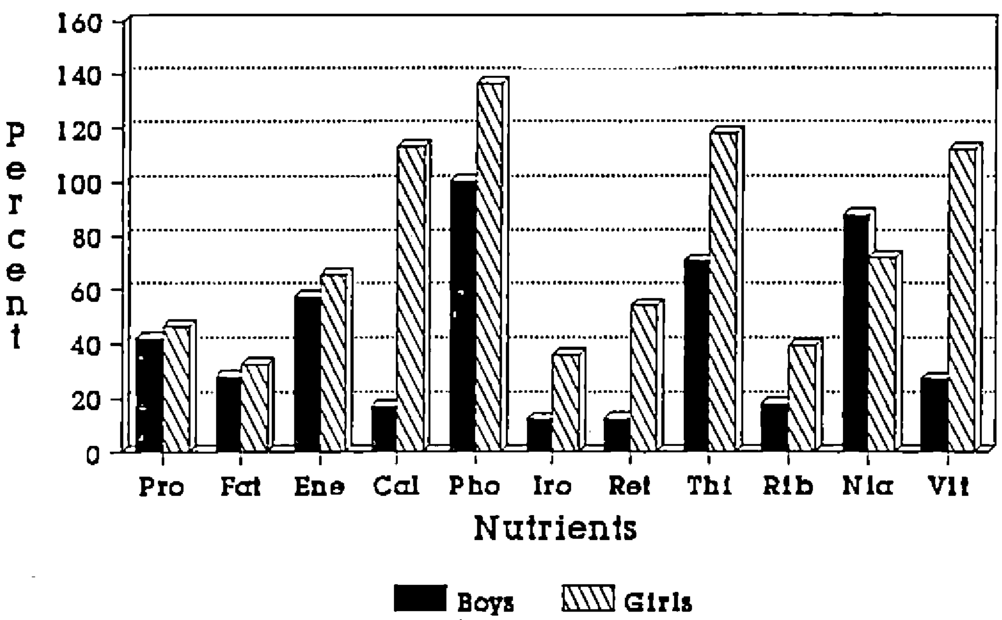
It was revealed that the mean haemoglobin values of boys and girls of all ages were lower than the standards. The deviations ranged from 0.42 g/100ml (11-year-old) to 2.74 g/100 ml (12-year-old) in the case of boys and 1.11g/100 ml (5- and 14- year-old) to 3.15 g/100 ml (13-year-old) in the case of girls. The data when analysed statistically revealed that the mean haemoglobin values at different ages were significantly lower (P = 0.01) than the standard values except for boys and girls aged 11 years and girls aged 14 years. The comparison of the mean haemoglobin values of boys and girls with the standard values are illustrated in Figs. 26 and 27 respectively.



Pro - Protein
Fat - Fat
Ene - Energy
Cal - Calcium
Pho - Phosphorus
Iro - Iron

Ret - Retinol
Thi - Thiamine
Rib - Riboflavin
Nia - Niacin
Vit - Vitamin C

Fig. 24. Nutrient intake of children (10-12 years) as percentage of RDA



Pro - Protein
Fat - Fat
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Cal - Calcium
Pho - Phosphorus
Iro - Iron

Ret - Retinol
Thi - Thiamine
Rib - Riboflavin
Nia - Niacin
Vit - Vitamin C

5. Nutrient intake of children
percentage of RDA

Table 62. Comparison of the mean haemoglobin levels of children with the standards

Age (Years)	Boys					Girls				
	Sample size	Haemoglobin Mean ± SE g/100 ml	Standard (g/100 ml of blood)	Reduction from the standard (g/100 ml)	't' value (comparison with the standard)	Sample size	Haemoglobin Mean ± SE g/100 ml	Standard (g/100 ml of blood)	Reduction from the standard (g/100 ml)	't' value (comparison with the standard)
5	17	9.11±0.19	11	1.89	10.19**	15	9.89±0.33	11	1.11	3.39**
6	13	9.62±0.29	12	2.38	8.27**	12	9.74±0.18	12	2.26	12.41**
7	19	9.77±0.31	12	2.23	7.28**	8	9.80±0.40	12	2.20	5.47**
8	16	9.58±0.16	12	2.42	14.89**	9	10.13±0.32	12	1.87	5.95**
9	12	10.12±0.21	12	1.88	9.14**	9	10.23±0.24	12	1.77	7.29**
10	21	10.21±0.23	12	1.79	7.83**	19	10.43±0.28	12	1.57	5.57**
11	6	11.58±0.49	12	0.42	0.87 ns	5	9.89±0.60	12	2.11	2.35 ns
12	10	9.26±0.15	12	2.74	18.26**	20	9.70±0.28	12	2.30	8.06**
13	7	10.30±0.24	12	1.70	6.94**	4	8.85±0.43	12	3.15	7.39**
14	7	10.58±0.35	12	1.42	4.06**	5	10.89±0.42	12	1.11	2.64 ns
15	7	11.06±0.22	13	1.94	9.01**	3	9.90±0.14	12	2.10	14.85**

** Significant at 1 per cent level
ns not significant

SOURCE
Standard - (Gopaldas and Seshadri. 1987)

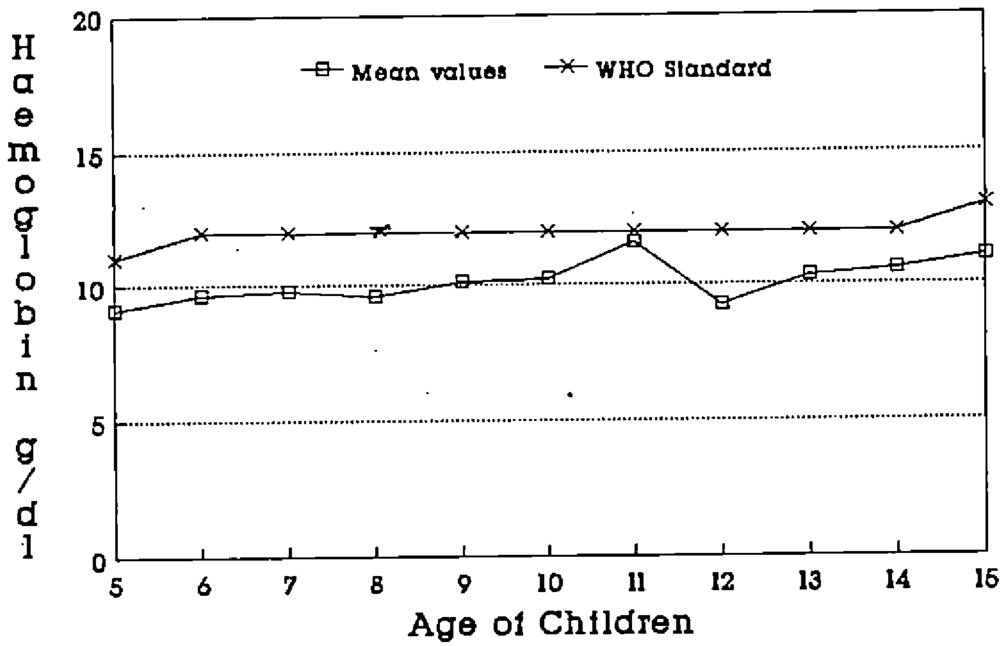


Fig. 26. Comparison of the mean haemoglobin levels of boys (5-15 years) with the standards

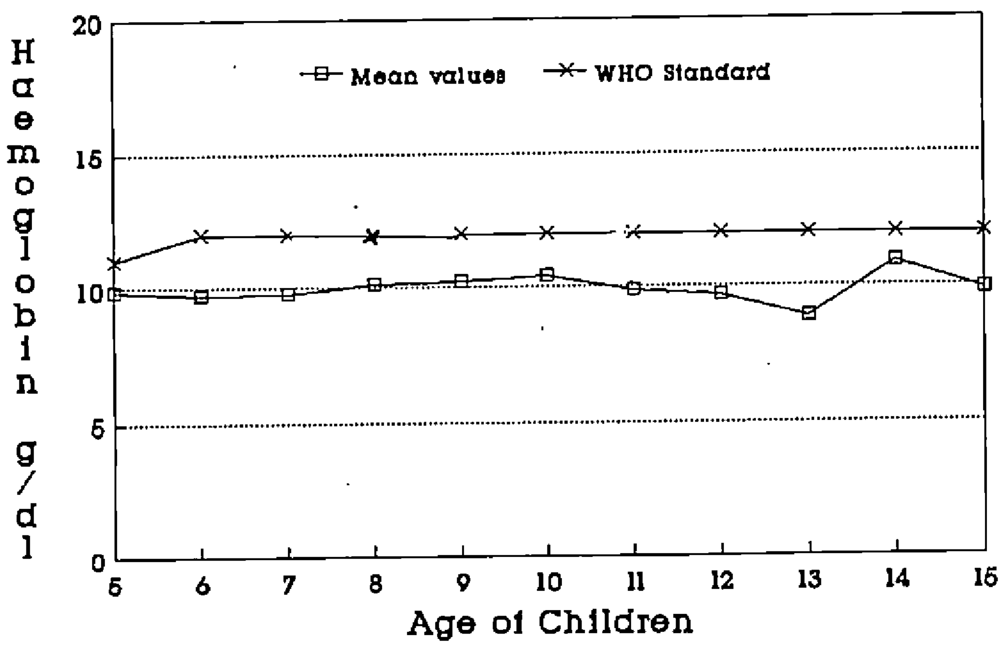


Fig. 27. Comparison of the mean haemoglobin levels of girls (5-15 years) with the standards

To interpret the iron status of the children they were grouped according to the criteria suggested by Gopaldas and Seshadri (1987) with reference to haemoglobin values and the details are given in Table 63.

The results indicated that 68.15 per cent boys and 43.12 per cent girls between 5 to 15 years of age had 'deficient' iron status on the basis of haemoglobin values while 26.67 per cent boys and 49.54 per cent girls had 'low' iron status. Only 5.18 per cent boys and 7.34 per cent girls had 'acceptable' values (Fig. 28). Among the different age groups also majority of the boys and girls had deficient levels except girls aged 7 to 9 years and 10 to 12 years who had low iron status (Fig. 29).

Serum profile of selected tribal children (7 boys and 3 girls) with specific reference to iron, protein and albumin, and packed cell volume, RBC count, total count and differential count of blood were also estimated. The values were compared with the normal values suggested by Chatterjee (1991).

The direct measurement of iron is very important in detecting iron deficiency status. The mean serum values for iron in the case of boys were found to be 89.57 µg/dl and in the case of girls it was 90 µg/dl (Table 64). All the children irrespective of sex were found to have a normal range of serum iron.

Table 63. Distribution of children based on iron status

Particulars*	5-6		7-9		10-12		13-15		Total	
	B	G	B	G	B	G	B	G	B	G
Deficient	23 (76.67)	15 (55.56)	28 (59.57)	9 (34.61)	20 (54.06)	17 (38.64)	21 (100)	6 (50.00)	92 (68.15)	47 (43.12)
Low	6 (20.00)	9 (33.33)	18 (38.30)	16 (61.54)	12 (32.43)	24 (54.54)	-	5 (41.67)	36 (26.67)	54 (49.54)
Acceptable	1 (3.33)	3 (11.11)	1 (2.13)	1 (3.85)	5 (13.51)	3 (6.82)	-	1 (8.33)	7 (5.18)	8 (7.34)
Total	30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

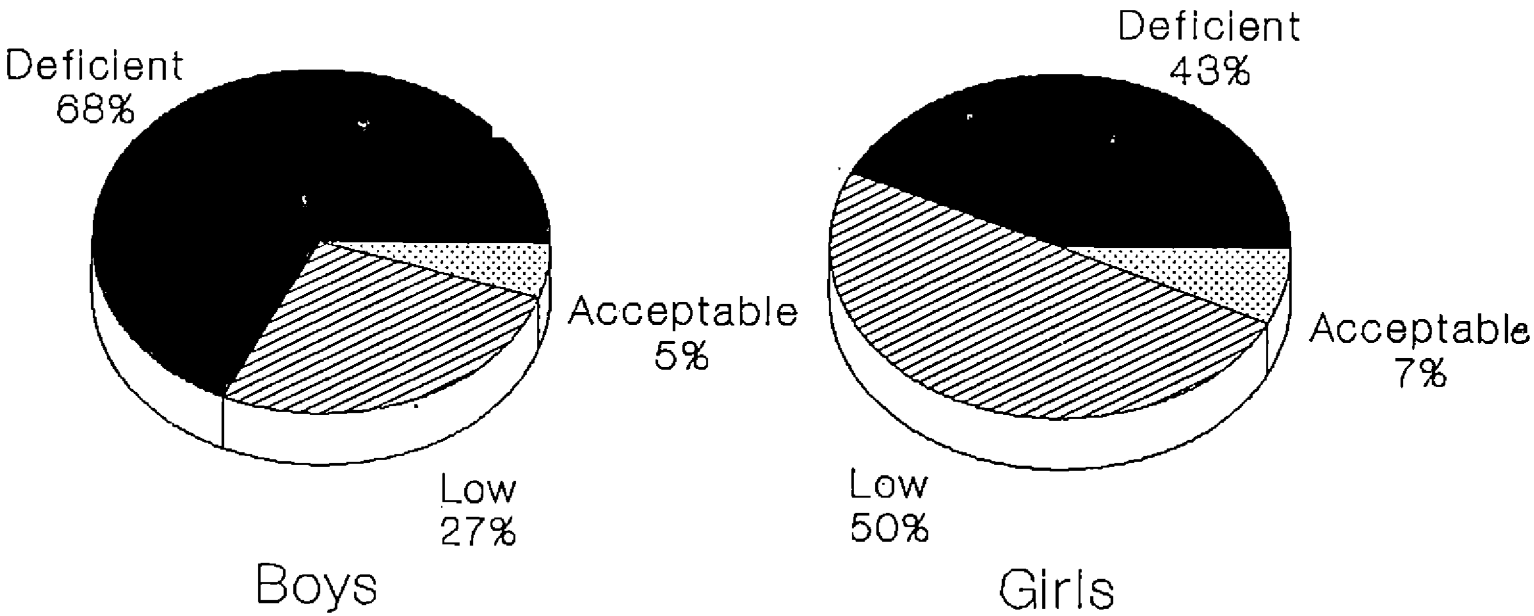
Age in years

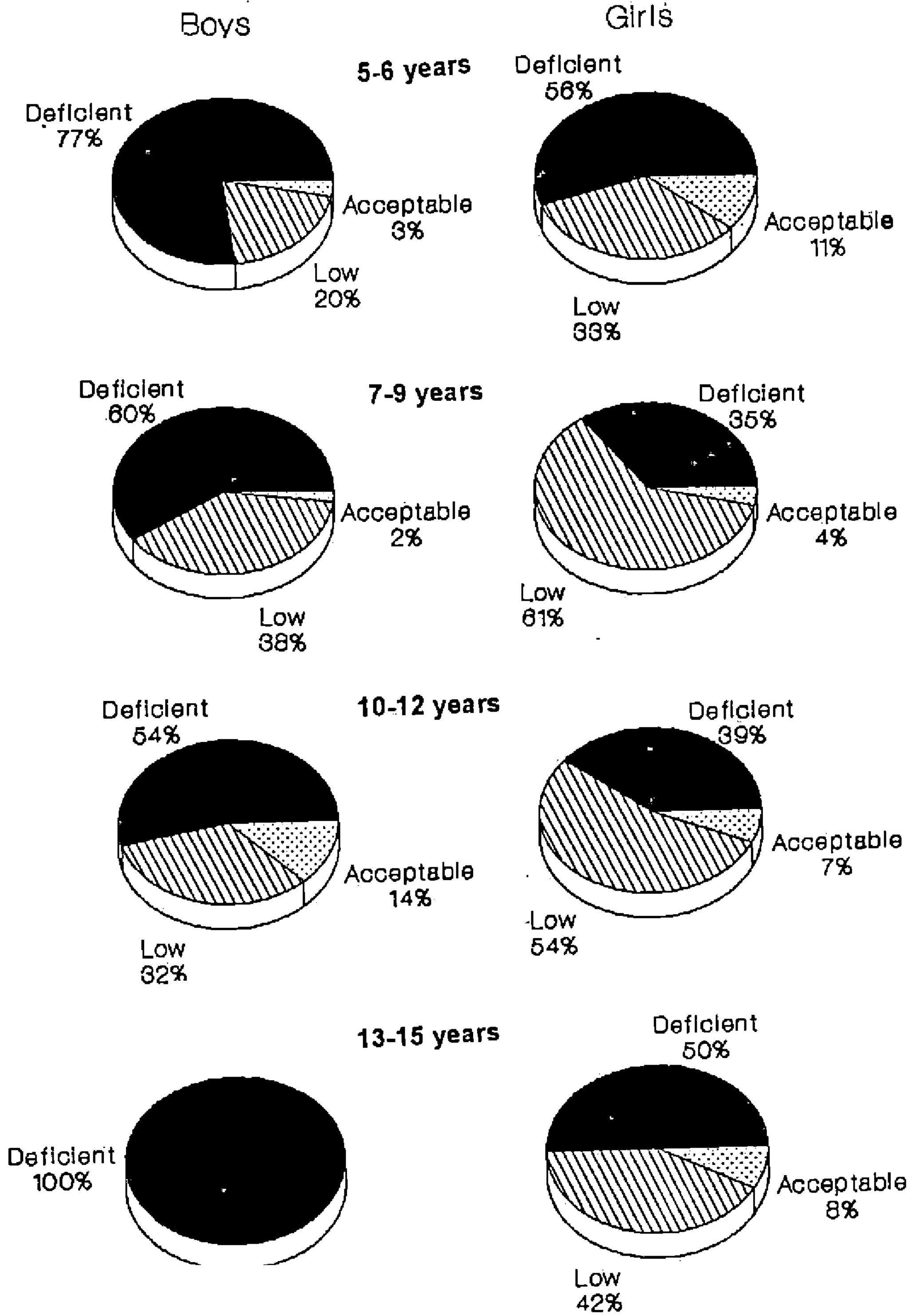
Number in parenthesis indicates percentage
B = Boys G = Girls

* Haemoglobin g/100ml

Age(years)		Deficient	Low	Acceptable
5	(M-F)	<10.0	10 to 10.9	⩾11.0
6 - 12	(M-F)	<10.0	10 to 11.4	⩾11.5
13- 15	(M)	<12.0	12 to 12.9	⩾13.0
13- 15	(F)	<10.0	10 t0 11.4	⩾11.5

Fig. 28. Iron status of children (5-15 years) on the basis of haemoglobin levels





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.n level

Table 64. Distribution of children on the basis of serum iron level and packed cell volume

Parameters	Iron status	Boys (n=7)	Girls (n=3)	Normal range
Serum iron (µg/dl)	Normal	7 (100)	3 (100)	50 to 150
	Below normal	-	-	
	Mean	89.57	90	
Packed cell volume (per cent)	Normal	-	-	40 to 45
	Below normal	7 (100)	3 (100)	
	Mean	31	29.67	

Number in parenthesis indicates percentage

Packed cell volume or haematocrit per cent determines whether an individual is normal, anaemic or polycythaemic. Table 64 indicates that packed cell volume of all children were lower than the normal range. The mean packed cell volume was found to be 31 per cent for boys and 29.67 per cent for girls.

To assess the protein status of children, serum protein and albumin were estimated. The results (Table 65) indicates that all the children had a normal range of serum protein and the mean values were 6.38 g/dl (boys) and 6.37 g/dl (girls).

Table 65. Distribution of children on the basis of serum protein and albumin levels

Parameters	Protein status	Boys (n=7)	Girls (n=3)	Normal range
Serum protein (g/dl)	Normal	7 (100)	3 (100)	6 to 8
	Below normal	-	-	
	Mean	6.38	6.37	
Serum albumin (g/dl)	Normal	7 (100)	3 (100)	3.2 to 5.5
	Below normal	-	-	
	Mean	3.61	3.73	

Number in parenthesis indicates percentage

All children had normal serum albumin levels and the mean values of boys was found to be 3.61 g/dl and for girls it was 3.73 g/dl.

To assess the general health status of the children blood parameters like RBC count, total count and differential counts were also determined. It was found that the mean RBC count of the children was 3.1 million/cu. mm for boys and 3 million/cu. mm for girls (Table 66); All the boys and girls had a lower count of red blood cells.

Table 66. Distribution of children on the basis of selected blood parameters

Sl.No.	Parameter	Indication	Boys n=7	Girls n=3	Normal range
1.	RBC count (million/ cu. mm)	Normal	-	-	4.5 to 5
		Below normal	7 (100)	3 (100)	
		Mean	3.1	3	
2.	Total count (per cu. mm)	Normal	7 (100)	3 (100)	4000 to 11000
		Above normal	-	-	
		Mean	8557.14	8866.67	
3.	Differential count				
	a) Neutrophils (per cent)	Normal	3 (42.86)	1 (33.33)	60 to 70
		Below normal	4 (57.14)	2 (66.67)	
		Mean	56	52	
	b) Lymphocytes (per cent)	Normal	2 (28.57)	1 (33.33)	25 to 30
		Above normal	5 (71.43)	2 (66.67)	
		Mean	37.71	43.67	
	c) Eosinophils (per cent)	Normal	3 (42.86)	1 (33.33)	1 to 4
		Above normal	4 (57.14)	2 (66.67)	
		Mean	6.28	4.33	

Number in parenthesis indicates percentage

The total count of blood revealed that all children had a normal count and the mean total count was found to be 8557.14 and 8866.67 per cu.mm for boys and girls respectively.

The results of the differential count indicated that 42.86 per cent boys and 33.33 per cent girls had a normal level of neutrophils while the rest showed lower level. In the case of lymphocytes, the count was normal among 28.57 per cent boys and 33.33 per cent girls and the rest had a higher level of lymphocytes in their blood. The eosinophil percentage was also found to be high among 57.14 per cent boys and 66.67 per cent girls and the rest had a normal percentage of eosinophils in their blood.

4.3.5. Examination of stool samples

Health disorders prevalent among these tribes may also be due to the unhygienic environment in which they are residing. Hence information related to worm infestation of the children was also collected and the details are presented in Table 67.

The analysis of the stool samples for worm infestations collected from 7 boys and 3 girls indicated that all the children studied were infected with either hookworm or roundworm or both. Most of the boys (71.43 %) and girls

(66.67 %) were found to have roundworm infection while 14.29 per cent boys and 33.33 per cent girls had hookworm infection.

