ANTHROPOMETRIC MEASUREMENTS OF INFANTS BELOW ONE YEAR OF AGE

by

Janaki Narayanaswami

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

April, 1974

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

The investigator expresses her sincere thanks to Mrs. R. Vijayalakshmi, B., M.Sc., Lecturer in Foods and Nutrition, Sri Avinashilingam Home Science College for Women, Coimbatore who, through her untiring guidance and help made the completion of this study possible.

The investigator wishes to record her deep sense of gratitude and indebtedness to Dr.(Mrs.) Rajammal P. Devadas, M.A., M.Sc., Ph.D.(Ohio State), Director and Principal, Sri Avinashilingam Home Science College for Women, Coimbatore, for her valuable suggestions, able guidance and untiring help towards the conduction of this study.

Heartfelt thanks are due to the Administrators and staff of the Municipal Maternity Centres, The Medical College Hospital and the Kuppuswami Naidu Memorial Hospital, Coimbatore for their active cooperation in conducting the study.

Finally the investigator expresses her appreciation to the 2039 infants and their parents who participated in this study without whom the study could not have been conducted.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

I. INTRODUCTION

Nutrition is fundamental to human development and influences it throughout the life span. It has far reaching effects on the physical, intellectual, emotional, psychological and social development of individuals (WHO, 1972, Ghai, 1973). Hence national efforts to improve the quality of human life must aim at reducing the alarmingly high death rates, hunger and malnutrition. The staggering dimensions of these maladies have led to widespread suffering and tragic loss of human potential (Berg, 1970). Malnutrition, - a proven killer of children, can wreak havoc with a country's growth potential. The resources that have gone into them is wasted, for malnourished children will not make any contribution to the society (Boerma, 1971).

Meeting adequately the nutritional requirements of infants is very important because infancy is a period of rapid growth and development. During the first year of life the baby must gain considerably in weight and length, the teeth must be cut, and bones mineralised and certain systems of the body must complete their growth, Miladi (1971) and Devadas (1972).

Various studies (Gopalan 1971, Devadas 1972) conducted in India reveal that the infants are malnourished and a high percentage of them succumb to death in the first few years of life. Infants who do survive malnutrition bear subtle mental and physical scars of malnutrition. For, a child's entire life is determined to a great extent by the food provided by his mother in the first few years of life. Serious dietary deficiencies in this period will damage his health, inhibit his growth and rob him of the chance to attain full physical development (Bengoa,1973). Hence investment in human resources development will prove a waste, if the foundation is neglected or wrongly laid.

Wholly preventable deficiency diseases are injuring infants, killing children and aging adults long before their time. Hundreds of millions of individual human lives with all their inherent potential are being threatened, narrowed, eroded and shortened, and finally terminated by malnutrition that degrades and destroys all that it touches (MacNamara 1973).

A beginning must be made to eradicate malnutrition. It is heartening to note that the Government of India has taken and is taking important measures in alleviating malnutrition. For these efforts to be successful, it is essential to find out the exact situation in a community

with regards to the nutritional status and the health of the people.

Surveillance of nutritional health in the young can be undertaken by means of dietary surveys, clinical signs, biochemical tests and anthropometric measurements. Ideally nutritional health in early childhood needs monitoring by measurements of at least weight, height head circumference, chest circumference, arm circumference and triceps skinfold (Jelliffe, 1973). Assessment of physical growth and analysis of the growth rate of infants and children has been cited as one of the most simple, inexpensive, reliable and important tool available as an index of nutritional status, Cameron (1969), Idnares et al (1972) and Sims et al (1972).

Nutritional anthropometry is the application of body measurements for the purpose of characterising man's nutritional status, Meredith (1935), Brozek (1956), Montagu (1960) and Bhadari (1972). Studies on the growth and physical development of infants and children provide determinants of a nation's health (Indian Council of Medical Research, 1975).

Anthropometric measurements when properly made and interpreted are useful in several nutritional contexts,

such as, evaluation of caloric requirements, assessment of nutriture of individuals, description of the present nutritional status of different populations and the demonstration of improvements, resulting from better economic agricultural or dietary practices.

Measures of physical growth are used in child health to monitor growth through (1) detecting abnormalities, (2) reassuring parents about the normality of their child's growth, (3) aiding in assessing suspected abnormalities of growth and in (4) evaluating treatment of growth abnormalities or of other disorders which may have, as a side effect on acceleration or retardation of growth, (Owen, 1973).

The under previledged communities are prone to nutritional disorders, as such growth retardation is commonly observed among the children of these communities. Nutrition workers in these areas face problems in the interpretation of the findings on growth of children, because no local standards are available for comparison, (Swaminathan, 1971). While the use of Healthy American or other Western standards for comparison would facilitate international comparisons, it is essential to work out standards for each nation and community in order to decide

the growth attainable by the particular community in the light of the given genetic potentialities, (Vijayaraghavan, 1970). Therefore this investigation was undertaken with the following aims:

1. To record the anthropometric measurements of infants below oneyear - in a cross sectional sample of 2039 infants.
2. To record the anthropometric measurements of 100 infants from their 4th month onwards upto their 9th month to observe their growth trends.
3. To arrive at possible standard values of the different anthropometric measurements of infants below one year.

It is hoped that the findings of this study, although limited to a small population of 2039 plus 100 infants, will be of interest to nutritionists, in arriving at some norms for Indian infants with respect to the selected anthropometric measurements.

II. REVIEW OF LITERATURE

The review of literature pertaining to this topic is discussed under the following heads:

A. Causes of malnutrition among infants.

B. Implications of malnutrition on the growth of infants.

C. The problem of feeding infants.

D. Assessment of growth of infants.

E. Anthropometric measurements as an index of nutritional status of infants.

F. The normal growth pattern of infants.

A. Causes of Malnutrition Among Infants:

The nutritional status of communities, especially their vulnerable - young infant and child populations, is the end result of many interacting moulding forces which vary greatly from one part of the world to another (Villarjos et al 1971, Sikri, 1972). In general, because of poverty, tradition and lack of parental understanding, the quantity or quality of the food available to the child is either marginal or limiting (Begated 1972, WHO 1972, Seth 1972).

The World Health Organization (1970) states that on an average three per cent of the children under five in the low-

income countries suffer from severe malnutrition (III degree malnutrition or below 60 per cent of standard body weight for age).

Cultural factors affect the nutrition of young children. Mothers all over the world are influenced to varying degrees by the impact of new cultural moulding forces (Gokulanathan and Verghese, 1969). The first is the influence of advertising of nutritionally, economically and culturally inappropriate and unaffordable foods for young children (Jelliffe, 1971). Another cultural stream influencing mothers in feeding their infants and children is the group of unscientific irrational systems and classifications often collectively termed food faddism, (Jelliffe, 1973).

Young (1970) opines that nutrition and infection are two synergistic environmental variables. Both, in their turn, affect the dynamics of a population. Infections are an important cause of malnutrition specially when infants are poorly fed, Gravioto (1970), Mata et al (1971) and McLaren (1973). Prevention and early management of infections has a major role in preserving the nutritional health in early childhood (Jelliffe 1969).

Economic considerations operate both on family and national level. Surveys carried out in 10 states in the

United States of America, show a strong correlation between incomes and nutritional status, (U.S. Department of Health, 1971). In addition a number of children and their spacing have both economic and biological relationships with nutritional status of young children and also of their mothers, (Jelliffe, 1973).

Srikantiah and Iyengar (1972) point out a clear evidence of socio-economic gradient in birth weights of infants, in that well-to-do mothers tend to have heavier babies than poor mothers. Among other environmental factors, handfeeding (Aykroyd, 1971) and house space available (Graham 1972) appear to affect the growth of infants.

B. Implications of Malnutrition on the Growth of Infants:

Irrespective of the cause, malnutrition and undernutrition have become problems of crisis proportions in many developing countries with millions of people dying every year, (Candau, 1971) (Balasubramaniam 1971). How and how much, childhood nutritional deficiencies affect adult morphology may be a controversial question, but one is aware that growth is affected by nutritional deficiencies (Stini 1972). At any point of time, in any place in the world, the maximum number of victims of malnutrition and undernutrition is found among

infants and children, who are supposed to be nation builders of the future, (United Nations International Children's Fund, UNICEF, 1972).

Devadas (1972) points out that in Tamil Nadu alone as of 1971, there were 59.9 lakhs of children below four yearsof age, and 10.6 lakhs of children below one year of age. According to the 1971 census report, the all India figures of infants between 0-12 months of age is 169,26, 104 (lakhs)(Task Force on Nutrition, 1972). This large number constitutes about 15 per cent of the Indian population. It is a population segment which is not only unproductive but also nutritionaly vulnerable.

There is little doubt that malnutrition is the biggest single culprit in the ecology of child mortality in the developing countries, (Food and Agricultural Organisation, FAO, 1970). The proportionate mortality rates among children below four years of age in our country is as high as 40 per cent while it is less than seven per cent in the developed countries, (Gopalan and Vijayaraghavan 1971).

Surveys carried out by the National Institute of Nutrition, (NIN) in four Southern states of India show that 4.5 per cent of the infants and children in the 0-5 year age groups suffer from severe malnutrition. Apart from such

such severe cases a large number of children suffer from mild or moderate malnutrition, (Reddy 1973).

Malnutrition during the fetal period and in infancy is also associated with intellectual impairment. Although the significance is not fully understood, severely malnourished children have brains smaller than average size (Monckeberg 1969) and have been found to have 15-20 per cent fewer brain cells than well nourished children, Liang (1967), Winick (1969), McCance (1970), Rosso et al (1970), Barnes (1971), Birch (1972), Manocha (1972), Gusman & Antenga O (1972) and Dobbing (1973).

The incidence of severe forms of protein calorie malnutrition like kwashiorkor and marasmus has been estimated to be around one to two per cent of all children in the age range of 0-5 years, (Gopalan 1972). Protein calorie malnutrition is known to affect all organs of the body. In acute stages of deficiency, some organs are affected to a greated extent than others, (Srikantia 1971).

