Prevalence of malnutrition among adolescent girls: A case study in Kalliyoor *panchayat,* Thiruvananthapuram

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Discussion Paper No. 35
2001

Kerala Research Programme on Local Level Development
Centre for Development Studies
Thiruvananthapuram

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English
Discussion Paper

First published 2001
Editorial Board: Prof. P. R. Gopinathan Nair, H. Shaji
Printed at:
Kerala Research Programme on Local Level Development
Published by:
Dr. K. N. Nair, Programme Co-ordinator,
Kerala Research Programme on Local Level Development,
Centre for Development Studies,
Prasanth Nagar, Ulloor,
Thiruvananthapuram 695011
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E-mail: krp@md1.vsnl.net.in
Url: http://www.krpcds.org/
Cover Design: Defacto Creations

ISBN No: 81-87621-37-0
Price: Rs 40
US$ 5

KRPLLD 2001 0750 ENG

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1. Introuction

Nutrition is defined as food at work in the body. A living organism is the product of nutrition. The human being requires more than 48 different nutrients for its well-being. Nutrients are chemical components derived from food, which help maintenance of body functions, body growth, and protection of the organs of the body.

Malnutrition denotes impairment of health arising either from deficiency or excess or imbalance of nutrients in the body. It is an ecological problem (Jelliffee and Jelliffee, 1989). It is the end result of multiple overlapping and interacting factors – physical, biological, social and cultural environment, and economic.

Adolescence is a period of transition between childhood and adulthood occurring between 12 and 18 years of age (Chilman and Nancy, 1994). In girls middle adolescence growth happens earlier (i.e., during 12-15 years) than in boys (i.e., during 13-16 years). Attainment of menarche is an important event in a girl's life. Adolescent girls form a crucial segment of the population and constitute, as it were, the vital 'bridge' between the present generation and the next (Raman, 1992). In recent years, increasing concern for the nutritional status of adolescents is evinced by nutritionists, health care professionals, politicians, and administrators.

In many developing countries, one-half of all children and adolescents fail to achieve their full genetic growth potential due to the combined effects of inadequate nutrition and frequent illness.

In India, the problem of malnutrition received recognition of the planners and policy makers right from the inception of Five-Year planning; a large number of national nutrition programmes were implemented to combat the menace of malnutrition. However, malnutrition still persists.

Maternal mortality in India (500 per 1,00,000 live births) is about 50 times that in developed

ACKNOWLEDGEMENTS: I express my deep gratitude to Prof. K. Narayanan Nair, Programme Co-ordinator, KRPLLD for the suggestions and advice at all stages of my study. My sincere gratitude goes to Ms Hema, the President of Kalliyoor *Panchayat*, who rendered all assistance during the study; the Fathima Clinic for conducting blood analysis; Dr Vijayalakshmi for holding a medical camp as part of the study; and Prof. Viswanathan Chettiyar, Government College for Women for chipping in with statistical analysis. I also thank Dr K. Nagaraj and Dr K. Navaneetham for their valuable suggestions. Last but not the least I am indebted to my co-investigators, Ms Padmadaya and Ms Nisha Vikraman, for their invaluable work.

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countries. The high rates are the result of the poor health status of adolescent girls who are married off even before their attaining full maturity. Malnutrition among adolescent girls in India is widespread due to deficient diet. Studies on their gestation performance have shown that high incidence of calampria, toxaemia, miscarriage, and premature deliveries occurs among under-nourished adolescent pregnant women.

Kerala has made notable achievements in the health front comparable to those of developed countries. Infant mortality rate is below 13 and expectation of life at birth is 69 years for men and 72 years for women (in 1996). The average age at marriage of girls in Kerala is 21.8 years. The relatively high health status of the people of Kerala has been achieved, however, in an environment of low levels of per capita income. The high health standards of several Asian countries such as Singapore, Taiwan, Hong Kong, and South Korea are associated with high per capita incomes, rapid rates of economic growth, and employment of the majority of the workforce in non-agricultural occupations, low levels of unemployment, and high nutritional levels.

Though Kerala has made significant progress on the health front, the nutritional status of adolescent girls remains poor. It is reported that 49 per cent of the adolescent girls (of 15 years of age) are under-height and 67 per cent are under-weight. Studies on the nutritional and the morbidity status of adolescent girls (between 6 and 14 years of age) conducted in the cities of Hyderabad, Delhi, and Calcutta have indicated that two-thirds of them are anaemic (WHO, 1992). Similar studies are not available for Kerala. The present exercise is an attempt to examine socio-economic factors, which account for the hihg prevalence of malnutrition observed among adolescent girls in the rural areas of Kerala with a view to developing an intervention programme.

2. Adolescence and Malnutrition: Concepts and measurement

An individual in the age of 12-18 years is referred to as an adolescent. Adolescence is a period of rapid growth. Boys and girls reach their peak stage of growth during this period. Girls reach their peak growth rate during 14 and 15 years because menarche occurs to them at 14 years of age. Nutrition is a major component of human health and it is from satisfactory nutritional status that many desirable objectives in quality of living are achieved. Lack of nutrition leads to poor health and even mortality. In a country like India with a multitude of social customs and beliefs cited against women, it is no wonder that the prevalence of malnutrition among girls remains quite high.