Table 67. Distribution of children on the basis of worm infestation

Infestation	Boys n=7	Girls n=3
Hookworm	1 (14.29)	1 (33.33)
Roundworm	5 (71.43)	2 (66.67)
Hookworm and roundworm	1 (14.29)	-

Number in parenthesis indicates percentage

4.3.6. Nutritional status index of children

The results of the nutritional status index developed from the measurements of height, weight, mid upper arm circumference, skinfold thickness, clinical scores and haemoglobin values for 135 boys and 109 girls between 5 to 15 years are presented in Table 68 and Fig. 30

It was indicated that the mean nutritional status index of boys ranged from 55.25 (13-year-old) to 138.80 (11-year-old) and girls from 39.13 (12-year-old) to 124.29 (13-year-old). The comparison of the mean nutritional status index

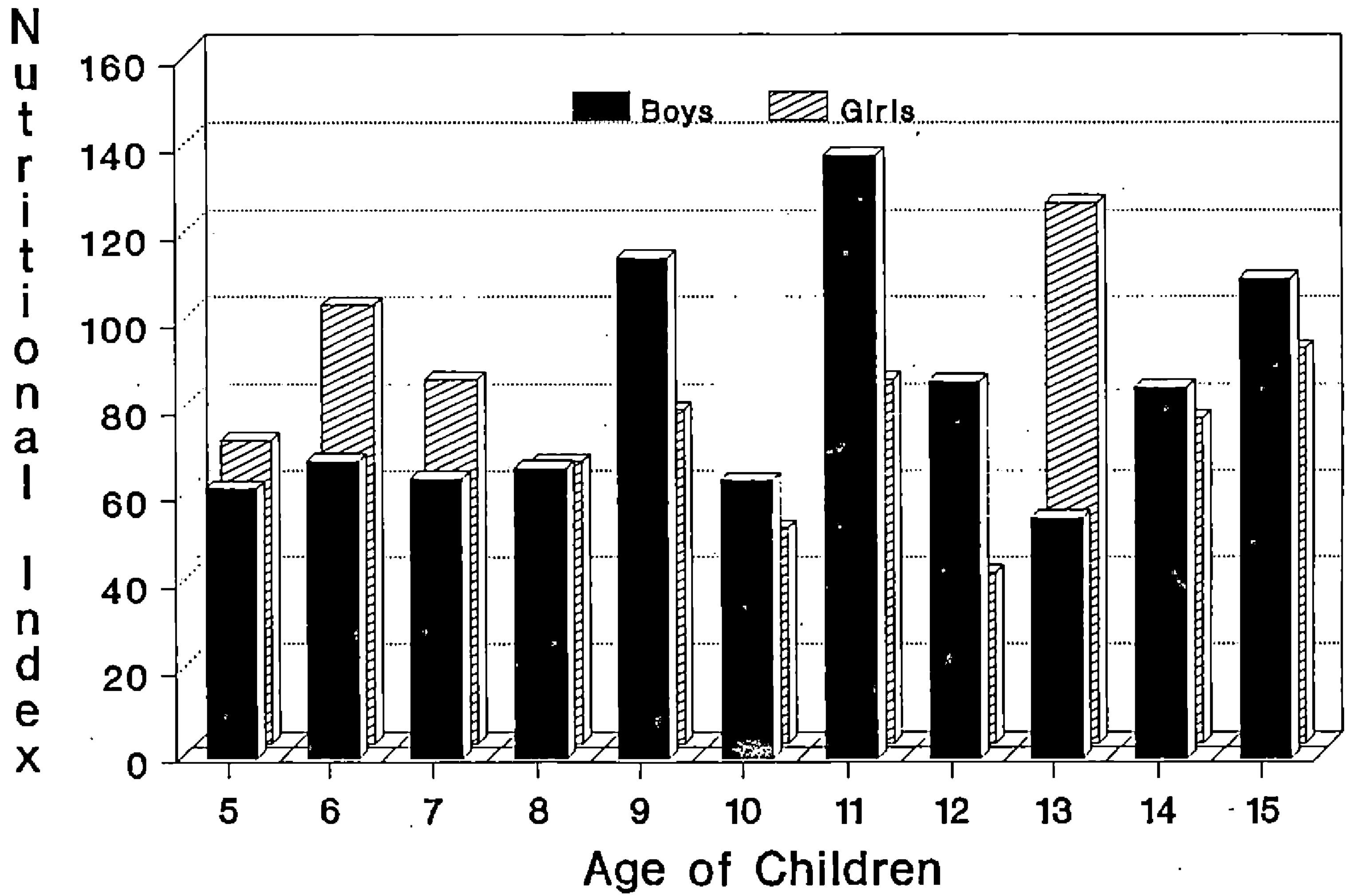
Table 68. Mean nutritional status index of boys and girls at different ages

Age (years)	Sample size B	Sample size G	Nutritional status index Mean ± SE Boys	Nutritional status index Mean ± SE Girls	't' value (comparison between boys and girls)
5	17	15	62.06±0.62	69.55±0.68	8.46**
6	13	12	68.35±0.64	100.82±0.86	31.17**
7	19	8	64.40±0.59	83.71±1.11	17.28**
8	16	9	66.76±0.57	64.63±0.82	2.28*
9	12	9	115.27±0.90	76.69±0.90	31.13**
10	21	19	63.89±0.56	49.35±0.59	18.45**
11	6	5	138.80±1.77	83.85±1.48	25.58**
12	10	20	86.73±1.09	39.13±0.33	55.69**
13	7	4	55.25±0.95	124.29±0.43	46.66**
14	7	5	85.37±0.98	74.65±0.43	9.39**
15	7	3	110.35±1.22	90.92±1.22	10.31**

B - Boys, G - Girls
** Significant at 1 per cent level
* Significant at 5 per cent level

of boys and girls at different ages showed that significant difference existed between the nutritional status index of boys and girls. It was evident from Fig. 30 that among the eleven groups ranging from 5 to 15 years the nutritional status indices of boys were significantly higher than that of girls in certain ages viz. 8, 9, 10, 11, 12, 14 and 15 years.

Fig. 30. Comparison of the mean nutritional status index of boys and girls.



The distribution of children into different categories of nutritional status by classifying the nutritional status index into low, medium and high (Table 69) revealed that only 28.89 per cent of boys and 21.10 per cent girls had high nutritional status, and 40 per cent boys and 47.71 per cent girls had medium nutritional status. The rest of the boys (31.11 %) and girls (31.19 %) had low nutritional status (Fig. 31). Among the four age groups also majority of the boys and girls of all age groups were found to have either low or medium nutritional status (Fig.32). The nutritional status index of 135 boys and 109 girls are given in Appendix VIII.

The one way Analysis of Variance (ANOVA) carried out showed that there is significant difference between the nutritional status indices of the different age groups for both boys and girls.

The comparison of the mean nutritional status indices using Duncan's Multiple Range Test (DMRT) revealed the following results. In the case of boys highest nutritional status index was obtained for 13 to 15 years followed by 10 to 12 years, 7 to 9 years and 5 to 6 years (Table 70). In the case of girls also 13 to 15 years had the highest mean nutritional status index followed by 5 to 6 years, 7 to 9 years and 10 to 12 years. The results also revealed that the mean nutritional status indices of boys in the three age

Table 69. Distribution of children on the basis of nutritional status index

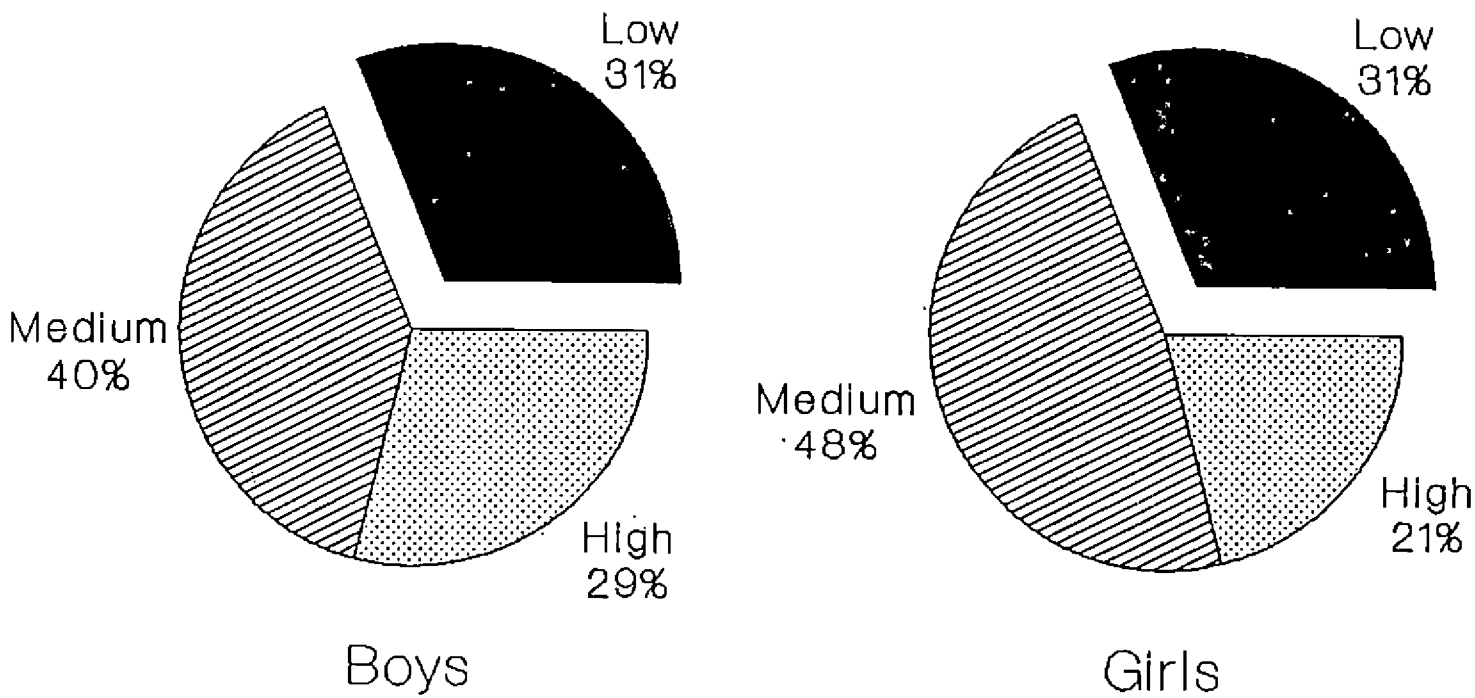
Particulars (Nutritional status index)	Age in years								Total	
	5-6		7-9		10-12		13-15			
	B	G	B	G	B	G	B	G	B	G
Low	9 (30.00)	4 (14.81)	9 (19.15)	8 (30.77)	18 (48.65)	17 (38.64)	6 (28.57)	5 (41.67)	42 (31.11)	34 (31.19)
Medium	13 (43.33)	18 (66.67)	26 (55.32)	11 (42.31)	7 (18.92)	19 (43.18)	8 (38.10)	4 (33.33)	54 (40.00)	52 (47.71)
High	8 (26.67)	5 (18.52)	12 (25.53)	7 (26.92)	12 (32.43)	8 (18.18)	7 (33.33)	3 (25.00)	39 (28.89)	23 (21.10)
Total	30 (100)	27 (100)	47 (100)	26 (100)	37 (100)	44 (100)	21 (100)	12 (100)	135 (100)	109 (100)

B - Boys

G - Girls

Number in parenthesis indicates percentage

Fig. 31. Percentage distribution of children(5-15 years) on the basis of nutritional status index



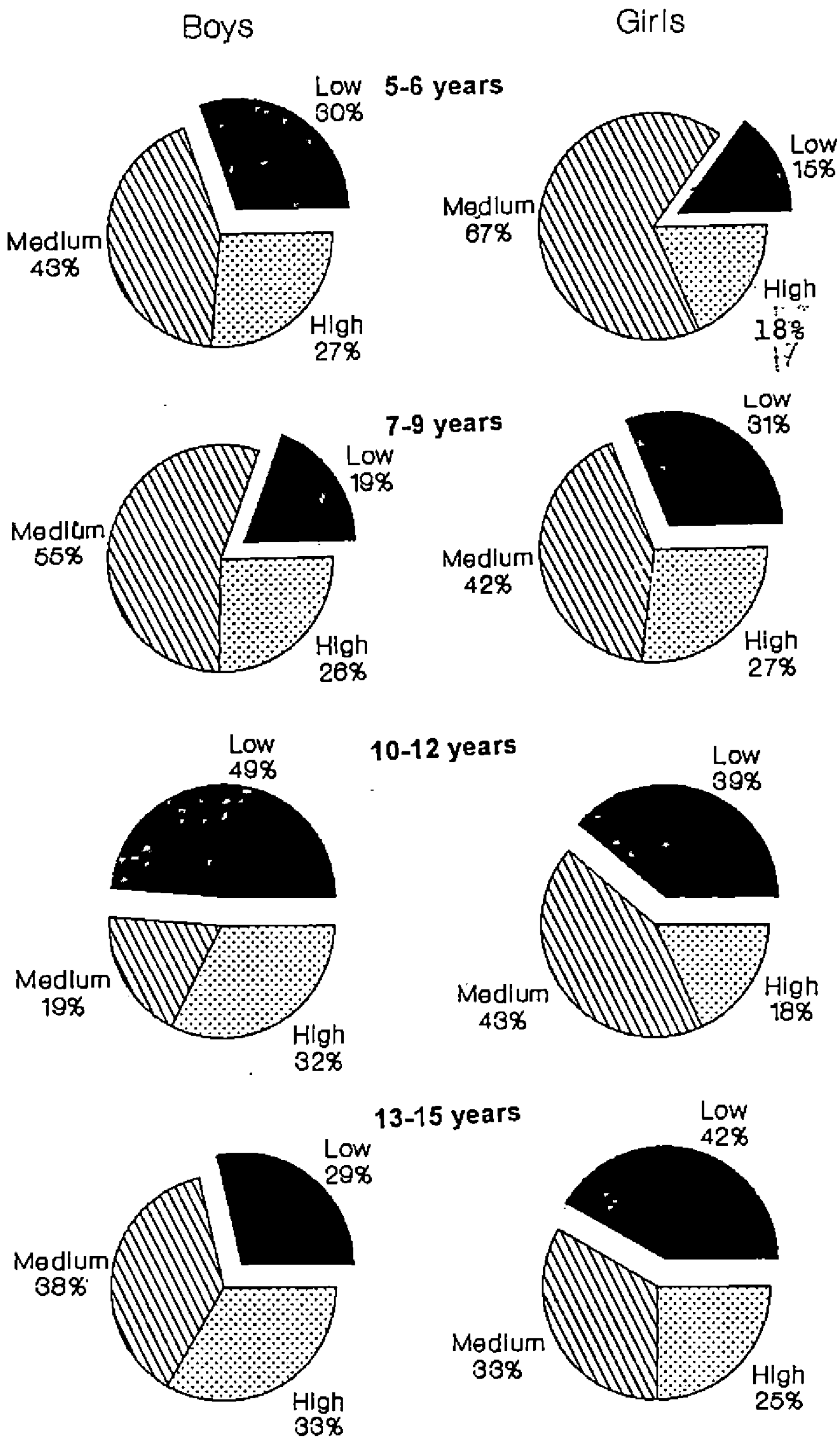


Fig. 32. Percentage distribution of children (different age groups) on the basis of nutritional status index

groups between 7 to 15 years were not significantly different while for girls, significant difference in nutritional status indices was seen between various age groups.

Table 70. Mean nutritional status index of different age groups (DMRT)

Age (years)	Boys	Girls
5-6	64.78a*	83.46b
7-9	78.19b	74.67c
10-12	82.21b	48.62d
13-15	83.65b	95.26a

* In a column, means followed by a common letter are not significantly different at 5 per cent level.

4.3.7. Factors influencing nutritional status of children

To ascertain the factors influencing the nutritional status of children correlation analysis and χ^2 test were carried out.

Family size, family income, food expenditure, amount spent for vices, number of children, birth order, birth spacing, personal hygiene, housing conditions and nutritional awareness of the respondents were the variables selected for correlation analysis.

As revealed in Table 71, in general, there was no significant relationship between the variables and nutritional status index of children. However birth order of boys had a significant negative correlation with nutritional status index.

Table 71. Correlation of independent variables with nutritional status index of children

Sl. No.	Independent variable	Correlation coefficient	
		Boys (n=135)	Girls (n=109)
1.	Family size	-0.0874	-0.0054
2.	Family income	-0.0139	-0.1407
3.	Food expenditure	-0.0302	-0.1345
4.	Amount spent for vices	0.0677	-0.1238
5.	Number of children	-0.0765	0.0269
6.	Birth order	-0.1746*	0.0346
7.	Birth spacing from the older child	0.0718	-0.0859
8.	Birth spacing from the younger child	-0.0805	0.1031
9.	Personal hygiene (adults)	-0.0235	-0.0393
10.	Personal hygiene (children)	-0.0133	-0.0071
11.	Housing condition	-0.0661	0.0464
12.	Nutritional awareness of the respondent	-0.1656	0.0806

* Significant at 5 per cent level.

Independent variables such as education and occupation of father and mother, education of children, morbidity status of the children, health facilities in the locality and participation of children in feeding programmes were tested statistically (χ^2) to find out the influence on nutritional status index of boys and girls and the results are presented in Tables 72 and 73. Some rows are pooled together in the calculation of χ^2 since the expected frequencies are less than 5.

Table 72. Association between independent variables and nutritional status index (boys)

Sl. No.	Independent variable	Nutritional status index			χ^2
		Low	Medium	High	
1.	Education of father				
	Illiterate	32	40	29	
	Lower primary	7	9	9	χ^2_2 0.058
	Upper primary and above	3	5	1	
2.	Education of mother				
	Illiterate	40	51	36	
	Lower primary	2	1	2	χ^2_2 0.33
	Upper primary and above	-	2	1	

Contd...

Table 72 Contd.....

3. Occupation of father					
Labour class	25	32	27		
Cultivator	7	12	4	χ^2_4	3.52
Job (Govt/Pvt)	-	1	-		
No work	10	9	8		
4. Occupation of mother					
Labour class	22	33	18		
Cultivator	10	10	8	χ^2_4	2.84
No work	10	11	13		
5. Education of children					
Illiterate	5	5	2		
Dropout	5	4	8	χ^2_4	4.46
School going	32	45	29		
6. Health facilities in the locality					
No facilities	21	25	14		
Health facilities available	21	29	25	χ^2_2	1.74
7. Morbidity status of the children					
No disease	22	20	13		
One disease	18	29	19	χ^2_4	6.18
Two diseases	2	5	7		
8. Participation of children in feeding programmes					
Participant	29	40	29	χ^2_2	0.38
Non participant	13	14	10		

Table 73. Association between independent variables and nutritional status index (girls)

Sl. No.	Independent variable	Nutritional status index Low	Medium	High	χ^2	
1.	Education of father					
	Illiterate	28	32	16		
	Lower primary	3	11	3	χ^2_4	4.53
	Upper primary and above	3	9	4		
2.	Education of mother					
	Illiterate	33	47	22		
	Lower primary	-	4	-	χ^2_2	1.74
	Upper primary and above	1	1	1		
3.	Occupation of father					
	Labour class	19	28	13		
	Cultivator	8	11	5	χ^2_4	0.76
	Job (Govt/Pvt)	2	4	-		
	No work	5	9	5		
4.	Occupation of mother					
	Labour class	23	31	13		
	Cultivator	6	8	5	χ^2_4	2.35
	Job (Govt/Pvt)	1	2	-		
	No work	4	11	5		
5.	Education of children					
	Illiterate	4	3	2		
	Dropout	3	4	3	χ^2_4	1.58
	School going	27	45	18		

Contd....

Table 73 Contd.....

6. Health facilities in the locality					
No facilities	14	27	10	χ^2_4	1.08
Health facilities available	20	25	13		
7. Morbidity status of the children					
No disease	8	19	8		
One disease	21	24	14	χ^2_4	4.29
Two diseases	5	9	1		
8. Participation of children in feeding programmes					
Participant	7	9	5	χ^2_2	0.25
Non participant	27	43	18		

The results revealed that no significant association existed between different variables and nutritional status index of both boys and girls.

4.3.8. Coefficient of correlation between independent variables and the nutritional status index (dependent variable) of children

The coefficient of correlation worked out between the 18 independent variables and nutritional status index of boys between 5 to 15 years age are given in Table 74.

able 74. Inter relationship of different factors with nutritional status index (boys) n = 135

X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
1	0.9545**	0.6402**	0.8826**	0.6229**	0.3527**	−0.1191	0.1791*	0.1516	0.0161	0.0879	−0.0903	0.0152	0.1432	0.1022	−0.2807**	0.1071	0.4213**
2		0.4099**	0.8199**	0.5904**	0.4052**	−0.0895	0.2018*	0.1664	0.0079	0.0820	−0.0482	0.0691	0.1374	0.1134	−0.2535**	0.1157	0.4091**
3			0.6110**	0.4653**	0.0870	−0.1438	0.0709	0.0699	0.0214	0.0362	−0.1613	−0.0556	0.0809	0.1123	−0.2420**	0.0047	0.2887**
4				0.5610**	0.2792**	−0.1319	0.2115*	0.1843*	0.0943	0.1272	−0.1160	0.0272	0.0613	0.1437	−0.2595**	0.0276	0.3307**
5					0.2031*	−0.1360	0.0298	0.0179	0.0074	0.1373	−0.1323	−0.0344	0.1488	0.0127	−0.3219**	−0.0330	0.2888**
6						0.0097	0.1113	0.0824	0.1040	0.0251	0.0184	0.0882	0.0680	−0.0273	−0.0809	0.1914*	0.4076**
7							0.2282**	0.2021*	−0.2022*	−0.1888*	0.9649**	0.3063**	0.1569	0.0317	0.7313**	−0.1293	−0.0874
8								0.9653**	0.1357	0.0975	0.2160*	0.1341	−0.0114	0.1475	0.2970**	0.0413	0.0139
9									0.1384	0.0584	0.1916*	0.0976	−0.0397	0.0720	0.2927**	0.0788	−0.0302
10										0.6624**	−0.2256**	−0.0603	−0.1214	0.2917**	−0.0956	−0.1141	−0.0235
11											−0.2154*	−0.0105	−0.0618	0.3229**	−0.1267	−0.2835**	−0.0133
12												0.3320**	0.1220	0.0137	0.7793**	−0.1066	−0.0765
13													0.0470	0.0388	0.3452**	−0.1495	0.0718
14														0.0838	0.0784	0.0663	−0.0805
15															0.0301	−0.2703**	0.0661
16																−0.1329	−0.1746*
17																	0.0380

= Weight; X_2 = Height; X_3 = Weight/height^2; X_4 = Mid upper arm circumference; X_5 = Skinfold thickness; X_6 = Haemoglobin; X_7 = Family size

= Income; X_9 = Food expenditure; X_{10} = Personal hygiene (adult); X_{11} = Personal hygiene (children); X_{12} = Number of children;

3 = Birth spacing (older child); X_{14} = Birth spacing (younger child); X_{15} = Housing condition; X_{16} = Birth order; X_{17} = Clinical score

8 = Nutritional status index; * = Significant at 5 per cent level; ** = Significant at 1 per cent level.

the boys showed a significant positive correlation with nutritional status index. Haemoglobin levels also revealed a significant positive correlation with nutritional status index.

Variables like family size, number of children, personal hygiene of adults and children, birth spacing from the younger child and housing and income showed negative but insignificant correlation with nutritional status index. However, birth order of boys had a significant negative correlation and birth spacing from the older child had a positive but insignificant correlation with nutritional status index.

The coefficient of correlation worked out between the independent variables and nutritional status index (dependent variable) for girls are presented in Table 75.