Abnormal behaviour in later years is also believed to be closely related with malnutrition in infancy (Scrimshaw 1971). Rajalakshmi and Ramakrishnan (1972) state that both animal and human studies point to the adverse effects of nutrition on both, behaviour and the biochemical, histological and electrophysiological characteristics of the brain. It is definite that malnutrition interferes with a child's ability to concentrate and to learn (Berg 1973).

C. The Problems of Feeding Infants:

A comparison of the growth of the Indian children with that of American children shows that there is a hardly any difference for the first six months but thereafter the Indian children fall away from the American standards and reach the 10th precentile below the standard weight, (Rao 1962). Children of most nationalities show the same development during the first six months. Retardation comes after that, either when the mother fails to supplement breast milk or when the child is weaned improperly (Mitchell, 1967; WHO 1972).

Recent investigations have demonstrated beyond any doubt that human milk has unique properties not possessed by the milk of any other mammals. The hypothesis that follows is that, "human milk is for babies and cow's milk is for calves", (Gellis 1972) and that cow's milk formulas are at best incomplete approximate substitutes to breast milk, (Jelliffe and Jelliffe 1971). Recent trends which are away from successful location have aroused interest in the comparative merits of breast milk, cow's milk and other formula feeds, (Bornstein, 1973). Oldham (1971) warns that artificial feeding though very convenient strays away from the basic rules of infant feeding that is, sufficient nourishment and the majority of this from the breast.

Under certain conditions, artificially fed babies when compared to breast fed infants are more prone to gastroenteritis, obesity, respiratory diseases, neonatal tetany, cotdeath, infantile eczema, and may be prone to hypertension and atherosclerosis in later years. Calcium absorption is also low and chances of dehydration are more in artifically fed infants, (Oppe 1972, Taitz 1972).

The advantages that breast milk has over other types of infant food is its biochemical composition, active-anti-ineffective propertios, low cost, convenience and a hormonal contraceptive function as shown in unsupplemented lactation in Phillipines, (Del Mundo and Adiao, 1970, Jelliffe and Jelliffe 1971), Salud, 1972) and Dugdale (1971), however in a study of 250 infants in Kaulalampur belonging to the low socio-economic class, feels, no benefit was achieved by breast feeding which he feels binds the mother to the home, keeping her away from gainful employment.

D. Assessment of growth of Infants:

Assessement of the nutritional status of the community may be done through:

1. Director Assessment of human groups which includes:

   a) clinical signs, (b) biochemical tests and
   c) nutritional anthropometry.

2. Indirect assessment through consideration of health statistics

and 3. Assessment of ecological factors (Jelliffe 1968).

1. Direct Assessment:

Clinical signs and biochemical changes are of little value in most cases as they are too late, too subjective, and too variable (Jelliffe 1973). Besides facilities for clinical and laboratory investigation are usually deficient in areas where malnutrition is prevalent, (Dugdale 1971) Robson et al (1973). Assessment of nutritional status in early childhood can be attempted in various ways but most usefully by serial anthropometry, (Jelliffe, 1971, Jelliffe and Jelliffe 1969).

2. Indirect Assessment:

The classical public health index of health in early childhood is the infant mortality rate. More modern considerations on child mortality in early years of life have indicated that more information may be obtained concerning the impact of malnutrition by teasing selected age ranges, (Bengoa 1973; Jelliffe 1973).

3. Assessment of Ecological Factors:

Assessment of ecological factors includes numerous considerations such as cultural and socio-economic factors in relation to actual food consumption (Marr, 1971; Jabry 1973). This aspect is particularly difficult to investigate in early childhood, especially during the transitional or weaning period, when variable but gradually increasing quantities of foods and decreasing amounts of breast milk are taken, (Jelliffe 1973).

B. Anthropometric measurements as an Index of Nutritional Status of Infants:

Anthropometry is the technique used, to express quantitatively the form of the body. It consists primarily of the direct measurement, by means of the anthropometer, callipers, steel tape and scales, of depths, breadths, circumferences and areas including detailed measurements of the head and face, (Jelliffe 1970, Mayer 1972).

Body measurements serve as guages of growth or failure of the same as related to nutrition. They have the advantage of being objective. They need only simple and relatively cheap apparatus, (Mosier 1970). Measurements of various physical dimensions reflect the lean body mass, adipose tissue and bone structure, (W HO, 1970) and (Falkner 1972).

Weight is the best indicator for short term judgement of growth and development. It fluctuates with illness, specially the dehydration of acute diaherreheal disease, and dietary deficiencies (Gorden and Scrimshaw, 1972; Fryer et al 1972).

Height is affected in undernourished infants and children. The femur normally grows relatively faster than other parts of the skeleton. So that change in leg length or cristal height may provide a sensitive index of adequate or inadequate nutrition in young infants and children(Swaminathan 1969, Wakhlu 1972).

Measurements, of head, chest and arm circumference, calculation of various ratios including Chest/Head ratio, the weight/Height ratio and Weight/Head circumference ratio and the triceps skinfold, all form important anthropometric indices (Jelliffe, 1967; Jelliffe, 1970, Gurney 1969, Lesy, 1971, Malina 1971, Gordon and Scrimshaw 1972, Sabry, 1973).

Anthropometry may be undertaken cores sectionally and longitudinally the former by repeated studies and the latter by growth curves (Jelliffe 1970). Cross sectional studies are essential in the construction of standards while longitudinal studies are indipensable for the study of individual differences, (Tanner, 1971). Research has shown that a mixed longitudinal survey is more efficient than a cross sectional survey alone, (Mathew 1969, Tanner 1971).

It has been the practice to compare the heights and weights and other measurements of Indian children with similar data obtained in America or other advanced countries. Such a comparison has an inherent limitation, in that racial differences and genetic make up have not been taken into consideration, (Nutrition 1970). Even within India the same type of growth is not possible in all regions, (Singh et al 1969, Mohanta, 1972). Although comparisons with local, national and international standards are necessary (Arroyava et al 1970), international standards have the disadvantages that the data are derived from a heterogeneous population, (Rao 1967). Local standards are perfect for comparisons of anthropometric data in that they are genetically appropriate for that community if collected from healthy immunised individuals, (Newman 1969, Gopalan 1971).

F. Normal Growth of Infants:

"Growth" is a form of motion and is characterised by the

1. Distance achieved after a certain period of time
2. Velocity during a certain period of time
3. Acceleration or deceleration
4. Whole complex curve of growth from birth to maturity (Nutrition Review 1952).

Growth is a complex process with a wide variability in its normal manifestations, (Mehta and Betkerur, 1973). It is a successive changein the magnitude of an external physical measurement. Taken on the human velocity of rate of growth, it naturally reflects the child's nutritional status at any particular time. The oldest published record of the growth of a child was made during the years 1759-1777 by Count Philibert de Montebeillard upon his son and was published in the Histoire Natturelle, (Tanner 1969).

Scientifically growth is the natural increase in the size of cells by multiplication and theire are certain peculiarities regarding growth:

a. An impulse to grow is a biological phenomenon

b. The younger the age of the organism, the more rapid is the growth

c. Few types of cells grow throughout life and few only upto a certain age dividing the growth pattern into general, neural, genital and lymphoid

and d. Each type of growth is interrelated. Growth is affected by sex, genetics, constitution, hormones, congenital defects and last but not the least nutrition (Dutta 1969).

The general velocity curve of growth in height begins at a considerable time before birth reaching its peak by the fourth moth after conception. Growth curves also indicate that this velocity decreases from birth onwards, but this decrease is interupted shortly during adolescence with the marked acceleration in growth, (Tanner 1969).

Growth in weight of the infants follows the same general pattern as growth in length except that the peak velocity is reached much later at approximately 34-36 weeks post menstural period. There is also evidence that about 34-36 weeks onwards, the rate of growth of the foetus slows down due to the influence of the maternal uterus whose available space is by then becoming fully occupied, (Tanner 1971).

Dobbing (1971) opines that there is a transient period, a growth spurt in the development of the brain in all growing animals - in humans it is thought to occur about three quarters of the way through pregnancy and to continue during the first 18 months to 2 years of postnatal life.

The rate at which an infant will grow varies widely during early months of life depending on the nutritional status, birth weight and maturity of the baby at birth (Jackson et al 1970). By the fourth or fifth month, the birth weight is doubled and by twelve months it is tripled, at the same time its length will have increased by a half from about 50-75 cms. (Venkatachalam and Rebello 1971). In an adult man developed as rapidly in the same time would mean a weight increase from 75 to 255 kg. and an increase in height to more than 2.2 meters. With increase in age, the infant increases 200 g. per week in the first three months, 150 g.

per week during the second three months, 100 g. per week during the third quarter and 50.75 g. per week from 9 to 12 months. After one year the rate of increase in weight and height slows down (Cameron and Hofvander 1971).

III. EXPERIMENTAL PROCEDURE

The experiment was planned to have two aspects - one cross sectional and the other longitudinal.

The steps involved in these two aspects were:

A. Selection of the samples for the cross sectional and longitudinal study

B. Assessing the family background and feeding habits of the infants

C. Recording the anthropometric measurements of the infants.

A. Selection of the samples for the cross sectional and longitudinal study:

The following criteria were applied for the selection of the two types of samples:

1. Age of infants
2. Socio economic status
3. General health of infants
4. Willingness of parent

1. Age of infants:

All infants below twelve months of age were selected for the study. The age was ascertained wherever possible through birth records or by the number of teeth erupted as suggested by Jelliffe (1969).

2. Socio economic status:

Infants from the low socio economic group, that is, whose family's total income ranged from Rs. 65-200 per month were selected. Infants belonging to the same socio economic class were selected because the growth pattern in this socio economic group was to be studied.

3. General health of the infants:

Care was taken to include only healthy, normal infants in the study. Only those who had no complaints of sickness or clinical manifestations, which might affect their anthropometric measurements were included.

4. Willingness of parent:

Only infants whose parents were willing and co-operative were included in the study.

