METHODS & MATERIALS

CHAPTER 3

METHODS AND MATERIALS

This Chapter has been discussed under the following heads :

A. GENERAL OBJECTIVES OF THE STUDY

B. SAMPLE SELECTION

C. EXPERIMENTAL DESIGN

D. PARAMETERS AND TECHNIQUES USED FOR DATA COLLECTION

E. COMPUTERIZATION OF DATA

F. STATISTICAL ANALYSIS

A. GENERAL OBJECTIVES OF THE STUDY

(i) To compare the nutritional status of male and female plantation workers among the three types of plantations.

(ii) To study the effect of peak and lean tea plucking seasons on the nutritional status of the workers.

(iii) To identify the socio-economic, environmental and other factors that are the major determinants of the nutritional status of these workers.

(iv) To evaluate the well being of these workers using the derived Quality of Life Index.

(v) To recommend corrective measures to the tea plantation management on the basis of the findings of the study.

B. SAMPLE SELECTION

(i) Sampling Universe

Of the 844 Tea Estates in Assam, 169 Tea Estates are run by the British Tea Company, 14 Tea Estates are run by Tea Corporation of Assam and the remaining 661 Tea Estates are run by various Native companies.

(ii) Sampling Frame

Out of these 844 Tea Estates, 2 from each category constituted the basic frame for sampling.

(iii) Sample Selection

To ensure that there is equal representation in the sample of the plantations within and beyond 20 km distance from Assam Agricultural University, the plantations of these three types namely 'British', 'Tea Corporation' and 'Native' were stratified.

Strata I - Distance from AAU < 20 kms

Strata II - Distance from AAU > 20 kms

From each strata one garden of each type was selected randomly, so that on the whole 6 gardens, 2 of each type, were covered.

Permission to conduct the study in the Tea Estates was obtained from the administrative management of each of the three plantations.

After selecting the plantations, a list of male and female workers was obtained from the management. Initially, from each plantation, 200 male and 200 female workers were randomly enrolled using Random Number Tables from each strata for the study. From-the enrolled sample, complete data were collected till a sample size of 150 male and 150 female workers was reached. A larger number of workers were enrolled to avoid reduction in sample size due to non co-operation or non-availability of the workers. Thus, from each type of plantation (British, Tea Corporation and Native) a total of 300 male and 300 female workers constituted the sample. Therefore, on the whole, 1800 (900 Male + 900 Female) workers were covered for the study. The data on half the sample (900 workers selected randomly from the full list) were collected during peak tea plucking season (June to November) and the other half was covered during lean tea plucking season (December to May) to compare the effect of seasonal variation on nutritional status.

C. EXPERIMENTAL DESIGN

The experimental design (Fig. 1) shows how the study progressed.

FIGURE 1

C. EXPERIMENTAL PLAN

Total tea plantations in Assam
(844)

- British (B) (n=169)
  - Within 20 Km: 150M 150F
  - Above 20 km: 150M 150F
- Tea Corporation (T) (n=14)
  - Within 20 km: 150M 150F
  - Above 20 km: 150M 150F
- Native (N) (n=661)
  - Within 20 km: 150M 150F
  - Above 20 km: 150M 150F

75M + 75F
From each plantation in peak tea plucking season (June to Nov.)

75M + 75F
From each plantation in lean tea plucking season (Dec to May)

Parameters Studied

- Socio-economic and environ-mental factors
  - a. Income
  - b. Education
  - c. Sanitation
  - d. Housing
  - e. Water source
- Anthropo-metry
  - a. Weight
  - b. Standing height
- Haemoglobin Estimation
- Stool Analysis for Presence/ Absence of inte-stinal parasites
- Diet survey Daily dietary intake 24 hrs. recall method
- Clinical signs of deficiency of macro and micro nutrients
- Morbidity

Note: All Investigations were carried out on the entire sample.

D. PARAMETERS AND TECHNIQUES USED FOR DATA COLLECTION

Underwood (1986) reported that no single variable can directly measure the nutritional status of an individual. The reliability and validity are improved by combining judiciously selected dietary, anthropometric and biochemical measurements to arrive at a composite physiological picture.