As revealed in the table a positive insignificant correlation was observed between the independent variables like number of children, birth spacing from the younger child, housing condition, birth order and clinical score with nutritional status index.

able 75. Inter relationship of different factors with nutritional status index (girls) n = 109

X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
	0.9341**	0.7056**	0.9114**	0.6613**	0.0160	0.0715	0.1937*	0.1825	0.1168	0.1432	0.1652	−0.1210	−0.0655	0.0581	−0.2265*	0.0752	−0.1757
		0.4293**	0.8395**	0.7047**	0.0971	0.1184	0.1758	0.1596	0.1201	0.1408	0.1875	−0.0903	−0.0765	0.1384	−0.1892	0.0481	−0.2267*
			0.6747**	0.3069**	−0.1699	−0.0768	0.1574	0.1667	0.0635	0.1193	−0.0072	−0.1644	−0.0094	−0.1174	−0.2538**	0.0496	−0.1034
				0.6458**	0.0473	0.0037	0.2109*	0.2047*	0.1871	0.2058*	0.0685	−0.2012*	−0.0917	0.1112	−0.2425*	0.1129	−0.0826
					0.0287	0.1427	0.1545	0.1476	0.1435	0.2335*	0.1535	−0.1314	−0.0400	0.1983*	−0.1520	0.0100	−0.0299
						−0.0408	−0.0178	−0.0325	0.0967	0.0945	−0.0728	−0.1320	0.1200	0.1019	−0.1626	0.0123	−0.0797
							0.1794	0.1804	−0.1876	−0.1514	0.7298**	0.1593	0.1212	−0.0171	0.5266**	−0.1267	−0.0054
								0.9622**	0.1951*	0.1775	0.1134	0.0442	−0.1122	0.0867	0.1547	0.0950	−0.1407
									0.1961*	0.1845	0.1196	0.0612	−0.0998	0.0484	0.1305	0.1176	−0.1345
										0.5836**	−0.2526**	−0.1038	−0.0657	0.1936*	−0.1832	0.1320	−0.0393
											−0.2286*	−0.1753	−0.1577	0.2901**	−0.1607	0.0046	−0.0071
												0.2115	0.0844	−0.0643	0.6864**	−0.0724	0.0269
													0.0402	0.0099	0.2124*	0.0421	−0.0859
														−0.0651	−0.1815	−0.1380	0.1031
															−0.0311	−0.2047*	0.0464
																−0.0183	0.0346
																	0.1451

= Weight; X_2 = Height; X_3 = Weight/height^2; X_4 = Mid upper arm circumference; X_5 = Skinfold thickness; X_6 = Haemoglobin; X_7 = Family size

= Income; X_9 = Food expenditure; X_{10} = Personal hygiene (adult); X_{11} = Personal hygiene (children); X_{12} = Number of children;

= Birth spacing (older child); X_{14} = Birth spacing (younger child); X_{15} = Housing condition; X_{16} = Birth order; X_{17} = Clinical score

= Nutritional status index; * = Significant at 5 per cent level; ** = Significant at 1 per cent level.

4.3.9. The inter-relationship of different variables contributing to the nutritional status index of the children

The results of the analysis of the inter-relationship of the 18 different variables of the study are also presented in Tables 74 and 75.

As revealed in Table 74, the weight of the boys indicated a significant positive correlation with height (0.9545), wt/ht^2 (0.6402), mid upper arm ci ıferenoe (0.8826), skinfold thickness (0.6229), haemoglobin (0.3527), income (0.1791) and nutritional status index (0.4213) while birth order showed a significant negative correlation.

A significant positive correlation was observed between height of the boys and wt/ht^2 (0.4099), mid upper arm circumference (0.8199), skinfold thickness (0.5904), haemoglobin (0.4052), income (0.2018) and nutritional status index (0.4091) while birth order showed a negative significant correlation.

Weight/height^2 influenced the birth order of the boys negatively and significantly while the variables such as mid upper arm circumference, skinfold hickness and nutritional status showed a significant positie correlation.

Mid upper arm circumferee showed a positive significant correlation with skind thickness (0.5610), haemoglobin (0.2792), income (0.2115), food expenditure (0.1843) and nutritional status index (0.3307) and a negative significant correlation with birth order (-0.2595).

A positive significant correlation was found between skinfold thickness and haemoglobin, and nutritional status index while birth order showed a negative significant correlation.

Haemoglobin showed a significant positive correlation only with clinical score and nutritional status index.

A positive correlation was observed between family size and income (0.2282), food expenditure (0.2021), number of children (0.9649), birth spacing from the older child (0.3063), birth order (0.7313) while personal hygiene of the adults (-0.2022) and children (-0.1888) showed a negative significant correlation.

Income of the family had a positive significant correlation with food expenditure (0.9656) and number of children (0.2160).

A significant positive correlation was found between food expenditure and number of children (0.1916).

The variables like food expenditure, birth spacing from the older child, birth order and income showed positive significant correlation with the total number of children in the family.

Personal hygiene of the adults had a significant positive correlation with the personal hygiene of the children (0.6624) and housing condition of the family (0.2917). Personal hygiene of the children also showed a positive significant correlation with the housing condition of the family (0.3229).

A significant positive correlation was observed between birth spacing from the older child and birth order (0.3452).

Birth order had a significant negative correlation with nutritional status index.

In the case of girls weight had a significant positive correlation with height (0.9341), wt/ht^2 (0.7056), mid upper arm circumference (0.9114) and skinfold thickness (0.6613) and a negative significant correlation with birth order (0.2265).

A significant positive correlation was observed between height and wt/ht^2 (0.4293), mid upper arm circumference (0.8395) and skinfold thickness (0.7047) and a negative significant correlation with nutritional status index.

Weight/height^2 showed a significant positive correlation with mid upper arm circumference (0.6747) and skinfold thickness (0.3069) and a negative significant correlation with birth order (0.2538).

Mid upper arm circumference had a significant positive correlation with skinfold thickness (0.6458), food expenditure (0.2047) income (0.2109), personal hygiene of children (0.2058) and showed a negative significant correlation with birth spacing from the older child (-0.2012) and birth order (-0.2425).

Skinfold thickness showed a significant positive correlation with personal hygiene of the children (0.2335) and housing conditions (0.1983).

Income of the family had a significant positive correlation with food expenditure and personal hygiene of adults.

Personal hygiene of adults had a significant positive correlation with personal hygiene of children (0.5836) and housing conditions (0.1936).

A significant positive correlation was observed between personal hygiene of the children and housing conditions (0.2901).

Number of children had a significant positive correlation with birth order (0.6864).

Birth spacing from the older child showed a positive significant correlation with the birth order of girls.

4.4. Prevalence of sickle cell anaemia and malaria among tribal children

To find out the prevalence of sickle cell anaemia and malaria among the Irula children of Attappady 76 boys and 66 girls between 5 to 15 years of age were subjected for the sickling test.

The results (Table 76) revealed that the incidence of sickle cell anaemia among boys and girls between 5 to 15

Table 76. Incidence of sickle cell anaemia among children

Age (years)	Boys			Girls		
	Present	Absent	Total	Present	Absent	Total
5-6	5 (23.81)	16 (76.19)	21 (100)	5 (33.33)	10 (66.67)	15 (100)
7-9	8 (25.81)	23 (74.19)	31 (100)	3 (17.65)	14 (82.35)	17 (100)
10-12	3 (20.00)	12 (80.00)	15 (100)	5 (17.86)	23 (82.14)	28 (100)
13-15	3 (33.33)	6 (66.67)	9 (100)	-	6 (100)	6 (100)
Total	19 (25.00)	57 (75.00)	76 (100)	13 (19.70)	53 (80.30)	66 (100)

Number in parenthesis indicates percentage of children years of age was 25 per cent and 19.70 per cent, respectively. Among the different age groups also sickle cell anaemia was found among boys and girls at different ages except girls between 13 to 15 years.

The association between the incidence of sickle cell anaemia and haemoglobin levels was examined for both boys and girls by χ^2 test of significance and it was found that these two factors are independent (χ^2 = 0.02 for boys and 3.21 for girls).

The results of the prevalence of malaria among boys and girls indicated that no malarial case was present among children.

4.5. Nutritional awareness of the tribal people and factors influencing nutritional awareness

Nutritional awareness of the respondents was assessed by asking 27 questions related to infant feeding practices, cooking practices and their knowledge regarding general health aspects. The percentage nutritional score obtained for the respondents are presented in Table 77.

The table revealed that 71.11 per cent of the respondents obtained a very low score ranging from 0 to 20 per cent while 22.78 per cent had a score within the range of 20 to 40 per cent. A percentage score ranging from 40 to

Table 77. Distribution of respondents on the basis of nutritional awareness score

Nutritional awareness score (per cent)	Number of respondents	Per cent
0-20	128	71.11
20-40	41	22.78
40-60	7	3.88
60-80	3	1.67
80-100	1	0.56
Total	180	100.00

60 per cent was observed among 3.88 per cent of the respondents and a still lower percentage of the respondents (2.23%) had a score of above 60 per cent.

Relationship between different variables like age of the respondents, family size, income, housing condition and land holding of the family with the nutritional awareness of the respondents (Table 78) indicated that except age, all the other variables were not associated significantly with the nutritional awareness scores obtained by the respondents.

Table 78. Relationship between selected socio-economic variables and nutritional awareness of the respondents.

Sl. No.	Independent variable	Correlation coefficient
1.	Age of the respondent	-0.3173**
2.	Family size	-0.0383 ns
3.	Income of the family	0.0712 ns
4.	Housing conditions	-0.1044 ns
5.	Land holdings	0.0507 ns

** Significant at 1 per cent level
ns not significant

An attempt to ascertain the association between the non-quantified independent variables like education of the respondent, occupation of the respondent, and mass media and urban contact of the respondent with their nutritional awareness (Table 79) indicated that significant association existed between education of the respondent and availability of mass media with nutritional awareness.

4.6. Attitude of the tribal people towards developmental programmes implemented in the locality

Developmental programmes were implemented in the area through balwadi, school, Integrated Tribal Development Project, hospital, voluntary organizations, etc. which gave emphasis on the overall development of the tribes. The attitude of the tribes towards developmental programmes

Table 79. Association between selected socio-economic variables and nutritional awareness of the respondents

Sl. No.	Independent variable	Nutritional awareness Low	Medium	High	χ^2	Association of χ^2
1.	Education of the respondent					
	Illiterate	98	26	40	χ^2_2 18.59**	0.31
	Lower primary	3	-	3		
	Upper primary and above	1	-	9		
2.	Occupation of the respondent					
	Labour class	61	17	23		
	Cultivator	8	3	5	χ^2_4 5.43	-
	Job (Govt./Pvt.)	2	0	7		
	No work	31	6	17		
3.	Mass media					
	Present	15	-	14	χ^2_2 9.61**	0.23
	Absent	87	26	38		
4.	Urban contact of the respondent					
	Absent	33	6	15	χ^2_2 0.90	-
	Present	69	20	37		

(Table 80) implemented through different agencies revealed that Irulas had a favourable attitude towards the programmes. Some of the programmes like balwadi and noon meal programmes were present only in seven of the nine hamlets studied and all of them had a favourable attitude while others had an undecided attitude. Only 55.56 per cent of the respondents had a favourable attitude towards the medical facilities and the rest had an unfavourable attitude mainly because of the non-availability of medical facilities. For the entire Attappady area only one primary health centre was available at Agali and the people from other hamlets had to travel a long distance to reach this centre for medical assistance.

Table 80. Attitude of the respondents towards the developmental programmes

Name of the programme	Attitude of the respondents			Total
	Favourable	Unfavourable	Undecided	
Balwadi	140 (77.78)	-	40 (22.22)	180 (100)
Non-meal programme	140 (77.78)	-	40 (22.22)	180 (100)
ITDP	180 (100)	-	-	180 (100)
Medical facilities	100 (55.56)	80 (44.44)	-	180 (100)
Voluntary organization	60* (100)	-	-	60 (100)

* Based on the opinions of 60 respondents

All the respondents revealed a favourable attitude towards the programmes implemented through Integrated Tribal Development Project. Regarding the voluntary organization namely NATURE, all the respondents in the three hamlets of Pudur panchayat, where the activities of the organization was confined had favourable attitudes towards its activities.

4.7. Direct and indirect effects of nutrients contributing to the nutritional status of children

Path analysis was carried out to find out the direct and indirect effects of the nutrients viz. protein, fat, energy, calcium, phosphorus, iron, retinol, thiamine, riboflavin, niacin and vitamin C contributing to the nutritional status of boys and girls. Since there is variation in the Recommended Dietary Allowances of nutrients for different age groups, age was also considered as an independent variable for the analysis.

The results of the analysis carried out for boys are presented in Table 81 and Fig. 33.

It was found that significant positive correlation existed between age (X_1) and nutritional status (0.5) and its direct effect was 0.3310 ie. 66 per cent of this correlation was contributed by the direct effect of age (X_1). The remaining 34 per cent of the correlation was due

Table 81. Direct and indirect effects of nutrients contributing to the nutritional status index of boys

Variables	Direct effect	Indirect effect: Positive	Indirect effect: Negative	Total correlation
X_1 (Age)	0.3310	4.3754 ($X_2, X_5, X_8, X_9, X_{11}$)	4.2064 ($X_3, X_4, X_6, X_7, X_{10}, X_{12}$)	0.5001*
X_2 (Protein)	2.9690	4.7551 ($X_1, X_3, X_5, X_8, X_9, X_{11}$)	7.45 ($X_4, X_6, X_7, X_{10}, X_{12}$)	0.2741
X_3 (Fat)	0.4384	2.5036 ($X_2, X_5, X_7, X_8, X_9, X_{11}$)	2.9109 ($X_1, X_4, X_6, X_{10}, X_{12}$)	0.0311
X_4 (Energy)	-3.2435	7.506 ($X_1, X_2, X_3, X_5, X_8, X_9, X_{11}$)	4.0699 (X_6, X_7, X_{10}, X_{12})	0.1926
X_5 (Calcium)	2.5333	3.0559 (X_1, X_2, X_3, X_8, X_9)	5.7012 ($X_4, X_6, X_7, X_{10}, X_{11}, X_{12}$)	-0.1120
X_6 (Phosphorus)	-3.5856	7.9485 ($X_1, X_2, X_3, X_5, X_8, X_9, X_{10}$)	4.2449 (X_4, X_7, X_{10}, X_{12})	0.1180
X_7 (Iron)	-0.9385	2.9629 (X_1, X_2, X_5, X_8, X_9)	2.1606 ($X_3, X_4, X_6, X_{10}, X_{11}, X_{12}$)	-0.1362
X_8 (Retinol)	1.3306	4.9938 ($X_1, X_2, X_3, X_5, X_9, X_{11}$)	6.2428 ($X_4, X_6, X_7, X_{10}, X_{12}$)	0.0816
X_9 (Thiamine)	1.5309	6.2684 ($X_1, X_2, X_3, X_5, X_8, X_{11}$)	7.7368 ($X_4, X_6, X_7, X_{10}, X_{12}$)	0.0625
X_{10} (Riboflavin)	-0.0634	6.7103 ($X_1, X_2, X_3, X_5, X_8, X_9, X_{11}$)	6.6253 (X_4, X_6, X_7, X_{12})	0.0216
X_{11} (Niacin)	1.8063	3.8958 ($X_1, X_2, X_3, X_7, X_8, X_9$)	5.4406 ($X_4, X_5, X_6, X_{10}, X_{12}$)	0.2615
X_{12} (Vitamin-C)	-1.8735	5.9577 ($X_1, X_2, X_3, X_5, X_8, X_9, X_{11}$)	4.2035 (X_6, X_7, X_{10})	-0.1193

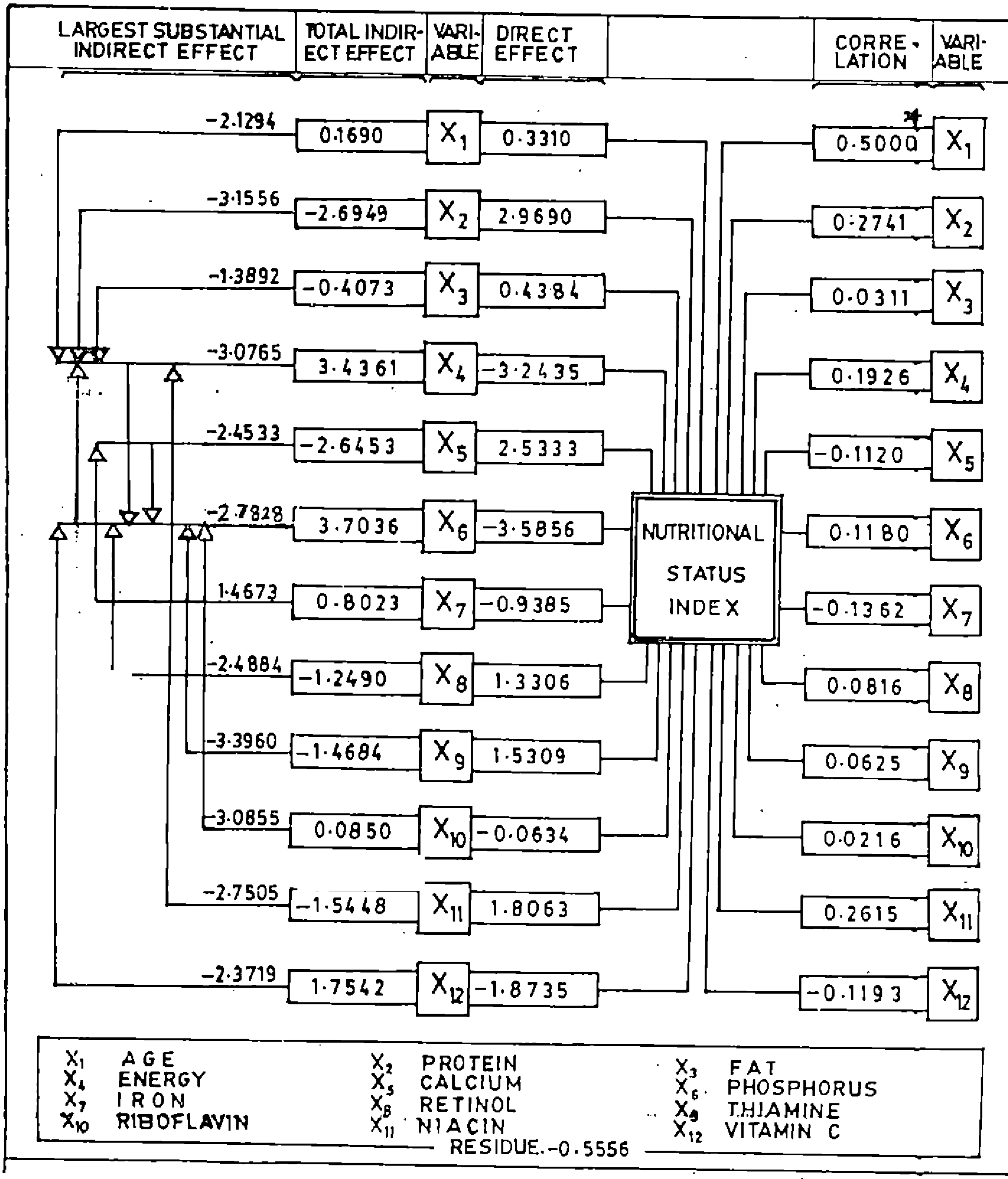


Fig. 33. Path diagram showing the direct and indirect effects of nutrients contributing to the nutritional status index of boys

to the positive indirect effect of protein (X_2), calcium (X_5) retinol (X_8), thiamine (X_9) and niacin (X_{11}) and the negative indirect effect of fat (X_3), energy (X_4), phosphorus (X_6), iron (X_7), riboflavin (X_{10}) and vitamin C (X_{12}). The indirect positive effect was especially through protein (X_2) and niacin (X_{11}) and the negative effect was mainly through energy (X_4) and phosphorus (X_6).

The correlation between protein (X_2) and nutritional status was 0.2741 and its direct effect was the highest (2.9690) among the different nutrients. The indirect effects added up for this correlation positively were through age (X_1), fat (X_3), calcium (X_5), retinol (X_8), thiamine (X_9) and niacin (X_{11}) (4.7551) and negatively through energy (X_4), phosphorus (X_6), iron (X_7), riboflavin (X_{10}) and vitamin C (X_{12}) (7.45). The indirect positive effect was mainly through thiamine (X_9) and niacin (X_{11}) and negative effect was through energy (X_4) and phosphorus (X_6).

A positive correlation was observed between fat (X_3) and nutritional status index. The direct effect contributed for this correlation was 0.4384. The indirect positive effect was mainly through protein (X_2) and other nutrients like calcium (X_5), iron (X_7), retinol (X_8), thiamine (X_9) and niacin (X_{11}). The negative indirect factors were age (X_1), energy (X_4), phosphorus (X_6), riboflavin (X_{10}) and vitamin C (X_{12}). The total positive and negative indirect effects were 2.5036 and 2.9109, respectively.

The correlation between energy (X_4) and nutritional status was 0.1926 and its direct effect was negative (-3.2435). The correlation was the result of of its indirect positive contribution through age (X_1), protein (X_2), fat (X_3), calcium (X_5), retinol (X_8), thiamine (X_9) and niacin (X_{11}) (7.506). The total negative indirect effect was 4.0699 and contributed through phosphorus (X_6), iron (X_7), riboflavin (X_{10}) and vitamin C (X_{12}). The positive indirect effect was especially through protein (X_2) and negatively through phosphorus (X_6).

The correlation between calcium (X_5) and nutritional status was low (-0.112) and its direct effect was 2.5333. The total positive and negative indirect effects were 3.0559 and 5.7012 respectively. The positive indirect effect was mainly through protein (X_2) and thiamine (X_9) and negative indirect effect was mainly through phosphorus (X_6) and Vitamin C (X_{12}).

The correlation between phosphorus (X_6) and nutritional status was 0.118 and its direct effect was negative (-3.5856). The correlation was the result of its indirect positive contribution through age (X_1), protein (X_2), fat (X_3), calcium (X_5), retinol (X_8), thiamine (X_9) and niacin

(X_{11}) and the indirect negative contribution through energy (X_4), iron (X_7), riboflavin (X_{10}) and vitamin C (X_{12}).

The correlation between iron (X_7) and nutritional status index was -0.1362 and its direct effect was negative (-0.9385). The total positive and negative indirect effects were 2.9629 and 2.1606 respectively.

The correlation between retinol (X_8) and nutritional status index was 0.0816 and its direct effect was 1.3306. The indirect positive effects added up for this correlation were through age (X_1), protein (X_2), fat (X_3), calcium (X_5), thiamine (X_9), and niacin (X_{11}) and negatively through energy (X_4), phosphorus (X_6), iron (X_7), riboflavin (X_{10}) and vitamin C (X_{12}).

The correlation between thiamine (X_9) and nutritional status index was 0.0625 and its direct effect was 1.5309. The positive indirect effects contributed for this correlation were through age (X_1), protein (X_2), fat (X_3), calcium (X_5), retinol (X_8) and niacin (X_{11}) and negative indirect effects were through energy (X_4), phosphorus (X_6), iron (X_7), riboflavin (X_{10}) and vitamin C (X_{12}).

The correlation between riboflavin (X_{10}) and nutritional status was 0.0216 and its direct effect was negative (-0.0634). The indirect effects contributed for this correlation positively were through age (X_1), protein (X_2), fat (X_3), calcium (X_5), retinol (X_8), thiamine (X_9) and niacin (X_{11}). The negative indirect effects were through energy (X_4), phosphorus (X_6), iron (X_7) and vitamin C (X_{12}). The total positive and negative indirect effects were 6.7103 and 6.6253 respectively.

The correlation between niacin (X_{11}) and nutritional status was 0.2615 and its direct effect was 1.8063. The indirect effects contributed for this correlation positively were age (X_1), protein (X_2), fat (X_3), iron (X_7), retinol (X_8) and thiamine (X_9) (3.8958) and negatively were energy (X_4), calcium (X_5), phosphorus (X_6), riboflavin (X_{10}) and vitamin C (X_{12}) (5.4406).

The correlation between vitamin C (X_{12}) and nutritional status was -0.1193 and its direct effect was negative (1.8735). The total positive and negative indirect effects were 5.9577 and 4.2035 respectively.