Applying the criteria mentioned above 2039 infants for the cross sectional study and 100 infants for the longitudinal study were selected from -

	Centre	No.of infants
1.	Meenakshiammal Maternity Home	25 infants
2.	R.K.Lal Maternity Centre	75 "
3.	V.V. Maternity Centre	50 "
4.	Raja Street Maternity Centre	60 "
5.	S.L. Maternity Centre	80 "
6.	Pattunulkara Maternity Centre	80 "
7.	Jail Road Maternity Centre	65 "
8.	C.T.M.O. Centre	30 "
9.	R.S. Puram Maternity Centre	70 "
10.	The Coimbatore Medical College Hospital, Children's Out Patient Department, Coimbatore	1254 "
11.	Kuppuswami Naidu Memorial Hospital for Women and Children, Children's out patient Department, Coimbatore	250 "

The centres 1-9 were under the jurisdiction of the Coimbatore Municipality and 10 and 11 were hospitals. Permission was obtained from the concerned authorities to conduct the study.

Table I gives the age and sex details of the infants in the cross sectional study.

TABLE I

AGE AND SEX DETAILS OF 2039 INFANTS - CROSS SECTIONAL STUDY

Sex	New born	N on the 1	2	3	4	5	6	7	8	9	10	11	12	Total
Males	214	50	50	51	60	67	70	81	70	78	132	52	78	1053
Females	201	50	50	54	51	69	92	53	79	79	86	52	70	986
Total	415	100	100	105	111	136	162	124	148	157	218	104	148	2039

In addition 100 infants for longitudinal study were selected from among the four month old infants available at the following centres:

	Centre	No. of infants
1.	S.L. Maternity Centre	40 infants
2.	Pattunulkara Maternity Centre	32 infants
3.	Jail Road Centre	16 infants
4.	V.V.M. Centre	12 infants

All 100 infants, 48 males and 52 femaleswere four months old at the beginning of the study period and were nine months old at the end of the study.

The selection of these infants were based on their regularity in attendance to receive the milk supplied in the municipal maternity centres and the willingness of the parents to be present regularly during the study.

B. Assessing the family background and feeding habits of the infants:

A questionnaire was formed which elicited information on the size of the family, income, parity of the infant, details about breast feeding, artificial feedings, supplementary feeds, and illness suffered by the infant. The questionnaire was so prepared as to fulfil the requisities of a good questionnaire according to Amerine et al (1965).

Thus the questions were realistic, free from ambiguity, appropriate in terminology and above all with no room for projection ofopinions, as could be seen in Appendix I.

C. Recording the anthropometric measurements of the infants:

The following anthropometric measurements were recorded on the cross-sectional as well as longitudinal study groups for arriving at the possible growth charts of Coimbatore infants and for comparison with the All India (1971), values.

1. Body weight
2. Body length or height
3. Head circumference
4. Chest circumference
5. Arm circumference
6. Skinfold measurements

Care was taken to see that all the anthropometric measurements were recorded at regular intervals of one month ($\pm$2 days).

All the recording of measurements was conducted early in the morning as weights are best recorded in the post-absorptive state and with minimum clothing as suggested by Jelliffe (1966) and the working hours of the centres were also mainly concentrated to the early morning hours.

1. Body weight:

Body weight was recorded accurately using a "Detecto Beam Balance". Measurement of weight was made with minimum clothing as suggested by Pachuria and Marwah (1970). While the younger infants were weighed in a recumbent position, the infants who could sit up were allowed to sit up on the balance and their weight recorded to the nearest 10 grams. The infants were encouraged to empty their bowel and bladder whenever possible, before recording the weights.

2. Body length or height:

Recumbent length of the infant was taken using an infantometer to the nearest millimetre. Satisfactory measurements of body length require the availability of two investigators, one holds the infant's head with 'Frankfurt plane'(This plane is defined by a line joining the left tragion and the lowest point of the inferior margin of the left orbit and is equivalent to the 'Line of Sight') vertica and applies gentle traction to bring the top of his head into contact with the fixed head board. The second person holds the infants legs straight, toes pointing directly upwards and also applying gentle traction brings the movable foot board to rest firmly

against the infant's heel, American Academy of Pediatrics, (1975), as shown in Figure 1.

3. Head circumference:

Head circumference was measured using a soft tape applied firmly around the head above the supraorbital ridges or the most prominent part of the frontal bulge anteriorly and over that part of the occiput which gives maximum frontal occipital circumference as per the recommendations of the American Academy of Pediatrics, (1975).

4. Chest circumference:

The chest circumference was recorded with a soft tape with the infant lying in the supine position. The recording was taken at the level of the nipples midway between inspiration and expiration as suggested by Pachauria and Marwah (1970).

5. Arm circumference:

The arm circumference was recorded by determining the mid point of the upper arm and measuring the circumference of the arm at the mid point with a soft tape (that is, midway between the acromial and olecranon process with the arm hanging freely relaxed, Malina, 1972).

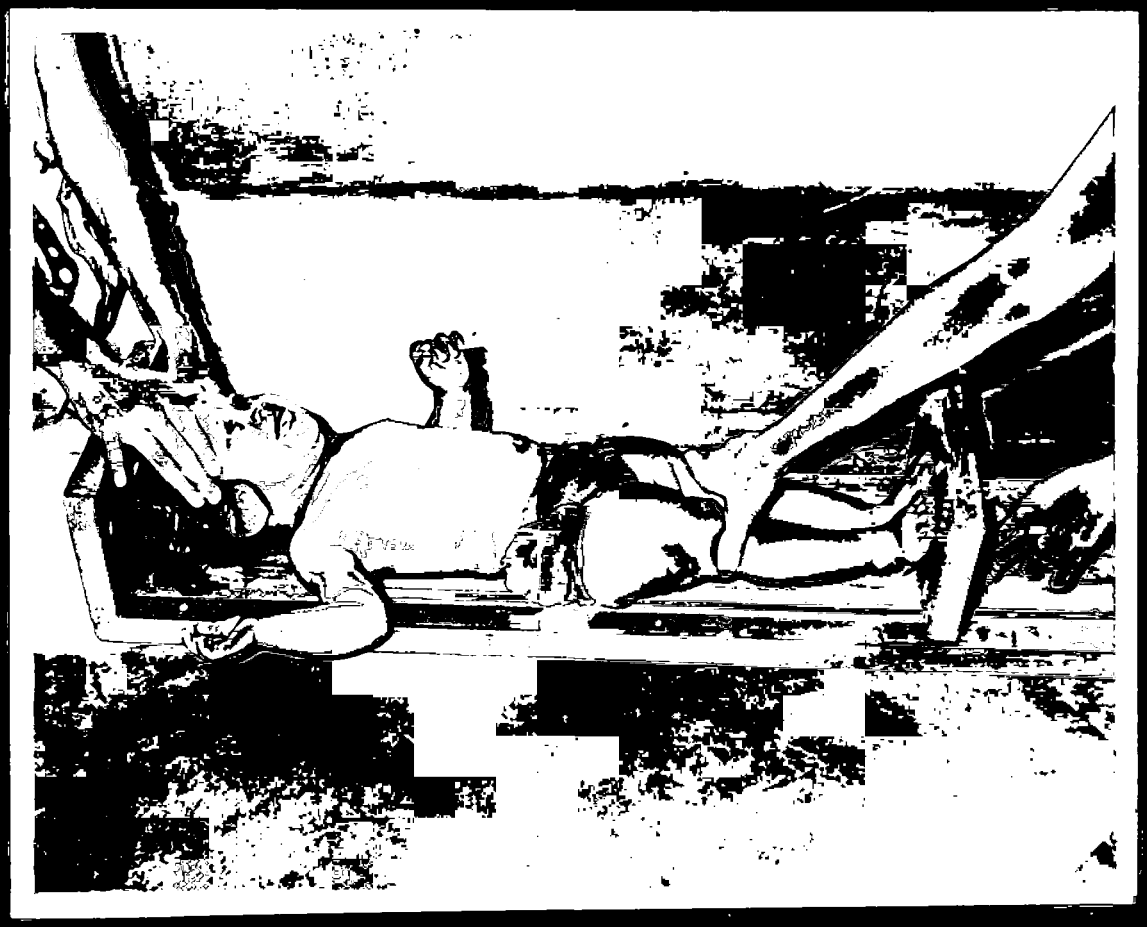

FIGURE - 1 MEASUREMENT OF LENGTH WITH INFANTOMETER.

6. Skinfold Measurements:

Skinfold measurements were recorded only for the 100 infants in the longitudinal study group, with a skinfold calipers (Harpenden type). This measurement was recorded when the infants crossed their sixth month. The technique used in making the measurementswere in accordance with the recommendations made by Myers (1973).

The collected data was treated separately for boys and girls. The mean anthropometric measurements along with the standard deviations and the 10th, 50th and 90th percentiles were calculated for the cross sectional as well as the longitudinal study groups. A growth chart was then arrived atwith these data.

It was compared with the available charts, that is, ICMR, West Bengal and also the Boston standards.

A comparison of the impact of breast feeding and combination feeding on the growth of infants were made by 't' ratio test. The pos ible role of parity in determining the heights and weightsof the infants was also studied by applying 'F ratio test'.

The Weight/Height ratio and the Chest/Head ratio were computed and compared with similar ratios obtained by ICMR, the correlation between heights and weightswas worked out and the correlation existing between them established.

IV. RESULTS AND DISCUSSION

The data pertaining to this study are discussed under the following heads.

A. Occupation of the heads of the families, and incomes.

B. Anthropometric measurements of the infants.

1. Mean height
2. Mean weight
3. Mean head circumference
4. Mean chest circumference
5. Mean arm circumference

C. Heights and weights of infants as affected by income of the family

D. Heights and weights of infants as affected by parity and sexes of infants

E. Heights and weights of breast fed and combination fed infants.

F. Weight Height Ratio and Chest/Head ratio of the infants.

G. Anthropometric measurements of the infants in the longitudinal study.

A. Occupation of the heads of the families and income:

Table II gives the details of the occupation and income of the families.

The monthly incomes of the 2039 families ranged from Rs. 65 to 200 per month. As such all the infants in the present study are from the lower economic strata.