Direct parameters of nutritional status such as dietary intake, anthropometry, biochemical and bio-physical parameters; the indirect parameters such as morbidity and mortality, socio-economic status and environmental factors such as housing and environmental hygiene, provide a useful indication of the nutritional status of an individual or a community (Ramachandran, 1987). Consequently a whole array of nutritional, health, socio-economic and environmental parameters have been utlized. The methods used are described below.

I. SOCIO-ECONOMIC EVALUATION (Quality of Life Index)

Socio-economic (SE) and environmental (E) variables such as income, literacy, food expenditure, type of housing, type of drinking water, type of sanitation are postively co-related with morbidity and nutritional status (Ameresekere, 1984, Rao et al, 1987). Very often a single or a combination of a few socio economic and/or environmental variables can serve as quite reliable proxy indicators for the health and nutritional status of the group or community under study. Income, literacy and type of housing were shown to be powerful proxy indicators for predicting or assessing the nutritional status of deprived mothers and children (Gopaldas et al, 1991). Generally, the list of socio-economic variables on which information is to be collected in the community or population group surveys ranges from a long list covering income, land holdings, expenditure on food, caste, religion, education, level of indebtedness, access to primary health care, clean water, safe sanitation and so on (Gopaldas et al,1988) to much shorter lists. In the present study, the socio-economic variables covered education, income, type of respondents house, source of drinking water, and toilet facilities. Information was collected on a structured proforma.

Quality of Life Index

There have been a few attempts to arrive at a composite score to assess the Quality of Life Index of various disadvantaged populations. The indicators used for assessing QLI by four groups of investigators are summarized below :

TABLE 4

Various indicators used for assessment of Quality of Life Index

Morris and Mc Alpin (1982) Physical Quality of Life Index to assess overall development	UNICEF (1989) Physical Quality of LIfe Index to assess 'Underfive Development'	UNDP (1991) To evaluate human Development	Present study (1991) Quality of Life Index to assess physical well being of plantation workers
1) Infant mortality 2) Life expectancy (at age one) 3) Basic literacy	1) The Mortality Rate of children under five 2) Life expectancy 3) Access to safe water 4) Literacy rate particularly among women 5) The proportion of children suffering from malnutrition	1) National income 2) Adult literacy 3) Life expectancy 4) Adult literacy with mean years of schooling	1) Education 2) Income 3) Housing 4) Water source 5) Sanitation

Morris and McAlpin (1982), using a set of three indicators, namely, Infant Morality, Life expectancy at the age of one, and Basic literacy, were able to cogently demonstrate, using India as their case study the notable and measurable differences in the Physical Quality of Life Index between Urban and Rural populations; between the various States of India; and between male and female populations in urban and rural India using the same methodology and the same set of easily available indicators from secondary data sources. UNICEF (1989) was interested in measuring progress and development particularly in the young child population by focussing more on the 'under fives'(U5MR).It was further pointed out that though Gross National Product (GNP) was a valuable indicator of a country's total economic production, it could not and did not reflect the true QLI of the country or population group being measured. In order to obtain a more reliable indication of Physical Quality of Life Index , the list of indicators were made longer and more specific by UNICEF. The information to be collected, however, was also more difficult to collect on a country to country basis.

In 1991, UNDP has proposed a slightly different set of indicators to assess Human Development. These were National Income, Adult Literacy, Life Expectancy and Adult Literacy with mean years of schooling. It emerges that the choice of indicators is of prime importance in relation to what type of development or progress is to be measured, namely, overall development, 'Under 5s' development or human development.

In the case of large groups of organized labour, especially those on plantations such as tea, coffee, rubber etc where the employer or management provides certain mandatory facilities to its working force such as housing, water, and sanitation - these provisions will naturally become important indicators to evaluate the QLI of the labour force in question. Consequently, we have evolved a QLI consisting of education, income, housing, water facility and sanitation. This is described in greater detail below.

The score alloted to each variable was similar without any weightage accorded to it and is elaborated as under:

Education	: 1.5	- Illiterate
	3	- Can read only
	4.5	- Can read and write
	6	- Primary pass
	7.5	- Upto middle school
Income	: 1.5	- less than Rs.300/pm
	3	- 300-450/pm
	4.5	- 450-600/pm
	6	- 600-750/pm
	7.5	- above 750/pm
Type of respondent's house	: 1.5	- Hut
	3	- Kutcha
	4.5	- Semi-pukka
	6	- Pukka
Source of drinking water	: 1.5	- Unsafe (tank, well)
	3	- Safe (Tap)
Toilet facilities used	: 1.5	- Open air
	3	- Non sanitary toilet
	4.5	- Sanitary toilet

In this manner, the highest score that a worker could obtain was 28.5 and the lowest was 7.5.