The results revealed that 45 per cent of the variation in nutritional status of boys was attributed to the factors like age and the intake of nutrients. The results of path analysis are given in Appendix IX-a and IX-b.

The results of the path analysis carried out for girls are presented in table 82 and Fig. 34.

Table 82. Direct and indirect effects of nutrients contributing to the nutritional status index of girls

Variables	Direct effect	Indirect effect: Positive	Indirect effect: Negative	Total correlation
X_1 (Age)	-0.6528	17.4139 ($X_2, X_3, X_7, X_8, X_9, X_{10}, X_{11}$)	16.6628 (X_4, X_5, X_6, X_{12})	0.0983
X_2 (Protein)	2.9181	19.1999 ($X_3, X_7, X_8, X_9, X_{10}$)	21.766 ($X_1, X_4, X_5, X_6, X_{11}, X_{12}$)	0.3520
X_3 (Fat)	1.0978	7.9605 ($X_2, X_7, X_8, X_9, X_{10}$)	9.032 ($X_1, X_4, X_5, X_6, X_{11}, X_{12}$)	0.0263
X_4 (Energy)	-5.0869	18.9911 ($X_2, X_3, X_7, X_8, X_9, X_{10}$)	13.7681 ($X_1, X_5, X_6, X_{11}, X_{12}$)	0.1301
X_5 (Calcium)	-8.0221	23.6132 ($X_2, X_3, X_7, X_8, X_9, X_{10}$)	15.1598 ($X_1, X_4, X_6, X_{11}, X_{12}$)	0.4313
X_6 (Phosphorus)	-15.2084	26.847 ($X_2, X_3, X_7, X_8, X_9, X_{10}$)	11.2699 ($X_1, X_4, X_5, X_{11}, X_{12}$)	0.3687
X_7 (Iron)	0.3507	23.4292 ($X_2, X_3, X_8, X_9, X_{10}$)	23.3012 ($X_1, X_4, X_5, X_6, X_{11}, X_{12}$)	0.4787*
X_8 (Retinol)	1.6642	19.2276 ($X_2, X_3, X_7, X_9, X_{10}$)	20.2421 ($X_1, X_4, X_5, X_6, X_{11}, X_{12}$)	0.6497**
X_9 (Thiamine)	19.1864	7.5494 ($X_2, X_3, X_7, X_8, X_{10}$)	26.3578 ($X_1, X_4, X_5, X_6, X_{11}, X_{12}$)	0.3780
X_{10} (Riboflavin)	3.5323	22.5684 (X_2, X_3, X_7, X_8, X_9)	25.7227 ($X_1, X_4, X_5, X_6, X_{11}, X_{12}$)	0.3780
X_{11} (Niacin)	0.4160	6.4634 (X_4, X_5, X_6, X_{12})	7.2489 ($X_1, X_2, X_3, X_7, X_8, X_9, X_{10}$)	-0.3695
X_{12} (Vitamin-C)	-0.1437	22.6666 ($X_2, X_3, X_7, X_8, X_9, X_{10}$	21.9141 ($X_1, X_4, X_5, X_6, X_{11}$)	0.6088**

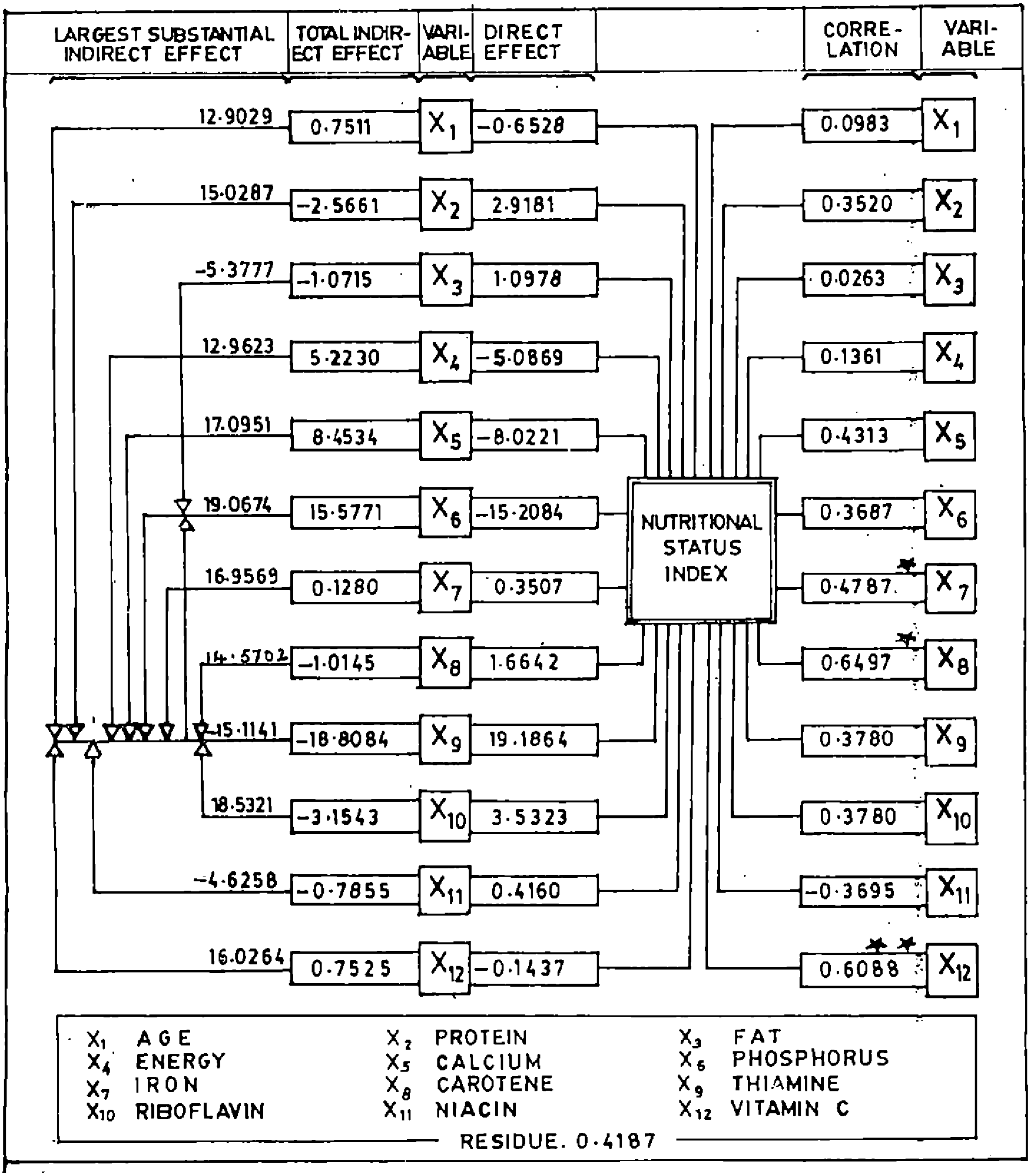


Fig. 34. Path diagram showing the direct and indirect effects of nutrients contributing to the nutritional status index of girls

The correlation between age (X_1) and nutritional status was 0.0983 and its direct effect was negative (-0.6528). The indirect positive contribution (17.4139) through protein (X_2), fat (X_3), iron (X_7), retinol(X_8), thiamine (X_9), riboflavin (X_{10})and niacin (X_{11}) and negative contribution (16.6628) through energy (X_4), calcium (X_5), phosphorus (X_6) and vitamin C (X_{12}) along with the direct effect resulted in this correlation. The direct positive effect was contributed especially through thiamine (X_9), protein (X_2) and riboflavin (X_{10}) and the negative indirect effect was mainly through energy (X_4), calcium (X_5) and phosphorus(X_6).

The correlation between protein (X_2)and nutritional status was 0.3520 and its direct effect was 2.9181. The indirect effects added up for this correlation positively (19.1999) were through fat (X_3), iron (X_7), retinol (X_8), thiamine (X_9) and riboflavin (X_{10})and negatively (21.766) through age (X_1), energy (X_4),calcium (X_5), phosphorus (X_6), niacin (X_{11}) and vitamin C (X_{12}). Among the different variables positive indirect effect was contributed mainly through thiamine (X_9), and niacin (X_{10}) and negative indirect effect was mainly through energy (X_4), calcium (X_5) and phosphorus (X_6).

The correlation between fat (X_3) and nutritional status was 0.0263 and its direct effect was 1.0978. This was due to the positive indirect effect (7.9605) of protein (X_2), iron (X_7), retinol (X_8), thiamine (X_9) and riboflavin (X_{10}) and negative indirect effect (9.032) of age (X_1), energy (X_4), calcium (X_5), phosphorus (X_6), niacin (X_{11}) and vitamin C (X_{12}). The positive indirect effect was mainly through protein (X_2), thiamine (X_9) and negative effect was mainly through energy (X_4) and phosphorus (X_6).

Correlation between energy (X_4) and nutritional status index was 0.1361 and its direct effect was negative (-5.0869). So the correlation was the result of its positive indirect contribution through protein (X_2), fat (X_3), iron (X_7), carotene (X_8), thiamine (X_9) and riboflavin (X_{10}) and negative indirect contribution through age (X_1), calcium (X_5), phosphorus (X_6) niacin (X_{11}) and vitamin C (X_{12}). The total positive and negative indirect effects were 18.9911 and 13.7681 respectively.

Correlation between calcium (X_5) and nutritional status was 0.4313 and its direct effect was negative (-8.0221). The correlation was due to the indirect positive contribution (23.6132) of protein (X_2), fat (X_3), iron (X_7), retinol (X_8), thiamine (X_9) and riboflavin (X_{10}) and indirect negative effect (15.1598) of age (X_1), energy (X_4), phosphorus (X_6), niacin (X_{11}) and vitamin C (X_{12}). The indirect positive effect was mainly through thiamine (X_9), riboflavin (X_{10}), retinol (X_8) and protein (X_2) and negative effect was mainly through phosphorus (X_6).

Correlation between phosphorus and nutritional status was 0.3687 and its direct effect was negative (-15.2084). This was due to the indirect positive contribution (26.847) of protein (X_2), fat (X_3), iron (X_7), retinol (X_8), thiamine (X_9) and riboflavin (X_{10}) and indirect negative effect (11.2699) of age (X_1), energy (X_4), calcium (X_5), niacin (X_{11}) and vitamin C (X_{12}).

Significant positive correlation was observed between iron (X_7) (0.4787) and nutritional status. The direct effect contributed for the correlation was 0.3507 ie. 74 per cent of the correlation was contributed by the direct effect of iron (X_7). The remaining 26 per cent is due to its positive indirect effect of protein (X_2), fat (X_3), retinol (X_8), thiamine (X_9) and riboflavin (X_{10}) (23.4292) and the negative indirect effect were the remaining (23.3012). Important indirect factors contributed for this correlation were thiamine (X_9), riboflavin (X_{10}) and protein (X_2) positively and phosphorus (X_6) and calcium (X_5) negatively.

The significant correlation observed between retinol (X_8) and nutritional status (0.6497) was due to the direct effect of carotene (X_8) (1.6642). Nutrients like protein (X_2), fat (X_3), iron (X_7), thiamine (X_9) and riboflavin (X_{10}) contributed for the indirect positive effects (19.2276) and negative indirect effect was due to the remaining factors (20.2421).

The correlation between thiamine (X_9) and nutritional status index was 0.3780 and the direct effect was 19.1864. Among the different nutrients thiamine (X_9) had the maximum influence on nutritional status of girls. The indirect positive effect was 7.5494 through protein (X_2), fat (X_3), iron (X_7), retinol (X_8), and riboflavin (X_{10}) and indirect negative effect (26.3578) was through age (X_1), energy (X_4), calcium (X_5), phosphorus (X_6) niacin (X_{11}) and vitamin C (X_{12}).

The correlation between riboflavin (X_{10}) and nutritional status was 0.3780 and its direct effect was 3.5323. The correlation was due to the indirect positive effect (22.5684) of protein (X_2), fat (X_3), iron (X_7), retinol (X_8) and thiamine (X_9) and indirect negative effect (25.7227) of age (X_1), energy (X_4), calcium (X_5), phosphorus (X_6), niacin (X_{11}) and vitamin C (X_{12}).

The direct effect of niacin (X_{11}) and nutritional status was low (-0.3695). The total positive and negative indirect effects were 6.4634 and 7.2489 respectively.

The correlation between vitamin C (X_{12}) and nutritional status was 0.6088 which is significant, where its direct effect was negative (-0.1437). So this correlation is the result of its indirect positive contribution (22.6666) via protein (X_2), fat (X_3), iron (X_7), retinol (X_8), thiamine (X_9) and riboflavin (X_{10}) and indirect negative contribution through (21.9141) age (X_1), energy (X_4), calcium (X_5), phosphorus (X_6) and niacin (X_{11}). The total positive and negative indirect effects were 22.6666 and 21.9141 respectively.

The results of the analysis revealed that 58 per cent of the variation in nutritional status of girls was attributed to the factors like age and intake of different nutrients. The results of path analysis are given in Appendix IX-c and IX-d.

DISCUSSION

5. DISCUSSION

The present study was carried out to assess the nutritional status and dietary habits of Irulas of Attappady and to identify the factors influencing the nutritional status of the tribal population with particular reference to children in the age group of 5 to 15 years. This chapter presents a critical discussion on the major findings and the details are presented under the broad sections such as

5 1. Socio-economic pattern of the tribal families

5.2. Food consumption and dietary pattern of the tribal families

5.3. Nutritional status of tribal children

5.4. Prevalence of sickle cell anaemia and malaria among tribal children

5.5. Nutritional awareness of the tribal people

5.6. Attitude of tribal people towards developmental programmes

5.7. Direct and indirect effects of nutrients on nutritional status of children

5.1. Socio-economic pattern of the tribal families

Joint family system prevalent in Kerala has fastly disintegrated and its place has been taken by nuclear type families. This social change has occurred in all the socio-economic strata of the society, and the same has been happening among Irula tribes also, with nuclear type families headed by male members as the common system. Similar type of families were observed among Cholanaickans of Nilambur, Paniyans and Kattunaickans of Wayanad, Kurumbas of Attappady (Mathur, 1977), and Kanikkar tribes of Amboori (Thomas 1989_1). This family pattern was also found among non-tribal communities of different socio-economic strata in the state (Thomas, 1989_2; Varghese, 1989; Cherian, 1992; Seshadrinath, 1993).

In Kerala marriageable age for boys and girls are 21 and 18. Earlier studies had indicated that among the underprivileged communities like scheduled tribes, the marriageable age was always found to be lower than that of the privileged communities. As evidenced in other tribal communities like Cholanaickans of Kerala (Mathur, 1977), tribes of Madhya Pradesh (National Institute of Nutrition, 1982) and Uralies of Kerala (Kattakayam, 1983), the Irula tribes of Attappady also followed the custom of early marriage. In a study among agricultural labourers of Trivandrum district, Thomas (1989_2) had found that early marriage was common among lower income strata of the population.

Dowry system is a prevailing custom among the various communities in Kerala. Unlike many non-tribal communities and privileged sections of the population of the state, the Irulas of Attappady were found to be in the habit of giving bride-price to the bride's family and it was fixed as Rs 101.25. Bride-price was compulsory among the tribes like Cholanaickans, Paniyans, Kurichians, Kattunaickans, Mudugas, Kurumbas and Irulas while neither dowry nor bride-price was prevalent among Mala Arayans of Kerala (Mathur, 1977).

Unlike other states, in Kerala small family norm has become very popular probably because of the availability of medical facilities, educational facilities and the constant exposure of public to small family norm through various media. A small family norm was reported among the non-tribal communities of Trivandrum district by Nagammal (1989), Thomas (1989_2), Cherian (1992) and Seshadrinath (1993). However such drastic changes in the family size cannot be expected among the tribal population residing in the remote parts of the state. Yet the average family size of the tribal families surveyed in the present study was found to be only 4.73. This finding is in line with the reports published by the Bureau of Economics and Statistics (1979)in which the average size of tribal household in Kerala was reported as 4.83 and as per the report published by the

Integrated Tribal Development Project (1984-85) where the average family size of the tribes of Attappady was found to be 4.5. Similar findings of a small family norm was observed among Uralies of Idukki district (Kattakayam, 1983) and Kanikkas of Trivandrum district also (Thomas, 1989_1).

The demographic profile of the population in Kerala is vastly changing. Unlike in earlier years, the percentage of adult population is increasing with a decline in child population. However family composition of tribes may be uncomparable with the non-tribal population residing in the state. As per the findings of the study 49.06 per cent of the population were adults above 18 years of age and 50.94 per cent comprised the child population. In contrast to this a higher percentage of adult population was found among the tribes of Amboori (Thomas,1989_1) and non-tribal agricultural labourers (Seshadrinath, 1993) of Trivandrum district.

Among the different states, Kerala has the highest sex ratio, which is expressed as the number of females per 1000 males and is a solitary exception while in all other states and Union territories the sex ratio is adverse to women (Manorama Year Book, 1991). The sex ratio of Kerala had reached a maximum in 1991 (Census, 1991) with 1040 females per 1000 males. However, sex ratio for scheduled tribes is adverse to females and this is in marked contrast to the general trend of sex ratio in the state. According to Census (1981) among scheduled tribes, male members outnumber female members in most of the districts and the exceptions are Malappuram, Trivandrum, Kottayam and Wayanad. Like most of the tribal communities of Kerala, the sex ratio of Irula tribes was found to be in favour of male members and was in contrast to the general population of the state where females predominate.

Literacy is an important demographic characteristic which is an indicator of the level of advancement of the people. It is all the more significant in the case of scheduled tribes as most of them were confined to the darkness of illiteracy and ignorance for centuries. According to Mathur (1983a) lack of education is a major handicap to the development of various tribal communities in Kerala. An assessment of the educational status of male and female members at different stages of life revealed that many of the male (68.26%) and female (86.13%) members were illiterate. The literacy level was found to decrease as age advances and a higher percentage of illiteracy was found among women. The distribution of male members of the Irula community at every stage of educational level from lower primary to college level was also greater than the female members. Census (1981) supported this finding in which lower percentage of literacy was reported among scheduled tribe women of different districts in Kerala, and Palghat district was found to have the lowest male and female literacy rates. On the whole the literacy level of the Irulas of Attappady (22.5%) was lower than the literacy rate of the scheduled tribes of Kerala (31.79%) (Census, 1981). However, it was higher than the literacy level of the tribes of India (Singh, 1985; Government of India, 1986).

The educational status of the Irula children was found to be better than the adults. Majority of the boys (88.23%) and girls (90.16%) between the age group of 5 to 15 years were literates, and among the literate children 87.41 per cent boys and 91.82 per cent girls were continuing their education during the period of survey. This observation was in agreement with the findings of an early study conducted by Chandrasekhar et al. (1990) who had found that the educational status of Irula and Lamba children was better than that of adults. The high literacy status among the children may be due to the free educational facilities enjoyed by the scheduled tribes and the financial support received from the governmental and non-governmental agencies for the same. Another notable point in this context was that the tribal families gave equal treatment for boys and girls with respect to education.

In India, the rate of drop outs continues to be very high at all levels of education both among scheduled castes and scheduled tribes (Government of India, 1986). Among Irulas only a few percentage of children became dropouts either at the lower primary or from the upper primary classes and the major reason attributed to this was found to be poverty. Mathur (1977) observed that the dropout rate of tribal students in Wayanad district was nearly 90 per cent at the lower primary stage and revealed that despite the incentive the tribes get for education the motivation for education can be enhanced only if it is coupled with economic utility.

Unskilled labour on daily wages was found to be the principal occupation of Irulas of Attappady. Major work undertaken by the tribes was agriculture labour. Only a few per cent of the total adult population (4.49%) was employed either in government job or in private sector. Thus the occupational pattern of Irulas was found to be almost similar to the Kanikkars of Amboori area (Thomas, 1989_1). Shah (1992) also reported that a large number of tribes of Kerala, Gujarat, Maharashtra and West Bengal earn their livelihood as agricultural labourers. Among children a few percentage of boys (11.77%) and girls (14.75%) were engaged in similar occupations and other domestic chores. The Paniya children of Wayanad district was also found to be active participants in the economic pursuits of the family (Mathur, 1977) and were burdened with domestic duties and obligations.

In Kerala, the per capita income was reported to be Rs 3451 during 1989-90 (Government of Kerala, 1990). As per the norms fixed by Government of India (Manorama Year Book, 1991), the individuals who had an annual income below Rs 6600 is considered as living below the poverty line. The economic status of the Irulas indicated that 57.23 per cent were in the monthly income range of Rs 401 to Rs 1000 and 4.44 per cent had above Rs 1000 and the rest had an income below Rs 401. Thus there was wide disparity in income among the families. The average monthly income was found to be Rs 503 among the surveyed families. About 61 per cent had an income below this average and 67.78 per cent of the tribal families were found to be below the poverty line. This finding is in accordance with the findings of Muraleedharan and Sankar (1991) about the tribes of Attappady. Thomas (1989_1) also reported an average monthly income of Rs 400 among the Kanikkar tribes and 65 per cent of the tribes were reported to be below the poverty line.

Family size is a major factor hindering or favouring the utilization of income available in the family. Hence the per capita income of the families was worked out and it ranged from Rs 101 to Rs 250 in 42.78 per cent of the families and the average per capita income was found to be Rs 113.78. In contrast to this, Muraleedharan and Sankar (1991) reported a per capita income of Rs 50 among the tribes of Attappady.

As per the report published by the Bureau of Economics and Statistics (1979), land plays a vital role in determining the economic and social status of the tribal communities of Kerala. Land is a means of livelihood for the tribes, it serves as security when loans are taken and above all ownership of land is a matter of social status for the tribes. Though majority of Irula tribes have their own land and cultivate different crops most of them were found to be working as agricultural labourers. Muraleedharan and Sankar (1991) reported that except Kurumbas all other tribes of Attappady have taken into settled agriculture from shifting cultivation and because of dispossession of land, many of them became agricultural labourers. In the present study also the respondents revealed that due to low economic returns, low rainfall and land alienation to the settlers they were forced to work as agricultural labourers to meet their day-to-day essential needs.

Domestication of animals is an alternative source of income of the Irulas of Attappady. Muraleedharan and Sankar (1991) also supported this view and reported that tribes of Attappady is endowed with a huge animal population consisting of cattle, goat and poultry and the development of animal husbandry has received prime importance ever since the formation of Integrated Tribal Development Project. Though majority of the tribes have domestic animals, most of them did not utilize the produce at home, instead they used to sell them to earn a few rupees to support their existence. This was in accordance with the observation made by Singh et al. (1987a) among the tribes of Ranchi district.

The monthly expenditure pattern of the families revealed that in most of the families major expenditure was spent for food (above 70%). This finding is in concurrence with the findings of Bureau of Economics and Statistics (1979) in which the food expenditure of 13 tribal communities of Kerala was reported to vary from 48.82 per cent to 76.14 per cent. Kaur and Mann (1988) also reported that among low socio-economic group families of Punjab the major expenditure incurred was for food. Cherian (1992) and Seshadrinath (1993) have also found similar trends in food expenditure among agricultural labourers of Kerala. Quiogue (1970) found that lower the income, the higher was the percentage or income spent on food. Rao (1987) reported that the poorest 40 per cent of the rural population in India spent over 80 per cent of their income on food.