Malnutrition has adverse influence on morbidity and mortality. It affects physical growth and development during the growth period and leads to generalised functional impairment, disability, diminished productivity, and inability to cope with environmental hazards including resistance to infection. The nutritional status of a person is essentially determined by intake of an adequate diet and a person's susceptibility to infections which interfere with digestion and assimilation.

The Indian Council of Medical Research (ICMR) in 1975 and the National Nutrition Monitoring Bureau (NNMB) of TCMR, 20 years later, had carried out country-wide studies of growth and development of children. The results of the studies are almost identical in the case of rural girls. The nutritional status of mothers showed little evidence of substantial improvement during the 20-year period.

The available data on adolescent growth between 14 and 18 years show that girls of poor rural communities gain height and weight at much lower rates than girls in affluent communities (NNMB, 1979). For example, among the poorest socio-economic groups of India the mean age at menarche is reported to be around14.50 years where as among higher income group it is only 13.20 years.

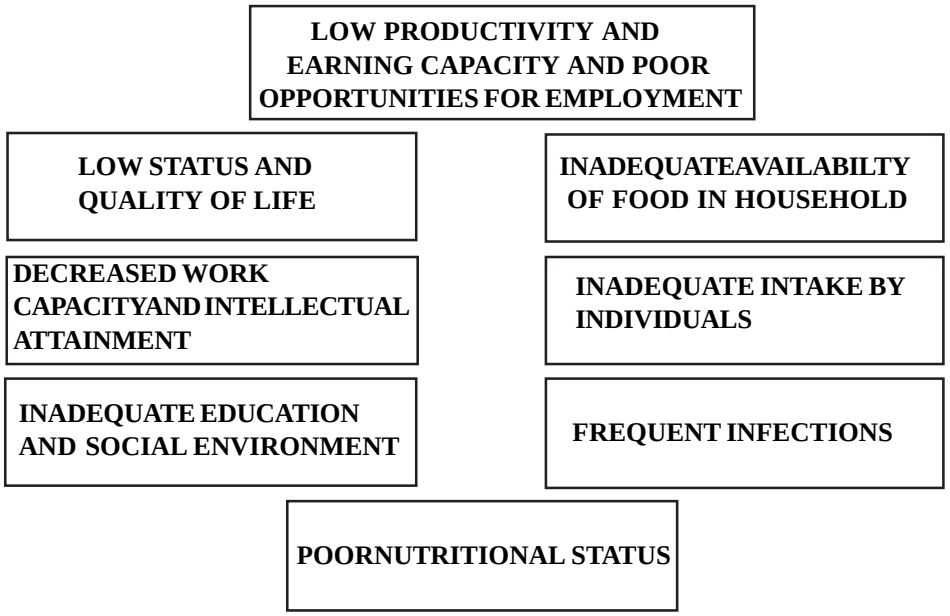
As a consequence of inadequate dietary intake of energy, protein, vitamin A, iron and riboflavin, nutritional deficiencies are widespread in India, particularly among the low-income groups of the population both in urban and rural areas (Fig. 2.1). Deficiency in iron and B-complex is common among adolescent girls (Table 2.1).

Nutritional requirements

Nutrients requirement varies according to age, sex, and occupation and phases of life. The requirements of a nutrient are defined by ICMR (1991) as amount of absorbed nutrients that is necessary to fulfil its physiologic function in the body; when applied to a group of individuals, it represents the average values for the group.

Recommended dietary allowances according to Rao (1990) depends on physiological requirements of nutrients, bio-availability of nutrients from habitual diets, and the extent of variation in the requirement between and within individuals in a given population (Tables 2.2 and 2.3).

Fig. 2.1 The Cycle of Malnutrition



Source: Report of the International Workshop towards More Effective Use of Primary Healthcare Technologies at the Family and Community Levels, P.68 Aga Khan Foundation, Geneva, UNICEF, New York, 1986.

Table 2.1

Age (years)	Height (cm)		Weight (kg)	
	Poor	Affluent	Poor	Affluent
14	145.9	156.6	35.1	47.4
18	150.9	158.9	41.9	52.3

Source: NNMB, 1979

Table 2.2 Recommended dietary allowances of energy and proteins

Recommended Dietary Allowances		Energy	Proteins
Particulars	Reference Body Weights	Energy (Kcls)	Proteins (gm)
13 – 15 yrs	47.8 Kg	2060	65

Source: NIN, 1992

Table 2.3 Recommended allowances of iron for Indian girls

Group	Iron requirement
Adolescents	
10 – 12 years	30 mgm
13 – 15 years	30 mgm
16 – 18 years	30 mgm

Source ICMR, 1992

Nutritional status of adolescent girls

To assess nutritional status, various anthropometric parameters and indices are used. The main indices are height, weight, and fat-fold thickness. Dietary intake and clinical assessment support these facts. Blood profile is also used to correlate the other indices.

Anthropometric measurements

Body measurements such as height and weight are important tools in evaluation of the nutritional status of individuals or groups. The following basic anthropometric measurements are made in nutrition surveys: (i) height, (ii) weight, (iii) arm circumference, and (iv) chest circumference. Weight for height and body mass index may be assessed based on height and weight. ICMR (1992) emphasises that in field studies to assess nutritional status heavy reliance must be placed on measurement of the external morphology of body.

