ASSESSMENT OF NUTRITIONAL STATUS OF SCHOOL GIRLS (10—15 yr old)

By

Maninder Saini

(L-86-H.Sc.-174-M)

Thesis

SUBMITTED TO THE PUNJAB AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF SCIENCE

in

FOODS AND NUTRITION

(Minor Subject : Food Science and Technology)

Department of Foods & Nutrition
College of Home Science
PUNJAB AGRICULTURAL UNIVERSITY
LUDHIANA-141004

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DEDICATED

TO MY

PARENTS

CERTIFICATE I

This is to certify that this thesis entitled, "Assessment of Nutritional Status of School Girls (10-15 yr old)", submitted for the degree of M.Sc. in the subject of Foods and Nutrition (Minor subject : Food Science and Technology), to the Punjab Agricultural University, Ludhiana, is a bonafide research work carried out by Miss Maninder Saini (L-86-H.Sc-174-M) under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

Dated 21.12.88

Major Advisor
(S.Verma)

CERTIFICATE II

This is to certify that the thesis entitled, "Assessment of Nutritional Status of School Girls (10-15 yr old)", submitted by Miss Maninder Saini (L-86-H.Sc-174-M) to the Punjab Agricultural University, Ludhiana, in partial fulfilment of the requirements for the degree of M.Sc. in the subject of Foods and Nutrition (Minor subject : Food Science and Technology) has been approved by the Student's Advisory Committee after an oral examination on the same, in collaboration with an External Examiner.

S. Verma 24/2/89

Major Advisor
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4 MAY 1989

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ABSTRACT

The study was conducted on one hundred school girls (10-15 yr. old) each from low (L) and high (H) socio-economic groups (SEG), to determine their nutritional status. The height, body weight, mid-upper arm circumference and triceps skin fold thickness of the girls from HSEG were significantly higher than those from LSEG at all age levels. All the anthropometric measurements were more than ICMR (1968) but less than NCHS (1974) standards.

The mean haemolgobin level of girls from LSEG was 10.08 g/100 ml which is quite low as compared to that of girls from HSEG which was 11.23 g/100 ml.

The mean age at menarche was lower by one year in girls from public school as compared to the girls from government school.

At this age, all the respondents were quite regular with their meals. Trend of snacking increased with increasing per capita income. The government school girls took more of cereals and pulses while the public school girls consumed more of milk, meat and eggs. But the overall mean intake of energy, protein, calcium and iron of the respondents was lower as compared to Recommended Dietary Allowance (ICMR, 1981).

The coefficient of correlation between body weight and age at menarche was negative and non-significant.

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CHAPTER I

INTRODUCTION

Nutritional requirement vary widely with age, sex, body size, activity and state of health of a person. Nutrition is one of the major factors responsible for the maintenance of health and physical fitness of human beings. The importance of health care of school children cannot be ignored because 'child's health is nation's wealth' (Dhingra et al., 1977). It becomes all the more important when it comes to adolescent girls who have to hold the responsibility of motherhood in their life.

'Adolescence' means to grow or to grow to maturity and it is the period of life during which the care free child is transformed to a responsible adult. This age group not only comprises 40.49 millions (Stat. Abs. Pb., 1981) of our total population but also is vulnerable and ignored.

A number of studies in various countries and those by Indian workers have shown that socio-economic status, parental education, family size and occupation of the parents are interrelated factors influencing the growth pattern of the adolescents. The children of poor socio-economic group take about a year more to mature than

their counterparts in upper economic group (Tanner and Marshal et al., 1968).

To assess the nutritional status of a group or an individual, nutrition anthropometry is being widely used as an important criterion. It is concerned with the measurement of various physical dimensions and gross composition of the human body at different age levels and degree of nutrition. A wide gap has been found between the low and high income groups with regard to both height and weight and other anthropometric parameters at all age levels (Rajalakshmi and Chandrasekaran, 1966).

Physical growth does not occur in a straight and steady manner throughout the growing period but consists of several series of alternating rapid and slow periods (Reddy, 1976). The menarche is an important episode on the milestone of a woman's life, followed by a sequence of manifestations of adolescence. General socio-economic and nutritional conditions of the family affect the sexual maturity (Stickowsky et al., 1967). Menarche is also related to body weight, development of skeleton and accumulation of sufficient fat (Ellison, 1982).

Biochemical aspect particularly the haemoglobin level in blood serves as an important way to find out the degree of physical fitness and iron status. Girls belonging to the higher socio-economic group have higher

mean haemoglobin level than those from poor economic group. Also, there is a gradual decrease in haemolgobin level with increasing age (Pai, and theopilus 1974). This demands a great attention because it leads to anaemic conditions by the time the girls reach their child bearing stage. This is the reason why most of the Indian mothers suffer from iron deficiency during pregnancy. So, care has to be taken during growth in adolescents.

It is an established fact that nutrition is one of the major environmental factors responsible for the maintenance of health and physical fitness. In turn, the state of nutrition of any community or a group depends to a great extent on the quantity and quality of food its members consume (ICMR, 1951). Malnutrition in the year's preceeding adolescence delays the appearance of adolescent growth spurt. It is remarked that the time of occurrence of adolescent spurt is a more sensitive indicator of nutritional deficiency than the growth rate at earlier periods (Tanner, et al., 1962).

A little work on heights and weights of rural primary school children taken during evaluation of mid-day meal programme was carried out by CARE in Punjab (Naik et al., 1975). Verma (1983) studied the nutritional profile of Ludhiana school children. But no systematic

comparative study on the nutritional status of adolescent school girls from high and low socio-economic group in Punjab has been conducted to find out the relationship between age at menarche and the body weight.

Therefore, the present investigation was conducted to determine and compare the nutritional status of adolescent girls from low and high socio-economic group with respect to sexual maturity with the following objectives :

(i) To assess the nutritional status of school girls (10-15 yr old) belonging to high and low socio-economic groups.

(ii) To determine the effect of nutritional status on their age at menarche.

CHAPTER II

REVIEW OF LITERATURE

The literature has been reviewed under the following sub-headings :

2.1 Growth studies

2.2 Physical maturation

2.3 Biochemical assessment

2.4 Food and nutrient intake

2.5 Dietary pattern and food habits

2.1 Growth studies

"Growth implies an increase in size or in mass and is defined in terms of height (measured in cm), and weight (measured in kg). The process of growth and development is a continuous one but all the processes go on at different rates throughout life as the new phases and periods unfold".

Studies on growth have revealed that education and intellect of the child are likely to affect the adolescent growth (Doughlas et al., 1967). Observations indicate that the average values of growth of city children are better than children from the villages (Phadke, 1968).

The standards and norms of our country are not easy to fix because of wide variation in the socio-economic status, ethnical differences, nutritional pattern and inadequate medical facilities (Aggarwal et al., 1970). The skinfold thickness of white children of both the sexes in America had more subcutaneous fat at each site than Negro children, the difference being most marked for the triceps skinfold (Malina, 1971).

According to Raghwan and his fellows (1971), the girls from higher (H) socio-economic group (SEG) are taller, heavier and do not exhibit any deficiency signs and well correspond to American girls upto 12 years of age. Between the ages 9-15 years, nearly every child grows rapidly in almost every bodily dimension giving rise to what is known as 'adolescent growth spurt' (Grinder, 1973).

A cross sectional study of physical growth was conducted by Kaul and his friends (1976) on adolescent girls from 9-20 years of age. They suggested that peak growth occured at the age of 12.5 years. It was also seen that the family income had effect on the growth status. Lower amounts spent per person per week on food were highly correlated with poor growth (Nelson and Naismith, 1979).

The simple anthropometric measurements provide the

simplest perhaps the most specific of the common methods of the screening of people at risk (Gray and Gray, 1980).

Girls in higher socio-economic group (HSEG) gain significantly less than girls in U.K. and U.S.A. but greater than those in the middle and lower socio-economic group (LSEG) (Sarretino, 1982; and Pereira et al., 1983).

The school girls from the higher income group were found to be taller and heavier than the girls from lower income groups (Verma, 1983). Newell and Co-workers (1984) measured height, weight and tricep skinfold thickness in girls and found that the American girls were taller and heavier than their national standards. There were greater incidences of over weight. They also tended to have larger triceps skinfold value of fat.

A comparative study of physical development indices, i.e. height and body weight showed that the age of maximum growth rate for all the indices was lower in 1983 than in 1963 indicating earlier maturity (Anroshchenko et al., 1985).

2.2 Physical maturation

The term 'menstruation' is of very ancient origin. The menarche is an important phenomenon occurring in girls

life followed by maturity traits and trends. Menstruation first marks its appearance as a sign of physical maturation. Observations have indicated that girls start their pubertal spurt at 10 years (Phadke, 1968).

Socio-economic status affected the growth pattern of adolescents. The girls in low (L) SEG took about a year more to mature than their counterparts in the HSEG (Tanner and Marshal, 1968). Frisch and Revelle (1970) proposed a hypothesis that a critical body weight may trigger adolescent events like menarche.

The age at menarche was 13.01 in girls from HSEG and 14.02 in girls from LSEG (Prabhakar et al., 1972). Girls with better general nutritional status receiving more daily calorie intake and more share of proteins showed earlier menarche (Bhalla and Srivastva, 1974). Similar findings have been reported by Tanner (1974). The British girls from HSEG menstruated at 12.6 years of age whereas the girls from LSEG took six months more to mature.

Physical growth characteristics like height and weight have been found to be directly related to sexual maturity (Aggarwal et al., 1976 and Tripathi et al., 1976). The secular trend and the difference in height for age and age at menarche are related to occupational class

reflecting the nutritional status (Tanner, 1976).

The mean age at menarche in different countries is illustrated in Table 2.1. The highest age is found in the girls from LSEG from India. A survey conducted in America concluded that girls from HSEG were more

Table 2.1 Age at menarche in different countries

Name of the country	Age at menarche in years
West Indies	13.9
U.S.A.	12.9
China	12.5
Japan	12.8
Middle-east	12.3
India : HSEG	12.8
LSEG	14.4

(Sathyavathi and Aggarwal, 1979 and Nagaswa, 1979).

likely than others of the same age group to have reached menarche. Age at menarche was positively related to weight/height^2. The data neither contradicted nor supported the hypothesis of critical body weight (Delgo et al., 1981). Better nutrition particularly more calories and protein contribute to early maturity (Tanner, 1981).

Fawmi and his associates (1983) reported that the menstruating girls from better educated and employed parents were taller, heavier and also had greater combined tricep and bicep skinfold thickness and mid-arm-circumference than those of non-menstruating girls. Lopez et al., (1983) also supported Fawmi confirming the effect of socio and cultural status on weight and age at menarche.

There was significant downward trend in the age at sexual maturity in girls from HSEG (Low et al., 1983). Malnutrition delayed menarche significantly (Omotunde, and Akingele 1983).

Both age and body weight were more important indicator of menarche than was the height. The mean age of menarche was calculated to be 13.1 years at which the mean weight and height were 38.4 kg and 152.1 cm respectively (Osteria, 1983). Tripathi et al., (1985) suggested that mean height in cm before menarche is 151.0±5.3 while after menarche is 152.7±5.2.

Most of the girls today are early maturers. Privileged socio-economic groups, better and healthier conditions of living, smaller families and increased exposure to mass media have played a significant role in lowering the age at menarche (Johal, 1986).

Rana and associates (1986) have suggested that although the menstruating girls were taller and heavier than those of non-menstruating but 30 per cent of the girls were below the expected optimal weight for menarcheal onset. There is significant association between meat eating and age at menarche resulting in six months earlier attainment in case of meat eater.

2.3 Biochemical assessment

Blood haemoglobin estimation is a good indicator of nutritional status. The consequences of low level of haemoglobin are increased incidence of diseases, like anaemia. Growth implies corresponding increase in the total haemoglobin level (Tanner, 1966).

Greger and associates (1978) studied the haemoglobin level of American girls. The average haemoglobin level was 13.8±1.1 g per 100 ml. It ranged between 12.0-15.6 g per 100 ml. Only one per cent of the American girls could be classified as poor in nutritional status with regard to iron. Also, the level of iron was same between the girls who had experienced menarche and those who had not.