As per the general family expenditure pattern next to food, importance is given for health, education, shelter, clothing and savings. Survey conducted in Kerala have indicated that non-tribal communities under low income strata are in the habit of giving more weightage to clothing, education, health, transport and fuel (Thomas, 1989_2; Seshadrinath, 1993), while among upper income strata they spent more for education, household expenses, clothing and savings (Varghese, 1989). However, the situation among the tribal communities is different. Thomas (1989_1) reported that the expenditure incurred under travel, education, housing, clothing, recreation and ceremonies were negligible among Kanikkars of Amboori area. Next to food, the Irula tribes of Attappady spent 10 to 30 per cent of their monthly income for the purchase of beedi, cigarette, alcohol, narcotics or tobacco. Moreover, unlike the non-tribal communities, items like education, shelter and health were not expenditure incurring items because of the aid available from governmental and non-governmental agencies for these items.

A tendency to have a 'hand to mouth' existence was prevalent among these tribal communities and they were unaware of the various saving methods. Thus the expenditure pattern of the families gives the inference that the money they get is mainly spent for meeting their food and personal expenditure neglecting all the other basic needs.

The tribal people of Kerala are not able to make both ends meet, with what they earn and just like other tribal communities of Kerala, indebtedness was a curse among the Irula tribes also. Many of the Irulas had taken loans from governmental and non-governmental agencies mainly for agricultural purposes and purchase of cattle. Mathur (1977) also reported high indebtedness among Irulas of Attappady.

The state government is trying to uplift the tribal communities through different ways and construction of houses is one of them. Though majority of the Irula tribes had their own houses and majority constructed it with the government aid, bathroom, latrine and drainage facilities were absent even in those houses also.

In Kerala, electrification has occurred in 1268 villages during 1989-90 (Government of Kerala, 1990). The remote areas where tribes inhabit are also included under this programme. In Attappady, out of the 137 hamlets, 25 hamlets were electrified as per the ITDP report (1984-85). However, kerosene was the popular fuel used for lighting purpose among Irula tribes. This finding is in concurrence with the report of Bureau of Economics and Statistics (1979) in which it has been stated that 96.26 per cent of the tribal families of Kerala used kerosene for lighting purposes. Another notable point in this regard is that even in the electrified houses, majority of the families used kerosene lamp because the fuse had been found removed due to the non-payment of monthly electric charges. This throws light on the irresponsible nature of the tribes which was considered as a common characteristic of similar communities and which may be partly responsible for their backwardness.

Water facilities available in the hamlets were utilized for drinking and cleaning purposes and majority of the Irulas preferred to take bath in the river or stream because of their reluctance to use pipe water or water from bore well for bathing.

Possession of utensils is a necessity of every household in all the communities including the tribes. However, unlike other communities, possession of furniture and vehicles like cycle or cart may be a matter of comfort in the case of tribal families. The report published by the

Bureau of Economics and Statistics (1979) had indicated that tribes mainly depended on earthenwares to meet the necessity and aluminium brass, stainless steel and bell metal utensils were used sparingly by the tribal households. In the present study, though the Irulas were found to use either earthenware or aluminium vessels in the kitchen, majority possessed stainless steel, brass or copper utensils also.

Like in other states, in Kerala, people are more familiar with different mass media like radio, television, tape recorder, video cassette, newspaper and magazines. Among different media, only radio had become popular among Irula tribes. This was considered as a physical asset by the tribal families who possessed the same.

Environmental factors are reported to affect the health of a community considerably while personal hygiene of an individual affects primarily his health. According to Ali (1987) information on personal hygiene can be elicited only through close observation of an individual's habit which grow by practice and eventually become part of culture. Tribes in general are reported to be indifferent towards their personal hygiene. In the present study most of the Irula adults were found neither to take bath nor to wash their clothes daily. Similar results were reported among

5.2. Food consumption and dietary pattern of the tribal families

Quantum of food required by any community will be influenced by the requirements of population within the community. The food requirement in turn will be based on the demographic profile of the community. In the present study child population was found to be 50.94 per cent, while adult population was 49.06 per cent. Because of this variation, the per capita food requirement of this community was found to be lower than the standard per capita requirement.

Indian tribes in general are non-vegetarians and in this study also, Irulas were found to have similar food habits. Cholanaickans and Kurumbas (Mathur, 1977), Kanikkars (Thomas, 1989_1), Uralies (Kattakayam, 1983), Bhuinyas of Orissa (Ali, 1983) Lanjia Saoras of Orissa (Ali, 1987), Kudubis of Karnataka (Rao, 1991), tribes of Manipur (Rao _et al_., 1991), Santhals and Pahariyas of Bihar (Moitra and Choudhary, 1991) were also habituated to non-vegetarian food.

The food consumption pattern of tribes were found to be similar to that of the lower income strata of the population residing in adjacent areas. In Kerala, rice is the staple the tribes of Ranchi district (Singh _et al_., 1987a) and Pillai _et al_. (1989) among the Irulas, Mudugas and Kurumbas of Attappady. In contrast to this, Ali (1987) reported that Lanjia Saoras of Orissa were found to have better personal hygiene compared to Kutia Kondhs.

Though majority of the tribes were illiterate, only very few families depended solely on mantra or traditional medicines for curing ailments and many of them followed either allopathic or homoeopathic facilities available in the locality.

Immunization is one of the best and most effective investments which any government can make towards the health of its citizens (Goud _et al_., 1980). The immunization status of Irula children in the present study was found to be not at all satisfactory and only a minority was found to be immunized against DPT, polio, tuberculosis and measles. Unsatisfactory immunization coverage was reported among the tribal boys of Udaipur district (Bhandari _et al_., 1975) and Ranchi district (Singh _et al_., 1987a). In contrast to this Chopdar and Mishra (1980) reported satisfactory immunization coverage among the tribal school children of Western Orissa.

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The food consumption pattern of tribes were found to be similar to that of the lower income strata of the population residing in adjacent areas. In Kerala, rice is the staple millets, mainly ragi and cholam, were found to be the predominant food grains consumed in this tribal area. This observation is in tune with the results reported by Chandrasekhar et al. (1990) who observed that the Irula families of Attappady and Lambas of Katchuvadi hills consumed ragi, cholam and rice as main food items. Cereal-millet combination was observed in the diet of Mompas of NEFA (National Institute of Nutrition, 1967), Khonds of Orissa (Roy, 1976), tribes of Kinwat area (Ingle et al., 1983), Manne tribes of Andhra Pradesh (Pingle, 1987) and Lanjia Saoras of Orissa (Ali, 1987).

Food expenditure is an important factor influencing the food consumption pattern. In this study, major expenditure incurred by the tribal families was mainly for cereals. Kaur and Mann (1988) in their study among the low socio-economic families of Punjab also found that they spent more money for the purchase of cereals. Thomas (1989_1) also reported that among Kanikkar tribes of Amboori area, major expenditure was incurred for the purchase of cereals. Irulas of Attappady in the present study were also observed to spent upto 80 per cent of their monthly income for purchasing cereals.

Next to cereals, pulses, fats and oils, spices and condiments and beverages, were the items on which the expenditure was incurred by majority of the families. Most of the tribal families did not spend any money for the purchase of fruits, milk and milk products and nuts and oilseeds.

An analysis of the frequency of use of various food items by the tribal households revealed that cereals were the main items included daily along with spices and fats and oils. Fruits, nuts and oilseeds, and milk and milk products were never included or occasionally used by the tribal families. Though majority of the Irulas were non-vegetarians, meat, fish or egg were occasionally included in their diet, and they subsisted on vegetarian foods due to lack of money. Santhals of Bihar, according to Moitra and Choudhary (1991) though non-vegetarians, subsisted mainly on vegetarian foods due to poverty.

The classification of different foodstuffs on the basis of the frequency of use in the daily diet of the Irulas indicated that the tribal diet had little variety with cereals, spices and fats and oils. Ali (1987) also observed that the dietary pattern of Lanjia Saoras of Orissa consisted of a gruel made of rice or millet with salt and chilly, while according to Roy and Roy (1967 & 1969) the diet of Nicobarese and Shompens was rich in variety.

Three main meals a day is the pattern followed in Kerala. The meal pattern of the surveyed families indicated that two-meal-a-day pattern was followed by most of the tribes while among Kanikkars of Amboori area three meal pattern was found to be very common (Thomas, 1989_1).

The culinary practices of preparing foods before cooking indicated that they were not aware of the nutritional advantage of soaking pulses, washing vegetables before cutting, cutting the vegetables into big pieces and eating raw foods. Singh (1984) and Singh et al. (1987a) also reported ignorance about diet and nutrition among the tribes of Bihar.

Cooking methods adopted by the families are very important and the methods followed by the tribes are usually different from the non-tribes. However, as observed among the tribes of Pottumavu (Prema, 1983) the predominant cooking method adopted by the Irula families was found to be boiling. Cereals were cooked by excess water method and subsequently straining the excess water, thus discarding most of the water soluble vitamins. Thomas (1989_1) observed the same method of cooking for cereals among Kanikkars. However, most of the families, though unaware about the nutritional advantage of absorption method of cooking green leafy vegetables, adopted this method for cooking, thus conserving most of the water soluble vitamins. Grilling, a method usually adopted by the ancient tribes for cooking flesh foods and roots and tubers, was not very common among the Irula tribes. Though boiling was adopted as the common method of cooking such foods, a few families occasionally adopted grilling also. Chandrasekhar et al. (1990) also reported that Irula families of Attappady and Lamba families of Katchuvadi hills adopted excess water method for cooking all the foods.

Just like the tribes of Pottumavu area as reported by Prema (1983) the Irula tribes were also ignorant about the importance of drinking safe water and most of them drank water without boiling.

Food storage practices at the household level followed by the tribes are similar to those of non-tribes. Moreover the agricultural practices of the tribes indirectly influenced the food storage habits. Cereals and pulses produced were stored in gunny bags by the Irula tribes. Chandrasekhar et al. (1990) also reported that, the Irulas and Lambas stored the cereals grown in the hills in sack or mud pots. The tribes who were not used to regular cultivation did not store any food grains and they used to purchase the required foods daily from the local market. Prema (1983) observed that Kanikkar tribes of Pottumavu in Trivandrum district were regular cultivators and were used to store foodstuffs in baskets and earthenwares, in their homes while Thomas (1989_1) reported that Kanikkar tribes of Amboori area were not in the habit of storing food articles at home and the food items required were purchased daily from the local market.

Food is preserved when it is available or produced in excess. Majority of the tribes in India were found to have a hand to mouth existence and hence are unaware of food preserving practices. The present study depicted similar findings among Irula tribes. In contrast to this, Chandrasekhar et al. (1990) reported that Irulas of Attappady and Lambas of Katchuvadi hills preserved wild variety of roots by pickling. The observations made by Thomas (1989_1) among Kanikkar tribes were different since they were observed to be familiar with sun-drying, pickling and salting as the common techniques of preserving foods.

Irula tribes of Attappady were aware of food restrictions during illness. Certain foods and food combinations were given or withheld by them during illness. During epidemics like chickenpox and mumps they used to take light foods and avoided oily foods. Tender coconut, curds, fruits, buttermilk and milk were reported to be included by the Irulas of Attappady during chickenpox and they avoided oily foods and salt during such conditions (Chandrasekhar et al., 1990). Just like the reports published by the authors the Irula tribes in the prêsent study also avoided papaya during pregnancy. It was also observed that they did not include any special foods during pregnancy, lactation, puberty or in the diets of children.

Tribes generally had faulty food habits mainly following certain fads and fallacies regarding food. Irula tribes did not reveal any such taboos. However, most of the families avoided the consumption of beef due to certain religious beliefs.

In contrast to the healthy dietary practices followed by the earlier generations of Attappady in which the diet consisted mainly nutritionally rich ragi or maize cultivated in their own fields, the present generation was found to depend mainly on rice purchased from the shops with lesser quantity of millets cultivated in the fields. This change in the eating trend may be due to decrease in the cultivation caused by erratic rainfall, decrease in the area of cultivable land, land alienation by the settlers and low economic returns from agriculture.

Infant feeding practices observed by a community will throw light on their nutritional awareness and knowledge. Among Irula tribes, majority of the mothers started feeding the baby with breast milk during the first day itself and gave colostrum to the baby which is highly nutritious and most suitable first food for a new born. This finding supports the study conducted by Chandrasekhar et al. (1990) among the Irula mothers of Attappady who observed that they were in the habit of giving colostrum to the new born.

Breast milk was accepted to be the ideal food for the baby and prolonged breast feeding practices was adopted by the Irula mothers. Similar positive indications in this regard were shown by the Nilgiri tribes (Belavady et al., 1959), Koya tribes of Orissa (Roy and Roy, 1971), tribes of Madhya Pradesh (Mudgal et al., 1979), Tharu tribes of Uttar Pradesh (Usha, 1983), tribes of Maharashtra (Mane and Bantey, 1987), Irulas of Attappady and Lambas of Katchuvadi hills (Chandrasekhar et al., 1990).

Scientific schedule of infant feeding practices insist on fixed time for feeding and regular interval between feeds. Such dietary regimen are not observed among the low income strata population (George, 1987). Among Irula tribes also, specific time schedule was not found to be adhered to for feeding, and 'baby's cry' was taken as a signal for a feed, by many of the mothers. Thomas (1989_1) also observed that Kanikkar tribes gave breast milk to the infant according to the needs of the child.

From the nutritional stand point weaning period is very important (Reddy, 1987). Weaning at correct age is very important for the proper health of the infant and as per an approved feeding schedule, the weaning is to be started from the third month onwards. The Irula tribes were in the habit of late weaning, starting the same between 6 to 8 months. Surveys among Todas, Kotas, Irulas and Kurumbas of Nilgiris (Belavady et al., 1959), Koya tribes of Orissa (Roy and Roy, 1971), tribes of Madhya Pradesh (Mudgal et al., 1979) Gond tribe of Bhoolandabri village (Mishra, 1983) and the tribes of Mandla block (Gupta and Rajput, 1983) had reported similar findings. Ragi kali or rice was found to be the main foods introduced to the baby as a supplement to breast milk by Irula tribes and the child was familiarised with all adult foods by one year. Tribes of Andhra Pradesh (Vimala and Ratnaprabha, 1987) and Lanjia Saoras of Orissa (Ali, 1987) are in the habit of following similar regimen.

5.3. Nutritional status of tribal children

In the present study anthropometry, clinical examination, food intake and biochemical estimations were the major determinants of nutritional status of tribal children. Among this, anthropometry is the most important practical and accepted technique for assessing the nutritional status of children.

Height-for-age profile shows the state of chronic malnutrition or stunting in children. The extent of height deficit in relation to age, as compared to regional standards can be regarded as a measure of the duration of malnutrition (Gopaldas and Seshadri, 1987).

Height-for-age profile of children between 5 to 15 years in this study indicated that mean height of boys and girls were significantly lower than the National and International Standards at all ages except for girls aged 14 and 15 years where the decrease was statistically not significant. In a study conducted by Gopaldas (1987) in Gujarat, the mean height of tribal children was observed to be lower than the ICMR standards. Bulusu and Chakravarty (1989) also reported malnutrition among the tribal children of West Bengal on the basis of height-for-age classification. In contrast to this, Chopdar and Mishra (1980) observed better height among tribal children of Western Orissa. Studies of Sarupriya and Mathew (1987) among scheduled tribes also revealed that 86 per cent of the adolescents had normal height for age and the rest had more height than the expected standards.

Weight-for-age is the most sensitive index to evaluate the body mass and thereby the current nutritional status. According to Gopaldas and Seshadri (1987) weight deficiency appears to be the best indicator of the prevalence of protein-energy malnutrition in children of all age groups. According to the authors, comparison of weight for age values with regional standards at corresponding ages will help to determine the degree of underweight in a community and this index is used to determine the current nutritional status. In the present study weight-for-age of children at different ages was found to be significantly lower than the National and International Standards. This is in agreement with the findings of Gopaldas (1987) who had found that the weight-for-age of tribal children of Gujarat was lower than the ICMR standards. Underweight as a nutritional problem was observed among tribal school children of Orissa (Chopdar and

Mishra, 1980) and also among majority of tribal adolescents between 13 to 18 years in Udaipur (Sarupriya and Mathew, 1987). Gore et al. (1977) and Patwari et al. (1979) also observed underweight among tribal children of Indravati river basin and school children of lower socio economic strata of Jammu and Kashmir. However, Swaminathan et al. (1971) had observed higher weight among Onge children upto 15 years.

Malnourished children identified according to the gradation of growth retardation also revealed that majority of the tribal children had different grades of malnutrition and only less than 12 per cent children had normal weight-for-age as per the expected standards. Malnutrition was observed among 90 per cent of tribal school children of Udaipur (Sankhla, 1987) on the basis of weight deficit.

A composite age independent index namely weight/height^2 ratio is another means used to detect the state of malnutrition, since it indicates weight in relation to height. Application of this index in the present study revealed that majority of the boys and girls were malnourished. This is in line with the findings of Gupta and Rajput (1983) who had detected that majority of male and female children of Mandla district were malnourished on the basis of weight/height^2 ratio.

Mid upper arm circumference is a useful indicator to assess the nutritional status of children. The mean mid upper arm circumference of the tribal children were significantly lower than the standards except for girls aged 13 and 15 years where the decrease was found to be insignificant. This finding is in conformity with the studies conducted in Ranchi district (Singh et al., 1987a) in which only a quarter of the children studied were found to be normal on the basis of arm circumference.

Skinfold thickness is a useful indicator of body fat and hence, the calorie reserve of the body (Gopaldas and Seshadri, 1987). The skinfold measurements of the children studied were significantly lower than the Indian Standards for both sexes at all ages except for 15-year-old boys where the decrease was not statistically significant. According to Jelliffee (1966) low skinfold measurements in school children are due to low calorie intake, greater physical exercise, and genetic variation. Roy (1978) observed a decrease in skinfold measurements among 35 per cent Juangs of Orissa. Classification of children into different grades of malnutrition based on skinfold thickness revealed that majority of boys and girls were malnourished.

Higher percentage of the girls were found to be malnourished on the basis of weight-for-age, weight/height^2 and skinfold thickness while the percentage of malnourished boys on the basis of height-for-age criteria was found to be higher. Singh et al. (1987a) also observed higher percentage of malnutrition among girls. Easwaran et al. (1972), in their study among the school children of Coimbatore, observed that boys were heavier and taller than girls. Gupta and Saxena (1977) noticed a lower percentage of undernutrition among rural and urban school children in Rajasthan with a preponderance among male children. Paul (1993) reported that the percentage of adolescent boys suffering from malnutrition were more when compared to girls. Poor nutritional status was observed among tribal and rural children of Udaipur (Gupta and Bhandari,1972 & 1974), under-privileged school boys (Pant and Solanki, 1989) and among the school boys belonging to the Bhil tribe of Madhya Pradesh (Taneja, et al., 1989).

Clinical examination of the tribal children revealed he occurrence of specific nutritional disorders such as naemia and vitamin A deficiencies. In a study conducted by ammi (1977) among the tribal children of Kerala, similar utritional disorders were reported. Vitamin and iron eficiency symptoms were observed among the tribal school children of Western Orissa (Chopdar and Mishra, 1980), Bhuinyas of Orissa (Ali, 1983), tribal children of Andhra Pradesh (Pingle, 1987), Madhya Pradesh (Taneja et al., 1989) and Attappady (Pillai et al., 1989). Surveys conducted among various tribes in different parts of India by Ali (1980b), Gupta and Rajput (1983), Goyal and Mathew (1987), Kumari and Rao (1987), Sankhla (1987), Sarupriya and Mathew (1987) and Rao et al. (1989) had also come to similar observations of nutritional symptoms among tribal children.

Non-nutritional manifestations such as dental caries was observed among children. The incidence of dental caries was reported to be high in Kerala (National Nutrition Monitoring Bureau, 1984).

The actual food intake of boys and girls between 5 to 15 years, estimated by the food weighment method revealed that the inclusion of various food groups was not in a balanced proportion in the tribal diet. Except cereals, generally the intake of all other food groups were below the Recommended Dietary Allowances for both sexes among the children. This finding is in accordance with the studies conducted among the tribes of Kinwat area (Pawar and Ingle, 1982; Ingle et al., 1983) and tribal adolescents of Udaipur (Sarupriya and Mathew, 1987) tribes of Maharashtra (Patil, 1987) in which it was observed that the consumption of all food stuffs except cereals and millets were below the recommended allowances. Fruits were not at all included in the daily diet of Irula children. Though majority of the Irula tribes were non-vegetarians, the consumption of meat, fish or egg were either nil or negligible in the diet of the children. Deficient food intake was reported among Kondhs of Orissa (Patel, 1983), Bhuinyas of Orissa (Ali, 1983), tribal children of Mandla district (Gupta and Rajput, 1983) and Udaipur (Sankhla, 1987; Goyal and Mathew, 1987) and Lanjia Saoras of Orissa (Ali, 1987). The intake of flesh foods was very low among the tribes of Mandla district (Gupta and Rajput, 1983), Orissa (Ali, 1983) and Ranchi district (Singh et al., 1987a; Singh, 1989). In contrast to this, the consumption of all foods except flesh foods were lower than the Recommended Dietary Allowances among the Onges (Rao et al., 1989).

Price (1984) observed that the actual food consumed by different populations of India depend largely on income and geographical area. Wong et al. (1985) found a direct relationship between the family income and food expenditure. The decreased intake of food stuffs among Irula children could also be attributed to the infiltration of non-tribes causing depletion of forest and other resources in the Attappady Valley and land alienation to the settlers which reduced the cultivable land of the tribes. Rao et al. (1983) reported that tribes subsisting on forest had a better nutritional status as compared to those depending on primitive cultivation.

Among the various nutrients, only phosphorus, calcium, niacin and vitamin C intakes of boys and girls at certain ages were found to be higher than the Recommended Dietary Allowances. All the other nutrients were below the prescribed levels. The intake of iron, retinol and riboflavin were found to be very low among boys and girls at different ages, which reflected in the low consumption of green leafy vegetables by the children. Agarwal (1991) pointed out that inadequate supply of nutrients like iron, folic acid, and Vitamin B12 causes nutritional anaemia characterised by reduced haemoglobin concentration. In this study also, the haemoglobin level of children was found to be lower than the standards. Deficient intake of nutrients among the tribes of India were reported by Sengupta (1980), Ali (1983), Ingle et al. (1983), Goyal and Mathew (1987), Ali (1987), Sankhla (1987) and Nutrition Foundation of India (1988). However, Gore et al. (1977), Singh and Sidhu (1980) and Rao et al. (1989) reported an adequate intake of protein among the tribes of Indravati river basin, Gaddi boys of Himalayas and Onges respectively.

Biochemical investigations represent the most objective assessment of the nutritional status of an individual. According to Thurnham (1974) haemoglobin estimations are the most useful screening test to identify anaemia. The haemoglobin levels of Irula children was significantly lower than the standard values at almost all ages. Low haemoglobin levels were observed among tribal children of Andhra Pradesh (Pingle, 1987; Kumari and Rao, 1987), Madhya Pradesh (Mathur, 1987) and Gujarat (Gopaldas, 1987).

An assessment of the iron status of children indicated that despite the low intake of iron in the diet, all the children had normal serum iron levels. However, packed cell volume which is the volume of red cells expressed as a percentage of the volume of whole blood indicated that all the children had a lower percentage of packed cell volume which gives an indication that majority of the children were anaemic. The decreased RBC count observed among children also gives an indication of anaemia among children. The normal serum iron levels may be due to the increased rate of cell breakdown observed in certain types of anaemia such as pernicious anaemia as reported by Varley (1976) and Tietz (1976).