TABLE II

OCCUPATION AND INCOME OF THE FAMILIES

S.No.	Occupation	Number of families
1.	Coolie	1200
2.	Small traders	238
3.	White collar and desk workers	225
4.	Mechanics	200
5.	Agricultural labourer	75
6.	Traditional crafts	75
7.	Others	26
	Total	2039

A majority of the parents were coolies. 'Coolie' indicates all those who earn their wages on a daily basis and includes masons, woodcutters, porters and the like. 'White collar and desk workers include those in clerical positions. Traditional crafts include such occupations like goldsmiths, weavers, basket makers and the like.

B. Anthropometric measurements of the infants:

1. Mean heights:

Table III presents the mean heights of infant boys and girls - in the cross-sectional study, age wise. (Appendix II).

TABLE III

MEAN HEIGHTS OF INFANT BOYS AND GIRLS OF THE CROSS SECTIONAL STUDY

Age in months	Mean height (cm)					
	Boys	Standard Deviation	All India values (1971)	Girls	Standard Deviation	All India values (1971)
New born	49.03	± 0.56	—	48.91	±2.38	—
1	52.60	± 5.38	—	52.20	±5.07	—
2	57.10	± 6.02	56.2	55.60	±3.53	55.0
3	60.66	± 1.36	—	57.12	±5.42	—
4	61.40	± 1.27	—	60.29	±3.84	—
5	64.59	± 4.05	62.7	61.35	±3.84	60.9
6	65.21	± 4.41	—	64.25	±4.17	—
7	65.80	± 2.96	—	64.84	±3.84	—
8	68.22	± 3.08	64.9	65.00	±4.07	64.4
9	69.08	± 3.89	—	68.16	±4.69	—
10	69.75	± 3.92	—	68.61	±4.69	—
11	71.00	± 4.16	69.5	69.24	±2.94	66.7
12	71.20	± 3.16	73.9	69.30	±3.47	72.5

The mean height of the infant boys ranged from 49.03 cm for the newborn to 71.00 cm for the 12 month olds, increasing nearly by half the birth length during the 12 months. About 22 cm have been added to the birth length in the first year of life of the infant boys. With regard to the infant girls, the corresponding increase was 20.39 cm in the first year. Somewhat similar findings have been reported by Cameron and Mofvander (1971) who recorded an increase of 25 cm in height in the first year of life for boys and girls.

A comparison of the mean heights of this study with the values available ICMR (1969) All India (1971) for the 2nd, 5th, 8th, 11th and 12th month, indicate that the mean heights of the infant boys in the study are slightly higher than the values of All India (1971) except at the 12th month, where in there is a decrease by 2.7 cm. The mean height of infant girls compare well with All India (1971) values except in the 11th month where the infants of the present study registered a height 2.5 cm. higher than the All India values and in the 12th month, a lower value by 3.2 cm. A similar study conducted by Devadas (1972) in Coimbatore indicates that the mean height of the infant boys was lower by 1.9 cm. in the present study in the 7-9 month age range, and by 0.6 cm in the 10-12 month age group. With regard to the infant girls, the mean height of the present study is in close agreement with the study is in

close agreement with the study of Devadas (1972), except at 10-12 months where in the infant girls of the present study had registered lower values by 1.8 cm. This is understandable in the light of the fact that both in the data of the ICMR and Devadas, the samples were drawn from all income levels. Where as, the sample in the present study was limited to the lowest income bracket. In general infant-boys were taller than infant-girls right from birth to the first year of life.

Figure 2 gives the percentile height distribution of the infants.

The 10th percentile of the Boston standard is clearly over the 10th and 50th percentile of the present study but the 90th percentile competes with the Boston 10th but fails to be overtaken by the 12th month.

The West Bengal average heights lie in between the 50th and 90th percentile of the present study.

2. Mean weights of infants

Table IV presents the mean weight of the infant boys and girls from birth to 12 months of age (Appendix III).

PERCENTILE DISTRIBUTION OF HEIGHTS

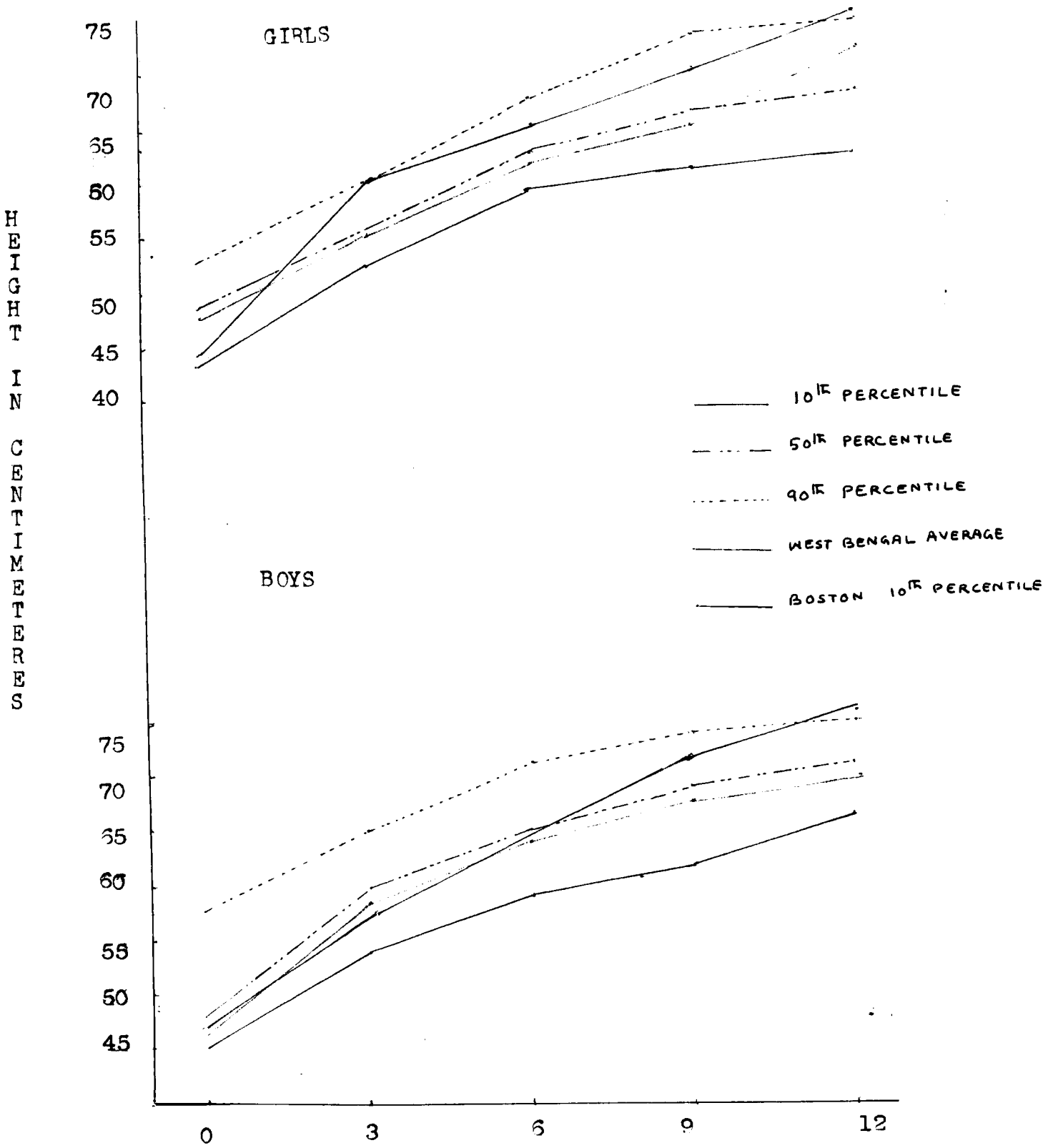

FIGURE 2

SCALE

y axis 1 cm = 5 cm

x axis 1 cm = 1 month

TABLE IV

MEAN WEIGHTS OF INFANT BOYS AND GIRLS

Age in months	Boys Weight(kg.)			Girls		
	Number	S.D.	All India	Number	S.D.	All India
New born	2.65	±0.49	-	2.65	±0.52	-
1	2.86	±1.00	-	3.32	±0.67	-
2	4.06	±3.40	4.5	4.36	±0.77	4.2
3	4.94	±1.09	-	4.40	±0.88	-
4	5.33	±1.03	-	4.90	±1.12	-
5	5.89	±0.93	6.7	5.27	±0.99	5.6
6	6.01	±1.03	-	5.73	±0.87	-
7	6.39	±0.94	-	5.96	±1.05	-
8	6.81	±0.84	6.9	6.12	±1.02	6.2
9	6.88	±0.95	-	6.48	±1.07	-
10	7.10	±1.09	-	6.58	±0.29	-
11	7.20	±1.27	7.4	6.60	±1.07	6.6
12	7.39	±1.07	8.4	6.85	±1.09	7.8

The mean weight increase of infant boys for 12 months is 4.7 kg., with a double fold increase even by the fourth month and three fold increase by the 12th month. These are in agreement with the views of Venkatachalam and Rebello (1971) and Cameron and Hofvander (1971).

The mean weight of infant boys in the present study was slightly lower than the All India values, the difference ranging from 0.09 to 1.1 kg. In the case of infant girls the values compared well with the 2nd, 8th, 9th and 11th month olds while for the 5th and 12th months a decrease of 0.4 and 1 kg. respectively were noticed. Also the infant girls could register a double fold increase in the mean weight only by the 5th month and did not triple at the end of one year.

Acomparison of the present study with that of Devadas (1972) reveals that the values of the present study were lower, the difference varying from 0.47-1.15 kg with respect to both infant boys and girls. This difference may be due to the fact that the present study was limited to lower socio-economic status while the afore said included both high and low socio-economic status. The general trend is that the infant boys are heavier than infant girls. Figure 3 shows the percentile chart of weights of infant boys and girls in the present study. The Boston 10th percentile is not consistently higher than the 90th percentile of the study in both the boys and girls, but finally overtakes it. The 90th percentile of the West Bengal study registered similar values as the present study but overtakes it in the 12th month.