The scores were converted to percentages and the respondents were classified into various grades of Quality of Life as indicated below :

Score		Percentage	Quality of Life
28.5 - 22.8	=	80-100%	Very good
22.7 - 17.1	=	60-79%	Good
17.0 - 11.4	=	40-59%	Fair
< 11.3	=	< 40%	Poor

II. NUTRITIONAL ANTHROPOMETRY

Nutritional anthropometry is concerned with the measurement of the variation of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition. The physical dimensions of the body are much influenced by nutrition. Selected body measurements can therefore provide valuable information concerning certain types of malnutrition in which body size and gross body composition are affected (Jelliffe 1966). Physical measurements when properly taken provide an inexpensive non invasive means of assessing and tracking nutritional status of individuals (Mathews, 1985).

Nutrition surveys and community based studies in developing countries usually approach the field assessment of body composition by anthropometry (Martorell et al, 1976; Bonterline et al, 1973; Frishanco and Gara, 1971; Dugdale, et al, 1970; Gurney 1969). Shimazona (1972) stated that anthropometric measurements are sensitive indicators of nutritional status.

Further, anthropometric measurements either alone or in combination are the most frequently used methods of assessing nutritional status for easy and accurate results (Dibley et al, 1987; Agarwal 1987; Sridharan et al, 1987; Kanawati, 1976).

Nutritional status usually cannot be determined from a single measurement. Determining the direction of change may be critical to correctly assessing the baseline nutritional status

Plate 1:
Weighing a subject on Krup's adult platform balance.

Plate 2:
Haemoglobin estimation by Cyanmethaemoglobin method.

of an individual. This can be illustrated by use of the anthropometric measurements of weight and height and their ratio to assess current and past nutritional status (Underwood, 1986; Abraham et al, 1987).

Weight

Weight is the anthropometric measurement most in use to assess malnutrition. Body weight is mainly made up of muscle, fat, bone and internal organs. In developing regions, the prevalence of malnutrition is best indicated by weight deficiency in all age groups. Weight is therefore, a key anthropometric measurement (Rao, 1987; Abraham, 1987; Underwood, 1986; Jelliffe, 1966).

Technique

The Krup's adult platform balance (Bathroom scale) was used as it is portable and convenient to use in the field. The Weighing scale was standardized against a Libra Detecto Weight cum-height meter. It was also periodically checked with a standard dead weight of 10 kg. The scale was adjusted to zero before each measurement.

The subject was asked to stand barefoot on the platform without touching anything else. All the heavy clothes/ornaments etc worn were removed before weighing. The weight was recorded to the nearest 0.5 kg (Plate 1).

Height

Height is a useful long term indicator of health as stunting occurs both in repeated diseases and PEM (Gurney, 1969; Jelliffe, 1966). The ratio of weight by height when below or above standard will reflect the positive or negative nutritional status (Underwood, 1986). The height of an individual is made up of the sum of four components : legs, pelvis, spine and skull (Jelliffe, 1966).

Technique

A non-flexible fibre glass tape was affixed to the wall so that the ground at right angle to it was smooth and even. Each subject was measured as he/she stood with head erect and heels, buttocks, upper part of back and occiput against the tape, the heels were close together with the arms hanging loosely at the side. A ruler was placed firmly on the head of the subject and the height was read off from the lower edge of the ruler. It was measured twice to the nearest 0.1 cm (Vaughan et al, 1981).

Body Mass Index - A measure of nutritional status

Body Mass Index (BMI = Weight/height^2 with weight expressed in kilograms and height in meters) is a quotient of two anthropometric parameters and is being used to assess the nutritional status of children as well as adults. BMI is an internationally accepted standard and is an objective measure of body weight in relation to height. Since it is difficult to assess the age accurately in absence of birth records, BMI which is an age-independent measure is considered more accurate than the regional standards to assess the nutritional status. This is in accordance with the previous recommendations of FAO (1987).