The haemoglobin value was below the acceptance level confirming the inadequacy of iron status of American girls (Lee, 1978), 60.4 per cent girls from LSEG and 31.7 per cent

girls from HSEG were suffering from anaemia in Kathwa (Patawari et al., 1979).

A study revealed that the haemoglobin level of white girls exceeded that of the black girls by about 0.5 g /100 ml indicating poor nutritional status of black girls (Kenny, 1985). The mean haemoglobin level of city girls was 13.34 g /100 ml while that of rural girls was 10.96 g /100 ml (Omotunde and Akinyele, 1985).

Haemoglobin level in the Canadian girls is mostly normal (Seoane et al., 1985). On the other hand, there was significant difference in the haemoglobin level of girls from the upper and lower socio-economic groups. The girls from LSEG had lower mean haemoglobin level than the girls belonging to rich families (Lyall, 1986).

2.4 Food and nutritional intake

More information on the nutritional status of adolescents would be of value. Adolescence is a period of life when a sufficient intake of energy and nutrients in the diet would seem of importance in order to realise the full growth potential of the individual (Dernin et al., 1974).

A survey conducted on adolescent girls doing normal work, reported that the subjects were eating

cereal based diets lacking in milk and milk products (Anuradha et al., 1975). The girls from the low socio-economic group had considerably low nutritional status than girls from public school belonging to HSEG (Dhingra et al., 1977).

A study carried out in Philippine on girls 13-15 year old indicated that the diets were 70 per cent deficit in calcium and iron (Guzman et al., 1981). Indian Council of Medical Research (1981) ~~was~~ reported that, on an average, iron loss during menstruation is 1 mg/day which should be supplemented through extra intake of iron rich foods.

One may distinguish the urban areas into three major socio-economic groups. Each group has its own characteristic food intake. The HSEG take high calories, proteins, fats and sugars. Over eating and consumption of imported foods is quite common. The middle SEG has a strong tendency to copy the HSEG, whereas the low socio-economic group consumed low calories, proteins and fats. The diets were unbalanced due to poverty (Martog, 1981).

A study on Carolina adolescent girls concluded that the rural and urban girls took similar amounts of protein equal to RDA but both were deficit in energy by 40 per cent (Steele and Spurgeon, 1983). Verma ~~in~~ (1983) reported

that the cereal, pulses, vegetables, fat and sugar consumption was lower than RDA but milk, egg, meat and fruit consumption especially by children of high income group was very high. The energy and protein intake of school children was lower when compared to RDA.

The daily energy intake of adolescent girls in Haryana was 300-500 Kcals less than RDA and the iron intake was also lower than RDA (Chandarana and Bhat, 1984) but the adolescent girls in London took 7 per cent more energy than RDA, though their iron intake waa also lower (Macket et al., 1984). Urban girls consumed more calcium and energy than rural girls (Mccoy et al., 1984). It was supported by Majjat (1984) and Pritchard et al. (1986) and they further added that the athletes took 1923 Kcal more energy than non-athletes.

Among girls, the characteristics with greatest influence on intake were different for different nutrients. Girls who regularly took vitamin supplements had higher median intake of calcium. Social status had the greatest influence with children from professional and managerial households eating more (Woodward, 1984). In the subsequent year, Woodward(1985) suggested that the pattern of intake varied from food to food.

Children from low socio-economic level received supplements less frequently in American schools than other children. But there was no significant difference between the iron status of one who received iron supplements and one who did not (Bevering and clancy, 1986).

On examining the sources of nutrients in the diets of teenagers in America, a group generally thought to be at risk, it was found that food of low nutrient density provided the most energy, fat and carbohydrates. Dairy products providing vitamin were more used by urban girls than the rural girls. As income increased, the consumption of fruits increased that of starches decreased (Kenny et al., 1986). The diet of adolescent girls was low in iron and calcium (Bull, 1988).

2.5 Dietary pattern and food habits

Marked variation and great irregularity in eating practices of adolescents is seen because of socio-economic and ethnical differences (Hueneman et al., 1968). The complexity of an adolescent diet increases significantly with an increase in the father's and mother's education and occupational level (Schorr et al., 1972).

It is reported that overweight girls were more conscious of their eating habits (Koufman et al., 1975). Of the adolescent girls, 40.9 per cent ate five times a day (Guezman et al., 1981). Truswell and Hill (1981) studied the food

habits of adolescents and found that the intake of fast foods, snacks and soft drinks increases during this age as they move out of their families. Their likes and dislikes depend on the social groups they join and missing of meals is a common problem.

Snacks in teenagers diet provide several dietary components particularly energy and iron (Bundy et al., 1982). Snacking extended the incidence of skipping meals by adolescents (Macdonald et al., 1983). Verma (1983) reported that teenager is a snacker, and takes generally three meals a day including a snack in the evening. The practice of snacking increases with increase in the income level.

A research study conducted in Chandigarh revealed that there were more of non-vegetarians than vegetarian girls and they took a lot of snacks as well (Fanai, 1983). The choice of food of adolescent is affected by the parents choice, country and origin (Curry, 1984). Girls prefer snacks with potatoes, desserts etc. (Woodward, 1986).

Skinner and his fellows (1986) kept 24 hour food records of adolescent girls. They reported that 34 per cent omitted breakfast and 27 per cent luncheon. Snacks contributed about one-third of the daily energy intake but their diets were low in calcium and iron. It is

suggested that the lean and fat girls took almost similar amount of snacks. Therefore, it does not appear that obesity is caused by over-eating (Storry et al., 1986).

CHAPTER III

MATERIALS AND METHODS

The present study was undertaken to investigate the nutritional status of 10-15 yr old school girls belonging to high and low socio-economic group of our society. Anthropometry, biochemical analysis and diet survey were the methods used to assess the nutritional status. The materials and methods used for the present study have been discussed under the following sub-headings :

3.1 Selection of schools

3.2 Selection of the respondents

3.3 Developing the tool

3.4 Collection of data

3.5 Standardization of recipes

3.6 Calculation of food and nutrient intake

3.7 Statistical analysis of data.

3.1 Selection of schools

Two high schools of Ludhiana city, one government and other public were selected. A Government and Public Schools were purposely selected since the students of

these schools represented the low and high socio-economic groups, respectively.

Moreover, the schools were near the University Campus and their staff and students showed willingness to cooperate with the investigator which was very important for carrying out this study.

Table 3.1 Selected schools of Ludhiana city

S. No.	Name of the school	Location
A	Guru Nanak Public School	Sarabha Nagar
B	Government High School	Gobind Nagar

3.2 Selection of respondents

For this purpose, selection of respondents was done by simple random sampling technique. Lists of girls from 6th to 10th standards were obtained from the class teachers. Every alternate student from low socio-economic group and every fourth student from high socio-economic group in the list was selected as respondent. A sample of one hundred and twenty-five girls each from both the schools was selected. The age of all the respondents in the sample ranged from 10-15 years.

3.3 Development of tool

After reviewing the relevant literature, a schedule (Appendix-I) was developed which consisted of the following sub-parts :

3.3.1 General information : It included age and parity, type and size of family, educational level and occupation of the parents and per capita income of the family.

3.3.2 Physical status : It included the following parts :

(a) Anthropometric measurements : The anthropometric measurements included the body weight, height, the triceps, skinfold thickness and mid-upper-arm circumference.

(b) Biochemical assessment : Blood haemoglobin level of the respondents and their body temperature were recorded for biochemical assessment.

(c) Physical growth : This comprised of age at menarche of the subject in exact years and months.

(d) Physical activity : It included the information

regarding the participation of respondents in games, hours of play in a day and other kinds of exercises.

3.3.3 Food habits : Information regarding the food habits, provision of supplementary food, packed lunch and common dietary pattern was collected. The food likes and dislikes of children were also recorded.

3.3.4 Diet surveys : Information regarding the food consumption was collected by 24 hours recall method for three consecutive days.

The interview schedule was pre-tested by administering it personally to twenty subjects, 10 each from high and low socio-economic groups belonging to the age group of 10-15 year old to ensure the validity of the questionnaire. On the basis of the pre-testing, some modifications were incorporated in the questionnaire. The sample used for pre-testing was excluded from final study sample.

3.4 Collection of data

Nutritional survey was conducted in the months of March and April, 1988 in Guru Nanak Public School and in the months of July and August, 1988 in Govt. High School.

The time gap in both the surveys was due to the summer vacations in the schools. All the respondents were explained the purpose of the study and made to fill the questionnaire with the help of the investigator.

3.4.1 General information : The general information was provided by the respondents themselves but the information regarding educational level, occupation of parents and family income was furnished by their parents on the sheets sent home through the children.

3.4.2 Physical status

(a) Anthropometric measurements : Four basic measurements (Jelliffe, 1966) were taken viz.,

- Height
- Weight
- Mid-upper-arm circumference
- Triceps skinfold thickness

Height : The measurement of height (cm) was taken with the help of a measuring tape. The total height of the subjects made up of the sum of four components viz., legs, pelvis, spine and skull was measured. The subject was asked to stand erect against the wall, without shoes with feet parallel and with heels, buttocks, shoulders and back of the head touching the wall. The

arms were hanging at the side. The reading was recorded to the nearest of 0.5 cm.

Weight : The body weight was taken to the nearest of 0.5 kg using the Satter's spring balance. The respondents were not wearing any heavy garments due to the climate and were asked to remove their shoes before weighing.

Heights and weights of the respondents were compared with ICMR standards (1968) and NCHS standards (1974).

Mid-upper-arm circumference : The mid-upper-arm circumference was measured to the nearest of 0.1 cm with the help of measuring tape by placing it gently but firmly round the limb to avoid compression of the soft tissues. The left arm was measured while hanging freely at its mid-point.

Tricep skinfold measurement : The Harpenden skinfold callipers were used to measure tricep skinfold measurement of thickness. The measurement was taken half way down the left arm between the tip of acromion process of scapula and clevanon process of the vera. Measurement was done while the arm was hanging freely at the side. The skinfold parallel to the long axis was picked up between the thumb and the fore-fingers of left hand and

was pinched away from the underlying muscle. The callipers were applied to the fold little below the fingers and reading was noted to the nearest of 0.1 mm.

(b) Biochemical assessment : Body temperature was measured with the help of a thermometer. Blood haemoglobin was tested with the help of Haemocytometer.

Haemoglobin estimation : (Kupp et al., 1964).

Principle : The haemoglobin is converted to acid Haematin by diluting with weak acid.

Procedure : The Sahli tube was filled with 0.1 N HCl to 10 mm^3 mark. The blood was drawn to 20 mm^3 mark in Sahli's pipette, the tip was wiped and the blood was expelled into the Sahli's tube. The pipette was rinsed with acid mixture taking care to leave no solution in the pipette when it was removed. After two minutes, the mixture was agitated. Distilled water was added till a match was obtained with the brown glass standard. The level of the fluid in the tube was then read and the results were expressed as Hb g/100 ml of blood.

(c) Physical growth : The subjects were asked to tick as to whether the menarche was attained or not. Those who had attained menarche were asked to consult their

mothers and were helped by the investigator to fill the exact age in years and months.

(d) Physical activity : The students were asked in which games they participated and on the average, the number of hours they played daily. They were also asked to mention any other exercise if they did.

3.4.3 Food habits : The term vegetarian, non-vegetarian and ova-vegetarian were clearly explained by the investigator before they were asked to tick the category they fell in. Enrolment under supplementary nutrition programme and its duration was informed by the subjects. They were asked to inform the composition of their packed lunch brought to school. The eatables bought from the school canteen or from the hawkers outside the school were also recorded. The students tick marked the meals they took. They were also asked to give at least five examples of foods liked and disliked by them.

3.5 Standardizing the weights of cooked foods

Three different dals most commonly used, green leafy vegetables and vegetables with gravy were cooked to different degrees of consistency in order to find weight of raw foods used in these diets. Dry seasonal

vegetables were also cooked. The volume of cooked dishes were converted into raw foods with the help of measuring katories. This helped in converting the cooked foods consumed by the subject to equivalents of raw foods to facilitate calculation of nutrients in the diets.