All children had a normal serum protein and albumin levels and indicated that there was no severe protein deficiency among the Irula children. Clinical manifestations of children also indicated the same result.

The total count of blood was observed to be in the normal range among all the children. The decrease in neutrophil percentage (neutropenia) observed among the children may be due to bacterial or viral infection or it may be due to anaemia. Usually among children lymphocyte count will be higher (lymphocytosis) than normal and it may also occur due to various infectious diseases like whooping cough, mumps, measles and typhoid. In the present study the lymphocytosis observed may be due to the prevalence of infectious diseases among children. Eosinophilia was detected among majority of the boys and the girls, indicating an unhealthy condition among the children. Usually eosinophilia is associated with hookworm, roundworm or tapeworm infestation, asthma or allergy. In the present study the eosinophilia observed may be due to worm infestations prevalent among the tribal children.

According to Ramachandran et al. (1979) hook worm infestation is one of the major causes of anaemia in the tropics. Mathur (1982) reported that parasitic worms constitute a public health problem particularly among communities with poor hygiene and inadequate sanitation. According to Anandan et al. (1985) intestinal infestation in a country depends on its socio-economic status, dietary habits, and hygienic environmental conditions. Hence, the worm infestation observed among Irula children of Attappady may be due to the poor socio economic, dietary practices and inadequate environmental sanitation.

According to Swaminathan (1986) nutritional status is the health status of an individual as influenced by the intake of essential nutrients. The distribution of children on the basis of nutritional status index developed, revealed that majority of the boys and girls had low to medium nutritional status. Among the different age groups, better nutritional status was observed among 13 to 15 years boys and girls. For boys the mean nutritional status index was found to increase as age increased. However, in the case of girls, a contradictory result was obtained upto 12 years, and 10 to 12 years had the lowest nutritional status probably due to the physiological changes which occur in the body during that period.

Birth order of boys was found to influence the nutritional status of children. Thomas (1989_2) also observed a significant negative correlation with nutritional status among the agricultural labourers of Trivandrum district. Rao and Gopalan (1971), Luwang and Singh (1981), Ahmed et al. (1982) also reported similar relationship between birth order and nutritional deficiencies.

5.4. Prevalence of sickle cell anaemia and malaria among tribal children

Incidence of sickle cell anaemia was observed among 25 per cent boys and 19.70 per cent girls between 5 to 15 years of age. Sickle cell anaemia was also observed among other tribes like Todas, Irulas and Badagas of South India (Lehmann and Cutbush, 1952), Mahar tribal children (Khandelwal and Paithankar, 1961), Kurmi community of Madhya Pradesh (Ghatge et al., 1977), tribes of Chotanagpur (Karan et al., 1978), Kutia kondh of Phulbani district (Ali, 1979), Bhil tribe of Rajasthan (Jain et al., 1981), Mina, Adivasi, Garasia and Gameti tribes of Rajasthan (Jain et al., 1983a) and the tribes of Wayanad (Feroze et al., 1989).

In the present study incidence of malaria was not detected among children. In contrast to this observation, positive cases of malaria was observed among hill Bhuinyas of Orissa (Ali, 1983) and tribes of Koraput district of Orissa (Rajagopalan et al., 1989; Jambulingam et al., 1989; Das et al., 1989).

5.5. Nutritional awareness of tribal people

Knowledge on nutritional aspects is very important for good health and well being of an individual and also to overcome wrong attitudes and practices. The nutritional awareness of the Irula tribes indicated that most of the women had low awareness regarding nutritional aspects. This finding is in tune with the observations made among the tribes of South Bihar (Singh, 1984), Ranchi district (Singh et al., 1987a) and Chotanagpur (Singh et al., 1987b) and Lanjia saoras of Orissa (Ali, 1987).

5.6. Attitude of tribal people towards developmental programmes

According to Menon and Prema (1975), the attitude of people towards the developmental programme will, to a considerable extent, determine the nature and extent of their participation and acceptance of the programme and the ideas and practices propagated through the programme.

Since the developmental programmes are helping the tribes in one way or other, all the respondents had a favourable attitude towards the various programmes implemented in the hamlets.

5.7. Direct and indirect effects of nutrients on nutritional status of children

The results of intercorrelation analysis indicated that almost all the nutrients had an insignificant correlation with nutritional status. So it was tried to investigate the reasons for the non-existence of correlation with the nutrients. This was examined by the path analysis which gives an indication of the direct influence of each of these nutrients along with the indirect effect of each of these with the remaining nutrients.

Among the nutrients, protein was found to have the highest positive direct contribution towards nutritional status of boys. This may be attributed to the negative total indirect effect especially through energy. Next to protein, calcium was found to have a direct positive effect on nutritional status and this is due to the negative total indirect effect especially through phosphorus.

No significant correlation was observed between thiamine and nutritional status, though its direct effect was found to be high and positive, among girls. Its indirect effect with factors like age, energy, calcium, phosphorus, niacin and vitamin C was negative accounting for

26.3578 and positive through the factors such as protein, fat, iron, retinol and riboflavin (7.5494). This high negative indirect effect led to an insignificant correlation.

Though there is no correlation with different nutrients and nutritional status, if the direct effect of each nutrient is observed, we can see that each nutrient has got its own influence on nutritional status whether it may be positive or negative.

SUMMARY

Biochemical investigations revealed that haemoglobin values of children were lower than the standard values and only a few percentage of children had an acceptable iron status on the basis of haemoglobin levels. Serum iron and protein levels of all the children were in the normal range while packed cell volume and RBC count were lower, indicating anaemia among children. Total count was found to be in the normal range among the children. Eosinophilia and worm infestations were found to be common among the children.

The nutritional status index of boys and girls indicated that majority of children had low to medium nutritional status. Among the different factors studied birth order of boys was found to influence their nutritional status.

Sickle cell anaemia was observed among boys and girls. However malaria was not common among the Irula children.

Nutritional awareness of the respondents revealed that majority had a low knowledge on infant feeding, cooking and health practices. A significant association was observed between age, exposure to mass media and education of the respondent with nutritional awareness. The tribes had a favourable attitude towards the developmental programmes.

6. SUMMARY

The present study entitled **Nutritional Status and Dietary Habits of Irulas of Attappady** was conducted among 180 families residing in the nine hamlets of Attappady valley.

The study carried out threw light on the socio-economic and dietary habits of the families, nutritional status of children, nutritional awareness and attitude towards developmental programmes of the respondents.

Information regarding socio-economic condition of the families indicated that majority of the families were of nuclear type with an average family size of 4.73 and sex ratio in favour of male members. Early marriage was very common among Irulas with a bride price of Rs 101.25

Educational status of the children was found to be better than the adults. Agriculture labour was the main occupation of the Irulas and most of them possessed land and domestic animals which also supplemented the family income.

Majority of the families were having a total monthly income of Rs 401 to Rs 1000 and were living under the poverty line with more debts and less savings.

The major expenditure of the families was for food followed by the expenditure incurred for beedi, cigarette,

alcohol, narcotics or tobacco. Majority of the families were living in government built houses without physical amenities like safe drinking water facilities, drainage and lavatory. Electricity facilities were available only in very few houses.

Wood was the sole source of fuel collected from the forest. The personal hygiene of the Irulas was found to be poor. Urban contact and exposure to mass media were unsatisfactory. Allopathic mode of treatment was followed by the tribes. Family planning and immunization coverage were also found to be unsatisfactory.

The Irula tribes were non-vegetarians. The expenditure pattern on food revealed that the major expenditure incurred by the families was for cereals followed by pulses, fats and oils, spices and beverages. The diet was found to be monotonous. Two-meal-a day pattern was followed by majority of the families.

Boiling and absorption method of cooking in earthen pots or aluminium vessels were commonly adopted for cooking foods. Gunny bags were used to store food articles mainly cereals and pulses.

Irula tribes followed certain food restrictions during illness on the basis of elders' advice and all the families followed certain dietary pattern on the basis of religious beliefs. No special food was included during puberty, pregnancy, lactation or in the children's diet.

Majority of the mothers started feeding the baby on the first day itself and prolonged breast feeding was common among Irula tribes. Late weaning was practised with ragi or rice as the weaning food.

The nutritional status of children revealed that the anthropometric measurements like height, weight, weight/height^2, mid upper arm circumference and skinfold thickness were lower than the National and International Standards for all ages. Majority of the children had different grades of malnutrition and only a minority of boys and girls had normal nutritional status on the basis of different anthropometric indices. In general, the girls of different age groups were found to have low nutritional status when compared to boys.

Clinical examination of children showed the occurrence of anaemia, vitamin A deficiency and dental caries among tribal children.

Food weighment survey revealed a deficient intake of all foods except cereals. The intake of most of the nutrients was also lower than the Recommended Dietary Allowances.

Biochemical investigations revealed that haemoglobin values of children were lower than the standard values and only a few percentage of children had an acceptable iron status on the basis of haemoglobin levels. Serum iron and protein levels of all the children were in the normal range while packed cell volume and RBC count were lower, indicating anaemia among children. Total count was found to be in the normal range among the children. Eosinophilia and worm infestations were found to be common among the children.

The nutritional status index of boys and girls indicated that majority of children had low to medium nutritional status. Among the different factors studied birth order of boys was found to influence their nutritional status.

Sickle cell anaemia was observed among boys and girls. However malaria was not common among the Irula children.

Nutritional awareness of the respondents revealed that majority had a low knowledge on infant feeding, cooking and health practices. A significant association was observed between age, exposure to mass media and education of the respondent with nutritional awareness. The tribes had a favourable attitude towards the developmental programmes.

The path coefficient analysis carried out among the micro-samples revealed that 45 per cent and 58 per cent of the variation in nutritional status of boys and girls respectively were attributed to the factors like age and the intake of various nutrients.

Suggestions for future line of work

Following studies can be conducted among the tribal communities of Kerala.

1. Micro level study on the influence of socio-economic variables on the nutritional status of tribal communities of Kerala.

2. Incidence of sickle cell anaemia among tribal and non-tribal communities and the factors influencing the prevalence of sickle cell anaemia.

3. Nutritive value of the locally available foods consumed by the tribes of Kerala.

4. Impact of nutrition education programmes on nutritional awareness of the tribes of Kerala.

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APPENDICES

APPENDIX I

Interview schedule to elicit information on socio-economic condition of the families

Serial Number:

1. Name of the respondent: (Wife/Husband) Age:

2. Name of the head of the family:

3. Address

   (a) House number
   (b) Name of the hamlet
   (c) Name of the village
   (d) Name of the Panchayat

4. (a) Religion: (b) Caste: (c) Sub caste:

5. Marital status: (i) (a) Married (b) Single
   (ii) If married

Particulars	Husband	Wife	Any other members (specify) 1	2	3
a) Age at marriage					
b) Married within the caste					
c) Intercaste marriage					
d) Consanguineous marriage					
e) Married more than once without divorcing					
f) Married but divorced					
g) Divorced and remarried					
h) Widow					
i) Widowed but remarried					

(iii) a) Is there any dowry system prevailing in your community? : Yes/No

b) If yes, specify whether it is given as

a) Cash
b) Ornaments
c) Utensils
d) Land
e) Others (specify)

6. Age of menarche:

7. a) Type of family (a) Nuclear
(b) Joint

b) Do you follow (a) Matriarchal system
(b) Patriarchal system

8. i. Size, composition, educational level, occupation and income of the family:

a) Adults Male (No.)
Female (No.)

b) Children (No.)

Below one year		1-3 year		4-6 year		7-9 year		10-12 year		13-15 year	
B	G	B	G	B	G	B	G	B	G	B	G

ii) Composition, educational level, occupation and income

Sl. No.	Name of the members	Relation ship with the head of the family	Age	Sex	Occup- ation	Income	Educational qualification								
							Illi- terate	L.P/ U.P	H.S	Coll- ege	Non for- mal edu- cat- ion	Conti- nuing educa- tion	Drop- outs	Posi- tion of the child	Reason for drop- out

iii) Details regarding the income

Sl. No.	Source of income	Daily	Weekly	Monthly	Annual	Total
1.	Govt. job					
2.	Private job					
3.	Animals					
4.	Land					
5.	Forest					
6.	Farm workers					
7.	Business					
8.	Coolie					
9.	Others (specify)					

iv) (a) Does the household engage in any small scale/cottage industry ? Yes/No

(b) If yes, specify:

Sl. No.	Name of the Occupation	Who does the occupation	No. of days per week	Income

(c) If the occupation (both main and subsidiary) is seasonal specify the total period in a year:

i) Main

ii) Subsidiary

v) Details regarding children's education

a) Do you give any preference for the child on the basis of sex in imparting education ? Yes/No

b) In both cases give reasons:

c) For the education of children, are you getting any aid from the government or other agencies? Yes/No

d) If yes

Name of the child	The agency which gives the aid	Facilities given	How it is utilized

9. Details regarding land holdings

i) Do you own any land : Yes/No

ii) If yes, specify the total area available :
Cents
Acres
Hectares

III) Specify how you got this land

a) Purchased
b) Received from government
c) Received from private person or institutions for payment
d) Partly received from government and partly from private persons or institutions
e) Received as dowry
f) Encroachment

iv) a) Do you cultivate any food crops in your land? Yes/No

b) If yes, give details of the farm produce

Sl. No.	Name of crop	Area under cultivation	Total produce/ per year Kg/Bags/No.	Quantity used at home /year kg/Bags/No.	quantity sold per year Kg/bags/No	Cost Income

10. Domestication of animals.

i) Do you have any domestic animals in your house? Yes/No

ii) If yes,

a) What are they?

b) From where did you get it

i) Government agency
ii) Purchased
iii) Others (specify)

c) How do you feed them:?

i) Open space
ii) Purchased feed material
iii) Both
iv) Waste food

d) Product per month (No. or volume)	Use of produce			Income from the produce
	By the family	Gift	Sale	

11. Do you have a kitchen garden in your house? Yes/No

If yes, specify

Items cultivated	production per month	use of produce			income
		by the family	Gift	sale	

12. Details of housing

i. Type of house : a) Own
b) Rented
c) Own house but constructed by government

ii) Specify whether the house is shared by two or more separate families: Yes/No

iii) If yes, specify
a) No. of families
b) Whether the families are related

Yes/No

iv) a) Thatching materials used

a) Straw
b) Bamboo leaf
c) Coconut leaves
d) Tiles
e) Asbestos
f) Others (specify)

b) Source of thatching materials:

a) Collected from forest
b) Purchased
c) Supplied by government agency
d) Others (specify)

v) Type of wall

a) Mud
b) Brick
c) Stone
d) Wood
e) Reed
f) Bamboo
g) Others (specify)

vi) Type of flooring

a) Mud
b) Cement
c) Wood
e) Others (Specify)

vii) Number of rooms in the house:

a) One room
b) 2-3 rooms
c) More than three rooms (specify)

viii) a) Do you have a separate kitchen in your house?

b) If no, from where do you cook food ?

a) Outside the house
b) other rooms (specify)

ix) Number of windows in the house

a) No windows
b) One
c) 2-3
d) More than three (specify)

13. Facilities regarding availability of water

i) Source of drinking water

a) Own well
b) Common well
c) Bore well
d) Ponds
e) Pipe water
f) Streams
g) River
h) Others (specify)

ii) Source of water for washing purpose

a) Own well
b) Common well
c) Bore well
d) ponds
e) Pipe water
f) River
g) Streams
h) Others (specify)

14. Do you have drainage facility in your home

Yes/No

15. i. Do you have a bath room of your own?

Yes/No

ii) a. If yes specify location:

a) Attached to the house
b) Outside the house

If no:

b. From where do you take bath?

a) River
b) Pond
c) Streams
d) House compound
e) Near the common well
f) Others (specify)

e) Near the common well
f) Others (specify)

16. i) Do you have facilities for urination and defecation in your house Yes/No

ii) If yes, specify whether it is
a) Own latrine
b) Community latrine

iii) if own did you build it/your own
Yes/No

iv) If no, specify the agency who built it

17. i. Do you have electrcity in your house?
Yes/No

ii) If no, what type of light do you use?
a) Candle
b) Kerosene lamp
c) Others (specify)

18. Details regarding possession of household goods:

a) i) Do you possess a radio in your house?
Yes/No

ii) If yes, specify
a) Frequency of use
b) Whether it is gifted or purchased
c) Programmes in which interested

b) Do you possess any of the following? (If any of these are present specify whether it is gifted or purchased)

i) Household utensils

a) Brass
b) Steel
c) Copper
d) Others (specify)

ii) Sewing machine

iii) Furniture

a) Table
b) Chair
c) Cot
d) Almirah
e) Others (specify)

iv) Cycle
v) Others (specify)

19. Details regarding the availability of fuel

i) Type of fuel used in the house

a) Wood
b) Agricultural waste
c) Cowdung
d) Others (specify)

ii) Source of fuel for the family

a) Collected from the surroundings of the house
b) Collected from forest
c) Purchased
d) Others (specify)

iii) Who is responsible for the collection of fuel?

a) Wife
b) Husband
c) Children
d) All the family members
e) Others (specify)

iv) Time spent in a day for fuel collection	Frequency of collection	Distance travelled	Quantity collected at each time	If purchased cost of material

20. Details regarding personal hygiene.

i) a) Do you take bath every day? Yes/No

b) if no, how often do you take bath

c) Why?

d) Do you insist your children to bathe daily?
Yes/No

e) If no, how often do they take bath

f) Why?

ii) a) Do you use soap to clean your body?
Yes/No

b) If no, what do you use to clean your body

c) Do your children use soap to clean their body?
Yes/No

d) If no, what do they use?

iii. a) Do you use oil before taking bath? Yes/No

b) If yes, specify the oil

c) If no, give reasons

d) Do your children use any oil before taking bath?

Yes/No

e) If yes, specify the oil

f) If no, give reasons?

iv. a) Do you comb your hair? Yes/No
b) Do you insist your children to comb their hair? Yes/No

v. a. Do you clean your teeth daily? Yes/No
b. If no, how often do you clean your teeth?
c. Do your children clean their teeth daily?
Yes/No
d. If no, how often do they clean their teeth?
e. If yes, with what will your children clean the teeth?

vi. a. Do you wash your hands before taking food? Yes/No

b. If no, why?

c. Do you insist your children to wash their hands before taking food?

d. If no, why?

vii. a. Do you wash your hands with soap after defecation?

Yes/No

b. Do you insist your children to wash their hands with soap after defecation?
Yes/No

viii. a. Do you change your clothes daily? Yes/No

b. If no, how often do you change your clothes?

c. Do you insist your child to change the clothes daily?

Yes/No

d. If no, how often do they char[illegible] clothes?

ix. a. Do you wash your clothes daily?
Yes/No

b. If no, how often do you wash the clothes?

c. Do you wash the children's clothes daily?
Yes/No

d. If no, how often do you wash the clothes?

x. a. Do you use foot wear? Yes/No

b. Do your children use foot wear? Yes/No

c. If no, why?

21. Facilities in the locality

Sl. No.	Facility	Present/ absent	Whether utilising	Reasons	Adequacy			Suggestions for improvement
					Good	Satisfactory	poor	
1.	Balwadis							
2.	School							
i)	Nursery School							
ii)	Lower Primary							
iii)	Upper Primary							
iv)	High School							
v)	Tribal School with/without hostel facility							
3.	Co-operative store							
4.	Public water supply							
5.	Road							
6.	Transport							
7.	Health							
i)	Hospital							
ii)	Dispensary							
iii)	Allopathy							
iv)	Ayurvedic							
v)	Homeopathy							
vi)	MCH centre							
vii)	PHC							
viii)	Medical shop							
8.	Recreation							
i)	Cinema theatre							
ii)	Play ground							
iii)	Television							
iv)	Radio							
9.	Electricity							
10.	Post Office							
11.	Bank							
12.	Market							
13.	Library							
14.	Veterinary hospital							
15.	Ration Shop							
16.	Others (specify)							

22. Monthly expenditure patterm

Sl. No.	Items	Amount spent/ month Rs.	Mode of payment			Person making the purchase	Per centage of expenditure
			Cash	Credit	Exchange articles instead of money		
1.	Food						
2.	Clothing						
3.	Shelter						
i)	Rent						
ii)	Repaying loan						
iii)	Maintenance						
4.	Personal expenditure						
i)	Tobacco						
ii)	Alcoholic drinks						
iii)	Pan supari						
iv)	Beedi						
v)	Cigarette						
vi)	Others (specify)						
5.	Transport						
6.	Education						
7.	Recreation						
8.	Health						
9.	Water						
10.	Fuel						
11.	Light						
12.	Ceremonies						
13.	Gift						
14.	Savings						
15.	Repaying loan						
16.	Others (specify)						

23. Details regarding savings

i) Do you have the habit of saving money: Yes/No

ii) If yes

Sl. No.	Mode of saving	Frequency of saving	Person responsible for saving	Purpose of saving	Amount saved per week/month/year
1.	Hundi				
2.	Chit funds				
3.	Post Office				
4.	Bank				
5.	Insurance				
6.	Local chitti				
7.	Loan for higher interest				
8.	Others (specify)				

24. Details regarding loan

i) Do you have facility for getting loan: Yes/No

ii) If yes, have you taken any loan? Specify

Sl. No.	Source of Loan	Amount Rs.	Interest (%)	Long term	Short term	Purpose
1.	Neighbours					
2.	Chit funds					
3.	Bank					
4.	Money lenders					
5.	Local persons for interest					
6.	Government					
7.	Others (specify)					

25. Participation in civic activites:

Sl. No.	Organization	Membership		Name of the family member	Office Bearer	
		yes	no		active	inactive
1.	Panchayat					
2.	Mahila Mandals					
3.	Political parties					
4.	Others (specify)					

26. i) Do you visit the nearest town? Yes/No
    ii) If yes, specify

    a) Name of the town
    b) How often do you visit
    c) Purpose of the visit
    d) Mode of conveyance

27. i) Do any medical/paramedical personnel visit your house/locality? Yes/No

    ii) If yes, specify the frequency of visit

Frequency	Medical	Paramedical
Daily		
Weekly		
Fortnightly		
Monthly		
Once in a while		

iii) Purpose of the visit

28. i) When any one of the family members is sick where do you go for treatment?

    a) PHC doctor
    b) Local allopathic doctor
    c) Homeopathy doctor
    d) Ayurvedic doctor
    e) Mantra
    f) Others (specify)

    ii) Why do you adopt such treatment?

    iii) Do you buy and give the medicine prescribed by the Physician to the sick person faithfully? Yes/No

    iv) If no, why?

29. i) Do you use any traditional medicine for treating ailments? Yes/No
    ii) If yes, specify:

Name of the plant or other items used in the medicine	Who prescribes it	Mode of preparaton	Purpose	How often given	Whether it is effective

30. i) How many pregnancies have you had? (including abortions, premature birth, still birth if any?)