Height

The reference standards prescribed by National Centre for Health Statistics have been accepted by WHO as the international standard against which heights and weights of samples may be compared throughout the world. Rao et al (1979) opine that the use of reference standard derived from a developed country sets impossible high standards for population, even of well-nourished groups, in developed countries.

WHO (1978) established the methodology for international use, the height for weight, and weight for age curves to detect adequate growth or nutrition, growth failure or malnutrition.

Decrease in height for age is evidence of chronic malnutrition. Shorter periods of malnutrition affect only weight for height. Though height is genetically determined, socio-economic deprivation during the period of growth is a leading cause of failure to reach genetic potential.

Weight for height

This index is independent of age. It is required as an index of current nutritional status. Weight for height and height for age is most widely used parameter for assessing growth and nutritional status.

Weight

Weight for age has been used as an index of malnutrition. Bodyweight often gives indication of the current nutritional status.

Mid upper arm circumference for age

Muscle and fat constitute the soft tissues that vary with deficiency of protein and calories. Measurements of the mid-upper arm circumference is the most useful and practical method

for assessing muscle mass, as this region is easily accessible and measurement requires only a flexible fibre glass tape.

Biochemical analysis

Haemoglobin estimation is used for assessing the prevalence of anaemia. For field studies cyanmethaemoglobin method is used. Iron, a constituent of haemoglobin, myoglobin, and a number of enzymes, is an essential nutrient for humans.

The accurate and reliable procedures are those which convert haemoglobin to one of its compounds, the concentration of which is determined by matching the colour with a known standard.

The cyanmethaemoglobin method is the most popular because it measures practically all haemoglobin except sulfahaemoglobin (INACU, 1985).Prevalence of anaemia is a grave nutritional problem. WHO (1990) reports prevalence of anaemia in about 30 percent of the population with still higher rates in developing countries. The prevalence of anaemia is higher among females than in males.

Large population surveys in rural India indicate that prevalence of anaemia in India according to WHO criteria (Tables 2.4) ranges from 38 to 72 percent depending upon age and sex. Studies conducted by Vijayaraghava (1990) based on National Institute of Nutrition reports that iron deficiency varies between 60 to 80% in India.

Table 2.4 WHO criteria for the diagnosis of anaemia

Determination	Levels considered Anaemia
Hb(g/dl venos blood)	
Children 6 – months – 6 years	< 11
Children 6 – 14 years	< 12
Adult males	< 13
Adult Females (Non-pregnant)	< 11

Clinical examination

Clinical examination is an important practical method for assessing the nutritional status. The method of clinical examination is usually based on examination for changes, that may be seen or felt in superficial epithelial tissues especially the skin, eyes, hair, and buccal mucosa (Jelliffe, 1996). Clinical surveys usually consist of physical examination, making anthropometric measurements and collecting samples of blood and urine for laboratory examination.

The rapid clinical assessment schedule of ICMR (1971) is widely used for field works. The rapid assessment scheduling has four groups (Table 2.5).

Table 2.5 ICMR – Clinical assessment schedule

Group I	**Healthy**
Group II	a. poor musculature
	b. Deficient subcutaneous fat
	c. Pallor of skin
	d. Lack of interest in surroundings
	e. Mild sign of any one of the following
	1.Bitot's Spots
	2.Xerosis
	3.Follicular hyper
Group III	1. Gross muscular wasting
	2. Bitot's Spots
	3. Xerosis
	4. Wrinkled Thickened conjunctiva
Group IV	1. Xerosis of cornea
	2. Red of Raw tongue
	3. Angular Stomatitis
	4. Cheilosis
	5. Spongy bleeding gum
	6. Dry Skin

Dietary assessment

Dietary assessment alone cannot be relied on for diagnosis of nutritional status but it may correlate with biochemical and clinical findings. However, dietary assessment is an important aspect of surveys of nutritional status studies (Frankle, 1986).

The three methods available to collect dietary data are:

(i) Log Book or inventory method
(ii) Oral Questionnaire method, and
(iii) Weighment method

Methods of diet survey

All the three methods are in common use in India.

Log Book or Inventory Method

This method may be used only with literate groups because a book containing several questions is entrusted with the head or the housewife of the family. The person so entrusted must enter all purchases in the book. Full co-operation from the householder is essential because reliability of the data depends on the entries made.

Oral questionnaire method

Oral questionnaire or interview is the most commonly used method of diet survey. The investigator prepares a diet survey questionnaire depending on the purpose of the investigation. After necessary modifications made based on the pilot studies, the investigator collects information on types and qualities of foods consumed. The data may not give accurate information, but only indicate approximate amounts. Therefore, this method is suitable only for collection of information on general dietary patterns or on dietary habits of large sections of population. General information such as choice of foods, foods avoided in certain conditions, foods included in special conditions or in festivals, food fads and fallacies, is collected. The advantages of the questionnaire method are that it is not a time-consuming method; large number of households could be covered within a short period of time.

Weighing of raw and cooked foods

This method is the most reliable one. But it is time-consuming and therefore not used for large samples. As the investigator cannot leave the questionnaire with the householder she has to stay near and record the amounts of various items of foods before and after cooking. The amount of food used may be recorded by weighing the leftovers after consumption. Often housewives show more raw foods to give a wrong impression about the food intake of the households concerned. Therefore the investigator must have some practical knowledge about the quantities of cooked foods of various sources.