Waterlow's classification (1989) was employed to categorize the subjects based on their BMI. A cut-off point of BMI at 20 has been accepted as the lower limit for adults of both sexes in the developed world whereas 18.5 has been considered a reasonable lower limit for developing countries on the basis of morbidity risks. Hence, a cut-off point of equal to or above 18.5 was selected to indicate normal nutritional status while a BMI of <18.5 indicated undernourished status.

III. BIO-CHEMICAL EVALUATION

Principle

Biochemical tests are those which measure directly the supply of nutrients and indirectly the changes reflecting metabolic alterations (Arroyave, 1960). Martin (1963) opined that biochemical methods offer the most effective means for assessing the nutritional status. Biochemical data in nutritional surveys are thought to be both specific and sensitive (Shimazona, 1972). Further, they can be used either for quantitative and/or qualitative assessment or for screening purposes (Jelliffe, 1966).

Biochemical estimations of nutritional significance can be carried out on a variety of body tissues. In field surveys, tests are confined to two fairly easily obtainable body fluids namely blood and urine. However, to collect these samples in a large scale field survey is difficult (Shimazona, 1972).

The ideal criteria for biochemical tests suitable for field work stress that the tissue to be analysed should be easily collectable, stable during transport, preferably not requiring refrigeration, not affected by a recent meal or by water load and capable of providing information not already available by non biochemical techniques (Whitehead, 1963).

Haemoglobin values are of prime importance in order to supply data on nutritional status. They also conform to the criteria listed by Whitehead (1963) for a good biochemical indicator. Also, the estimation is simple and it is most feasible to obtain a quick and fairly accurate estimation of nutritional status. Further, haemoglobin estimation along with anthropometry is one of the best indicators for the assessment of nutritional status (Dibley, 1987; Agarwal, 1987; Sridharan, 1987; Vijaylakshmi & Sarla, 1987).

Thus data were collected on haemoglobin levels using the method outlined below.

(a) Haemoglobin Estimation by Cyanmethaemoglobin method (Oser, 1971)

Principle

The blood is treated with Drabkins reagent containing potassium ferricyanide, potassium cyanide and sodium bicarbonate.

The ferricyanide oxidises the haemoglobin to methaemoglobin which then reacts with cyanide to form cyanmethaemoglobin. This is a red coloured compound and absorbs light at 540 millimicrons. Haemoglobin has maximum affinity for cyanide, therefore all the three forms of haemoglobin i.e oxy-haemoglobin, sulphur-haemoglobin and Carboxy-haemoglobin are converted to cyanmethaemoglobin. Hence the total haemoglobin can be measured.

Standardisation

Different aliquots of standard cyanmethaemoglobin (from Council for Scientific and Industrial Research Centre for Biochemicals, VP Chest Institute, Delhi) of 1,2,3,4 and 5 ml were taken into 5 tubes with the concentration of Hb in the tubes as 15.5, 12.4, 9.3, 6.2, and 3.1 g/dl respectively. The volume was made upto 5 ml with Drabkins reagent. Plain Drabkins reagent served as a blank.

All the test tubes were rolled lightly between the hands and allowed to react for 10 minutes. Optical density was measured in a colorimeter at a wavelength of 540 millimicrons (Oser, 1971). The instrument was set to zero using Drabkins reagent as the blank. The optical density was plotted against the concentration to obtain a standard Hb curve (Appendix I). From the graph, a factor was calculated by dividing the concentration with the corresponding colorimetric reading. This was 34.4 in the present study.

Technique for Sample Collection and Analysis

The bulb of the finger was cleaned with an alcohol swab. It was then pricked with a sterilised lancet. The first drop of blood was discarded (as it was mixed with alcohol). Then 0.02 ml of blood was pipetted into 5 ml of Drabkins reagent (Plate 2). The blood was mixed well and allowed to react for 10 minutes. The tube was read at 540 millimicrons. The optical density obtained was multiplied by the factor (from standard curve) to obtain the Hb value in g/dl.

(b)Stool Examination for Presence/Absence of Intestinal Parasites

Principle

Examination of stool forms an important part of the diagnosis of intestinal parasitic infections and also for those helminthic parasites which localise in the biliary tract and discharge their eggs into the intestine. In protozoal infections, for example, in amoebiasis and giardiasis, either trophozoites or cystic forms may be detected in the stool, the former being found during the chronic phase. In helminthic infections, such as ascariasis, hookworm infection trichuriasis, either the adult worms or their eggs are found in the stool (Chatterjee, 1981).