3.6 Calculation of nutritive value of diets

The raw amount of all the foods consumed daily was tabulated. Then average daily intake of each food was calculated and their protein, energy, calcium and iron contents were calculated using the Nutritive Value of Indian Foods (ICMR, 1985). The results of mean nutrient intake were compared with the Recommended Dietary Allowances (ICMR, 1981).

3.7 Statistical analysis of the data (Gupta, S.P., 1987)

'Standard error' for the various anthroplmetric measurements viz., weight, height, tricep skinfold thickness and mid-upper-arm circumference; food and nutrient intake was calculated.

Coefficient of correlation (r) was also calculated for body weight versus age at menarche.

't' test was applied to various parameters viz., weight, height, mid -upper-arm circumference, triceps

skinfold thickness, energy, protein, calcium and iron to find out the level of difference between the low and high socio-economic group. The various formula's used for statistical analysis are as follows :

1 Arithmatic Mean $(\bar{X}) = \frac{\Sigma X}{n}$

2 Per cent adequacy = $\frac{100}{RDA}$ X Present study

3 Standard error (S.E.) = $\frac{\sigma}{\sqrt{n}}$

4 Test of difference between two means 't' :

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where $S = \frac{\Sigma(X_1-\bar{X}_1)^2 + \Sigma(X_2-\bar{X}_2)^2}{n_1 + n_2 - 2}$

$$\nu = (n_1 + n_2 - 2) \text{ d.f.}$$

5 Coefficient of correlation (r) :

$$r = \frac{\Sigma(X-\bar{X})\ (Y-\bar{Y})}{\sqrt{\left[\Sigma(X-\bar{X})^2\right]\left[\Sigma(Y-\bar{Y})^2\right]}}$$

CHAPTER IV

RESULTS AND DISCUSSION

The results have been discussed under the following sub-headings :

4.1 Anthropometric measurements of adolescents

- 4.1.1 Weight
- 4.1.2 Height
- 4.1.3 Mid-upper-arm circumference
- 4.1.4 Triceps-skinfold measurement

4.2 Biochemical analysis : measurement of blood haemoglobin level

4.3 Dietary survey

- 4.3.1 Meal pattern
- 4.3.2 Fodd habit
- 4.3.3 Food intake
- 4.3.4 Nutrient intake

4.4 Effect of body weight on the age at menarche

The selected subjects were one hundred each from low and high socio-economic group. Rest of the girls were dropped from the sample either because of disease or incomplete response.

The selected subjects both from high (H) and low (L) socio-economic group (SEG) were divided into six categories on the basis of their age (Table 4.1).

Table 4.1 Distribution of girls according to their age

S. No.	Age group (Years)	% of girls	
		HSEG	LSEG
1	+10	18	7
2	+11	14	6
3	+12	21	17
4	+13	21	30
5	+14	21	25
6	+15	5	15

The general information about (1) type of family, (2) size of family, (3) parity, (4) education of the parents, (5) occupation of the parents, and (6) monthly per capita income of the family is given in Table 4.2.

Table 4.2 General information of the subjects

S. No.	Factors	Number of girls	
		HSEG	LSEG
1	Type of family		
	(i) Nuclear	81	97
	(ii) Joint	19	3
2	Family size		
	(i) 1-4	27	12
	(ii) 5-7	56	69
	(iii) > 7	17	19
3	Parity		
	(i) 1	52	30
	(ii) 2	32	19
	(iii) 3	14	25
	(iv) 4	2	17
	(v) 5	0	7
	(vi) 6	0	1
	(vii) 7	0	1

4 Parents education	Father	Mother	Father	Mother
(i) Illiterate	0	0	19	55
(ii) Primary	1	0	8	16
(iii) Middle	1	1	10	10

contd...

Table 4.2 contd...

S. No.	Factors	Number of girls			
		HSEG		LSEG	
		Father	Mother	Father	Mother
(iv)	Matric	7	17	56	20
(v)	Graduate	28	43	5	0
(vi)	Postgraduate	60	39	1	0
5	Parents occupation				
(i)	Self-employment	0	0	40	3
(ii)	Service	20	11	52	7
(iii)	Professional	26	14	0	0
(iv)	Businessmen	45	2	5	0
(v)	Farming	5	0	1	0
(vi)	Unemployed	1	73	1	90

6 Monthly per capita income	HSEG	LSEG
(i) ∠500	0	98
(ii) 501-750	0	2
(iii) 751-1000	10	0
(iv) 1001-1250	26	0
(v) 1251-1500	39	0
(vi) >1501	25	0

Out of the total sample (200), one child from LSEG and three children from HSEG did not have male parent living.

4.1 Anthropometric measurements of school girls

4.1.1 Weight : The mean weight of the girls from both the socio-economic groups have been given in Table 4.3. The mean weight of the girls from HSEG ranged from 29.7 kg to 54.5 kg while in girls from LSEG, the range was from 27.0 kg to 45.5 kg. This difference in mean weights was found at all age levels. When compared with the national standards given by the Indian Council of Medical Research (ICMR, 1968), the girls from HSEG were found to be 125.8 to 140.4 per cent whereas the girls from LSEG were 104.3 to 114.4 per cent of ICMR values. The reason why even the low socio-economic group exceeds the weight standards of ICMR is that the standards were formed long time back at national level where a large percentage of people are below the poverty line, but the subjects of the study belong to the families who are able to afford two meals a day and school education for their children, and are above the poverty line. Moreover, because of ethnic differences, the Punjabi children are better off than their counterparts.

Table 4.3 Mean weight in (kg±SE) of school girls as compared to ICMR (1968) standards and NCHS (1974) standards.

Age	Present study		ICMR standards	% adequacy		NCHS standards	% adequacy	
	HSEG*	LSEG		HSEG	LSEG		HSEG	LSEG
+10	29.7±1.2	27±2.6	23.6	125.8	114.4	32.55	91.2	82.9
+11	34.9±1.6	29.2±1.8	26.4	132.1	110.4	36.26	96.4	80.4
+12	40.5±1.2	31.5±1.4	29.8	135.9	105.7	42.51	95.3	74.1
+13	46.9±1.5	36.9±0.9	33.3	140.8	110.8	43.85	106.9	84.2
+14	48.8±2.0	38.3±1.0	36.8	132.6	104.0	45.00	108.4	85.1
+15	54.5±1.6	40.5±0.9	38.8	140.5	104.3	47.27	115.3	85.6

*P $>$ 0.05

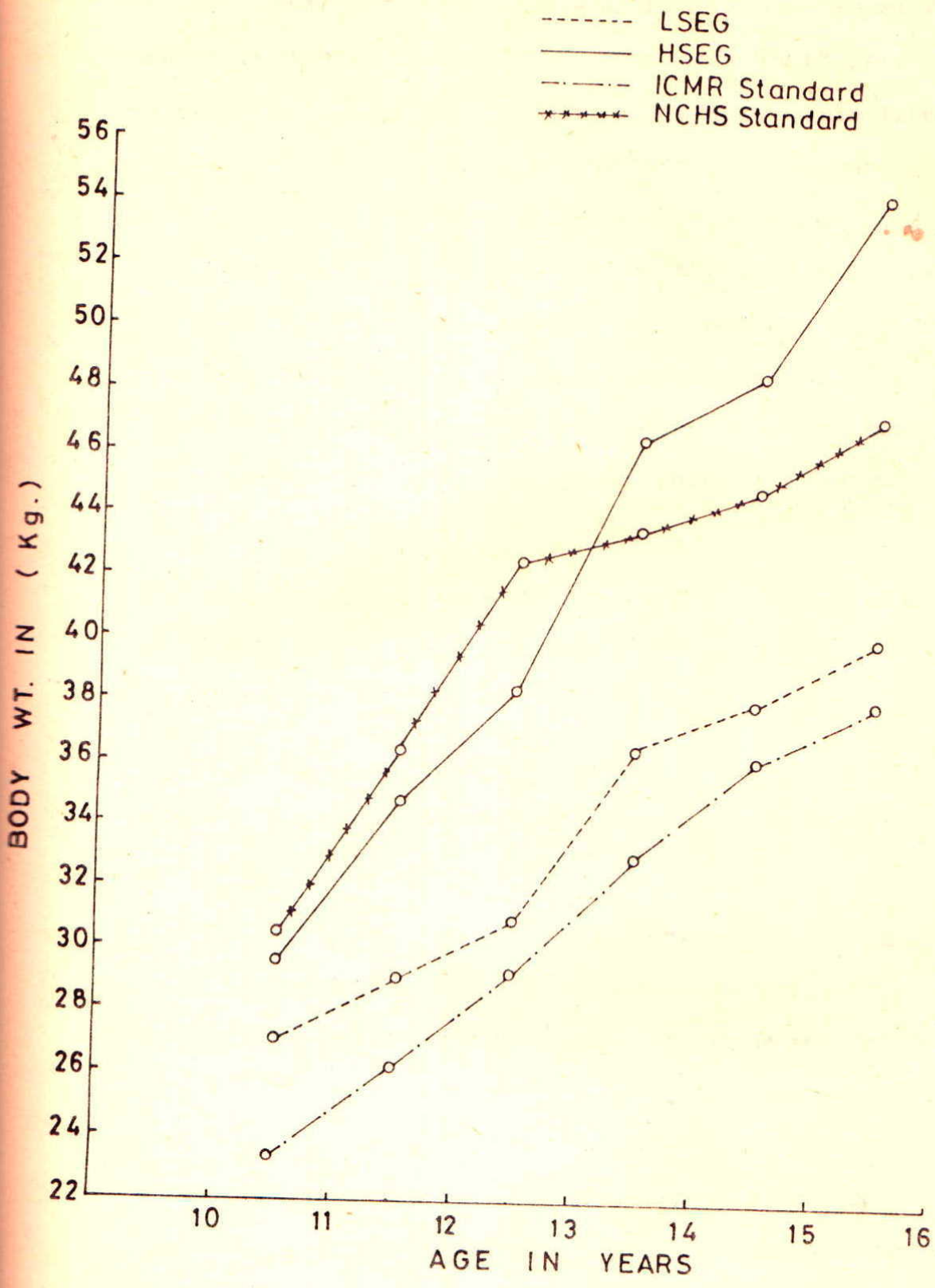

FIG.1: MEAN WEIGHT OF GIRLS AS COMPARED TO ICMR (1968) STANDARDS AND NCHS (1974) STANDARDS.

Another comparison made with National Center of Health Statistics, USA (NCHS) standards (50th percentile value), revealed that the mean weights of girls from HSEG were 91.2 to 115.29 per cent of the standard weight, whereas the mean weights of girls from LSEG were only 74.1 to 85.6 per cent of the NCHS standards. The table further revealed that mean weights of girls from LSEG remained below the NCHS standards at all age levels but those from HSEG rise above the standard weights after the age of 13 years showing a growth spurt at this age.

The per year increment in weight of girls was 4.5 kg and 2.6 kg in girls from HSEG and LSEG respectively.

The difference in the mean body weights of HSEG and LSEG girls was found to be significant at five per cent level of significance.

According to Tanner (1962), the spurt should normally start from 12 to 14 years in case of girls. Between the age of 9 to 16 years, nearly every child grows rapidly in almost every bodily dimension giving rise to what is known as 'adolescent growth spurt' (Grinder 1973). The results of the present study show that the girls from HSEG show a growth spurt at the age

of 13 years, whereas girls from LSEG do not attain great increment at this age. However, adolescents do vary a lot as to begin growth spurt yet we can say that socio-economic status has a great impact on the body weight of adolescents.

4.1.2 Height : The mean heights of girls from HSEG and LSEG are presented in Table 4.4. The mean height of girls from HSEG ranged from 137.9 cm to 158.7 cm, whereas the heights of girls from LSEG varied from 130.9 cm to 151.97 cm. The values of mean height in girls from HSEG were more than the ICMR standards, whereas that of those from LSEG compared well with the ICMR standards. The HSEG girls were 105.28 to 111.06 per cent of the standards, whereas LSEG girls were 100.5 to 103.66 per cent of the standards.