Prevalence of malnutrition among adolescents

Various studies indicate that the mortality rate for girls in India is higher than that for boys. Among children in the age group of 5-14 years the mortality rate of girls is 6.1 while among boys it is only 4.9 (Kumari, et al, 1990). A large proportion of the morbidity and mortality arises from the interaction of malnutrition and infection (Lartson, et al, 1986).

Cross sectional data of ICMR growth study (1972) show that between the ages of 10 and 18 years, the maximum growth takes place between the ages of 10 and 15 years; thereafter the rate of increase is small particularly with respect to height. Socio-economic and rural-urban differences are also observed with increments in growth (Srikantia, 1989).

Raman (1992) used various parameters for assessing the nutritional status of girls especially in terms of the extent of deficiency in different income groups. Even after attaining menarche a large percentage of girls in rural areas and urban slums remain weight deficient (<75 percent NCHS standard) compared to the upper middle income group in which only 20 percent showed deficiency in weight. Similarly, height deficiency (<90 percent) is seen in almost 20 percent of girls in urban slums and rural areas as against 6 percent among upper class girls. The deficiency is of a much higher order in body mass index (BMI) or the index of fat fold thickness.

3. Design of the Study

Kalliyoor *panchayat* was selected as the study area. Kalliyoor *panchayat* has 12 wards and it is an area representative of the study variables in the rural areas of Kerala. There are 9486 households. Multi-stage sampling procedure was adopted for the investigation.

Sample selection

Throughout the study, the random sampling techniques were used except at the secondary stage. For the selection of primary stage units (PSUs), simple random sampling method without replacement (SRSWOR) was adopted.

It was found desirable to adopt a 10 percent sampling scheme. Thus, out of 9486 households, 949 households were selected using SRSWOR. This sample consists of the primary stage units (PSU).

Selection of subjects

Adolescent girls in the age group of 14-15 years were selected as the sample for the study since it is this period which shows the peak rate of growth among adolescent girls.

There were 205 adolescent girls belonging to this age group in the selected households i.e. P.S.U. Out of them, 110 belonged to the 14 years group and 94 to the15 years group. These girls constituted the second stage units (SSU) which implies that the census enumeration technique was adopted in the selection of SSUs.

Selection of study variables

The major study variables under investigation were economic (parents' income level and occupational status, size and composition of the household), anthropometric (measurements of height, weight, and body mass index), and clinical (biochemical, stool analysis, and dietary status). Biochemical analysis and weighment method were done only among a subsample; they are highly expensive and time-consuming. In community nutrition research, 10-20 percent subsamples are normally selected for detailed investigation.

From the 205 adolescent samples (SSU), 20 percent were selected as the subsample. Thus 41 tertiary stage units (TSU) were selected for detailed study. For the selection, systematic sampling procedure was followed.The sampling interval (K) was obtained as 5(i.e 205/41). The integer 3 from 1 through 5 was selected randomly using Tippetts Random Number Table. So the random start is 3 and the subsequent selected units are 8, 13, 18 ……205, which give rise to 41 units.

Tools

A suitably structured interview schedule was developed to elicit information regarding family background, socio-economic status, and individual particulars of the subsample. A pre-

tested schedule was used to collect information on demographic, occupational, and income status of the household.

Anthropometric measurements of height and weight and mid-upper-arm circumference were taken using internationally accepted methods. Based on the collected data, weight for height and body mass index were calculated.

Dietary assessment

In accordance with the procedure laid down by the National Institute of Nutrition (1972), 24 hours' food intake for two days was recorded using recall method. Weighment method was used for detailed study of dietary intake of 20 percent subsamples.

Clinical assessment

ICMR rapid assessment schedule (1972) was used by a physician to assess the clinical status of the 205 samples.

Biochemical assessment

Twenty percent subsamples' hemoglobin level was analysed using cyanmeth haemoglobin method.

Stool analysis

Stool analysis of 205 samples was done using smear techniques.

Pilot survey

A pilot survey was conducted among 10 families to find out the adequacy of the prepared tool. The investigating team fixed prior appointment with the housewives and the adolescent girls of these households for baseline data collection, based on their convenience.

Recording of the foods and nutrient intake

The nutritional profile of a group is best prepared by finding out quantitatively, the various kinds of food consumed by it. For this purpose, we used the recall method. The dietary study was done during April-May, so that the normal dietary pattern can be recorded round the clock, these months being the vacation period for educational institutions.

Two days' recall was recorded and two days' weighment method was carried out. All the raw foods used for cooking were weighed in the raw form and the cooked food weighment was recorded. The portion consumed was recorded by weighing the plate waste. Raw equivalents for these food items were calculated. The nutrients available from food intake were calculated using the nutritive values tables of Indian foods (1990). A bazaar balance was used to weigh the food items. Since the sample comprised adolescent girls, outside

catering was not applicable to them. Weighment method was used for 20 percent sub-sample's dietary intake.

Recording of anthropometric measurements

The following measurements were recorded by investigators using internationally accepted standard procedure given by Jelliffce (1966).

Height

A vertical tape fixed perpendicular to the ground on the wall was used as the scale. This tape was of non-stretchable fibre glass. It was fixed with transparent adhesive tape and care was taken to see that there were no folds or tilting to any side. During the examination also the scale was repeatedly checked for loosening of the adhesive tapes or tilting of the scale.