__ PERCENTILE DISTRIBUTION OF WEIGHTS

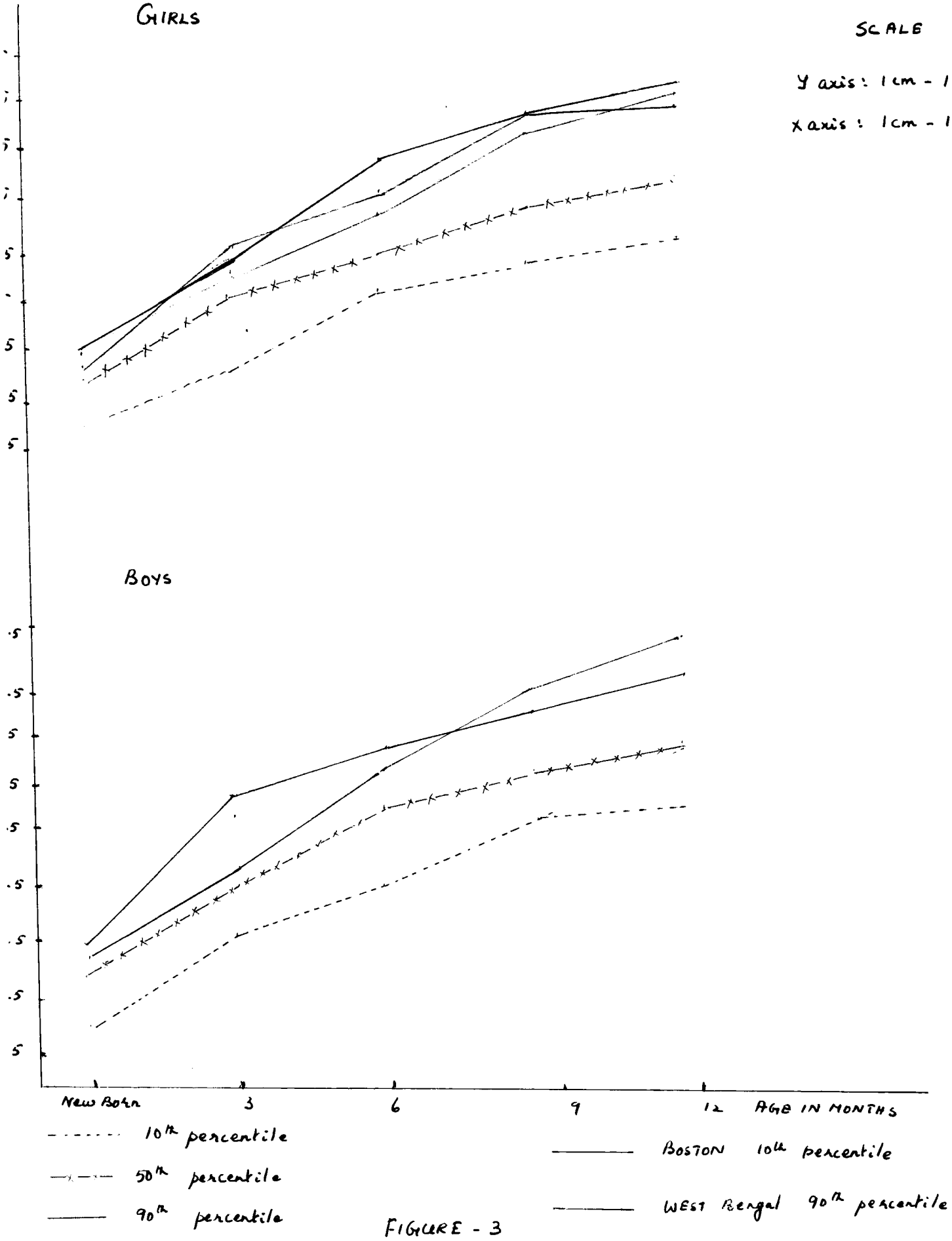

FIGURE - 3

3. Head circumference:

Table V presents the mean head circumferences of the infant boys and girls from birth to 12 months (Appendix IV).

TABLE V

MEAN HEAD CIRCUMFERENCE OF INFANT BOYS AND GIRLS

Age in months	Mean head Circumference in cm.					
	Boys	S.D.	All India Values	Girls	S.D.	All India Values
New born	33.70	2.69 ±	-	33.09	1.95 ±	-
1	36.40	2.69 ±	-	34.78	2.12 ±	-
2	38.00	2.82 ±	38.6	36.40	2.20 ±	37.7
3	38.80	2.59 ±	-	37.08	2.51 ±	-
4	40.08	2.06 ±	-	38.88	2.55 ±	-
5	40.90	2.49 ±	41.3	40.31	2.78 ±	40.6
6	41.60	2.49 ±	-	40.31	2.79 ±	-
7	41.60	1.87 ±	-	40.81	1.36 ±	-
8	43.20	2.45 ±	42.6	41.34	2.67 ±	41.7
9	43.60	2.45 ±	-	41.69	1.72 ±	-
10	43.60	2.49 ±	-	42.30	1.56 ±	-
11	43.90	1.66 ±	43.7	42.73	2.40 ±	42.4
12	43.90	3.55 ±	44.4	43.29	3.18 ±	43.6

The mean increase in head circumference of both boys and girls was 10.2 cms over the 12 month period. The mean

PERCENTILE DISTRIBUTION AND MEAN HEAD CIRCUMFERENCE

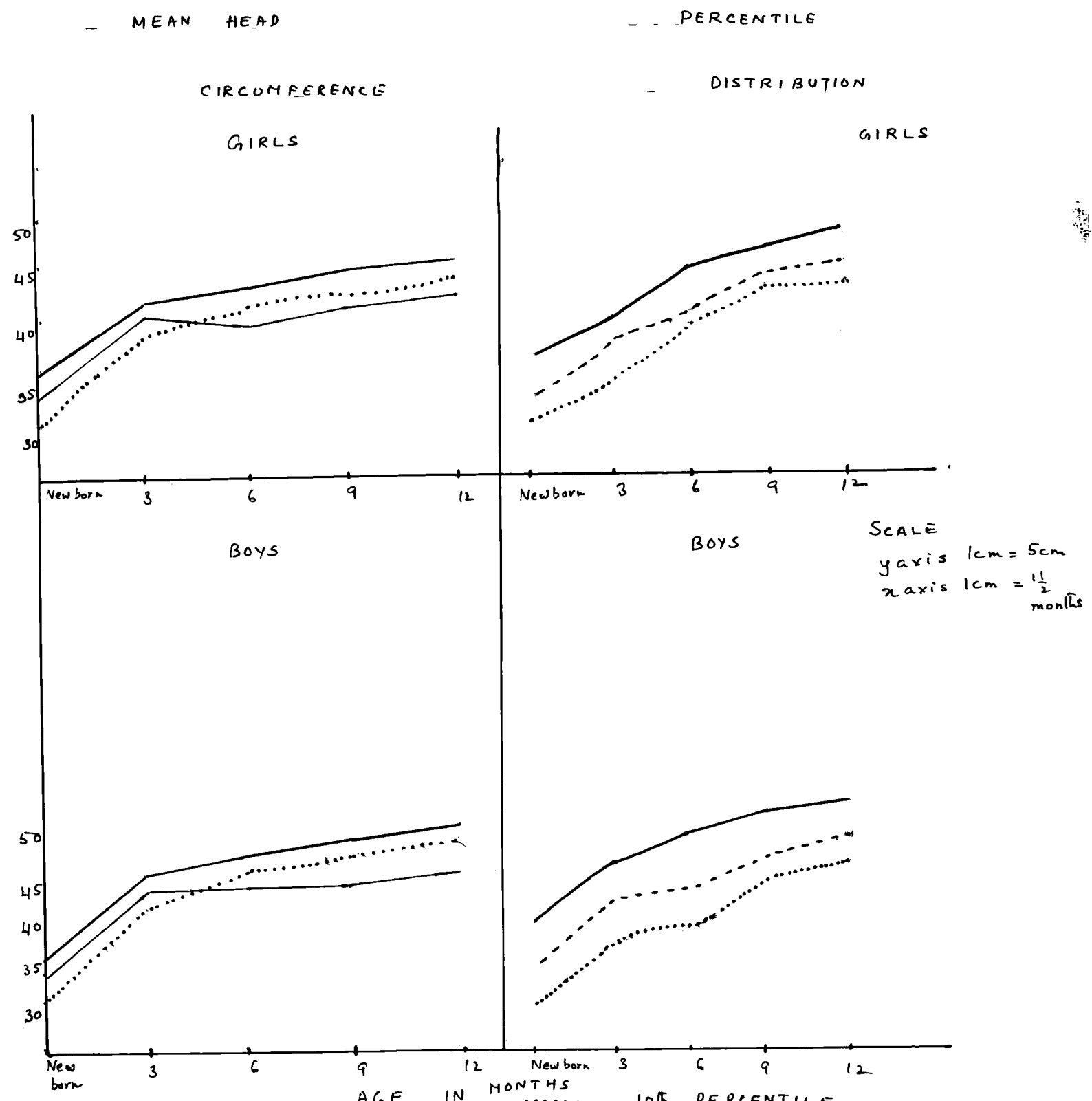

FIGURE - 4

head circumference of infant boys and girls are in close agreement with the findings of the All India studies (1971). The infant boys seemed to record a higher head circumference than their female counterparts as indicated by the Table V. Figure 4 gives the percentile chart for the head circumference of infant boys and girls. Since no percentile charts were available, comparisons could not be made . Comparison of mean head circumference with the values of obtained by Ghosh et al (1971) reveal that both for boys and girls the values of the present study are higher but, lower than American values pointed out by them.

4. Chest circumference:

Table VI records the chest circumference of infant boys and girls from birth to twelve months (Appendix V).

TABLE VI

MEAN CHEST CIRCUMFERENCE OF INFANT BOYS AND GIRLS

Age in months	Chest circumference in cm.					
	Boys Means	S.D.	All India	Girls Means	S.D.	All India
New born	32.37	±2.87	-	32.20	±2.33	-
1	35.30	±3.12	-	35.10	±2.49	-
2	37.90	±3.24	36.0	37.50	±3.75	34.7
3	39.10	±2.69	-	37.70	±3.00	-
4	40.10	±2.29	-	38.86	±2.87	-
5	41.80	±4.38	39.4	40.80	±3.25	38.0
6	42.08	±2.96	-	40.87	±2.24	-
7	42.67	±2.50	-	41.38	±2.54	-
8	43.70	±2.96	41.1	41.09	±2.67	39.5
9	43.70	±2.65	-	42.15	±3.96	-
10	43.72	±3.17	-	42.62	±2.45	-
11	44.80	±2.59	42.2	43.93	±2.91	40.5
12	44.80	±2.59	43.3	43.65	±2.93	42.3

The chest circumference of infant boys increased by 12.43 cm while the increase for girls was 11.45 cm in the first year of life.