The association between bacteria, virus and parasitic infection and malnutrition has been well documented and critically reviewed. In human populations, there is a synergistic interaction between nutrition, infection, and infestation and these in concert have an adverse influence on nutritional status (Jelliffe, 1966). Impaired nutrition tends to decrease resistance to parasitic infection or its consequences, parasitism in turn impairs the nutritional status of the host (Scrimshaw et al, 1968).

Nutritional impairment may result from infection with gastrointestinal parasites. These agents may interfere with the absorption of the digested dietary substances, compete with the host for essential nutrients or provoke the loss of endogenous nutrients. The high prevalence and chronicity of intestinal parasites makes them a public health problem especially in areas where malnutrition is rampant. It is therefore, interesting to study the relationship between the two and their effect on each other (Solomons and Keusch, 1981). Thus, stool examination for detecting parasites is necessary. A simple microscopic examination of stool is carried out for the diagnosis of intestinal parasites, both protozoal and helminthic. For the demonstration of trophozoites, a fresh stool sample is used and the smear is stained. In case of helminths, either the whole adult worm or segments of the worm (as in case of round worm and tape worm) can be seen with the naked eyes. In some cases, however, detection of the adult worm may be difficult but the eggs are present in all stool specimens and can be identified by microscopic examination of stool (Chatterjee, 1981).

Technique for Stool Sample Collection

Wide mouthed, labelled and stoppered plastic bottles, along with a flat spatula - like stick were provided to each subject. The subject was requested to bring a fresh sample of the stool to the health care centre. The samples were collected by the investigator from the health centre of the garden and were analysed the same day.

Technique for Stool Analysis

The stool samples were analysed in three phases :

(i) Microscopic examination of the unstained smear

(ii) Microscopic examination of the stained smear

(iii) Analysis by the concentration method.

(i) Unstained smear

This is generally employed for the identification of protozoal trophozoites or helminthic eggs or larvae.

A minute portion of the faeces was diluted with normal saline (0.9 %) and a drop was taken on a clean microscopic glass slide. A cover slip (No.1 or No.0) was then gently placed over it so as to spread out the emulsion into a thin, fairly uniform and transparent layer.

(ii) Stained smear

This is used for identifying the cystic forms of the parasites and also for the study of the nuclear characteristics for the identification of species.

For this, a drop of the stool in normal saline was taken and to it one drop of diluted Lugol's iodine (Appendix II) was added. This was covered with a cover slip. Any excess fluid was wiped away with a filter paper.

Both the stained and unstained preparations were first examined under the low power of the microscope (X10) from one end of the cover slip to the other. Any suspicious looking particles were observed under higher magnification (X40). The slides were discarded in a 5% solution of Lygol after examination.

(iii) Concentration Technique

The aim of the concentration technique is :

(a) To increase the number of cysts, trophozoites, eggs or larvae in the preparation.

(b) To eliminate most of the faecal debris.

(c) To present the organism in an unaltered state so that they may be easily identifiable.

There are two major types of concentration techniques :

(a) Floatation

(b) Sedimentation

In the floatation technique, the faecal matter is mixed in a solution of higher density than that of the eggs. The eggs, therefore, float on the superficial portion of the fluid.

In the sedimentation technique, however, the reverse occurs. The faecal matter is mixed with water or solutions of density below that of eggs. The eggs are, therefore, concentrated at the bottom. The liquid is then drained away and the eggs examined. In the present investigation, the zinc sulphate centrifugal floatation method was employed only if no cysts/trophozoites/eggs/larvae were visible in both stained and unstained smears.

Procedure

About 1 gm of faeces was placed in a test tube and 2-3 ml of zinc sulphate (specific gravity 1.180, Appendix II) was poured into it. They were mixed well with a glass rod. The tube was half filled with zinc sulphate solution and centrifuged at 3000 rpm for 10 minutes. The test tube was then filled to the brim with more zinc sulphate and a cover slip was placed over it. The cysts floating on top got adhered to the cover slip. After 15 minutes the cover slip was removed, placed on a clean slide and examined under the microscope first under low power and then under high power.

IV CLINICAL ASSESSMENT FOR SIGNS OF NUTRITIONAL DEFICIENCIES

Clinical assessment of a community can give valuable and objective information on the nutritional status of a community.