The mean heights of girls from HSEG were 97.65 to 102.6 per cent adequate while those from LSEG were 92.40 to 97.58 per cent adequate when compared with NCHS standards (50th percentile value).

The table further reveals that the height increases rapidly at the age of 11 to 13 years in case of girls from HSEG which is in line with that of ICMR and NCHS age's of growth spurt. But in case of girls from LSEG, it is delayed by one year, i.e. it starts at the age of 12 to 14 years.

Table 4.4 Mean height (cm±SE) of school girls in comparison to ICMR (1968) standards and NCHS(1974) standards

Age	Present adequacy		ICMR standards	% adequacy		NCHS standards	% adequacy	
	HSEG*	LSEG		HSEG	LSEG		HSEG	LSEG
+10	137.9±1.5	130.9±3.0	122.4	107.39	101.94	138.19	99.7	94.72
+11	141.7±1.8	138.5±3.0	133.6	106.06	103.66	145.11	97.65	95.44
+12	152.6±1.0	139.97±1.6	139.2	111.06	100.5	151.47	102.06	92.40
+13	154.9±1.2	146.8±1.1	143.9	106.94	102.01	153.75	100.09	95.40
+14	155.3±1.1	150.1±1.2	147.5	105.28	101.76	154.54	100.49	97.12
+15	158.7±1.2	151.97±1.8	149.6	106.08	101.58	155.73	101.9	97.58

*P > 0.05

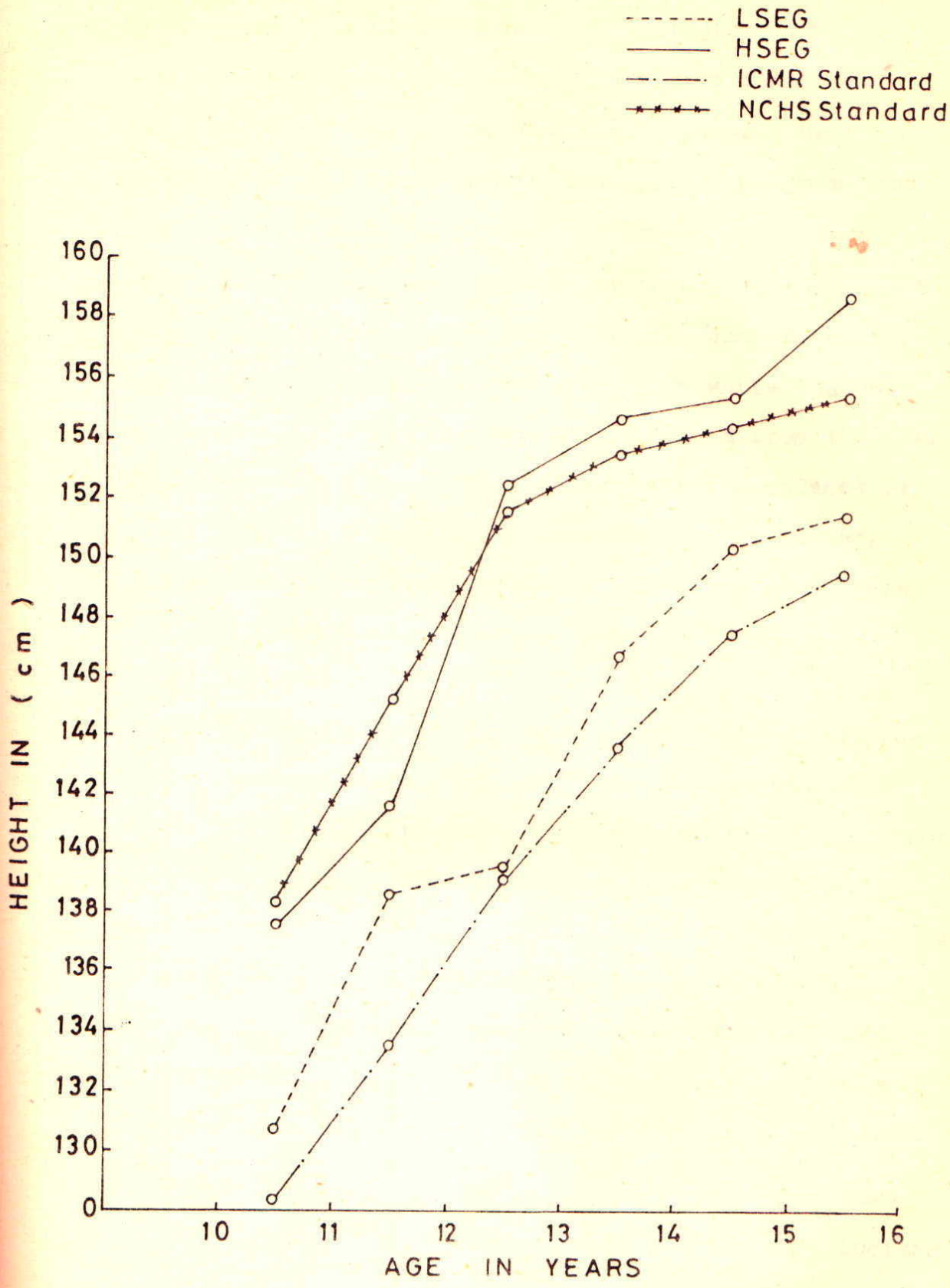

FIG.2: MEAN HEIGHT OF GIRLS AS COMPARED TO ICMR STD.(1968) AND NCHS STD. (1974)

The difference in mean height of girls from HSEG and LSEG was found to be highly significant at five per cent level. The Fig. 2 also shows the gradual increase in mean height at all age levels from both the socio-economic groups in comparison with ICMR and NCHS standards. The mean height of adolescent girls in Bikaner as reported by Banerji and Bhattacharya (1968) ranged from 134.1 cm to 155.3 cm while that of South Indian girls, the mean height ranged from 135.0 cm to 154.75 cm (Sousia, 1969). Thus, the respondents of the present study from HSEG were found to be taller, whereas those from LSEG remain at almost an equal level to that of South-Indian girls.

4.1.3 Mid-upper-arm circumference (MUAC) : The values of mean MUAC of girls from HSEG and LSEG are given in Table 4.5. The figure in the girls from HSEG varied from 19.6 cm to 24.0 cm, whereas in the girls from LSEG, this range was from 19.1 cm to 22.05 cm. After comparing these values with the NCHS standards, it was found out that the girls from HSEG were 89.02 to 99.17 per cent of the standard, while the adolescents from LSEG were 79.68 to 91.42 per cent of the NCHS MUAC standard values.

The maximum increment in MUAC of girls from HSEG occured at the age of 12 to 14 years, whereas this increment

Table 4.5 Mean mid-upper-arm circumference (cm±SE) of school girls as compared to NCHS (1974) standards

Age	Present study		NCHS standards	% adequacy	
	HSEG*	LSEG		HSEG	LSEG
+10	19.6±1.1	19.2±1.5	21.1	92.89	91.42
+11	21.1±0.7	19.1±0.4	22.4	94.19	85.26
+12	21.2±0.6	19.6±0.4	23.7	89.02	82.7
+13	23.1±0.4	20.36±0.4	24.3	99.17	83.78
+14	23.9±0.6	20.48±0.3	25.2	94.84	79.68
+15	24.0±0.4	22.05±0.5	25.4	94.4	86.81

*P > 0.05

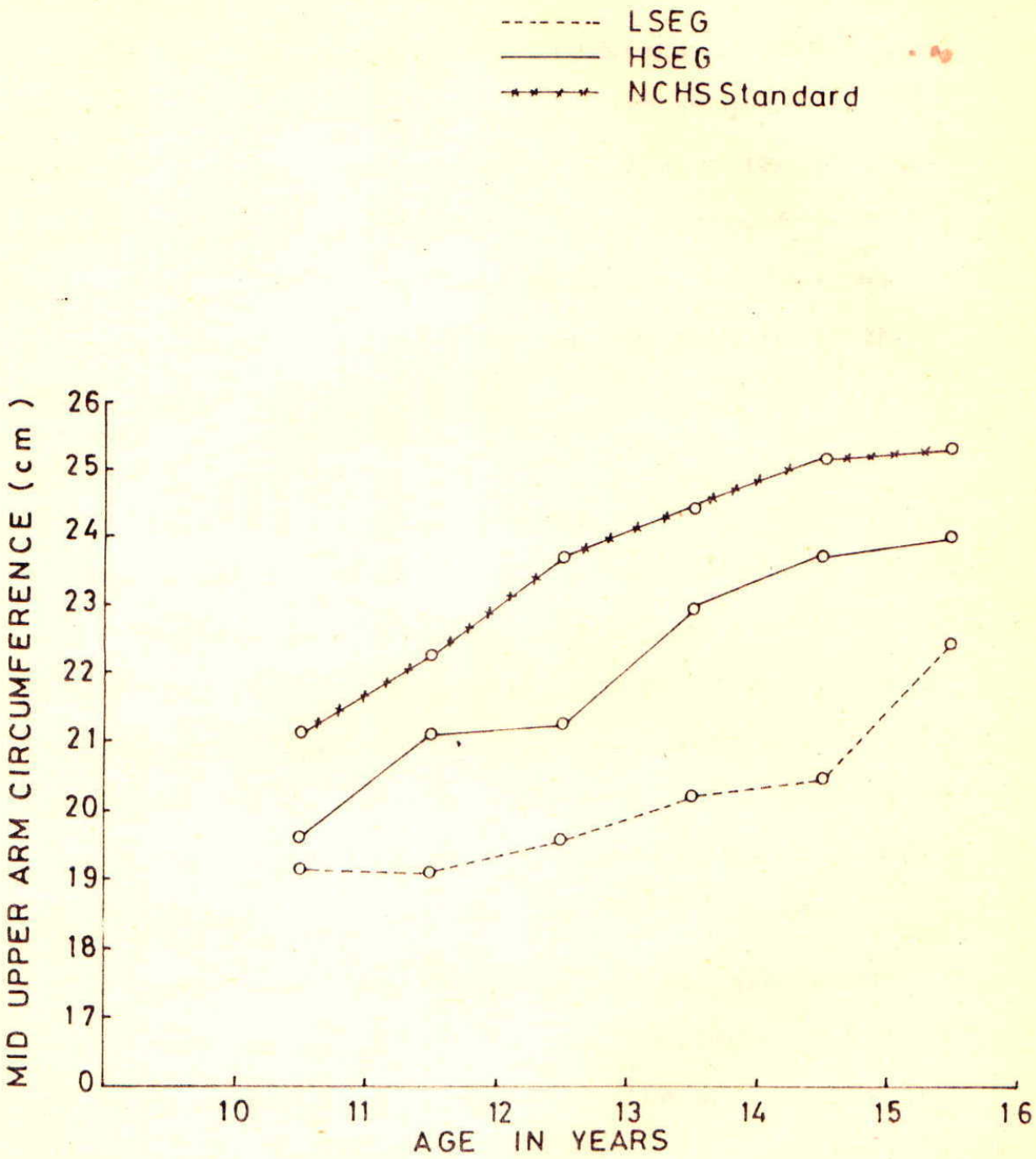

FIG.3: MEAN MID-UPPER-ARM CIRCUMFERENCE OF SCHOOL GIRLS AS COMPARED TO NCHS STDS. (1974)

in girls from LSEG is gained at the age of 14 to 16 years. The MUAC increments in girls from both the SEG's occur after the growth spurt in height. This indicates that the adolescents gain weight during this age which increases the circumference of the arm. The difference in mean values of MUAC of girls from HSEG and LSEG was found to be significant (Fig.3). The values of MUAC of South-Indian girls ranged from 18.0 cm to 20.7 cm (Sousia, 1969). The present study shows higher values in Punjabi girls as compared to South-Indian girls.