PERCENTILE DISTRIBUTION OF CHEST CIRCUMFERENCE

10th percentile
50th percentile
90th percentile

GIRLS

SCALE

Y axis : 1 cm - 5 cms.

X axis : 1 cm - 1 month.

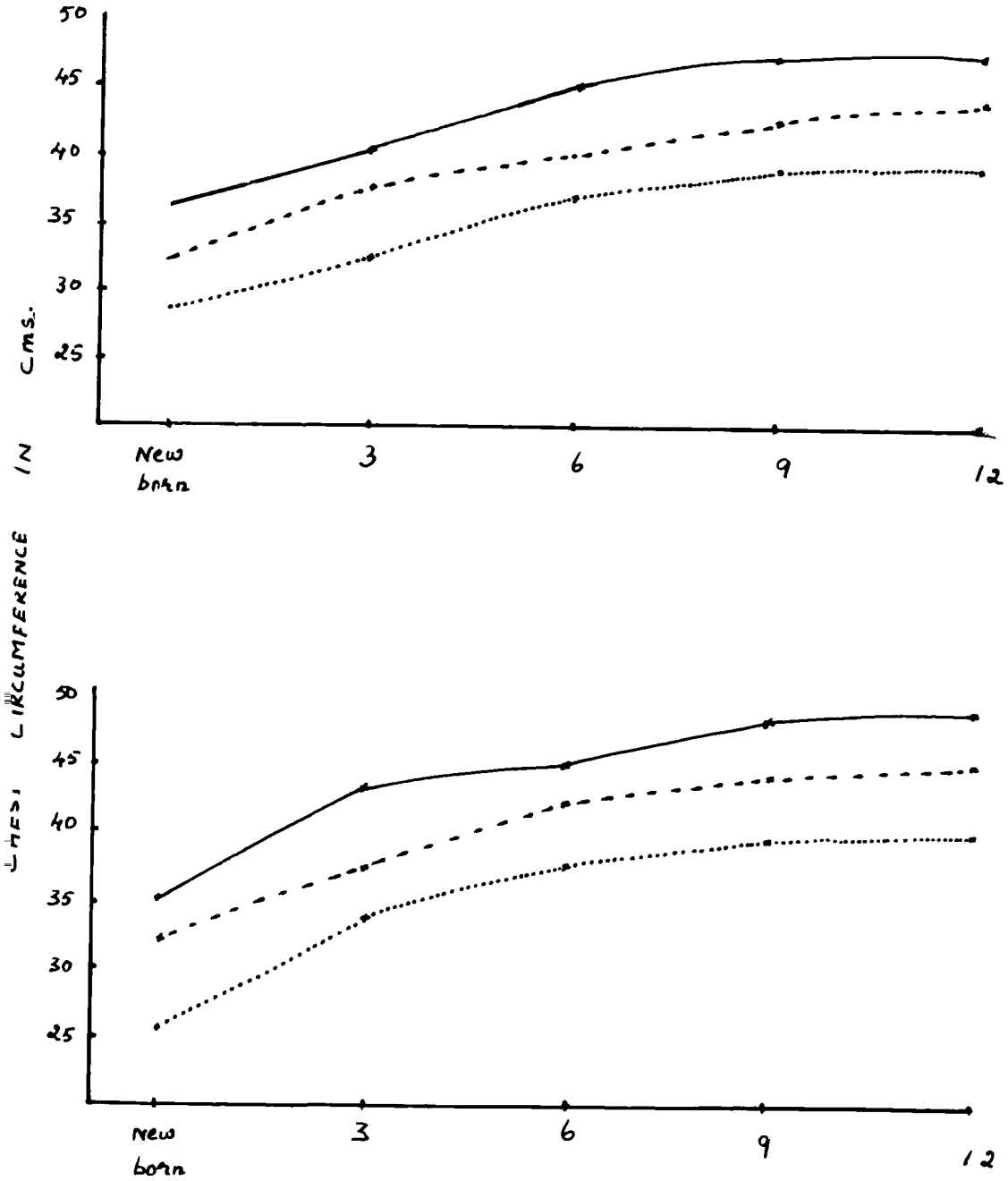

FIGURE 5

Comparison with All India values indicate that for both infant boys and girls in the present study the mean chest circumference was higher, differentranging from 0.7-2.6 cm and 1.3 - 2.8 cm respectively. Figure 5 gives a percentile chart for the chest circumference, of infant boys and girls. However no comparisons were available.

5. Arm circumference:

Table VII presents the arm circumference of the infant boys and girls of the present study (Appendix VI)

TABLE VII

MEAN ARM CIRCUMFERENCE OF INFANT BOYS AND GIRLS

Age in months	Arm Circumference (cm)			
	Boys	S.D.	Girls	S.D.
New born	9.70	±1.64	9.89	±1.48
1	10.90	±1.49	10.30	±1.78
2	11.56	±0.004	11.61	±1.37
3	12.36	±1.49	11.79	±1.55
4	12.75	±1.61	12.40	±1.56
5	12.83	±1.47	12.58	±1.80
6	12.80	±0.01	13.00	±1.52
7	13.15	±1.59	13.00	±1.58
8	13.60	±0.05	13.00	±1.48
9	13.60	±1.95	13.36	±1.47
10	13.60	±1.51	13.36	±1.49
11	13.05	±1.01	13.36	±1.48
12	13.60	±1.34	13.37	±1.38

According to Hofvander and Cameron (1971) the arm circumference at birth should be around 11 cm and about 16 cm. at the end of 12 months, with an increase of 5 cm in the first year of life. In the present study, the infants started with a lower arm circumference of 9.70 and 9.89 cm. respectively for boys and girls who could reach only 13.60 and 13.37 cm. at the end of one year of life. The increase was 3.9 and 3.48 cm. respectively, which is lower than the values recommended by Hofvander and Cameron (1971). Figure 6 gives the percentile distribution and mean arm circumference. Comparison of the mean arm circumference of the present study with two other Indian studies indicate that, the values for both boys and girls were higher in the present study as compared with studies of Manik (1970) and Gupta (1971).

C. Heights and weights as affected by income levels

As has already been stated, all the infants for the cross-sectional study were drawn from the lower socio-economic strata with their families on an income of Rs. 65-200/month. However to find out differences if any, between the heights and weights of infants and the differences in income, in terms of less than Rs. 100/month and more than Rs. 100/month, the data were analysed statistically.

Percentile Distribution of Arm Circumference and Mean Arm Circumference compared with other Indian studies.

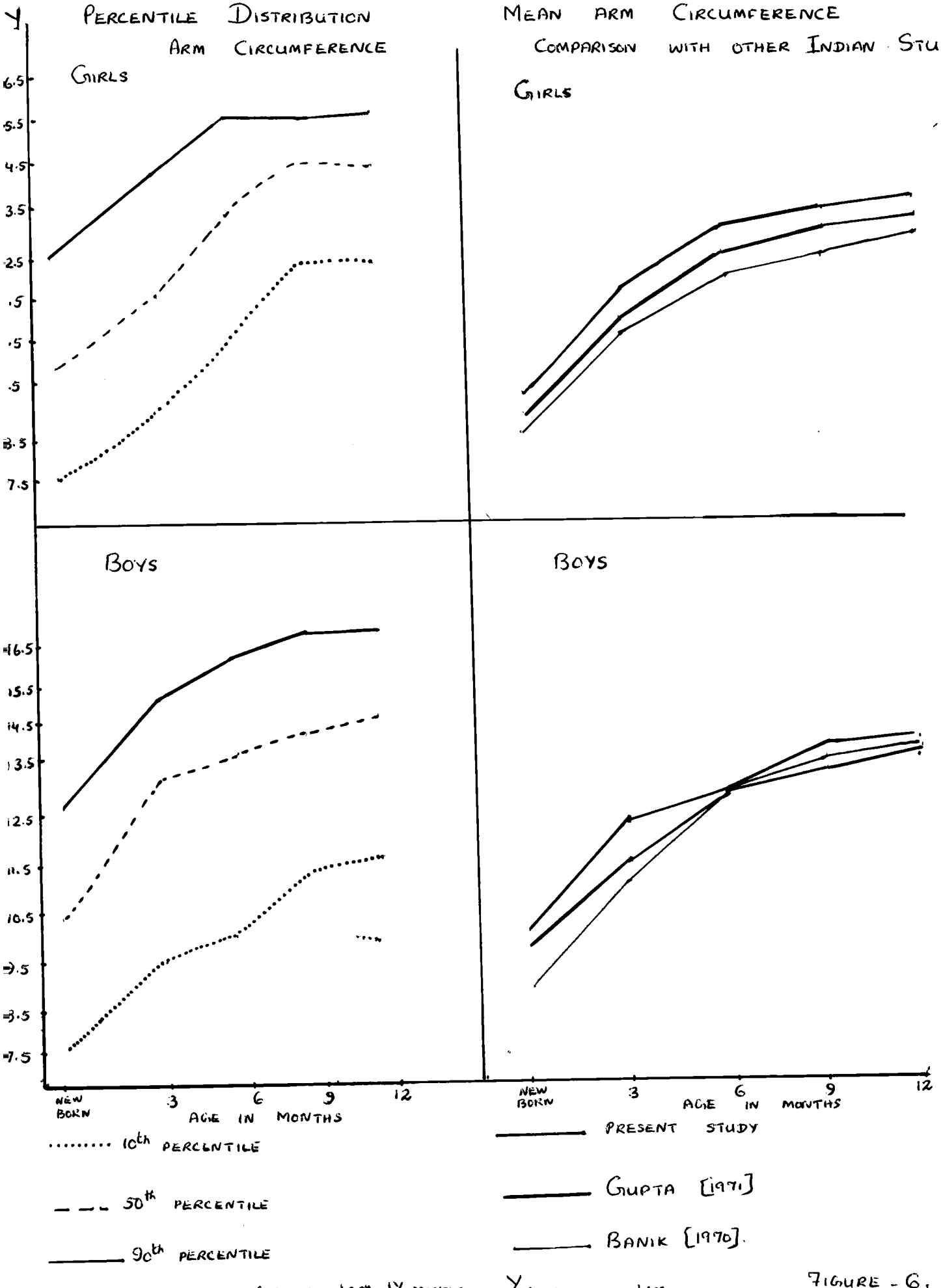

Figure - 6.