Clinical examination has always been and remains an important practical method for assessing the nutritional status of a community. The method is based on examination for changes, believed to be related to inadequate nutrition, that can be seen or felt in superficial epithelial tissues especially the skin, eyes, hair and buccal mucosa, or in organs near the surface of the body such as parotids and thyroid glands (Jelliffe, 1966).

Pearson (1966) stated that in poor health and low intake of nutrients, depletion of nutrients from the body stores occurs. As starvation progresses functional impairment occurs and finally the anatomical lesions characteristic of the clinical deficiency manifest.

Clinical examination yields good results if special attention is paid to the skin, the eyes and the mouth. Because, here one can find the most overt effects of low intake of certain nutrients. Such important findings are xeropthalmia, night blindness, cheilosis, angular stomatitis and glossitis (Krehl, 1960). FAO (1963) reported that serious shortage of nutrients may result in clinical signs of a specific deficiency disease.

Shimazona (1972) commented that clinical examination was of some value for the identification of characteristic nutritional syndromes, but it was relatively of little value in survey because the appearance of the clinical signs is too late and too non specific to be useful in the detection of mild forms of malnutrition. Sensitivity and specificity however can be obtained by systematic assessment of clinical symptoms and signs. Further to assess nutritional status of populations or individuals, assessment should include dietary, biochemical and clinical components as well (Underwood, 1986).

Justifying clinical examination as a method of assesssing nutritional status, Isaksson (1972) stated that it is not difficult to clinically recognize the undernourished subjects as

Plate 3: Clinical examination of eyes

Plate 4: Clinical examination of tongue

they are often inactive, lethargic, dehydrated with flaccid muscles, and have dry and coarse skin. Rao (1978) opined that clinical signs may vary according to geographical locations.

According to Gopaldas and Seshadri (1987), clinical assessment of a community can give valuable information to the public health worker, especially in those regions of the world where malnutrition is widespread. Clinical examination is an important practical method for assessing the nutritional status of a community. The relatively easy organization and low expense of nutritional assessment by means of clinical examination may make the method simple, easy to master for a beginner and yielding results that are easy to interpret.

In this study, the rapid clinical examination proforma (Appendix III) as outlined by Jelliffe (1966) was used for clinical assessment. A thorough systematic head to toe examination of all the subjects was carried out (Plate 3 and 4). Any unusual symptoms present in any part of the body mentioned in the proforma were recorded.

V DIET SURVEY

The nutritional status of an individual is dependent on the dietary intake of various foods and nutrients, inadquate consumption leading to malnutrition. In the evaluation of the nutritional status of a community the assessment of the dietary intake is very important. Information on dietary intake is obtained through diet surveys.

Several methods of diet survey exist,but the one most widely used is the 7 day weighment method in which actual quantities of food stuffs consumed by a family are weighed and recorded daily for a period of 7 days. This method though fairly accurate is tedious. Its significance decreases in a community of poor socio-economic status where the day-to-day variation in intake is minimal (Madhavan and Swaminathan, 1966). An alternative method is, therefore, necessary.

Young, et al (1952) compared the 24 hour recall method with a 7 day record and dietary history to assess the variations in the three methods. However, the authors concluded that the 24 hours recall would yield approximately the same mean value as the 7 day record with groups of 50 people or more.

A comparative study of the oral questionnaire method and 7 day weighment method of diet surveys was done by Pasricha (1959). The reliability of the oral questionnaire method in assessing the dietary intake of individuals was demonstrated. It was reported that the oral questionnaire technique was as good as the weighment method when applied to individuals. Burk and Pao (1976) commented that for random samples and in large scale surveys, the 24 hour dietary recall method gives high response rates, and seems to be the most reliable method. Estimated records for 1 and 3 days were considered sufficient to give reliable dietary intake. Augustin (1976) reported similar findings while studying rural families in Hyderabad. Frank et al (1977) commented that the 24 hour dietary recall method allows a small staff to collect reliable data on a large number of samples.

Gersovitz et al (1978) tested the validity of 24 hour dietary recall and 7 day dietary record by comparing reported intake with unobstrusively obtained observations on actual intake. Paired 't' test results for both the 24 h dietary recall and 7 day dietary record suggested that both methods provide about equally accurate estimates of mean intake.