4.1.4 Triceps skinfold thickness (TSF) : The mean values of TSF are shown in Table 4.6. It is very clear from the table that the range of TSF value in girls from HSEG ranged from 10.8 mm to 14.5 mm and from 8.4 mm to 10.85 mm in girls from LSEG. These values are 85.19 to 94.61 per cent of the NCHS standards, in case of girls from HSEG. On the other hand, TSF of girls from LSEG was 57.5 to 69.9 per cent of the NCHS standards.

The increment in the values of TSF also occurs at the same age level when maximum increment of MUAC values is observed confirming that the adolescents gain weight from 12 to 15 years in case of HSEG and from 13 to 16 years in case of LSEG. The increase in the value of

Table 4.6 Mean triceps skinfold measurement (mm±SE) of girls as compared to NCHS (1974) standards

Age	Present study		NCHS standards	% adequacy	
	HSEG*	LSEG		HSEG	LSEG
+10	10.8±0.8	8.4±0.7	12	89.99	69.9
+11	12.3±1.5	8.5±0.6	13	97.62	65.38
+12	12.5±1.0	8.7±0.7	14	89.28	60.7
+13	13.7±1.0	8.8±0.4	15	91.33	58.6
+14	14.3±1.2	9.2±0.3	16	89.37	57.5
+15	14.5±1.1	10.85±0.09	17	85.29	63.8

*P > 0.05

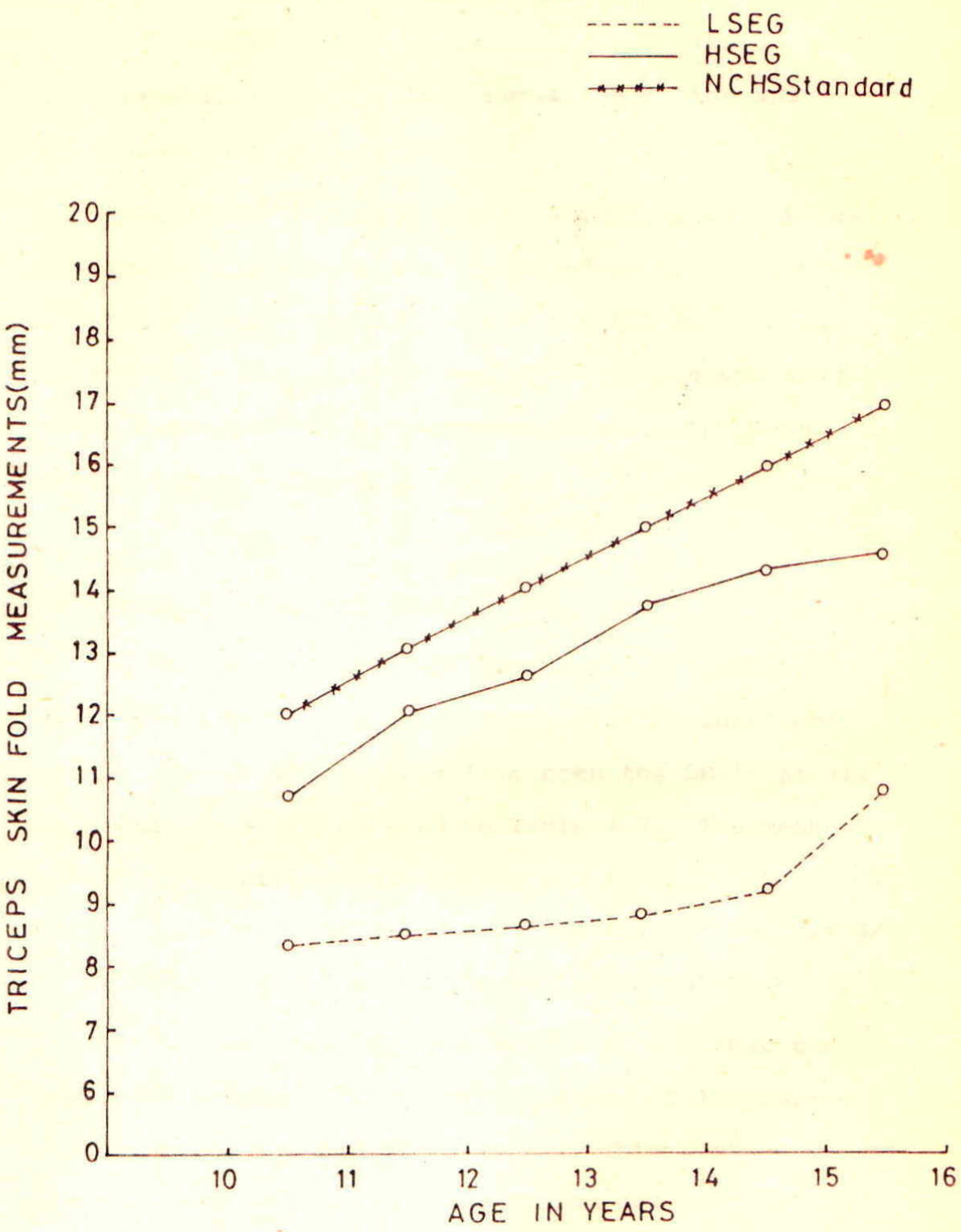

FIG. 4 : MEAN TRICEPS SKIN FOLD MEASUREMENTS OF SCHOOL GIRLS AS COMPARED TO NCHS STD. (1974)

TSF is consistent at all age levels in the girls from HSEG while it is not in girls from LSEG. The difference in the TSF values between both the SEG's was significant (Fig. 4).

According to Malina (1971) subcutaneous fat was more in white children when compared to Negroes, the difference being most marked for the TSF measurement. Therefore, it can be concluded from the present study that the socio-economic factors influence the total anthropometric make-up of the body.

4.2 Bio-chemical assessment

Blood haemoglobin (Hb) level was analysed to identify the girls suffering from anaemic conditions. The mean Hb values of girls from both the SEG's at all age levels are illustrated in Table 4.7. The mean Hb values in the girls from HSEG ranged from 10.8 g/100 ml to 11.7 g/100 ml, while these values varied from 9.4 g/100 ml to 10.6 g/100 ml in the girls belonging to LSEG.

It can be observed from the Table 4.7 that the level of haemoglobin rises till the age of 12 years and declines after the age of 14 years. This feature is common in both the SEG's. The reason for this may be the loss of iron during menstruation in girls at the

Table 4.7 Mean haemoglobin level in girls (g/100 ml)

Age in years	Mean Hb level (g/100 ml)	
	HSEG	LSEG
+10	11.0	9.8
+11	11.4	10.6
+12	11.7	10.6
+13	11.7	10.3
+14	10.8	9.8
+15	10.8	9.4

age of 14 years and onwards. This results in gradual lowering of iron status with increasing age in adolescent girls. Similar results were also reported by Pai and Hegsted (1974) which stated that Hb level decreases with increasing age.

Body temperature was recorded to eliminate the subjects suffering from any other disease which could affect the level of iron in blood. The Table 4.8 gives the percentage of girls at three different levels of haemoglobin adequacy.

It is obvious from Table 4.8 that 51 per cent of girls are anaemic in LSEG, while 56 per cent of girls from HSEG have an acceptable Hb level. The Hb level in

Table 4.8 Percentage of girls at three different levels of haemoglobin

Haemoglobin level* (g/100 ml)	Percentage of girls in	
	HSEG	LSEG
(i) Deficient (<10)	20	51
(ii) Low (10-11.4)	24	41
(iii) Acceptable(≥11.5)	56	08

*Gopaldas, T. and Sheshadri, S. 1980.

American girls ranged from 12.0 g/100 ml to 15.6 g/100 ml. Only one per cent of the girls could be classified as poor in nutritional status with regard to iron (Greger, 1978), whereas in the present study, the iron status of girls from LSEG is very poor, leading to anaemic conditions. The reason for high incidence of anaemia in adolescents is manifold but the major cause is a discrepancy between high need of iron for the formation of Hb to compensate the loss during menstruation (Sjolin, 1981).

4.3 Dietary survey

4.3.1 Meal pattern : The common meal pattern in all the girls was as follows :

(i) Breakfast

(ii) Lunch

(iii) Evening Tea

(iv) Dinner

All the girls from high socio-economic group had been reported to take the milk before retiring to bed. The Table 4.9 shows that 59 per dent of the girls from HSEG took five meals a day, whereas in case of girls from LSEG, 43 per cent of the girls took five meals and 54 per cent of girls took four meals daily.

Table 4.9 Meal pattern of school girls

No. of meals/day	Percentage of girls in	
	HSEG	LSEG
3	05	03
4	28	54
5	59	43
6	08	00

Most of the girls brought packed lunch with them. Seventy-four girls from HSEG brought lunch to school which generally consisted of plain or stuffed paratha, chapati with cooked vegetables, bread, sandwitches, eggs, fruits, etc. On the other hand, 67 girls from LSEG took lunch to school which was simply a chapati, plain paratha with pickle or a seasonal vegetable.

The girls who did not bring lunch took snacks either from school canteen or hawkers standing outside

the school premises. The public school girls preferred cold drinks, Channe Bhathura, Samosa, Tikki, etc. while the government school girls took Fried dhal, toffees etc.

The breakfast of girls from HSEG comprised of stuffed paratha, milk, eggs, sandwitches etc. But the girls from LSEG generally took plain paratha, chapati, bread, pickle, tea, etc. in the morning. The lunch and dinner of the girls from HSEG was almost similar consisting of rice, chapati, pulse, meat, curd, salad, fruit etc., whereas the girls in the low income group ate chapati, rice, pulse and a seasonal vegetable. The difference in the two SEG's was also seen in the consumption of the evening snack. The girls from HSEG preferred cold drinks, milk, snacks, sandwitches, fast foods, etc. in the evening, while the other group of girls liked tea, sweets, such as burfi, ladoo and biscuits.

It was observed from the study that mostly the girls were regular in taking their meals. But at the age of 15 years, they became conscious of their weight and started missing their meals. The commonly missed meals were breakfast and lunch. Bogio and Klepping (1981) suggested that breakfast skipping increased with age and that the habit was most prevalent among female adolescents. The children from HSEG drank milk before going to bed (Verma, 1983). Similar results have been shown by the present study too.

4.3.2 Food habit : From the results of the dietary survey, the girls were divided into three main categories according to their food habits (Table 4.10). A large number (76 per cent) of the girls were non-vegetarian in case of HSEG, whereas 41 per cent of the girls were meat eaters from LSEG. The reasons are religious beliefs and preferences of the subjects.

Table 4.10 Distribution of girls according to their food habits

Food habits	Number of girls	
	HSEG	LSEG
Vegetarian (Non-meat eaters)	9	30
Non-vegetarian (Meat eaters)	76	41
Ova-vegetarian (Egg eaters)	15	29

The foods liked and disliked by the girls from both the SEG's are given in detail in Appendix-II. The preferred foods by the girls of LSEG were rice, vegetables, sweets, such as burfi, gulab jamun, etc. The girls from HSEG liked rice, pulses, nooddles, chicken etc.

A few vegetables, such as bottle gourd, pumpkin, ash gourd and squash melon, were disliked by all the respondents.

Snacking and fast foods were a common feature among the public school girls. They preferred Samosas, Tikki, hot dogs, sandwitches, Channe Bhatura etc. The teenagers of HSEG were very fond of Chinese fast foods specially nooddles, chopsoy, munchurian and Chinese soups.

Musgrave et al., (1981) had also stated that adolescents eat a greater variety of snacks and females more than males. Verma (1983) found out that the practice of consuming snacks was related with socio-economic status. The children from higher income group snacked more often than did the children from lower income group.

4.3.3 Food intake : The average food intake of girls 10 to 12 years old and 13 to 15 years old, along with the recommended dietary allowances (ICMR, 1981) are given in Table 4.11.