Weight

Weighment was taken using a machine (Model 235 PBW) supplied by UNICEF. Checks on the scale were made routinely before recording the weighment of each sample and the pointer was adjusted to zero using the screw provided. Samples were allowed a light dress but their foot wear was removed while weighing. The scale was cross-checked with the beam balance weighing machine before each survey. Weighment was recorded to the nearest 0.5 kg.

Mid-upper arm circumference

This was also taken using the same fibre glass tape. The site was carefully selected, half way down the arm between the tips of the acromion process of the ulna on the left side. Measurement was taken with the arm hanging relaxed at the side. The tape was placed gently but firmly round the arm to avoid compression of soft tissues. Measurements were taken to the nearest 0.1 cm.

Assessment of clinical status

Clinical assessment based on the ICMR rapid clinical assessment method (1972) was done by a physician after modification to suit the needs of the study.

Samples were grouped into four categories: Group I denoting persons, healthy and free from diseases, Group II comprising girls' poor musculature and mild deficiencies, Group III with persons with gross muscular wasting and moderate deficiencies, and Group IV consisting of the unhealthy with sever symptoms.

Estimation of haemoglobin level

Haemoglobin value is of great practical use in assessment of the severity of anaemia. Haemoglobin values were estimated for 41 sub samples. Cyanmethaemoglobin method was

followed (Vasley, 1975). A field modification of this was done as suggested by National Institute of Nutrition (1976) in which 0.02 ml fresh blood obtained by finger prick without squeezing was run on to a strip of Whatman No.1 filter paper (2 cm, 4 cm) and allowed to dry. Such specimens were transferred in small test tubes and dissolved for 10 minutes in 5ml of Drabkin solution; haemoglobin is then estimated.

Stool analysis

Stool analysis for worm infestation was done for 205 samples using smear technique.

4. Result and Discussions

The present study discussed the prevalence of malnutrition among adolescent girls in the rural area surveyed in the following order.

(i) Economic and demographic aspects
(ii) Health-related aspects
(iii) Nutritional status (in terms of:
    a. Anthropometric profile
    b. Dietary pattern and nutrient intake
    c. Blood profile
    d. Clinical status and
    e. Stool analysis), and
(iv) Awareness of health and nutrition aspects.

Economic and demographic aspects

As was reported earlier, the sample consisted of 205 adolescent girls: 111 of age 14 years and 94 of age 15 years. Socio-economic and demographic factors have great impact on the nutritional status. The types of the family, family size, type and quantity of food consumed and income status of the family influence the health status of adolescent girls. The breakdown of the sample by religion, type of family, income, and employment of the parents is discussed below.

Religion status

More than three-fourths of the sample (158 girls) were Hindus; Christians constituted more than one-eighth (28 girls); and slightly less than one-tenth (19 girls) were Muslim.

Family pattern

The majority of the sample lived in nuclear households. Out of the total of 205 households, only 38 constituted extended households.

Composition of the family

The majority of the families had only less than three children. The size distribution of the households is given in Table 4.1 More than 70 percent of the households had only less than five members.

The occupation of the parents, classified into six categories, is presented in Table 4.2.

More than 55 percent of the households are of agriculture labourers. Only about 10 percent live by farming. Fishing is the mainstay of nearly another 10 percent. In general, the study area consists of population mostly dependent on agriculture and related activities.

Table 4.1 Size distribution of households

Details of members	No.s	Percentage
3 members	14	6.83
4 members	102	49.75
5 members	31	15.13
6 members	14	6.83
7 members	6	2.93
8 members	26	12.68
9 members	12	5.85
Total	205	100.00

Table 4.2 Occupational status of the heads of households

Occupation	No.s	Percentage
Agriculturists	20	9.75
Agricultural labourers	114	56.62
Private Jobs	12	5.86
Government Job	26	12.67
Business	12	5.86
Fishing	21	10.24
Total	205	100.00

Income status of families

Table 4.3 shows that the average income of the vast majority of the households was less than Rs. 4000 per annum. The households are poor judged in terms of any accepted standard.

Table 4.3 Income status of households

Monthly Income	Number of Households	Percentage
Up to Rs. 2000	23	11.2
Rs. 2001-4000	128	62.4
Rs. 4001 – Above	54	26.3
Total	205	100.0

Health-related aspects

Anthropometric assessment

Height, weight, and weight for height and body mass indices were estimated for evaluating the growth pattern of the adolescent girls.

Mean heights of the sample were compared with NCHS standard and NNMB standard of Kerala (1989-1990) and (1996).