Table VIII presents the association between mean heights, weights and income levels.

TABLE VIII

ASSOCIATION BETWEEN MEAN HEIGHTS AND WEIGHTS AND INCOME LEVELS

Age	Mean height cm	S.D.	Association with income	Mean weights kg.	S.D.	Association with income
Boys						
New born	49.05	0.56	6.7*	2.65	±0.5	0.85
1-6 months	60.79	±3.7	2.06	4.67	±1.4	5.07
7-12 months	69.10	±3.5	1.26	7.2	±1.1	0.87
Girls						
New born	48.91	±2.9	0.11	2.65	±0,52	3.45
1-6 months	59.9	±4.2	2.97	4.8	±0.39	0.95
7-12 months	69.7	±4.1	0.53	6.7	±0.39	1.07

* Significant at 5 percent level

There was no association between the two groups. In other words, whether a particular family belonged to the income group of below N. 100 or above N. 100 did not make any difference with reference to the mean height and weight. This is but reasonable since the difference between the two groups in terms of income is very less(Appendix VII).

D. **Heights and weights of infants as affected by parity and sexes:**

Table IX presents the relationship between mean height and weight measurements of the infants andparity and sexes.

TABLE IX

MEAN HEIGHT AND WEIGHT AS CORRELATED WITH PARITY AND SEXES OF INFANTS

Measurements	Age in months	Variance between parity		Variance between sexes	
		Mean sum of squares	'F' Ratio	Mean sum of squares	'F' Ratio
Heights in cm	New born	0.96	1.33	1.13	1.964
	1-6	0.745	37.20	0.02	1.000
	7-12	0.11	1.00	38.5	3500.00*
Weight in kg.	New born	0.0408	100.00*	0.0004	1.00
	1-6	0.015	1.00	0.135	9.00
	7-12	0.055	1.00	1.04	19.01*

*Significant at 5 per cent level

There was no significant difference (applying 'F' test - Appendix VIII) due to parity with regard to the mean height of infants of both sexes. As for the mean weight parity seemed to influence only the birth weight of the infants. The difference was statistically significant at 5 per cent level.

The difference between the 2 sexes was also found to be statistically significant only for the 7-12 months age group at 5 per cent level for both heights and weights.

E. Heights and weights of breastfed and combination fed infants:

Table I presents the mean heights of infants breast fed and combination fed (Appendix IX).

TABLE X

THE MEAN HEIGHTS OF INFANTS AS AFFECTED BY THE TYPE OF FEEDING GIVEN

(BREAST FED VS COMBINATION FED)

Age	Heights in cms									
	Girls					Boys				
	Breast fed		Combination fed		Variance 't' value	Breast fed		Combination fed		Variance 't' value
	Mean height	S.D.	Mean height	S.D.		Mean height	S.D.	Mean height	S.D.	
1 month	51.2	± 4.09	50.75	± 6.6	0.129	55.1	± 2.65	64	± 4.98	2.77
2 month	60.0	± 1.00	64.88	± 2.39	0.87	56.40	± 5.5	58.9	± 3.30	1.08
3 month	55.35	± 12.26	64.0	± 8.4	1.0	54.65	± 4.13	56.6	± 4.85	0.58
4 month	59.28	± 2.25	59.5	± 1.22	0.19	62.05	± 4.09	62.2	± 3.74	0.05
5 month	60.5	± 3.7	62.25	± 3.50	0.77	66.5	± 4.75	64.60	± 4.73	0.59
6 month	63.44	± 2.6	65.70	± 4.54	0.99	64.64	± 1.23	65.00	± 4.52	0.38
7 month	62.25	± 4.98	64.40	± 4.31	0.39	64.80	± 3.64	65.35	± 4.61	0.19
8 month	64.59	± 2.78	64.24	± 3.02	0.17	68.00	± 4.47	71.00	± 3.35	0.74
9 month	68.75	± 9.90	68.10	± 4.20	0.16	70.1	± 3.52	68.75	± 3.92	0.50
10 month	68.63	± 5.45	68.90	± 2.95	0.12	69.61	± 3.08	69.65	± 4.28	0.04
11 month	67.85	± 3.64	69.27	± 4.31	0.50	71.75	± 3.42	70.95	± 4.37	0.25
12 month	68.60	± 1.59	69.30	± 3.5	0.40	70.75	± 3.63	71.5	± 4.45	0.24

Table X reveals the fact that although the mean height of the breast and combination-fed infants of both sexes differed (Combination-fed, being higher) the difference was not statistically significant. A higher mean height in the case of the combination fed group may be attributed to the fact that the combination fed infants have the advantage of other foods in addition to breast milk.

Table XI compares the weights of breast fed Vs combination fed infant boys and girls (Appendix X).

TABLE XI

RELATIONSHIP BETWEEN WEIGHTS OF INFANTS AND THE TYPE OF FEEDING GIVEN
(BREAST Vs COMBINATION FED)

Age	Girls					Boys				
	Breast fed		Combination fed		Variance Ratio 't' value	Breast fed		Combination fed		Variance Ratio 't' value
	Mean weight kg.	S.D.	Mean weight Kg.	S.D.		Mean weight kg.	S.D.	Mean weight kg.	S.D.	
1 month	3.30	± 0.78	3.5	± 0.5	0.4560	4.95	± 1.5	4.45	± 1.01	0.69
2 month	4.3	± 0.76	4.6	± 0.8	0.552	3.90	± 1.35	4.90	± 1.58	0.16
3 month	4.21	± 0.76	4.16	± 1.1	0.076	5.15	± 1.20	4.99	± 0.84	0.21
4 month	4.86	± 1.21	51	± 1.1	0.2851	5.15	± 4.53	5.4	± 2.17	0.18
5 month	5.87	± 0.52	5.4	± 0.8	1.586	6.50	± 0.19	6.5	± 0.33	0.00
6 month	5.78	± 0.30	5.7	± 0.27	0.013	7.15	± 3.25	6.10	± 1.72	0.85
7 month	5.5	± 0.42	6.09	± 1.03	0.957	6.00	± 0.10	6.70	± 0.90	2.55*
8 month	5.8	± 1.27	6.15	± 0.98	0.391	5.96	± 0.80	6.80	± 0.90	2.1*
9 month	6.8	± 0.32	6.45	± 0.97	0.425	6.28	± 0.70	6.79	± 1.04	0.12
10 month	6.7	± 0.86	6.55	± 1.44	0.266	6.80	± 0.90	6.71	± 1.09	0.48
11 month	6.3	± 0.70	6.6	± 1.11	0.460	7.25	± 0.74	6.97	± 4.50	0.23
12 month	6.56	± 1.3	6.99	± 0.98	0.594	7.83	± 1.15	7.40	± 1.23	0.85

Although the mean weights of breast fed and combination fed infants of both sexes differed (combination fed being higher) the difference is not statistically significant.

Table XII presents the various types of weaning foods given for the infants.

TABLE XII

TYPES OF WEANING FOODS GIVEN

S.No.	Weaning Foods	Number of infants fed
1.	Ragi Koolu	632
2.	Rice koolu	188
3.	Iddli	96
4.	Bread	80
5.	Biscuits	55
6.	Commercial Weaning foods (Farex, Nagott and like)	20
		-
	Total	1071

Table XII reveals the common foods used for weaning infants. The foods listed were used by infants in the combination fed group of 1071 infants. Ragi koolu seemed to be the most popular item of weaning.

F. Weight/Height Ratio and Chest Head Ratio of the Infants:

Table XIII presents the mean Weight/Height Ratio of infant boys and girls with the correlation between Heights and weights (Appendix XI).

TABLE XIII

MEAN WEIGHT/HEIGHT RATIO OF INFANTS

Age	Weight/ Height Ratio Boys	Coefficient of correlation 'r'	Weight/ Height ratio girls	Coefficient of Correlation Girls
New born	0.06		0.05	
1 - 6 months	0.09	+0.7805	0.06	+ 0.4082
7 -12 months	0.08		0.09	

The value of 'r' for boys was +0.7805 and in the case of girls it was +0.4802, thus indicating that there was a positive correlation between heights and weights in both sexes in agreement with the ICMR study (1972).

Table XIV gives the mean Chest/Head ratio of the infant boys and girls in the present study.

TABLE XIV

MEAN CHEST/HEAD RATIO OF INFANTS

Age	Chest/Head ratio			
	Boys	S.D.	Girls	S.D.
New born	0.87	± 0.21	0.87	±0.21
1-6 months	0.94	± 0.48	0.93	±0.48
7-12 months	1.00	± 0.21	0.98	±0.21

Table XIV indicates the Chest/Head ratio in the infants. The new born infants boys and girls had a Chest/Head ratio of 0.87. The Chest/Head ratio of 1-6 month infant boys was 0.94 and that of infant girls was 0.93. For the age group of 7-12 months, the ratio was 1.00 for boys while it was 0.98 for girls. Obviously there was a definite increase in the chest/head ratio with increase in age. The Chest/Head ratio of infant boys was slightly higher than the girls. The Chest/Head ratio in the present study correlates well with the values of Cameron and Hofvander (1971) who have expressed that the Chest/Head ratio should start exceeding one in the first year of life (Appendix XII).

Table XV presents the anthropometric measurements of the infants in the longitudinal study, over a period of six months for boys and girls (Appendix XIII and XIV).