Every cereal intake of girls (10 to 12 years old) from HSEG and LSEG was 127.07 g and 212.20 g respectively, while the older girls consumed 211.76 g and 296.7 g. In both the cases, girls from LSEG consumed more of cereals

Table 4.11 Average daily food intake (g±SE) of school girls as compared to RDA (ICMR, 1981)

(10 to 12 year old)

Foodstuff	RDA	Present study			
		HSEG	%adequacy	LSEG	% adequacy
Cereals	320	127.07±1.4	37.88	212.2±0.8	66.31
Pulses	70	30.00±0.6	42.8	35.0±1.2	50
Leafy vegetables	100	4.19±0.4	4	2.55±0.4	2.5
Other vegetables Root vegetables	75	32.77±0.5	43.5	17.20±0.7	22.9
Fat/oil	35	33.25±0.7	94.8	25.76±0.2	73.4
Milk	250	350.07±1.2	140.0	64.23±0.4	25.06
Sugar/ jaggery	50	29.2±0.6	58.4	30.15±0.5	60.3

contd...

Table 4.11 contd...

(13 to 15 year old)

Foodstuff	RDA	Present study			
		HSEG	% adequacy	LSEG	% adequacy
Cereals	430	211.76±0.4	49.2	296.70±0.9	69.0
Pulses	70	24.00±0.9	34.28	29.70±1.4	42.4
Leafy vegetables	100	3.8±0.6	3.8	0.54±2.4	0.5
Other vegetables	75	35.25±1.1	46.9	15.95±1.2	21.1
Root vegetables	75	7.9±1.4	10.5	9.36±0.8	12.4
Fat/oil	35	32.2±1.2	91.9	26.21±0.9	74.8
Milk	250	362.00±0.8	144.80	71.95±1.2	28.7
Sugar/ jaggery	30	21.39±1.2	71.2	18.95±1.4	62.9

comparatively. However, when compared with RDA (ICMR, 1981), the intakes were far from satisfactory. Similar trend was found in case of pulse,intake, where the percentage adequacy was only 42.8 and 50 in girls from HSEG and LSEG respectively.

The intake of leafy vegetables was negligible in all the respondents but the younger consumed more green leafy vegetables as compared to older ones. The intake of roots, other vegetables was also much below the RDA's. However, the girls from HSEG consumed more vegetables as compared to those from LSEG. Besides, the respondents from HSEG were also consuming fruits (16.6 g to 27.09 g per day), whereas this amount was much less (7.0 to 10.57 g) in case of girls from LSEG.

Milk intake was adequate in case of girls from HSEG, whereas the adequacy of milk intake varied from 25.1 g to 28.7 g in case of girls from LSEG. The respondents from HSEG also consumed flesh foods varying from 27 g to 30 g. Intake of fats and oils was 33.25 g and 25.21 g in girls from HSEG and LSEG respectively. This is found to be nearly adequate in girls from HSEG but inadequate in their counterparts from LSEG. All the respondents were taking sugar and jaggery much less than the RDA's.

According to Verma (1983), the children from higher income group consumed more of milk, fruits, eggs and meat, whereas the cereal consumption was found to be more in case of girls from poor families. The present study also reveals similar results but suggests that the inadequacy in consumption of foods is still present as compared to the Recommended Dietary allowances.

4.3.4 Nutrient intake : The mean daily nutrient intake of adolescent school girls from high and low SEG's as compared to Recommended Dietary Allowances (RDA) as suggested by the Indian Council of Medical Research (ICMR, 1981) is presented in Table 4.12.

The table shows that all the girls had lower intakes of energy at all age levels. The public school girls consumed 1580.24 Kcals to 1770.40 Kcals of energy daily which was 75.2 to 80.47 per cent of the RDA. The government school girls consumed still lower amounts of energy, i.e. 1250.60 Kcals to 1420.50 Kcals daily which was 59.55 to 64.56 per cent of the RDA.

The source of energy in case of girls from HSEG was mainly from fats and oils, sugars, cereals, milk, meat products and snacks while the girls from LSEG derived their share of energy from cereals and sugars. The energy intake of the girls from HSEG was found to be

Table 4.12 Mean daily intake of important nutrients of girls as compared to recommended dietary allowances

Nutrient	RDA	Present study			
		HSEG	% adequacy	LSEG	% adequacy
I Energy (Kcals)					
10-12	2100	1580.24±0.4*	75.2	1250.6±0.6	59.55
13-15	2200	1770.4±0.5*	80.47	1420.5±0.7	64.56
II Protein (cm)					
10-12	41	39.33±0.5*	95.92	21.50±0.9	52.65
13-15	50	38.70±1.1*	77.40	25.86±1.1	51.72
III Calcium (mg)					
10-12	600	609.18±1.2*	101.53	225.05±1.3	37.5
13-15	700	659.20±0.9*	94.17	245.5±1.4	35.07
IV Iron (mg)					
10-12	25	14.46±1.4	57.84	9.54±1.1	38.16
13-15	35	10.82±1.2	30.91	10.35±0.9	29.57

Recommended daily allowances by ICMR (1981).

*P > 0.05

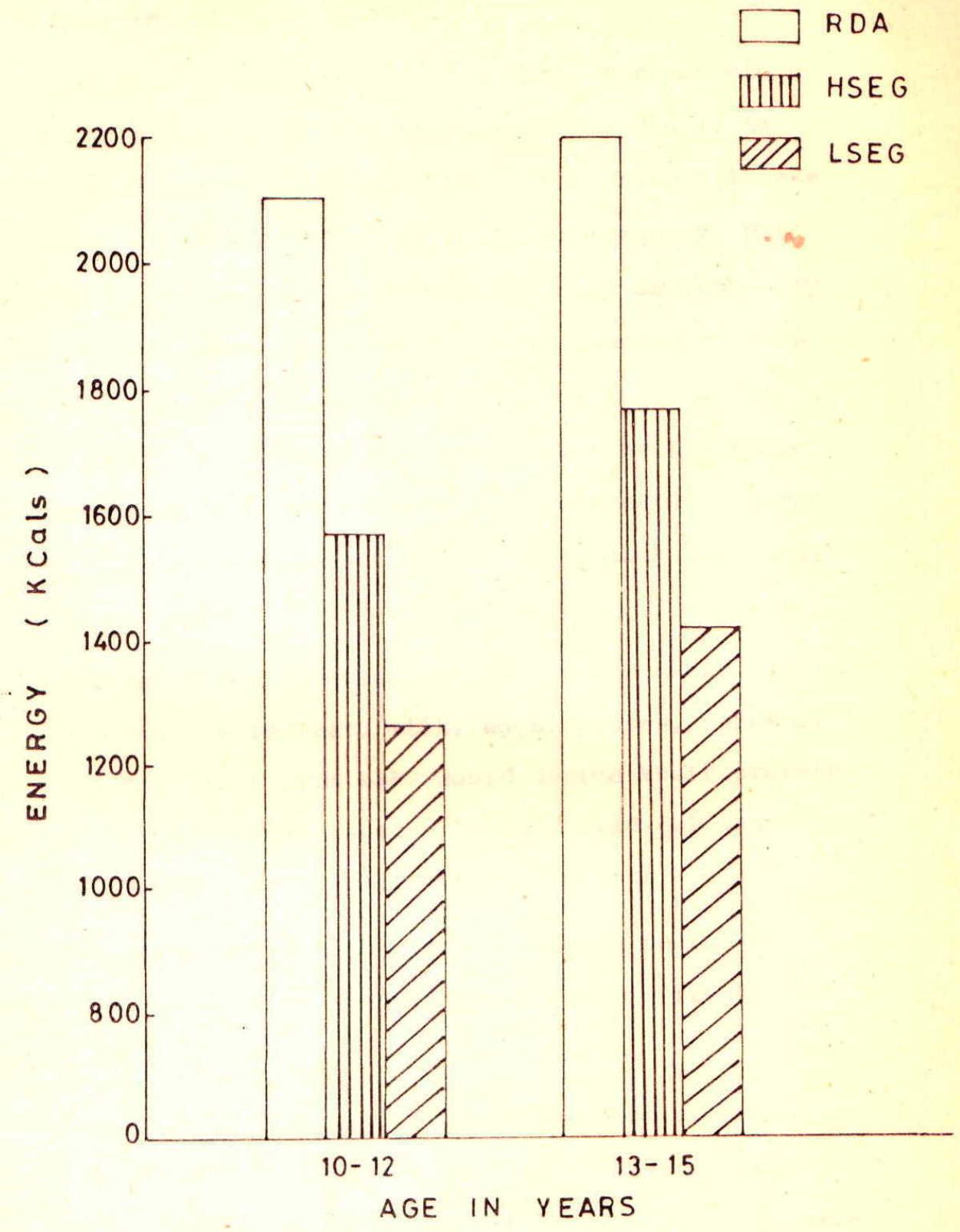

FIG. 5: MEAN DAILY ENERGY INTAKE OF GIRLS AS COMPARED TO RDA, ICMR (1981)

significantly higher than girls from LSEG at five per cent level of significance.

The recommended dietary allowances for protein intake was also not met by both the SEG's. In 10 to 12 year old girls belonging to HSEG, the protein intake was close to the RDA (92.95 per cent of adequacy) but the protein consumption of girls from poor SEG was only 52.65 per cent adequate. On the other hand, the girls who were 13 to 15 year old had still lower levels of protein than the previous age group. The public school girls consumed 77.4 per cent of the recommended protein level, while the government school girls took only 51.72 per cent of the RDA.

The foods contributing protein in the diets of the girls from HSEG were meat, milk, eggs, pulses, cereals, etc. But the girls from LSEG could derive their protein from pulses and cereals specially the fried dal bought from the hawkers during their recess periods.

The difference in the protein intake in the two groups was found to be significant. It is quite evident from Fig. 6.

The table further illustrates the mean calcium intake of girls from both the SEG's. As it was previously seen that the milk intake of the girls from HSEG who were 10 to 12 year old exceeds the RDA, similarly the calcium

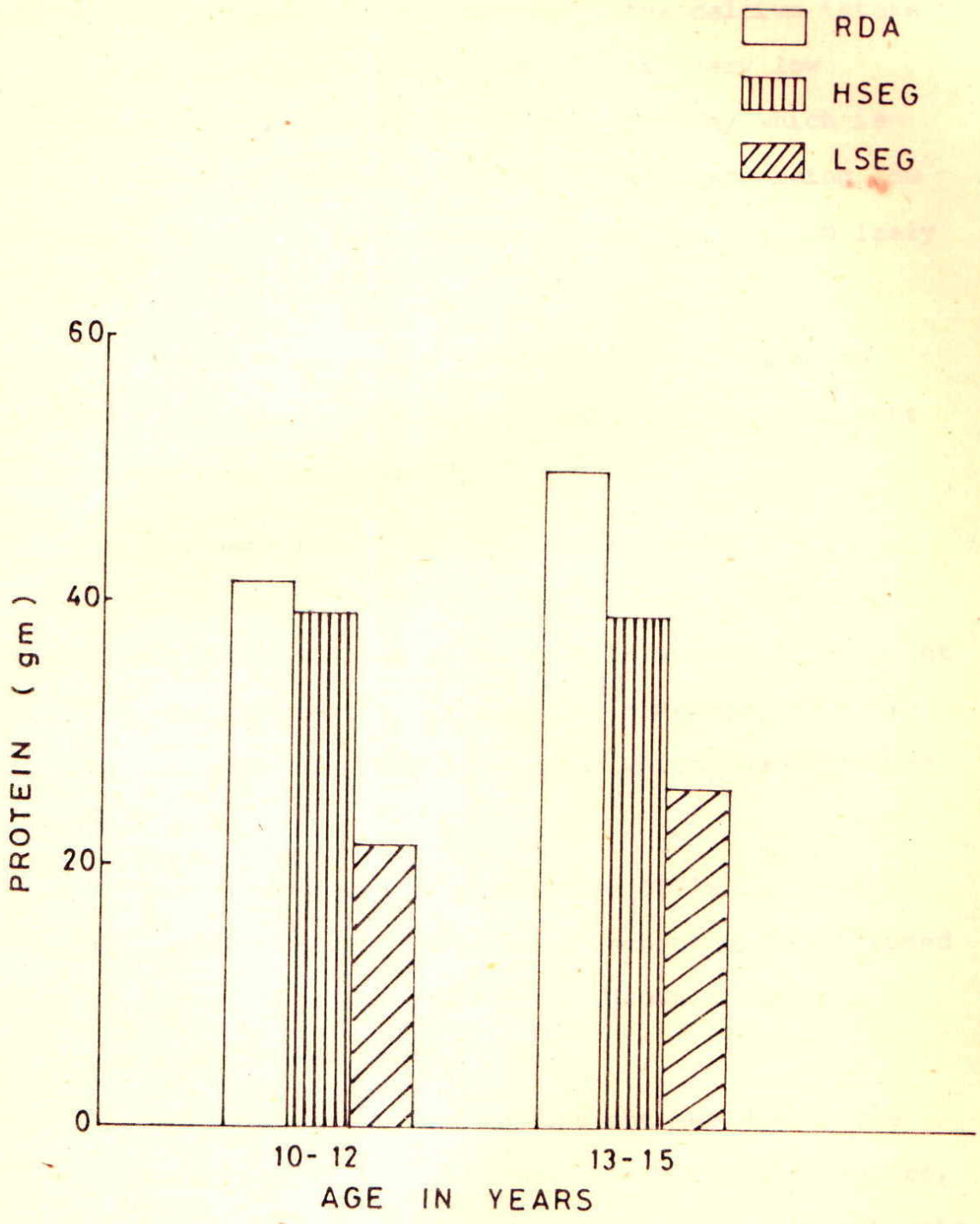

FIG.6 : MEAN DAILY PROTEIN INTAKE OF GIRLS AS COMPARED TO RDA, ICMR (1981)

intake of this age group was adequate, whereas the calcium intake in the older girls of HSEG was 94.17 per cent of RDA. On the contrary, the calcium intake of the girls from poor income level is very low ranging from 225.05 mg to 245.5 mg per day which is 35.07 to 37.50 per cent of RDA. The reason being low intake of calcium rich foods like milk and green leafy vegetables.