Table 4.4 Comparison of mean height with NCHS and NNMB studies

Studies	Age in Years			
	14 Years		25 Years	
	Mean Height	S D	Mean Height	SD
NCHS	160.40 cm		161.80 cm	
STUDY GROUP	149.85 cm	5.86	150.10 cm	5.41
NNMB (1989-90)	149.00 cm	6.37	149.50 cm	5.30
NNMB (1996)	150.60 cm	6.48	155.2 cm	6.70

The growth pattern of the sample lay beneath the NCHS standard. The mean height gain of the sample was 149.85 cm among 14 years group and 150.10 cm among 15 years against 160.40 cm and 161.80 cm of NCHS standard (Table 4.4). Srikantia (1989) reported that among 10 years group girls of 10 States, Kerala girls were the shortest with a mean height of 125.00 cm. According to Gopalan (1992) even among well-to-do Indians, the growth rate is not as that prescribed by the NCHS standard. National Nutrition Monitoring Bureau in 1989-'90 and again in 1996 conducted studies among adolescent girls in Kerala and their results agree with those of the present study. Comparison of the height gain among different income groups was done to find out whether income status influences the height gain of the samples. The results are given in Tables 4.5,4.6, and 4.7

Table 4.5 Height profile of 14 and 15 years group

Age in Years	Height in Cm						Total Number of Sample	Total Percent
	130-141		142-153		Above 154			
	Nos.	%	Nos.	%	Nos.	%		
14	13	11.70	68	61.20	30	27.10	111	100
15	10	10.64	60	63.83	24	25.53	94	100
					Grand Total		**205**	

Table 2.10 shows that the majority of the girls in the sample had a height ranging from 142-152 cm.

Table 4.6 Height profile of the sample among different income groups (14 years)

Height	130-141 cm		142-153 cm		154cm and above		Total No.s
IncomeRs(cm)	No.s	%	No.s	%			
Up to 2000	8	27.60	14	48.29	7	24.18	29
Rs. 2001 –4000	5	7.14	47	67.14	18	25.7	70
Rs.4001 – and above	0	-	7	58.33	5	41.69	12
Total	13		68		30		111

Tables 2.11 and 2.12 indicate that as the level of income of the households increases, height also improves. Among the lowest income group, 28 percent were with a height range of

130–141 cm whereas among the high income group there was more in this height range. In the same way, while only 24 percent of the lower income group had height of 154cm or above among the highest income group, the corresponding proportion was 42. Among the 15 years age group, only 13 percent had height above 154cm and above from lower income group while among higher income group, the proportion was 36 percent. However, statistical analysis using X2 test of independence revealed that height gain is not significantly influenced by income among the girls of 14 and 15 years of age.

Table 4.7 Height profile of the sample among different income groups (15 years)

Height IncomeRs(cm)	**130-141 cm**		**142-153 cm**		**154cm and above**		**Total No.s**	**Total %**
	No.s	%	No.s	%				
RsUp to 2000	2	13.33	11	73.34	2	13.33	15	100
Rs. 2001 –4000	5	9.25	36	66.66	13	24.09	54	100
Rs.4001 – and above	3	12.00	13	52.00	9	36.00	25	100
Total	10		60		24		94	

Weight

Weight for age has been used as an index for assessing malnutrition. Body weight often gives indications of the current nutritional status. Undernourished adolescents with history of severe childhood undernutrition have varying deficiencies of weight for age and height for age (Table 4.8).

Table 4.8 Comparison of mean weight with NCHS and NNMB studies

Studies	**Mean Weight**			
	14 Years		**15 Years**	
	Weight in Kg	**S D**	**Weight in Kg**	**SD**
STUDY GROUP	44.20	+ 5.13	45.10	+ 5.31
NCHS	50.30		53.70	
NNMB (1989-90)	37.70	+ 5.81	42.50	+ 5.75
NNMB (1996)	41.20	+ 5.20	42.50	+ 5.95

The weight status of the girls in the sample, both belonging to 14 years and 15 years, was below the NCHS standard. But the NNMB values are seen to be much lower than that of the sample. The current body weights (average) of the female population of rural areas and those belonging to low-income groups were only 70-85 percent of the reference body weight (Rao, et al, 1989). NNMB (1996) and the present study showed lower standards of weight gain among adolescent girls. Chatterjee (1990) reported that major consequence of girls' nutritional deprivation in early childhood and adolescence is their failure to achieve full growth potential.

Studies conducted by ICMR (1972) among female population reported that socio-economic differences were visible in the weight gain of adolescent girls. The weight profile of the sample based on income level is given in Table 4.9

Table 4.9 Weight profile of the sample among different income groups (14 years)

Weight IncomeRs(kg)	25- 35 kg		36-46 kg		47-57 kg		T otal	
	No.s	%	No.s	%	No.s	%	No.s	%
RsUp to 2000	9	19.36	21	67.74	4	12.90	31	100
Rs. 2001 –4000	9	13.24	42	61.76	17	25.00	68	100
Rs.4001 – and above	0	0	5	41.67	7	58.33	12	100
Total	15		68		28		111	

Table XIV provides data on weight status of 14 year old girls among different income groups. It gives some insight into the influence of income on growth pattern. Among the lower income group (Rs 2000 or less) less than 20 percent of the sample had weight status of 25 to 35 kg whereas among higher income group (Rs 4001 and above) there was none in the weight category. Similarly among the higher income group (Rs 4001 and above) 58 percent of the sample were in the weight range of 47 to 57 kg whereas among the lower income group only 13 percent came under this range. Among the 15 year old group also better weight profile was found among higher income groups (Table 4.10)

Table 4.10 Weight profile of the sample among different income groups (15 years)

Weight IncomeRs(kg)	30-40 Kg		41 –51 Kg		52 kg&above		Total
	No.s	%	No.s	%	No.s	%	No.s
Up to 2000	8	53.33	5	33.33	2	13.33	15
Rs. 2001 –4000	19	35.20	29	53.70	6	11.10	54
Rs.4001 – and above	2	8.00	12	48.00	11	44.00	25
Total							94

Among the 15 year old girls, range of 30-40 kg indicated underweight. It is seen that 53 percent of the low-income group (Rs 2000 per month or less) were in this weight range; the corresponding proportion among the high income group (Rs 4001 and above) constituted only 8 percent. Forty-four percent of the sample from the high income group was of the weight range of 52 kg and above. But when the income and growth pattern is statistically treated using X2 test of independence, it showed no significance.