No. of pregnancies	Abortions	Premature birth	Still birth

ii) If any child had died give the following details:

Sl. No.	Age of the child at death	It's birth order	Reported cause by the mother

iii) Do you use any traditional medicine to terminate unwanted pregnancies?

iv) If yes, specify the medicine:

v) Have you used any birth control measures? Yes/No

a) adopted by the advice of the doctor
b) through traditional medicines

vi) If traditional medicine is used, specify

Source and nature of the medicine	Who prescribes the medicine	Method of preparation	How the medicine is used

31. i) Has your child received any immunization? Yes/No

ii) If yes,

Child who received immunization	Age at which given	Name of the immunization	How often repeated	Reasons

32. What fre the major illness your child had suffered in the past?

Sl. No.	Name of the illness	Child who suffered
1.	Measles	
2.	Tuberculosis	
3.	Chicken pox	
4.	Mumps	
5.	Whooping cough	
6.	Diphtheria	
7.	Polio	
8.	Scabies	
9.	Others (specify)	

33. What are your children's major activities

Sl.	Activity	Boy	Girl
	ol		
	ehold work		
	outside the house		
	ol and work		
	rs (specify)		

APPENDIX II

Interview schedule to elicit information on dietary habits of the families

(Item No.1 to 4 has to be completed by the investigator before starting the survey)

Serial Number:

1. Name of the respondent. :
   (Wife/Husband)

2. Name of the head of the family:

3. Address :

   a) House number
   b) Name of the hamlet
   c) Name of the village
   d) Name of the panchayat

4. Total income of the family :

5. Type of food consumed generally:

Vegetarian — Lacto vegetarian, Ovovegetarian

Non-vegetari

6. a) Name of the staple food

   b) Is it available throughout the year : Yes/No

   c) If no, what is your staple food during that time:

7. i. Details regarding the important wild roots/fruits consumed by the family:

Name	Season of availability	When used	How consumed	The person responsible for collection

ii) If food grains are available in sufficient quantity, would you resort to collection of roots, fruits etc.

Yes/No

8. i. Does the household catch/hunt fishes, birds or animals:

Yes/No

If yes, specify the items:

ii) a) Do you use bow and arrow for hunting? Yes/No
b) If yes, do you use any poison in the arrows ? Yes/No

iii) a) Do you use any poison for fishing and catching birds Yes/No

b) If yes, for question (ii b) and (iii a) specify

a) Name of the poison:
b) Is the poison available in the locality:
c) How is the poison prepared:

9. i) Do you or any of the family members have the following habits:

a) Smoking - Men/Women
b) Use of alcohol - Men/Women
c) Use of narcotics/ Drugs - Men/Women
d) Use of tobacco - Men/Women

ii) If yes, a) Specify the items used

b) Frequency of use

iii) Do you prepare alcoholic drinks at home? Yes/No

iv) If yes, specify the items used for this purpose:

10. i) Details of food expenditure of the family

Sl. No.	Foods	Quantity purchased	Total cost	Frequency of purchase: Daily	Weekly	Fortnightly	Monthly	Mode of purchase: Cash	Credit	Exchange articles instead of money	person responsible for purchase	Percentage of food expenditure	Home production	Person responsible for home production
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Cereals													
2.	Pulses													
3.	Green leafy vegetables													
4.	Other vegetables													
5.	Roots & tubers													
6.	Fruits													
7.	Nuts & oil seeds													
8.	Milk													
9.	Milk products													

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	Fats & oils													
11.	Sugar and Jaggery													
12.	Spices and condiments													
13.	Flesh foods and egg													
14.	Beverages													
15.	Prepared foods													
16.	Other edible forest produce													

ii) Why do you buy the prepared foods from outside?

11. i) Frequency of the use of various foods

Sl. No.	Food articles	Frequency of use							
		Daily	More-than 3 times a week	Less than 3 times a week	Once in a week	Once in two weeks	Once monthly	Occasionally	Never
1.	Cereals								
2.	Pulses								
3.	Green leafy vegetables								
4.	Other vegetables								
5.	Roots & tubers								
6.	Fruits								
7.	Nuts and oil seeds								
8.	Milk								
9.	Milk products								
10.	Fats and oils								
11.	Sugar and jaggery								
12.	Spices and condiments								
13.	Flesh foods and eggs								
14.	Prepared foods								
15.	Beverages								
16.	Other edible forest produce								

ii) Who is responsible for deciding the frequency of the inclusion of various foods in the daily diet.

12. i) Do you maintain accounts for food expenditure: Yes/No

ii) If yes A) In what form
- a) Written
- b) Memory

B) Period
- a) Daily
- b) Weekly
- c) Monthly

13. Details regarding meal planning:

i) Do you plan your meals in advance ? Yes/No

ii) If yes, what is the basis for planning
- a) Total family requirement
- b) Money available
- c) Likes and dislikes of family members
- d) Others (specify)

14. i) How many times do you or your family members take food daily?
- a) Once
- b) Twice
- c) Thrice
- d) Morethan three times
- e) As and when they like
- f) Others (specify)

ii) a) Do you maintain specific time schedule for taking food? Yes/No

b) Specify the reason

iii) Do you eat any food in between the main meals? Yes/No
If yes, specify
- a) Name of food
- b) when?

iv) Do you use boiled water or water without boiling for drinking?

v) a) Have you changed your food pattern because of any religious reasons? Yes/No
b) If yes, specify

Reason	Name of foods			
	omitted		included	
	Daily	Occasionally	Daily	Occasionally

vi) a) Do you believe that your family diet pattern has been changed from that of your ancestors?
Yes/No

If yes,

b) Can you specify the food habits that your parents and grand parents had followed

c) What are the changes that you have adopted in your food habits

15. a) Do you change your food habits according to the availability of foods during different seasons? Yes/No

b) If yes, give details:

Season	Changes adopted
Summer	
Winter	
Rainy	

16. Methods of preparing foods before cooking

I i) Dry food articles (like cereals & pulses)
a) Washing and drying (soon after purchase)
b) Washing just before cooking
c) Clearing/Winnowing and then washing
d) Without washing
e) Others (specify)

ii) If washing is adopted, state as to how many times the following food articles are washed

Name of food articles	Once	Twice	Thrice	Morethan thrice	wash till water is clear
a) Cereals					
b) Pulses					

iii) a) Do you soak pulses before cooking: Yes/No
b) If yes,
a) Name or pulses
b) Time of soaking
c) Reasons for soaking

II. i) Fresh food items

a) When do you wash fruits and vegetables?

Name of food	Before cutting	After cutting
Fruits		
Green leafy vegetables		
Roots and tubers		
Other vegetables		

ii) How do you cut vegetables?

a) Into very small pieces like grating
b) into small pieces
c) Into big pieces
d) According to the type of preparation
e) No such criteria followed

iii) Do you cut vegetables long before cooking or just prior to cooking ?

a) Long before cooking
b) Just prior to cooking

iv. a) Do you eat any foods raw? Yes/No

b) If yes, specify:

Name of foods	No. of times that you consume them daily

17. i) Methods employed for cooking

Sl. No.	Food	boiling	Steaming	Stewing	Boiling and straining	Excess water method	Absorption	Deep frying	shallow fat frying	broiling	grilling	Any spl methods
1.	Cereals											
2.	Pulses											
3.	Leafy vegetables											
4.	Roots and tubers											
5.	Other vegetables											
6.	Fruits											
7.	Flesh food											
8.	Egg.											
9.	Milk											
10.	Rare fruits/ vegetables (specify)											

ii) Do you throw away the excess water of the cooked foods?

Yes/No

iii) If no, how do you use this later?
a) Drinking
b) For cooking dhal/meat/
c) Others (Specify)

18. Details regarding cooking of foods
i) How many times do you cook meals in a day?
a) Once
b) Twice
c) Thrice
d) Morethan thrice

ii) Who does the cooking?

iii) What are the type of cooking vessels used?

a) Copper	f) steel
b) Aluminimum	g) Stone
c) Iron	h) Wooden
d) Brass	i) Bronze
e) Earthen pots	j) Others (specify)

iv) What is the type of hearth/stove used at home?

19. In feeding whom do you consider the most important person in the family

Preference	Individual	Reasons
First		
Second		
Third		

20. i. How do you serve the meals after cooking

a) Meals taken by the male members first and then by the female members
b) Meals taken by the head of the family first and then by others
c) Meals taken by the children first and then by other members
d) Meals taken together by all the members
e) No such criterion followed

ii) How do you cut vegetables?

a) Into very small pieces like grating
b) Into small pieces
c) Into big pieces
d) According to the type of preparation
e) No such criteria followed

21. Use of leftover foods

i) Do you use leftover foods? Yes/No

ii) if yes, specify

Item leftover and reused	How is it reused

22. Method of storage of foods

i) Do you store any foods in your house : Yes/No.

ii) If yes, specify

Sl. No.	Name of food	Method of storage	Period of storage	Season	Whether it is used by family or sold	Container for storage	Reason
1.	Cereals						
2.	Pulses						
3.	Green leafy vegetables						
4.	Other vegetables						
5.	Roots and tubers						
6.	Fruits						
7.	Milk						
8.	Meat						
9.	Egg						
10.	Fish						
11.	Others (specify)						

iii) Do you employ any specific treatment before storing the food stuffs? Yes/No

iv) If yes, specify the treatment

23. Details of food preservation

i) Do you preserve any foods in your house? Yes/No

ii) If yes, specify

Sl. No.	Foods preserved	Methods used	Season	Period over which preserved	Containers used for preservation	Reasons
1.	Cereals					
2.	Pulses					
3.	Leafy vegetables					
4.	Other vegetables					
5.	Roots and tubers					
6.	Fruits					
7.	Milk					
8.	Meat					
9.	Egg					
10.	Fish					
11.	Others (specify)					

iii) How do you use the preserved foods?

iv) Do you purchase preserved foods from outside? Yes/No

v) If yes, specify the items

24. Details regarding the feeding of children

i) Do you prepare and serve any special foods for school children ? Yes/No

ii) If yes, specify

Particulars	Name of food	Method of preparation	Frequency of feeding	Reason
Boys				
Girls				

iii) If no, give reasons

iv) a) Do you avoid any food item from the diet of school children? Yes/No

b) If yes, specify

Particulars	Name of food	Reason
Boys		
Girls		

v) Do you maintain special timing for feeding your children: Yes/No

vi) Do your children participate in the school feeding programme or any other feeding programme? Yes/No

vii) If yes,

a) Specify the name of the feeding programme
b) Benefits that children get from the programme
c) Specify whether the children consume the food at the centre or bring home
d) What is your opinion about the programme?

25. Foods given/avoided during special conditions

Sl. No.	Conditions	Foods given	Reason	Foods avoided	Reason
1.	Infancy				
2.	Pre-school children				
3.	Adolescents				
4.	Pregnancy				
5.	Lactation				
6.	Old age				

26. Foods prepared for special occasions

Occasion	Foods prepared	Reason
Birth		
Death		
Marriage		
Feast		
Others (specify)		

27. Infant feeding practices

i) When do you start breast feeding the new born baby?

First day				2nd day	3rd day	After 3rd day (specify)	Reasons
Soon after birth	6 hrs. after birth	7-12 hrs after birth	After 12 hrs				

ii) a. What is the first item of food given to the baby?

b) When it is given

c) Reasons for giving

iii) Do you give colostrum to your baby? Yes/No

iv) Do you consider colostrum important for the health of the baby?

v) Specify reasons also

vi) Views of the mother regarding breast feeding Good/Bad

vii) Specify reasons

viii) How long do you breast feed the infants

a) Until next pregenancy
b) Less than 6 months
c) One year
d) Two years
e) More than two years (specify)

ix) What is the interval between breast feeding

a) Every two hours
b) Every three hours
c) When the mother feels that the child is hungry
d) When the child cries
e) Any other (specify)

x) Do you give any other food item in-between breast feeding: Yes/No

28. Details regarding weaning?

i) What is the age of weaning the infant?

ii) Specify the reasons for weaning at that age.

a. Mother's pregnancy
b. Mother's illness
c. Others (specify)

iii) What are the foods included during weaning?

Foods included	Quantity

iv) Do you prepare any special weaning food: Yes/No.

v) If yes, give details of the preparation and quantity given:

Preparation	Quantity

29. Details regarding supplementary feeding

Supplement	Age at which intro-duced	Quantity given at a time	No. of feeds	Interval between feeds	Reasons for introducing the food
Liquids other than breast milk					
Semi solid foods					
Solid foods					

30. i) Do you take your child when you go for work: Yes/No

ii) If yes, do you feed your baby in the work place? Yes/No.

iii) If yes,
a) Number of times you feed the baby
b) Foods given

iv) If no, who looks after the child and who feeds them.

a) Mother
b) Sister
c) Elder children
d) Neighbours
e) Others (specify)

31. Diet during illness

Sl. No.	Illness	Foods Given	Reasons	Foods avoided	Reasons
1.	Cold				
2.	Fever				
3.	Diarrhoea				
4.	Chicken pox				
5.	Measles				
6.	Others (specify)				

32 i) Epidemics prevalent in the locality during the past three years?
ii) Specify whether family was affected by the above edpiemics? Yes/No
iii) If yes specify:
a) Name of the illness
b) Name of the individual
c) Age at which the disease was affected

33. i) Is there any handicapped person in your family? Yes/No

ii) If yes, specify

Name of the person	Age	Sex	Cause if known	How long he is handicapped

iii) Does the handicapped individual get any benefit from the government or any other agency: Yes/No
iv) If yes, specify the details of the benefit

34. a. Details regarding the developmental programmes in the locality

i) Is there any developmental programmes in the locality? Yes/No

ii) If yes, specify: Whether you or any other family member is a participant

iii) if yes, specify

Name of the participant	Age	Name of the programme	Opinion about the programme			
			Good	Satisfactory	Poor	Not functioning properly

b) The benefits the participant get from the programme

a) Food
b) Medicine
c) Health check-up
d) Immunization
e) Domestic animals
f) Nutrition education
g) Agricultural implements
h) Loans
i) Job
j) Others (specify)

35. i) Do you consider some foods good for health: Yes/No

ii) If yes, specify the name of food stuffs

a) Strength giving
b) Good for eyes
c) Good for blood
d) Good for pregnant woman
e) Good for nursing woman
f) Good for infants
g) Good for children
h) Good for sickness
i) Others (specify)

APPENDIX - III

Procedure adopted for anthropometric measurements

Weight-for-age

For weighing, platform weighing balance was used, as it is portable and convenient to use in the field. The weighing scale was checked periodically for accuracy. The scale was adjusted to zero before each measurement. The subject was having minimum clothing and was asked to stand on the platform of the scale, without touching anything, and looking straight ahead. The weight was recorded to the nearest 0.25 kg. Each reading was taken twice to ensure correctness of the measurement.

Height-for-age

To determine height the anthropometric rod designed by the National Institute of Nutrition was used. The rod was placed perpendicular to the ground, taking care to see that the floor area was even and not rough. The subject was asked to remove the slippers, stand with the centre of the back touching the scale, with the feet parallel and heels, buttocks, shoulders and back of the head touching the rod. The head was held comfortably erect, the arms hanging loosely by the side. The ruler was held on the top of the head in the centre, crushing the hair at right angle to the scale, and the height read off from the lower edge of the ruler to the nearest 0.5 cm. Each reading was taken twice to ensure correctness of the measurement.

Mid upper arm circumference

Mid upper arm circumference was measured to the nearest 0.1 cm with a tape by placing gently but firmly round the limb to avoid compression of the soft tissues. The left arm was measured while hanging, at its mid point.

Skinfold thickness

Skinfold thickness was determined using a skinfold caliper. A lengthwise skinfold was firmly grasped and slightly lifted up between the finger and thumb of left hand. Care was taken not to include underlying muscle. The calipers was applied about 1 cm below the operators finger at a depth about equal to the skinfold, while the skinfold was still gently held throughout the measurement. The measurement was read to 0.1 mm accuracy.

APPENDIX IV
Schedule for clinical assessment
(N.A.C.I.C.M.R.)

1. Sex
2. Age
3. Height
4. Weight

I. General

6. Appearance
   0. Good
   1. Fair
   2. Poor
   3. Very poor

II. Eyes (A) Conjunctiva

7. Xerosis

   0. Absent, glistening and moist
   1. Slightly dry on exposure for a minute, lack of lustre
   2. Conjunctiva dry and wrinkled
   3. Conjunctiva very dry and Bitot's Spots present.

8. Pigmentation
   0. Normal colour
   1. Slight discolouration
   2. Moderate browning in patches
   3. Severe earthy discolouration

9. Discharge

   0. Absent
   1. Watery, excessive lachrymation
   2. Mucopurulent
   3. Purulent

B, Cornea

10. Xerosis

   0. Absent
   1. Slight dryness and diminished sensibility
   2. Haziness and diminished transparency
   3. Ulceration

11. Vascularization

   0. Absent
   1. Circumocorneal infection
   2. Vascularization of cornea

(c) Lids

12. Excoriation

   0. Absent
   1. Slight excoriation
   2. Blepharitis

13. Folliculosis

   0. Absent
   1. A few granules
   2. Lids covered with extensive granules
   3. Hypertrophy

14. Angular conjunctivitis

   0. Absent
   1. Present

(D) Functional

15. Night blindnes

   0. Absent
   1. Present

NB: Exclude other eye diseases not associated with nutritional defects

III. Mouth

(A) Lips

16. Condition

   0. Normal
   1. Angular stomatitis, mild
   2. Angular stomatitis, marked

(B) Tongue

17. Colour

0. Normal
1. Pale but coated
2. Red
3. Red and raw

18. Surface

0. Normal
1. Fissured
2. Ulcered
3. Galzed and atrophic

(C) Buccal mucosa

19. Condition

0. Normal
1. Bleeding and/or gingi-vitis
2. Pyorrhoea
3. Retracted

(D) Gums

20. Condition

0. Normal

(E) Teeth

21. Fluorosis

0. Absent
1. Chalky teeth
2. Pitting of teeth
3. Mottled and discoloured teeth

22. Caries

0. Absent
1. Slight
2. Marked

IV. Hair

23. Condition
0. Nomal
1. Loss of lustre
2. Discoloured and dry
3. Sparse and brittle

V. Skin

(A) General

24. Appearance
0. Normal
1. Loss of lustre
2. Dry and rough or crazy pavements
3. Hyperkeratosis, phrynoderma

25. Elasticity

0. Normal
1. Diminished
2. Wrinkled skin

(B) Regional

26. Trunk

0. Normal
1. Collar-like pigment-ation and dermatitis around the neck
3. Moon face

27. Face

0. Normal
1. Nasolabial seborrhoea
2. Symmetrical sub-orbit pigmentation
3. Moon face

28. Perineum

0. Normal
1. Scrotal or puddendal dermatitis

29. Extremities

0. Normal
1. Symmetrical dermati-tis with pigmentation of glove or stocking type

VI. Adipose Tissue (to be judged by the examination of the arm over the biceps)

30. Quantity

0. Normal
1. Deficient

VII. Oedema

31. Distribution

0. Absent
1. Oedema on dependent parts
2. Oedema on face and dependent parts
3. General anasarca

VIII. Bones

32. Condition

0. Normal
1. Stigmata of past rickets

IX. Heart

33. Size

0. Normal
1. Apex outside the nipple line
2. Enlarged

X. Alimentary system

34. Appetite

0. Normal
1. Anorexia

35. Stools

0. Normal evacuation
1. Diarrhoea

36. Liver

0. Not palpable
1. Palpable

37. Spleen

0. Not palpable
1. Palpable

XI. Nervous system

38. Calf tenderness

0. Absent
1. Present

39. Paresthesis

0. Absent
1. Present

APPENDIX V

Schedule for individual food consumption survey - Weighment method

Name of the investigator: Date:

Name of the head of the family Address:

Name of the subject:

Age of the subject:

Name of the Meal	Food consumption			
	Menu	Weight of total raw ingredients used by the family (g)	Weight of total cooked ingredients used by the family (g)	Weight of total cooked ingredients used by the individual (g)
Breakfast				
Lunch				
Evening tea				
Dinner				
Others				

APPENDIX - VI

Procedure adopted for biochemical estimations

Estimation of haemoglobin (Cyanmethaemoglobin method)

Principle

Haemoglobin is converted into cyanmethaemoglobin by the addition of KCN and ferricyanide. The colour of cyanmethaemoglobin is read in a photoelectric colorimeter at 540 nm against a standard solution. Since cyanide has the maximum affinity for haemoglobin, this method estimates the total haemoglobin.

Reagent

Drabkin's solution-Dissolve 0.05 g of KCN, 0.20 g of potassium ferricyanide and 1.00 g of sodium bicarbonate in 1 litre of distilled water.

Procedure

20 µl of blood is transferred with the help of a haemoglobin pipette and delivered on to a Whatman No.1 filter paper disc. The filter paper is air dried, labelled and can be stored upto one week. The portion of filter paper containing the blood is cut and dipped in 5 ml of Drabkin's solution taken in a test tube. Wait for 30 minutes and mix the contents in the tubes, take the readings

in a photoelectric colorimeter. The reagent blank (Drabkin's diluent) is adjusted to zero.

Construction of standard curve

If the blood drawn from the subject contains haemoglobin 15 g/dl after estimation then prepare three reference standards as follows.

1. Reference standard A

4 ml of blood in 1000 ml Drabkin's reagent contains haemoglobin 15 g/dl.

2. Reference standard B

300 ml of reference standard A + 200 ml Drabkin's reagent contains haemoglobin concentration of 10 g/dl.

3. Reference standard C

200 ml of reference standard A + 300 ml Drabkin's reagent contains haemoglobin concentration of 7.5 g/dl.

Thus we have three reference standards at three levels of haemoglobin concentration. Use 5 ml from each standard whenever haemoglobin estimations are done.

Estimation of serum Iron (Wong's method)

Principle

Iron is determined colorimetrically making use of the fact that ferric iron gives a blood red colour with potassium thiocyanate.

Reagents

1. 30% H_2SO_4

2. 7% Potassium persulphate solution: 7 g potassium persulphate is dissolved in glass distilled water and the solution made upto 100 ml.

3. 40% Potassium thiocyanate solution: 40 g KCNS is dissolved in 90 ml glass distilled water. 4 ml acetone added and the volume made upto 100 ml.

4. Standard iron solution: 702.2 mg ferrous ammonium sulphate is dissolved in 100 ml glass distilled water and after addition of 5 ml of 1:1 Hcl, the solution is made upto 1 litre and mixed thoroughly (0.1 mg Fe/ml). The standard solution is prepared fresh once in 6 months.

Working standard solution (10 µg/ Fe/ml) is prepared by diluting the above solution 10 fold.

Procedure

Two ml of Conc. H_2SO_4 is taken in a 50 ml volumetric flask. Add exactly 0.5 ml of well mixed blood, mix and to this add 2 ml of potassium persulphate, agitate the flask, cool and dilute with about 25 ml distilled water. Then 2 ml of sodium tungstate is added and the volume made upto the mark. Filter using Whatman No.42 filter paper. Transfer 15 ml of the filtrate to a fresh tube, add 1 ml of potassium persulphate and 4 ml of potassium thiocyanate. Mix and read the colour at 540 nm in a colorimeter. A standard (10-100 ug) is run similarly and a standard graph is prepared.

Packed cell volume - Wintrobe's method

Fill the Wintrobe's tube till the 100 mm mark on top with a pasteur pipette ensuring that there are no air bubbles in the blood column. Centrifuge this tube for 15 minutes at 3500 rpm until packing is complete. After centrifuging, the blood is separated into 3 layers; a column of red blood cells at the bottom, a narrow middle layer of buffy coat of white blood cells and platelets and the top most fluid column of plasma. The percentage of the height of the column of blood occupied by packed red cells constitutes the haematocrit.

Serum Protein

Principle

The CONH groups in the protein molecule react with copper sulphate in alkaline medium to give purple colour which is then read at 540 nm.

Reagents

1. Biuret reagent. Dissolve 4.25 g of potassium sodium tartarate (KNa $C_4H_4O_6$ $4H_2O$), 1.5 g of cupric sulphate ($CuSO_4$ $5H_2O$) and 2.5 g potassium iodide in about 500 ml of distilled water. Dissolve 4 g of NaOH in the solution and make up the volume to 1 litre.