Hunt et al.(1979) tested the validity of 24 hours dietary recall by comparing it with the computerized food frequency questionnaire in the same subjects. The two methods produced similar mean estimates of nutrient intake. In rural children (5-15 yrs) Rasanen (1979) reported that besides being economical and easy, the observation-interview method was preferable for food consumption surveys and gave highly repeatable results for group consumption.

Karvetti et al (1985) studied the validity of 24 hour dietary recall with a comparison of recalled and observed food and nutrient intake. The study revealed that women had more accurate results than men and the results of the recall method in those of 35 to 44 yrs old were the most accurate.

Sevenhuysen et al (1989) in a recent study proposed a photographic procedure for the measurement of individual food consumption. The food amounts recorded photographically at the three times of eating were compared with amounts obtained from recall interview 24 hour after the lunch. They suggested that there was a significantly lower error in the recall method than the actual, whereas the photographic method comes to near about the actual. They suggested that in field studies the photographic method is less suitable than the 24 hour dietary recall method. The photographic method is very costly too. Keeping the above points in mind the present study decided to use 24 hour observation interview method as outlined by Rassanen (1979) to assess the food and nutrient intake of the workers.

All the foods generally consumed by the tea plantation labourers were standardized in the laboratory using standard cups, plates, glasses, bowls and spoons (Appendix IV). The same utensils were used for the survey.

Each worker or the wife/mother/mother-in-law was explained the purpose of the study and she was requested to carefully observe what her husband /son/daughter-in-law/herself, who was a subject of the study, ate for the subsequent 24 hours. To begin with, there was a general discussion of the number and type of meals consumed the previous day. Then each meal was discussed chronologically from first to last. All raw and cooked foods were recorded meal by meal (Plate 5 and 6). The wife/mother/mother-in-law/woman worker was asked to indicate the quantity of each raw ingredient which was used for a particular dish as well as the final amount of the cooked dish, using her own household measures. These were converted to standard measures by using standard cups, bowls and spoons. Then the

Plate 5: Weighment of raw food materials

Plate 6: Weighment of cooked food

amount of each dish consumed by the target labourer was recorded on a standard proforma (Appendix V) developed by National Institute of Nutrition, Hyderabad. From this the amount of raw food consumed by each worker was calculated. Thereafter, the nutrient intake of the worker was determined from the food composition tables (Gopalan, et al 1989).

VI MORBIDITY STATUS

Morbidity or a diseased state is defined as a condition in which bodily health is seriously attacked, deranged or impaired, a departure from a positive state of health, or an alteration of the human body interrupting the performance of vital functions (Park and Park, 1977).

Prevalence of certain chronic conditions such as malaria, tuberculosis, cardio-vascular diseases, gastrointestinal and renal diseases, influenza and bronchitis were recorded on a pretested proforma. Data were also obtained on any short term morbidity/ill-health like fever, diarrhoea, vomiting which had occured in the preceeding two months from the day of the interview. This was reconfirmed with records at the health care centre of the garden.

E. COMPUTERIZATION OF DATA

An IBM - PC/XT compatible system was used for data entry, statistical analysis and tabulation of data.

Special purpose software was developed to provide data entry forms very similar to the survey schedules. These forms were displayed on the visual display unit attached to the computer system for the purpose of data entry. Data were entered and verified. The software also provided online assistance for developing the code list as well as encoding the data. The data were coded for easy entry in the computer. The package used for analysis was SPSS.

F. STATISTICAL ANALYSIS

(i) Means, standard deviations (SD) and standard errors (SE) were calculated for all the quantitative parameters.

(ii) Percentage prevalence was calculated for qualitative parameters like clinical signs etc.

(iii) Student's 't' test was applied while making comparisons of quantitative parameters.

(iv) Analysis of variance was used to make within and between group comparisons of various quantitative parameters.

(v) Chi-square test was employed to determine the relationship between all the qualitative parameters.

(vi) Analysis of multiple regression was carried out to predict the relative influence of variables under study on the nutritional status, and

(vii) Analysis of co-variance was carried out wherever appropriate.

Levels of significance selected were:

($P < 0.05$) Significant *

($P < 0.01$) Highly significant **

($P < 0.001$) Very highly significant ***

Formulae used were from Snedecor and Cochran (1967).