Weight for height

Weight for height is a good indicator of growth pattern and may be used to assess malnutritional status. If the sample's weight range is

< 75 –wt for height - Severe malnutrition,
75% - 84 wt for height - Moderate malnutrition,
85% - 90% wt for height - Marginal malnutrition, and
> 90%, wt for height - Normal

The samples weight for height is tabulated in Table 4.11

Table No. 4.11 Weight for height of the sample

Percentage range	Numbers	Percent
<75 wt for ht	17	8.29
75%-84% wt for ht	55	26.83
85%-90% wt for ht	31	15.12
>90% wt for ht	102	49.76

Nearly about 50 percent of the samples are seen to have proper weight for height.

Body Mass Index (BMI)

Body mass index is used as a measure to assess the weight profile and growth pattern of an individual. It is calculated using the formula BMI = Wt/Height in sq. m. If the BMI is below 18.5, the person is termed to be underweight. Among 14 years age group 53 percent and among 15 years group 33 percent are with a BMI value below 18.5.

Nutrient Status

Dietary surveys are not indicative of malnutrition by themselves; biochemical assays either direct or indirect, are more useful indicators of nutritional status. It is possible, however, to identify the development of nutrient deficiency at the intake level. This is the principle on which the major methods of nutrients assessment are based on. In general, dietary intake is assessed by 24 hour recall method using the oral questionnaire for two consecutive days. In our study, detailed weighment method was used for 41 subsamples.

Table 4.12 Mean nutrient intake of the sample

Nutrients	RDA	14 years Mean Kcals	Deviation	15 years Mean Kcals	Deviation
Energy (Kcals)	2060	1451 + 368	- 609	1713 + 368	- 347
Protein (gm)	65	38.44 + 2.1	- 26.56	39.14 + 2.8	- 25.86
Iron (mgms)	30	14.10 + 1.4	- 15.90	13.14 + 1.5	- 16.86
Vitamin A (ugm)	2480	1460 + 127	- 1020	1490 + 128	- 990

It is widely acknowledged that the dietary intake of nutrients of the majority of Indians is below the desirable levels. The analysis of the data in Table 2.17 showed that the mean intake of energy, proteins, and iron of the subsample is below RDA. The weighment method

which was done among the subsample showed that the mean nutrient intake is slightly higher. This may be due to the on-the-spot weighment of food items. In such situations, it is likely that the persons concerned become self-conscious and try to show more food.

Table 4.13 Mean nutrient intake of the subsample

Nutrients	RDA	14 years	15 years
Energy (Kcals)	2060	1521 + 372	1808 + 371
Protein (gms)	65	39.60 + 2.8	40.23 + 2.1
Iron (mgms)	30	15.10 + 1.5	15.23 + 1.6
Vitamin A (ugm)	2480	1620 + 132	1640 + 137

Table 4.14 Mean nutrient intake of subsample compared to findings of other studies

Age in Years	Energy Kcals	RDA	Protein Gms	RDA
14 - study group	1451 + 368	2060	38.44 + 2.1	65
14 – NNMB Kerala (1996)	1577 – 00	2060	41.20	65
15- study group	1713 + 368	2060	39.14 + 28	65
15 – NNMB Kerala (1996)	1577 – 00	2060	41.10	65

Tables 2.18 and 2.19 show that energy and protein intake of our sub-sample and also of the NNMB study group are below RDA. This dietary deficiency has led to poor height and weight profile of the sample (Tables 2.12 and 2.13).

Prevalence of anaemia is more among adolescent girls and women than among other groups. About 80 percent of the total anaemic cases are due to iron deficiency in the diet (Muratee, 1990). Iron content of the diet of the subsample was assessed and was found inadequate. Mean iron intake of the 14 years group was 14.10 mg and of the 15 years group, 1.14 mg as against the RDA of 30 mg per day. NNMB has not reported many studies on the prevalence of anaemia since haemoglobin determination was not included in its survey protocol (Rao, 1989). NNMB (1975-‘80) conducted a rural survey in Kerala and reported the iron intake of girls in the age group of girls 13-16 years as 15.80 mg. In the present study the iron intake is still lower. ICMR conducted (1975-‘80) a nation-wide survey on food intake of all age groups .The reported data indicated that the lowest iron intake among adolescent girls was in Kerala (ie.15.80 mg) whereas the highest intake was in Karnataka with a daily intake of 32.7 mg as against the RDA of 30mg.

Leafy vegetables are the mines of calcium, vitamin A, iron, and vitamin C. Therefore the consumption patterns of leafy vegetables among the sample were examined.

It was observed that 27 percent of the sample consumed leafy vegetables once in a week. Forty-three percent consumed it twice a week and 30 percent, only occasionally. The recommended amount of leafy vegetables for an adolescent girl, by National Institute of

Nutrition (1984), is 100 gm per day where as the average consumption of leafy vegetables according to NNMB (1996) study among rural adolescent girls in Kerala was only 4 gm. The mean intake of leafy vegetables consumption among our subsample (weighment method) is only 7 gm per day.