The calcium intake of the girls belonging to HSEG's was found to be significantly higher than that of girls from LSEG (Fig.7).

The mean intake of iron by all the girls was very low. The 10 to 12 year old girls belonging to HSEG consumed 14.46 mg of iron which was 57.84 per cent of the RDA, while the girls of the same age group from LSEG consumed only 9.54 mg of iron which was 38.16 per cent of RDA.

The older girls from both the SEG's had still lower intake of iron. The public school girls consumed 30.91 per cent, whereas the poor income group girls consumed 29.57 per cent of RDA.

The requirement of iron was not met due to the low intake of the iron rich foods like cereals, pulses, green leafy vegetables and flesh foods. The iron intake by the girls of HSEG who were 10 to 12 year old was

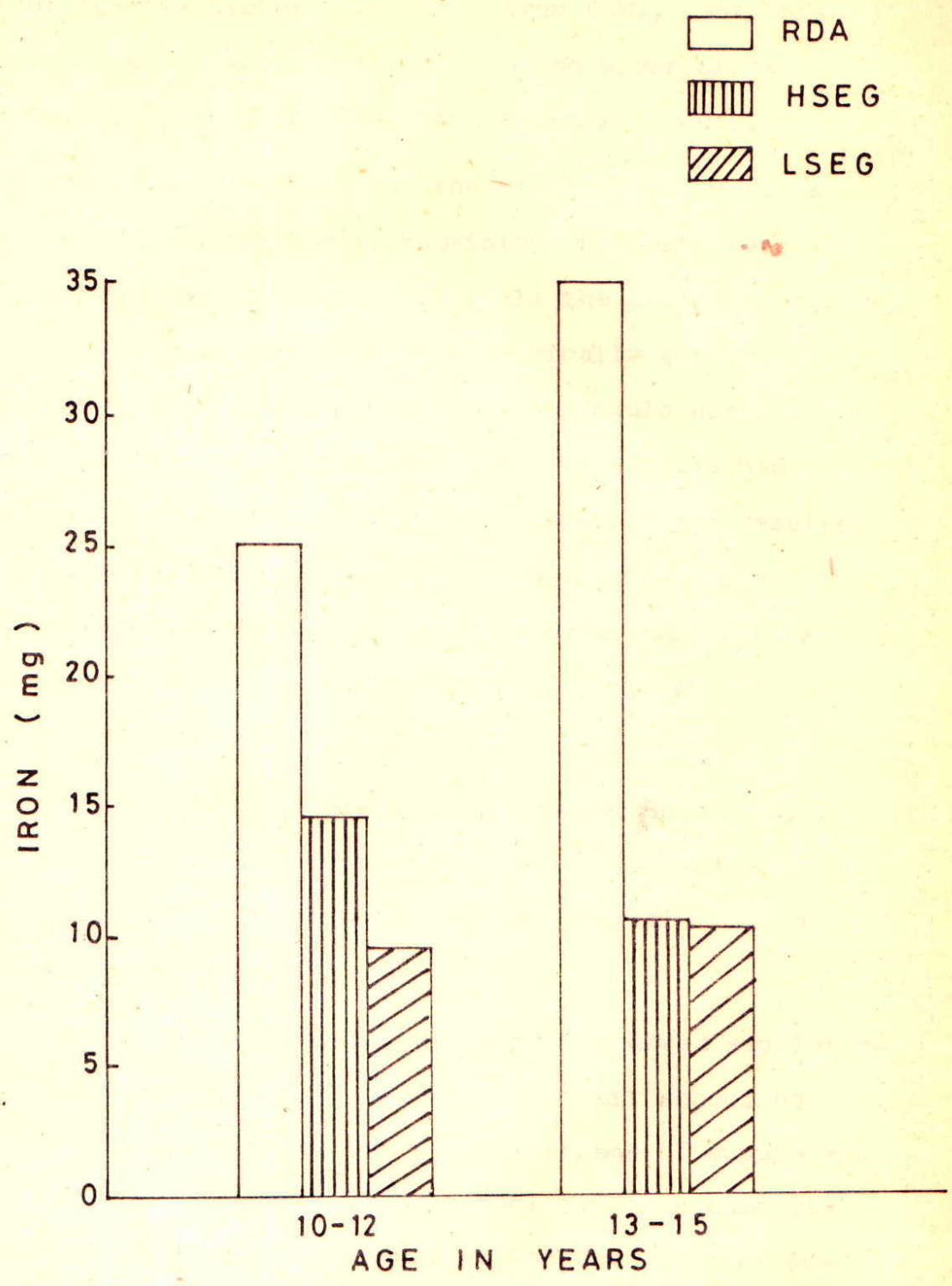

FIG. 8: MEAN DAILY IRON INTAKE OF GIRLS AS COMPARED TO RDA, ICMR (1981)

significantly higher than girls from LSEG. But this difference was non-significant in the older girls belonging to high and low socio-economic groups.

The public school had the provision of various games such as Basketball, Badminton, Handball, etc. These games were compulsory for all the girls, therefore, these girls were classified as physically active. On the other hand, the government school could not provide the facilities of these games, hence the girls had the option to participate in such games. This resulted in 54 girls participating in the games like Handball and Kho-Kho who were classified as physically active and 46 per cent of non-participating girls as physically inactive.

So, higher the level of physical activity, more will be the food consumption. This is the reason why the girls from HSEG are ahead in the nutrient intake of the girls from LSEG.

The government school girls had received supplementary food till the fifth standard of their schooling, while the public school had no such scheme of supplementary nutrition, yet the government school girls were poorly nourished comparatively. This is because of lower food intake by girls in LSEG during the adolescent growth spurt.

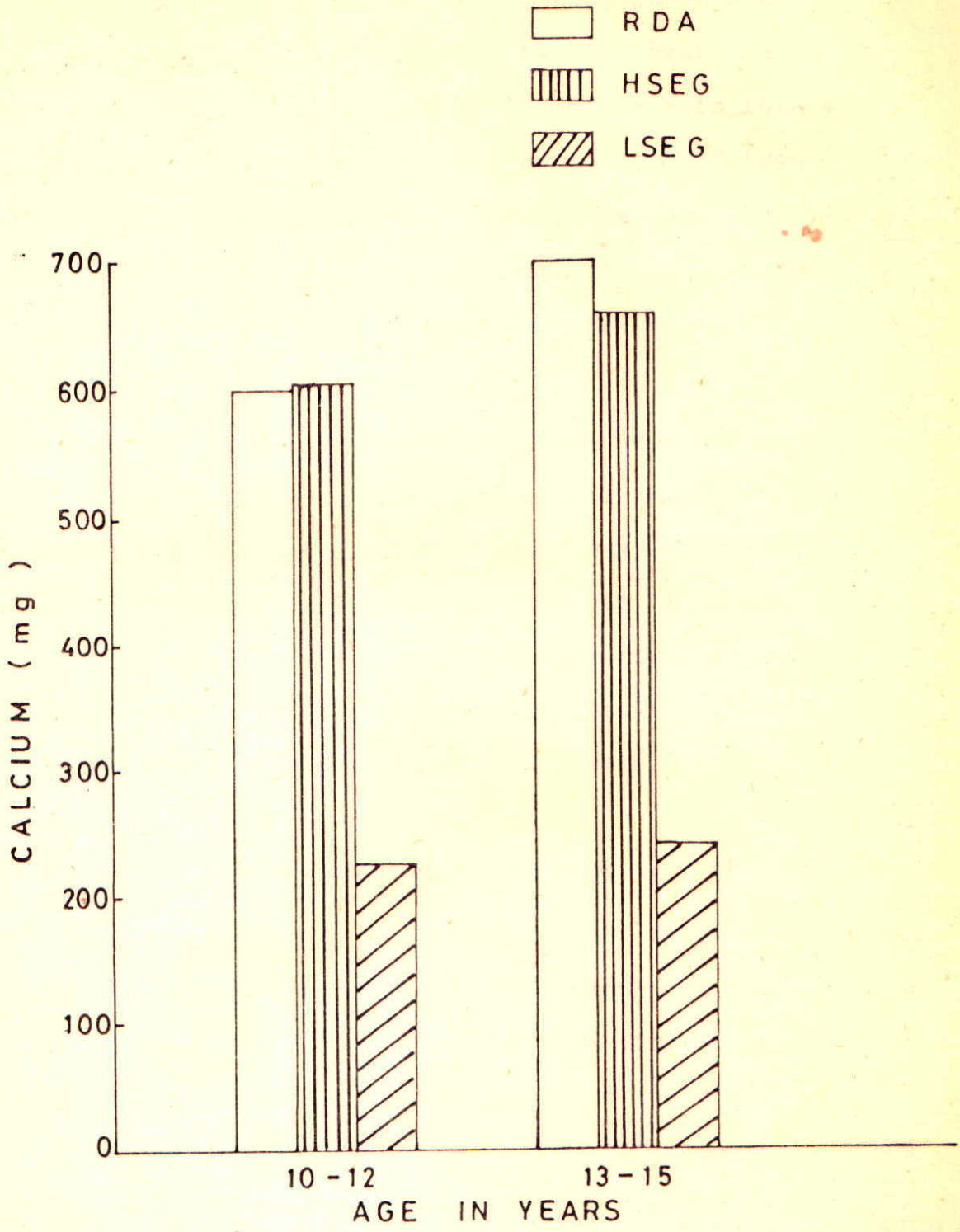

FIG.7: MEAN DAILY CALCIUM INTAKE OF GIRLS AS COMPARED TO RDA, ICMR (1981)

Durnin et al (1974) reported that energy intakes of adolescent appear to have fallen steadily over the years. According to Guzman et al (1981), the protein intake was adequate in case of girls while calcium and iron intake was 70 per cent below the RDA. Verma (1983) found out the inadequacy in the energy intake but the protein intake was found to be adequately taken by adolescents.

The present study showed that the average energy and protein intake was inadequate in all the respondents. The calcium intake of girls from HSEG was adequate which is not the case in girls from LSEG. This is because of the high level of milk intake in the former group. The average daily intake of iron was also found to be far below the RDA's in all the respondents.

4.4 Effect of body weight on the age at menarche

The present study revealed that 55 girls from public and 57 girls from government school had attained menarche. The Table 4.13 shows that 46 girls from HSEG started menstruating at the age of 11 to 13 years, while 48 girls out of 57 from the LSEG started menstruating at the age of 12 to 14 years. The girls from higher income groups had lower age at menarche than the girls from lower income group.