2. Standard: The standard protein solution may be either a pooled normal human serum (standardised by Kjeldahl method) or a solution of pure albumin in saline.

Procedure

To 0.1 ml aliquots of standard, test plasma and blank (saline or distilled water) add 5 ml of biuret reagent. Mix well and keep for 30 min. Read absorbances of test and stnadard against blank at 540 nm.

Calculation

Total protein g/100 ml

$$= \frac{\text{reading of test}}{\text{reading of standard}} \times \text{concentration of standard}$$

Serum albumin

Reagents

1. 40% NaOH in distilled water.
2. 2% boric acid: Dissolve 20g of reagent grade boric acid in about 500 ml of hot distilled water and add 2 ml of 0.1% bromocresol green in alcohol (or aqueous solution of the sodium salt) and finally make up the volume to 1 litre with distilled water.
3. 0.01N H_2SO_4 (standardised)
4. 28% sodium sulphite

Procedure

Add 4.8 ml of 28% sodium sulphite solution to 0.2 ml of plasma. Mix by rotating the tube for 2 to 3 min. Filter the solution through a whatman No. 40 filter paper. Take 2.5 ml of the filtrate and proceed the digestion, distillation and titration as detailed below.

Transfer the filtrate into a 50 ml long necked micro-Kjeldahl flask and wash the sides of the flask with distilled water. Add 2 ml of concentrated sulphuric acid and digest on a heated sand bath or on the microdigestion unit. When charring begins and white fumes appear in the flask stop digestion for a while to allow the flask to cool and add a few drops of hydrogen peroxide. Continue the

Run the blank preparation through all the steps by taking distilled water in place of sample.

Calculation

Albumin content of plasma = X x 0.875 g/100 ml

Enumeration of red blood corpuscles

The method involves an accurate dilution of a measured quantity of blood with a fluid which is isotonic with the blood and which will prevent its coagulation. A dilution of 1 to 200 is usually necessary. The diluted blood is placed in a counting chamber and the number of cells in a circumscribed volume is enumerated under a microscope.

Materials

1. Red cell pipette: It is a capillary tube, graduated in 10ths, which opens into a bulb, with a red glass bead. The bulb when filled to the mark above it (101) will hold 100 times the quantity of fluid contained in 10 divisions of the capillary tube.

2. Counting chamber. A Neubauer counting chamber (haemocytometer) with ratings is commonly used.

3. Diluting fluid. A solution of 1% formalin (10 ml/l, 40% formaldehyde) in 31.3 g/l tri sodium citrate.

digestion till the solution becomes clear. If necessary repeat the addition of hydrogen peroxide and digestion to hasten the process. Add distilled water and boil for a few minutes and allow the flask to cool.

Take 10 ml of the boric acid solution in a 100 ml conical flask and place in such a way that the tip of the condenser outlet of the steam distillation apparatus dips below the surface of the boric acid solution. If the colour of the boric acid solution has faded, 2 or 3 drops of bromocresol green indicator may be added. Transfer the digested sample completely by means of repeated rinsings to the chamber of the steam distillation apparatus. The chamber should be previously cleared off any contaminating ammonia by repeated washings. Add about 8 ml of 40% NaOH (or a quantity enough to make the mixture alkaline) to the digest in the chamber. Start the steam generation and make the distillation set airtight. Steam distill till about 30 ml distillate is collected into receiving flask. Lower the receiving flask and stop the steam generation. Wash the condenser outlet tube into the receiving flask with a little distilled water.

The solution in the receiving flask is coloured blue at this stage. Titrate the contents against 0.01 N H_2SO_4 till the original green colour is obtained.

Procedure

The blood is drawn by mouth suction upto the 0.5 mark, the tip of the pipette is wiped clean and the diluent is drawn in until the solution fills the pipette and reaches the '101' mark. If the blood is being taken directly from the finger of the subject this procedure should be done quickly to avoid coagulation. The pipette is shaken by holding it loosely in one hand (after removing the attached rubber tubing) between the thumb and the forefingers at least for 3 min. before loading it in the chamber. Alternately, 20 μml of blood can be diluted in 4.0 ml of the diluting fluid in a test tube.

The coverslip is put on the counting chamber. A few large drops of the mixed solution are discarded from the pipette and then a small quantity of the diluted blood is put between the coverslip and the ruled platform of the counting chamber. The chamber should not overflow and there should not be any air bubble in the chamber. The solution is allowed to settle for a couple of minutes and then the counting is done under the high power of a microscope.

In the Neubauer ruling, the small squares in the central large 1 mm square are used for the enumeration of erythrocytes.

The number of cells in the four corner groups of 16 squares are counted and also one central group including those cells which lie within the area or on the dividing lines to the left or above the section. If the dilution has been 1 to 200 (blood drawn to 0.5 mark) then the total number of cells found in the 5 groups of 16 squares is multiplied by 10,000 in order to give the number of cells in millions for mm^3 of blood.

Calculation

The smallest square have an area of 0.0025 mm^2 and are 0.1 mm deep, being thus 0.00025 in volume. Since 80 such squares are counted a volume of 0.00025x80 or 0.02 has been covered. In order to give the value per mm^3 the number of cells counted must be multiplied by 50. However, since the dilution is 1 to 200, the multiplication factor is 50 x 200 or 10,000.

Total leucocyte count

Principle

The enumeration of leucocytes is carried out according to the same principle as that of erythrocytes. Leucocytes being less numerous a dilution of only 1 to 20 is used and the diluent is usually one which destroys the red blood corpuscles.

Materials

1. WBC pipette: A WBC pipette is similar to a red cell pipette with a white coloured glass bead, but calibrated to give 1 to 20 dilution.

2. Diluent fluid: Mix 2.0 ml glacial acetic acid and 1 drop of gentian violet in 100 ml of water.

3. Neubauer counting chamber: Same as that used for erythrocyte count.

Procedure

The method of counting is similar to that for erythrocytes except that the count is made in 4 large (1 mm) corner squares of Neubauer counting chamber.

Calculation

The total number of cells in 4 squares is multiplied by a factor of $\frac{50 \times 20 \times 1}{1 \times 0.1 \times 4}$ to give the count per mm^3 of blood.

Differential leucocyte count

Materials

1. Leishman's stain: Dissolve 0.2 g of Leishman's dye in 100 ml of acetone free methanol at 50°C for 15 min with occasional shaking. Cool and filter the solution.

Na_2HPO_4 $2H_2O$ to 1 l with water.

Preparation of blood smear: Place a drop of blood collected either directly or in EDTA on to clean glass slide about 1-2 cm from one end. A spreading slide is placed at an angle of 45° pproximately on the slide and move it backwards so that it makes contact with the blood. The drop should spread out quickly along the line of contact of the spreader with the slide. With a single swift forward movement spread the blood along the surface of the slide. The drop of blood taken should be just sufficient to produce a smear of 3-4 cm in length. The ideal thickness is such that there is some overlap of red cells throughout much of the film length.

Procedure

Place the slide flat on two glass rods over a sink. Cover the slide with the stain and wait for 2-3 min. Dilute the stain by the drop by drop addition of buffered water and stain for a period of 5-7 min. Drain off the stain and wash in water. Air dry and view it under microscope.

Choose the ideal portion of the smear for counting by scanning the smear under low power. Start counting under high power or oil immersion objective from the edge of the smear moving the smear towards the centre. Identify and count the leucocytes as they appear. Shift the slide laterally and then move towards to the edge. Repeat this movement till a total of 100 cells are counted. Express the values of different morphological types as the percentage.

Worm infestation

Take a small amount of faeces and emulsify in approximately 10 ml of saline. Strain the faecal suspension through gauze into a centrifuge tube (15 ml size). Centrifuge at 2000 rpm for two minutes. Pour off the supernatant.

Add 10 ml of saline to the sediment and mix. Centrifuge again at the same speed for two minutes. Pour off the supernatant.

Add 10 ml of 10 per cent formalin to the sediment. Mix and allow to stand for 5 minutes.

Add 3 ml of ether, stopper the tube and shake well. Centrifuge at 1500 rpm for two minutes. Centrifuging will yield four layers, the sediment containing parasites and ova, formalin layer, faecal debris and the top layer of ether.

Free the layer of debris and pour off the top three layers.

The sediment is examined by mixing with a few drops of iodine stain. A few drops of saline may be added and the sediment examined without staining. Ova and Cysts may be detected in these preparations.

Sickle cell anaemia

A drop of venous or capillary blood is taken on a slide and add one or two drops of freshly prepared 2 per cent sodium meta bisulphite. A cover slip is placed over it and sealed on all four sides using wax or vaseline. The preparation is observed after 15 to 30 minutes by means of high power objective of a microscope. A control must be set up with isotonic saline instead of the reducing agent.

APPENDIX VII

Questionnaire to elicit information on the nutritional awareness of the respondents

1. Do you give colostrum to the baby
2. When do you start feeding the baby
3. What is the frequency of feeding the baby
4. What is your opinion about feeding colostrum
5. What is the period of breast feeding
6. What is your opinion about breast feeding
7. When do you start weaning
8. What is the weaning food that you give to the baby
9. Do you keep any time schedule for taking meals
10. Do you boil the drinking water
11. How will you prepare the food articles (cereals and pulses) before cooking
12. How many times do you wash cereals
13. Do you soak pulses before cooking
14. Do you wash green leafy vegetables before cutting
15. Do you wash other vegetables before cutting
16. Do you wash the roots and tubers before cutting
17. How will you cut the vegetables
18. Do you eat any raw vegetables

19. Do you consider certain foods good for

    a. strength giving

    b. Good for eyes

    c. Good for blood

    d. Good for pregnant woman

    e. Good for nursing woman

    f. Good for infants

    g. Good for children

    h. Good for sickness

20. Do you process any food articles at home.

APPENDIX VIII

Nutritional Status index of boys and girls

5 Years	Boys	Girls
n = 17(B)	61.75	67.19
= 15(G)	62.13	68.54
	62.67	66.73
	59.75	70.83
	63.56	67.54
	60.11	69.07
	60.73	66.57
	65.54	72.99
	60.04	69.90
	58.37	65.74
	61.19	69.27
	61.06	73.84
	68.69	70.65
	62.75	72.40
	62.19	71.96
	60.21	
	64.20	
6 years	67.13	102.77
n = 13(B)	67.96	100.83
= 12(G)	71.64	95.07
	66.77	100.22

	68.85	103.94
	68.15	104.71
	67.85	99.89
	72.44	95.93
	64.01	99.82
	68.48	103.83
	70.06	101.57
	66.38	101.25
	68.81	
7 years	66.57	88.13
n = 19(B)	66.65	88.39
= 8(G)	68.82	82.88
	61.73	82.73
	65.49	83.31
	62.45	82.04
	65.22	80.33
	64.69	81.84
	65.68	
	63.14	
	63.41	
	63.87	
	62.03	
	64.76	
	64.48	
	60.78	
	70.24	

	60.94	
	62.65	
8 years n = 16(B) = 9(G)	68.80	63.53
	69.05	62.19
	65.44	66.22
	63.49	65.03
	63.89	68.63
	65.31	64.32
	69.10	63.79
	66.73	66.80
	70.43	61.14
	67.57	
	67.82	
	65.25	
	64.01	
	64.62	
	67.98	
	68.74	
9 years n = 12 (B) = 9(G)	115.26	78.56
	121.45	73.77
	114.07	79.96
	116.76	79.87
	110.86	73.02
	116.48	74.72
	113.43	77.87
	117.09	76.02

	112.44	76.43
	116.88	
	113.40	
	117.09	
10 years	62.24	48.98
n = 21(B) = 19(G)	65.33	50.14
	62.70	48.64
	58.69	46.91
	59.70	45.23
	66.53	53.30
	63.83	53.49
	64.31	49.48
	64.30	55.19
	63.75	50.02
	69.81	49.23
	65.17	48.99
	64.19	47.91
	64.97	46.69
	64.30	47.81
	63.29	48.67
	64.23	50.92
	61.87	46.92
	60.72	49.08
	64.40	
	67.43	

11 years	138.62	85.76
n = 6(B)	132.37	87.44
= 5(G)	140.85	83.55
	142.50	82.84
	136.17	79.68
	142.28	
12 years	89.41	38.79
n = 10(B)	88.44	38.22
= 20(G)	87.27	37.10
	86.35	41.73
	85.32	38.29
	80.13	39.13
	87.91	38.90
	92.37	39.90
	84.04	42.36
	86.09	40.73
		38.23
		39.91
		37.34
		40.17
		39.04
		37.37
		38.56
		40.09
		37.32
		39.36

13 years	55.21	122.90
n = 7(B)	56.63	124.47
= 4(G)	54.67	122.16
	55.97	127.62
	58.79	
	51.22	
	54.25	
14 years	86.63	75.31
n = 7(B)	86.75	73.62
= 5(G)	87.98	74.18
	81.06	74.39
	86.16	75.73
	83.07	
	85.92	
15 years	115.56	89.98
n = 7(B)	112.08	89.87
= 3(G)	106.47	92.91
	111.34	
	109.98	
	107.93	
	109.09	

APPENDIX IX-a. Direct and indirect effects of nutrients contributing to the nutritional status index of boys

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	r
X_1	0.3310	1.8847	-0.0178	-2.1294	0.4370	-1.8566	-0.1084	0.2070	0.8148	-0.0243	1.0319	-0.0699	0.5*
X_2	0.2101	2.9690	0.1750	-3.1556	0.8689	-3.1188	-0.1481	0.8322	1.2237	-0.3072	1.4452	-0.9903	0.2741
X_3	-0.0135	1.1849	0.4384	-1.3892	0.0038	-1.1854	0.0217	0.3675	0.2861	-0.0159	0.6396	-0.3069	0.0311
X_4	0.2173	2.8885	0.1878	-3.2435	0.7585	-3.0765	-0.1284	0.7048	1.2174	-0.0358	1.5317	-0.8292	0.1926
X_5	0.0571	1.0184	0.0007	-0.9711	2.5333	-2.4533	-0.5436	0.7559	1.2238	-0.0582	-0.3907	-1.2843	-0.112
X_6	0.1714	2.5824	0.1449	-2.7828	1.7333	-3.5856	-0.1682	0.9235	1.4499	-0.0545	0.9431	-1.2393	0.118
X_7	0.0382	0.4685	-0.0101	-0.4437	1.4673	-0.6425	-0.9385	0.3052	0.6837	-0.0286	-0.3320	-0.7037	0.1362
X_8	0.0515	1.8568	0.1211	-1.7181	1.4391	-2.4884	-0.2153	1.3306	1.0089	-0.0410	0.5164	-1.7800	0.0816
X_9	0.1726	2.3731	0.0819	-2.5792	2.0251	-3.3960	-0.4191	0.8769	1.5309	-0.0573	0.7352	-1.2832	0.0625
X_{10}	0.1268	1.7404	0.1098	-1.8306	2.3263	-3.0855	-0.4240	0.8299	1.3847	-0.0634	0.1624	-1.2852	0.0216
X_{11}	0.1891	2.3755	0.1552	-2.7505	-0.5479	-1.8721	0.1725	0.3804	0.6231	-0.0057	1.8063	-0.2644	0.2615
X_{12}	0.0123	1.5694	0.0718	-1.4356	1.7366	-2.3719	-0.3525	1.2642	1.0485	-0.0435	0.2549	-1.8735	-0.1193

Residue = 0.5556

X_1 = Age
X_2 = Protein
X_3 = Fat
X_4 = Energy
X_5 = Calcium
X_6 = Phosphorus
X_7 = Iron
X_8 = Retinol
X_9 = Thiamine
X_{10} = Riboflavin
X_{11} = Niacin
X_{12} = Vitamin-C

* Significant at 5 per cent level

** Significant at 1 per cent level

APPENDIX IX-b. Intercorrelation of age and nutrients with nutritional status index of boys (n=20)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1		0.6348**	-0.0407	0.6565**	0.1725	0.5178*	0.1155	0.1556	0.5322*	0.3831	0.5713**	0.0373	0.5001
X_2			0.3991	0.9729**	0.3430	0.8698**	0.1578	0.6254**	0.7993**	0.5862**	0.8001**	0.5286*	0.2741
X_3				0.4283	0.0015	0.3306	-0.0231	0.2762	0.1869	0.2504	0.3541	0.1638	0.0312
X_4					0.2994	0.8580**	0.1368	0.5297*	0.7952**	0.5644	0.8480	0.4426	0.1927
X_5						0.6842**	0.5792	0.5681	0.7994**	0.9183**	-0.2163	0.6855**	-0.1120
X_6							0.1792	0.6940**	0.9471**	0.8605**	0.5221*	0.6615**	0.1179
X_7								0.2294	0.4466*	0.4518*	-0.1838	0.3756	-0.1362
X_8									0.6590**	0.6462**	0.2859	0.9501	0.0817
X_9										0.9045**	0.4070	0.6849**	0.0645
X_{10}											0.0899	0.6860**	0.0210
X_{11}												0.1411	0.0216
X_{12}													-0.1192

X_1 = Age, X_2 = Protein, X_3 = Fat, X_4 = Energy, X_5 = Calcium, X_6 = Phosphorus, X_7 = Iron, X_8 = Retinol, X_9 = Thiamine, X_{10} = Riboflavin, X_{11} = Niacin, X_{12} = Vitamin-C

* Significant at 5 per cent level

** Significant at 1 per cent level

APPENDIX IX-c. Direct and indirect effects of nutrients contributing to the nutritional status index of girls

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	r
X_1	-0.6528	1.6901	0.0898	-3.2022	-3.5578	-9.8520	0.1698	0.4964	12.9029	1.9795	0.0854	-0.0508	0.0983
X_2	-0.3781	2.9181	0.7155	-4.7949	-3.8177	-12.5911	0.1968	0.7916	15.0287	2.4673	-0.1062	-0.0785	0.3520
X_3	-0.0534	1.9017	1.0978	-3.4331	-0.1003	-5.3777	0.0584	0.1408	4.8599	0.9997	-0.0543	-0.0142	0.0263
X_4	-0.4109	2.7503	0.7409	-5.0869	-2.2815	-10.9729	0.1438	0.4418	12.9623	1.9520	-0.0500	-0.0528	0.1361
X_5	-0.2895	1.3887	0.0137	-1.4467	-8.0221	-13.1888	0.3221	1.4513	17.0951	3.3423	-0.1067	-0.1281	0.4313
X_6	-0.4229	2.4159	0.3882	-3.6702	-6.9568	-15.2084	0.3061	1.2480	19.0674	3.4214	-0.1020	-0.1180	0.3687
X_7	-0.3160	1.6376	0.1827	-2.0856	-7.3675	-13.2754	0.3507	1.3648	16.9569	3.2872	-0.1349	-0.1218	0.4787*
X_8	-0.1947	1.3881	0.0929	-1.3506	-6.9961	-11.4048	0.2876	1.6642	14.5702	2.8888	-0.1568	-0.1391	0.6497**
X_9	-0.4390	2.2857	0.2781	-3.4367	-7.1477	-15.1141	0.3099	1.2638	19.1864	3.4119	-0.1003	-0.1200	0.3780
X_{10}	-0.3658	2.0383	0.3107	-2.8110	-7.5905	-14.7309	0.3263	1.3610	18.5321	3.5323	-0.1013	-0.1232	0.3780
X_{11}	-0.1341	-0.7447	-0.1433	0.6120	2.0585	3.7307	-0.1138	-0.6274	-4.6258	-0.8598	0.4160	0.0623	-0.3695
X_{12}	-0.2310	1.5950	0.1082	-1.8689	-7.1493	-12.4846	0.2972	1.6108	16.0264	3.0290	-0.1803	-0.1437	0.6088**

Residue = 0.4187

X_1 = Age; X_2 = Protein; X_3 = Fat

X_4 = Energy; X_5 = Calcium; X_6 = Phosphorus; X_7 = Iron

X_8 = Retinol; X_9 = Thiamine; X_{10} = Riboflavin; X_{11} = Niacin

X_{12} = Vitamin-C

* Significant at 5 per cent level

** Significant at 1 per cent level

APPENDIX IX-d. Intercorrelation of age and nutrients with nutritional status index of girls (n = 18)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1		0.5792*	0.0818	0.6295**	0.4435	0.6478**	0.4841*	0.2983	0.6725	0.5604*	0.2054	0.3538	0.0981
X_2			0.6517**	0.9425**	0.4759	0.8278**	0.5612*	0.4757*	0.7833**	0.6985**	-0.2552	0.5466*	0.3518
X_3				0.6749**	0.0125	0.3536	0.1664	0.0846	0.2533	0.2830	-0.1305	0.0986	0.0252
X_4					0.2844	0.7215**	0.4100	0.2655	0.6756**	0.5526*	-0.1203	0.3674	0.1359
X_5						0.8672**	0.9184**	0.8721**	0.8910**	0.9462**	-0.2566	0.8912**	0.4310
X_6							0.8729**	0.7499**	0.9938**	0.9686**	-0.2453	0.8209**	0.3684
X_7								0.8201**	0.8838**	0.9306**	-0.3244	0.8474**	0.4783*
X_8									0.7594**	0.8178**	-0.3770	0.9679**	0.6493**
X_9										0.9659**	-0.2411	0.8353**	0.3776
X_{10}											-0.2434	0.8575**	0.3777
X_{11}												-0.4334	-0.3694
X_{12}													0.6085**

X_1 = Age
X_2 = Protein
X_3 = Fat
X_4 = Energy
X_5 = Calcium
X_6 = Phosphorus
X_7 = Iron
X_8 = Retinol
X_9 = Thiamine
X_{10} = Riboflavin
X_{11} = Niacin
X_{12} = Vitamin-C

* Significant at 5 per cent level

** Significant at 1 per cent level

NUTRITIONAL STATUS AND DIETARY HABITS OF IRULAS OF ATTAPPADY

BY

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ABSTRACT

A study on the nutritional status and dietary habits of Irulas of Attappady was carried out among 180 families to assess the socio-economic and food consumption pattern of the tribal families and also to assess the nutritional status of the children between the age group of 5 to 15 years.

The results of the study indicated that majority of the families were of nuclear type with an average family size of 4.73. Majority of the adult members were illiterate Agriculture labour was the main occupation of the tribes and most of the families were below the poverty line. Housing conditions and personal hygiene of the families were found to be poor.

Irula tribes, in general, were habitually non-vegetarians. Major expenditure of the family income was incurred for food especially cereals. Diet was found to be monotonous with less variety. Two-meal-a-day pattern was the standard system followed by the families, which included cereals, fats and oils and spices and condiments. Boiling was the predominant cooking method followed by the Irula tribes. Gunny bags were used to store cereals and pulses.

Tribal families followed certain food restrictions during illness and special foods were not included either in

the diet of pregnant or lactating women or in the diet of children. Prolonged breast feeding and late weaning was practised by the Irula tribes.

The nutritional status of the children between 5 to 15 years of age was deficient and it was revealed in the anthropometric measurements like height, weight, mid upper arm circumference and skinfold thickness. Food weighment survey revealed a deficient intake of all foods except cereals. The intake of most of the nutrients was low. Low to medium nutritional status was observed among most of the children and birth order of the boys was found to influence their nutritional status.

Anaemia was the most important clinical symptom observed among children which was reflected in the biochemical examination of blood for haemoglobin, RBC count and packed cell volume. Sickle cell anaemia and parasitic infestations were observed among the children.

The respondents had a favourable attitude towards the developmental programmes implemented by various agencies to improve their health status. However awareness about health and nutrition was found to be poor.