Vitamin a is required for proper vision and for growth and maintenance of the integrity of epithelial tissue. The requirement of vitamin A for an adolescent girl is 2400ugm of B carotene. As a consequence of inadequate dietary intake of vitamin A, the prevalence of Vitamin A deficiency is a major nutritional problem. Vitamin intake of adolescent girls in our study group is 1460 um for the 14 yrs group and 1490um for the 15 years group.

Clinical assessment

Clinical examination of the sample showed that only about one-third of the girls were healthy; about 56 percent had deficient subcutaneous fat deposit – an indication of protein and energy deficiency; and more than 10 percent had pallour of skin which results from protein and mineral imbalance in the diet (Table4.15).

Table 4.15 Clinical assessment status of sample

Clinical Status	14 years		15 Years		All	
	No	%	No	%	No	%
Healthy	42	37.80	27	28.72	69	33.66
Deficient subcutaneous fat deposit	59	53.10	55	58.51	114	55.61
Pallor of Skin	10	9.10	12	12.77	22	10.73
Total	111	100.00	94	100.00	205	100.00

Haemoglobin profile

Anaemia is a condition in which there is diminished oxygen-carrying capacity of the blood as a result of reduction in total circulating haemoglobin in blood (Anita, 1989). Anaemia may be due to various causes, but iron deficiency is one of the commonest causes for anaemia. Muratee (1990) reported that 80 percent of the total anaemic cases are due to iron deficiency. In order to find out the haemoglobin level of the sample 20 percent subsamples were selected randomly for haemoglobin test by biochemical technique of cyanmeth haemoglobin method. The data revealed that among the 14 years group 45 percent and among the 15 years group 48 percent had haemoglobin level below 11 g/dl. This indicated that they were anaemic by WHO (1990) criteria (which stipulate that those above 11g/dl level as non-anaemic and below 11g/dl as anaemic).

Hookworm infestation can cause anaemia. Stool test was done for entire sample by smear techniques to assess worm infestation. The result showed that there was not any case of hookworm infestation but 17 cases of Ascarisis (roundworm infestation) were found. Since levels of public hygiene are in general high in Kerala, worm infestation rates are relatively low. Moreover, the habit of using footwear is common even in rural areas.

Special food consumption by the sample during puberty

Special dietary care has to be given to girls during their adolescent period since it is this that forms the second spurt period of their growth. The onset of menarche in demands more blood forming nutrients. Nutritional status influences the age at which menstruation begins. Data on income status of the sample (Table 2.7) revealed that 11.7 percent of the sample had an income of Rs 2000 or less per month. Therefore in their daily diet many protective and body building foods may not be included. But during puberty girls are given special food. Similarly due to food fads and fallacies, certain essential food items are be avoided. Data collected on these aspects revealed that on the onset of menarche, special foods are given to girls. The special foods given constituted only fruits (like banana), milk or egg, not included in their normal daily diet. Ten percent of the sample had traditional blood-forming foods during puberty: 31 percent avoided certain essential foods in their daily diet during menarche believing that those items enhance bleeding during menstruation.

Table 4.16 Special foods taken by adolescent girls

Food item	**14 years**	**15 years**	**All**
	No **%**	**No %**	
Fruit	98 (84.68)	90 (95.74)	188 (91.71)
Fleshy foods- Milk	58 (52.25)	67 (71.28)	125 (60.97)
Egg	47 (42.34)	24 (25.53)	71 (34.63)
Traditional foods	10 (9,01)	11 (11.70)	21 (10.24)
Bakery items	9 (8.11)	24 (25.53)	33 (16.10)

Table 2.21 shows that 92 percent of the sample had locally available fruits especially banana, during menarche; 61 percent were given milk, (35 percent) received egg additionally during the period; 16 percent were given special bakery items. There are certain traditional dietary habits still practised by rural people. Hibiscus flowers, turmeric, fenugreek, tender coconut, and other parts of coconut were incorporated with jaggery, rice powder, and ayurvedic herbs and prepared into pasta. This is given to increase blood volume and to stimulate growth. About 10 percent had this special pasta diet during puberty.

A similar analysis was done with respect to foods avoided during puberty. Thirty-one percent of the sample avoided fish, egg or meat. The reasons given for avoiding these essential food items were that they cause more bleeding and so result in difficult menstruation. This belief among the rural households has no scientific backing. This is a food fallacy prevailing among them.

Awareness of health nutrition aspects

Details about the sample's knowledge about balanced diet were elicited and analysed. It is found that only 34 percent were aware about the importance and composition of balance diet; 66 percent were totally ignorant of this aspect. Along with higher preparation of food products, proper interfamily distribution and better selection of food items are also essential

to ensure balanced diet for the members of the households. There are many low-cost food items, which are highly nutritious and only through nutrition education, rural people will be able to select low-cost and highly nutritious items to ensure balanced diets. Locally available cheap fruits and vegetables provide many essential nutrients which are present otherwise only in costly sources. Indian gooseberry, for example, is far better in its vitamin C content than apple or orange. Only through imparting nutrition knowledge, malnutrition can be brought under control among the rural population particularly since protective and body building foods are in scarce supply and beyond the reach of the poor.

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