Table 4.13 Age at which the girls attained menarche

Age in years	Number of girls	
	HSEG	LSEG
+10	2	0
+11	26	0
+12	20	17
+13	7	31
+14	0	9
+15	0	0

The value of coefficient of correlation 'r' was -0.05. It did not reveal a significant relationship between the body weight and the age at menarche.

The present study contradicts the work done by Osteria (1984) which says that body weight is related to the age at menarche. The findings support the work done by Rana et al. (1986), which says that not weight but the genetic and environmental factors play an important role in the age at menarche. In addition to this, exposure to mass media also plays a role in bringing down the age at menarche especially in girls belonging to HSEG.

CHAPTER V

SUMMARY AND CONCLUSIONS

The study on the "Assessment of Nutritional Status of School Girls (10-15 yr old)" was undertaken using anthropometric measurements, physical maturation and biochemical assessment as indicators of nutritional status. There were 200 girls, 100 each from low and high socio-economic groups. Four basic body measurements, viz., height, weight, mid-upper-arm circumference and triceps skinfold thickness were taken. Blood haemoglobin level was also tested. In addition, their dietary intake was assessed.

The average body weight of girls from HSEG and LSEG varied from 29.7 to 54.5 kg and 27.0 to 40.5 kg respectively. In both the cases, the value of this measurement was higher than of ICMR (1968) standards. On comparison with the NCHS (1974) standards (50th percentile), the mean weight of girls from HSEG compared well whereas that of those from LSEG was only 74.1 to 85.6 per cent of the standard.

The mean height of the girls from HSEG ranged from 137.9 to 158.7 cm, whereas it varied from 130.90 to

151.9 cm in girls from LSEG. Girls from both the groups were found to be taller than ICMR standards. But when compared with the NCHS standards (50th percentile), the height of girls from HSEG compared well (97.65 to 102.06 per cent) but that of girls from LSEG varied from 92.40 to 97.58 per cent of the standard.

The girls from HSEG were found to be taller and heavier than those from LSEG. The growth spurt in girls from HSEG occurred during 11 to 13 years of age and that in girls from LSEG during 12 to 14 years of age. That means girls from LSEG took one year more to mature as compared to their counterparts from HSEG.

The mid-upper-arm circumference (MUAC) of girls from HSEG ranged from 21.1 to 25.4 cm and of the girls from LSEG 19.6 to 24.0 cm. MUAC of both the groups was less when compared with the NCHS standard (50th percentile) for corresponding ages.

The triceps skinfold measurement for girls from HSEG ranged from 10.8 to 14.5 mm and 8.3 to 10.35 mm in girls from LSEG. In all the four bodily measurements our girls specially from LSEG laged much behind when compared to NCHS standards.

All the anthropometric measurements viz., weight, height, midd-upper-arm circumference and skinfold

thickness were significantly higher in girls from HSEG than the girls from LSEG at five per cent level of significance.

The mean haemoglobin value of girls in HSEG and LSEG ranged from 10.8 to 11.7 g/100 ml and 9.4 to 10.6 g/100 ml, respectively. The value of haemoglobin declined after the age of 14 years.

Information about food intake and food habits was collected by 24 hour recall method. There were three main meals and an evening snack in the meal pattern of respondents from both the socio-economic groups. In addition, most of the girls from HSEG drank milk before bed time.

The girls from public school took more of meat, milk, egg, fruit, fast foods and snacks than those from the government school.

The cereal consumption was only 37.8 to 49.2 per cent of RDA in case of girls from HSEG, while it was 66.31 to 69 per cent of RDA in girls from LSEG. The pulse intake was 42.8 to 34.28 per cent of RDA in girls from HSEG, whereas in girls from LSEG, it ranged from 42.4 to 50.1 per cent of RDA. The vegetables were consumed in lower amounts at all age levels by all the respondents. The green leafy vegetables were the

least consumed food by the girls. Mean intake of fruits and flesh foods in case of girls from HSEG was 27 g and 30 g respectively while in case of girls from LSEG, the fruit consumption was 10.8 g only. Milk, fat and meat were consumed at reasonably higher level by the girls from public school than those from government school. No marked difference in the intake of sugar was observed in the two groups studied.

The daily mean intake of energy in Kcals per day in girls from HSEG and LSEG ranged from 1580.24 to 1770.40 Kcals and 1250.60 to 1420.50 Kcals respectively. It was found much below the requirements. The intake of energy by the girls from HSEG and LSEG was only 75.2 to 80.47 per cent, and 59.55 to 64.56 per cent of RDA, respectively.

The protein intake of girls of public school and government school ranged from 77.40 to 95.92 per cent and 51.72 to 52.65 per cent of RDA, respectively, while the mean daily intake of calcium in the girls from HSEG was adequate (94.17 to 101.53 per cent of RDA) but in case of those from LSEG, it was very little (35.07 to 37.5 per cent of the RDA) when compared with the ICMR standards. The mean daily intake of iron by the girls from HSEG and LSEG ranged from 30.91 to 57.84 per cent and 29.57 to 38.16 per cent of the standard,

respectively.

The level of energy, protein and calcium intake was significantly higher in girls from HSEG than those from LSEG. But no significant difference had been observed in levels of iron intake in the two groups studied.

The total number of girls menstruating in HSEG was 55 while it was 57 in the LSEG because there were more of older girls in case of LSEG than HSEG. The girls from HSEG and LSEG started menstruating during the age of 11 to 13 years and 12 to 14 years, respectively. The public school girls attained maturity prior to the government school girls. However, no correlation between the body weight and the age at menarche in adolescent girls had been found.

From the above discussion, it can be concluded that :

1 The girls from HSEG have significantly higher values of anthropometric measurements than girls from LSEG.

2 The growth spurt occurs a year later in the girls from LSEG as compared to those from HSEG.

3 The level of haemoglobin has been found to be 11.2 g/100 ml in case of girls from HSEG and 10.0 g/100 ml in girls from LSEG. The level declined in both the SEG's after the age of 14 years. Therefore, iron supplements should be encouraged at this stage.

4 The cereal, pulse, vegetable, fat and sugar consumption was lower than RDA in both the SEG's but milk consumption was higher than RDA in case of girls from HSEG.

5 The recommended dietary allowances (ICMR, 1981) for energy, protein, calcium and iron seem to be higher. Though the energy intake of girls is lower than RDA, yet these girls were taller and heavier than ICMR (1968) standards. Nevertheless these standards need revisions.

6 The girls are snackers and they should not be encouraged to replace their meals with snacks.

7 The body weight does not effect the age at menarche to a significant level. But other factors like environment, heredity, exposure to mass media and food intake play an important role.

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Appendix-I

QUESTIONNAIRE FOR SURVEY

"Assessment of Nutritional Status of School Girls (10-15 yr old)"

Nutritional survey of school girls (10-15 yr old)

1 General information :

1 Name

2 Age

3 Class

4 Birth order

5 Socio-economic aspects

6 Family : Nuclear/Joint

7 Address

S. No.	Name	Sex	Age	Education	Occupation	Income	Relation to the head

II Physical status

1 Anthropometric measurement :

(a) Weight (kg)

(b) Height (cm)

(c) Mid-upper-arm circumference (cm)

(d) Skin fold thickness (mm)

2 Biochemical assessment

(a) Haemoglobin level

3 Physical growth

(a) NM/NAM

(b) Age at menarche : _____Years____Months

4 Physical activity

(a) In which games do you participate ?

(b) How many hours do you play ?

(c) Any other exercise ?

III Food habits

1 Vegetarian/non-vegetarian/ova-vegetarian

2 Were you enrolled under any supplementary nutrition programme ? If yes, then did you get to eat and till which class ?

3 Do you take packed lunch to school ? If yes, usually what ?

4 What do you usually eat during school break ?

5 Common dietary pattern :

Meals

Breakfast

Mid-morning

Lunch

Evening tea

Dinner

Other

6 List down :

Foods liked	Foods disliked

IV Dietary intake for three days :

Meals	Ist day	2nd day	3rd day
Breakfast			
Mid-morning			
Lunch			
Evening Tea			
Dinner			
Others			

Appendix-II

Foods likes and dislikes of school girls

Food groups	HSEG		LSEG	
	No. of girls liked	No.of girls disliked	No.of girls liked	No.of girls disliked
1	2	3	4	5
I Cereals				
Rice	70	0	14	0
Bread	2	1	5	0
Paratha	7	0	2	1
Chapati	0	0	1	0
Poori	7	0	2	0
II Pulses				
Rajmah	47	1	24	4
Chanae (Bengal gram dal)	27	2	8	1
Black chanae	3	1	0	0
Black gram	0	0	8	2
Lentil (Masar)	0	0	3	13
Rongi	0	2	0	2
Green gram	0	0	6	19
Cowpeas	0	0	1	0
Dal	10	11	0	0
Soya bean	0	1	0	0
Fried dal	0	0	12	0

contd...

1	2	3	4	5
III Vegetables				
(a) Leafy vegetables				
Palak	5	6	2	0
Saag	5	2	3	4
Cabbage	4	5	4	4
Fenugreek	1	2	0	0
(b) Roots				
Potatoes	10	7	23	10
Onions	1	1	0	1
Carrots	1	1	8	4
Radish	0	0	1	1
Shalgam	0	3	3	11
Arbi	10	3	8	15
(c) Other Vegetables				
Peas	7	5	38	2
Ginger	0	2	0	0
Capsicum	2	9	0	7
Beans	3	0	0	0
Ash gourd	0	1	2	30
Brinjal	9	25	12	50
Lady fingers	47	16	45	16
Bitter gourd	14	29	25	26
Ghia	2	36	7	45

contd...

1	2	3	4	5
Squash melon	10	61	1	44
Pumpkin	6	61	7	59
Ridge gourd	1	18	5	49
Tomatoes	6	5	0	0
Bottle gourd	0	1	7	40
Cauliflower	13	16	65	4
(d) Fruits				
Plums	1	0	1	0
Apples	3	2	23	3
Mango	17	1	51	1
Orange	5	1	5	3
Bananas	2	5	31	2
Grapes	2	0	10	2
Sapota	1	1	3	5
Pear	1	4	10	5
Litchi	1	0	2	0
Lemon	0	1	0	0
Papaya	0	0	1	3
Jack fruit	0	0	0	2
Ber	0	0	1	0
Pomegranate	0	0	3	2
Guava	0	0	4	2
Pineapple	0	0	1	2

contd...

1	2	3	4	5
(e) Fish				
(i) Flesh				
Fish	2	0	0	0
Pork	0	6	0	0
Beef	0	1	0	0
Egg	17	10	24	15
Mutton	10	13	3	15
Chicken	50	8	0	0
(f) Milk				
(ii) Milk products				
Milk	4	2	3	2
Curd	2	1	1	0
Cheese	10	2	8	0
Lassi	2	0	1	0
Kheer	4	3	1	0
Butter	0	2	0	0
Tea	0	1	0	0
Custard	1	1	0	0
Ice-cream	18	0	0	0
Cold coffee	1	0	0	0
(g) Snacks				
(iii) Fried/baked				
Hot dogs	1	0	0	0
Pastries	4	0	0	0
Cakes	3	1	0	0
Paties	1	0	0	0

1	2	3	4	5
Ham's	1	0	0	0
Pakora	0	0	2	13
Samosa	0	0	11	0
(h) Sweets and dishes				
Cold drinks	11	1	0	0
Rasna	1	1	0	0
Halwa	1	0	3	5
Choclates	2	0	0	0
Jaggery	1	0	0	0
Ladoo	0	0	2	4
Kalakand	0	0	1	2
Rasgulla	0	0	2	0
Gulab Jamun	0	0	1	0
Jalebi	0	0	0	2
Pera	0	0	1	3
Barfi	0	0	2	0
(i) Some cooked foods				
Noodles	49	3	0	0
Curry	8	3	1	0
Naggets	0	0	8	6
Chopsouy	3	0	0	0
Munchurian	1	1	0	0
Dosa	1	1	0	0
Baked beans	1	0	0	0
Pizza	1	0	0	0