TABLE XV

ANTHROPOMETRIC MEASUREMENTS OF THE INFANTS IN THE LONGITUDINAL STUDY

Anthropometric measurements	age of the infants in months					
	Months					
	4	5	6	7	8	9
Infant Boys:						
Length cm.	59.8	60.8	61.0	62.5	64.2	66.88
Weight kg.	4.91	5.19	5.53	5.98	6.36	6.52
Head circumference cm	38.43	38.43	38.80	40.52	43.82	45.02
Chest circumference cm.	36.83	37.10	37.10	37.10	41.0	41.4
Arm circumference cm.	13.10	13.1	13.5	13.5	1.35	13.5
Triceps skinfold mm	—	—	9.5	—	—	—
Infant Girls:						
Length in cm	59.23	60.30	60.77	62.22	62.78	63.38
Weight kg.	4.87	5.06	5.25	5.41	5.50	5.68
Head circumference cm	37.59	38.26	39.02	40.0	41.20	41.93
Chest circumference cm	36.0	36.28	39.70	40.72	40.81	41.00
Arm circumference cm	11.65	12.15	12.70	12.45	13.54	13.63
Triceps skinfold mm	—	—	9.00	—	—	—

The mean increase in the height of infant girls from the 4th to 9th month of life in the longitudinal study was found to be 4.15 cm for a period of six months, and 7.08 cm for boys. The mean weight increase for girls was 0.81 kg. and 1.61 kg. for boys.

The head circumference increased by 5 cm in the case of infant girls, and by 4.3 cm in the case of infant boys.

Arm circumference increased by 1.93 cm for girls and by 0.4 cm for boys.

The increase in height and weight over six months is illustrated in Figure 7. The increase in the mean weights of infants compares well with the recommended value of 1 kg. increase in the 4-9 months, Cameron and Hofvander (1971). The triceps skinfold recorded 9.5 mm in the case of boys and 9 mm in the case of girls which is 90 per cent standard(Jelliffe, 1966) for six months old infants.

The values obtained for the various anthropometric measurements in the longitudinal study compareswell with the values of the cross-sectional study revealing the general pattern of growth.

The mean increase per month of all the anthropometric measurementswere not uniform, since the infants in this group fell in the 4-9 month age group, when at some stage weaning

INCREASE IN HEIGHT AND WEIGHT OF INFANTS
IN THE LONGITUDINAL STUDY

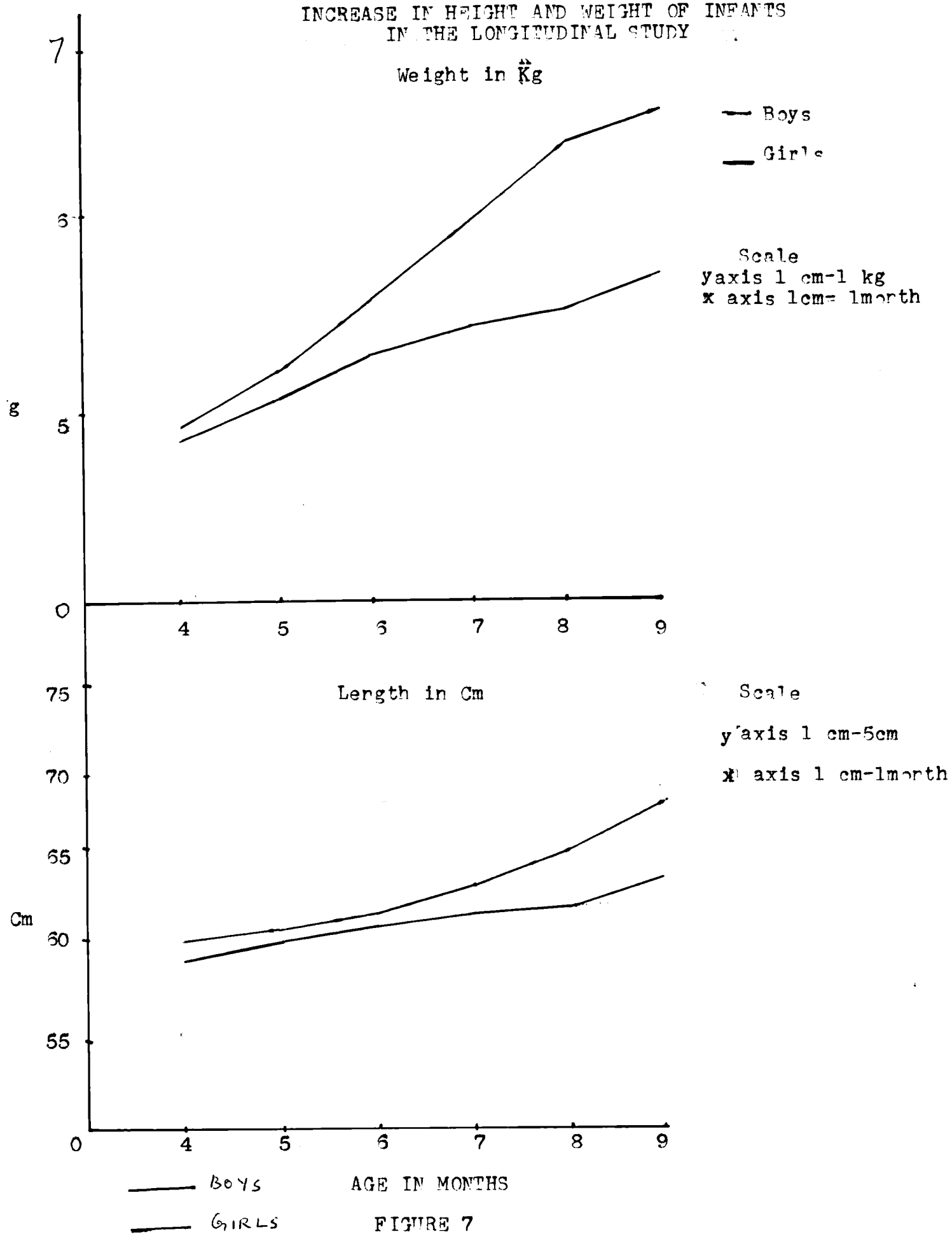

FIGURE 7

would have been instituted with the introduction of weaning foods, the adequacy or other-wise of which is not known. These transitional adjustments could be the answer for the non uniformity in the mean increases per month.

V. SUMMARY AND CONCLUSION

This study on anthropometric measurements of infants under one year of age was carried out in eight municipal maternity centres and two hospitals in Coimbatore city. Two thousand and thirty nine infantswere studied cross sectionally and 100 infants longitudinally for 6 months. The income level of the families of all the infants ranged from Rs. 65/- to Rs. 200/- per month. The whole sample was thus representing the low socio economic group.

The findings of the study are:

1. Both infant boys and girls increased their birth length by a half in the courseof the first year.

2. The infant boys and girls registered a two fold increase in weight by the 4th and 5th months respectively. A definite threefold increase in birth weight was acnieved by the infant boys in the twelve months while the infant girls, lagged slightly behind.

3. The arm circumference of the infants at the end of the 12 month period was13.6 cm. for boys and 13.37 cm for girls. Although these were low when compared with the western standards of 16 cm the arm circumference measurements compare well with those of Indian studies.

4. There was no significant difference with regard to the weights and weights of infants due to their parity, income level or type of feeding (breast feeding alone or combination feeding).

5. The combination-fed infants, who constituted about 50 per cent of the total sample were fed on ragi, ganji, rice kanji, iddli, bread or biscuits in addition to breast milk. Commercial weaning foods were not popular because of their prohibitive cost, barely one per cent of the total sample using them.

6. The mean weight and height ratio had a positive correlation indicating that weight and height correlate well with each other.

7. The Chest/Head ratio indicated that the ratio was 1.00 at the end of 12 months in the case of infant boys and 0.98 in the case of infant girls, thus conforming the Cameron and Hofvaunder's (1971) recommendation.

8. The mean increase in all the anthropometric measurements of all the infants in the longitudinal study were not very uniform, possibly due to the transitional nature of the weaning period.

9. Infant boys were heavier and taller than infant girls. They also had a higher head, chest and arm circumferences than the infant girls, which is in tune with All India (1971) standards.

On the basis of these findings, the investigator recommends that:

1. Further studies on the anthropometric measurements of infantsare to be made in different income levels to arrive at genetically suitable standards for comparison of growth.

2. Compulsory recording of weights and heights of infants be ensured by the municipality and other Governmental bodies at monthly intervals so that the growth of the infants can be monitored along the desirable channels.

BIBLIOGRAPHY

Amerine. Maynard, A. Rosemarie Pangborn, Edward, B. Roessler 1965	"Principles of ensory Evaluation of foods" Academic Press. New York p. 220.
American Association of Pediatrics, 1973	"The Assessment and Recording of Measurement of Growth of Children" A Report on a small Conference. Pediatrics. Vol.51, No.3, p. 461.
Arroyave, G., Dinning, J.S., Frank J., Gopalan, C., Hepper, A.E., Jelliffe, D.B. and Whitehead, R.G. 1970.	"Assessment of Nutritional status". American Journal of Clinical Nutrition. Vol.23, No.6, pp. 809 - 811.
Aykroyd, W.R., 1971.	"Nutrition and Mortality in Infancy andearly childhood. Past and present relationship". The American Journal of Clinical Nutrition. Vol.24, No.4 p. 481.
Balasubramanian, S.C., 1970	"Growth and development of children". Nutrition, Vol.V No.1, Oct., p.1.
Barnes, R.H., 1971	"Nutrition and Man's Intellect and Behaviour". Federation Proceedings. Vol.30, p. 1429.
Bengoa, J.M., 1972	"Nutritional significance of mortality statistics". Proceedings of 3rd Western Hemisphere Nutrition Congress Bal Habor, Florida, p. 3.
Berg Alan, 1970	Nutrition as a National Priority - Lessons from the Indian Experiment. American Journal of Clinical Nutrition. Vol.23 No.11, p. 890.
Berg, Alan 1973	"The Nutrition factor its role in National Development" Brookings Institution, pp. 9, 51, 65.

Bhandari, M.R. 1972	"Physical Dimensions and the Gross Composition of the Human Body at Different Ages and Degree of Nutrition" Indian Journal of Pediatrics. Vol.39, July, p.9.
Bhandari, M.R. and Patel, G.P., 1973	"Dietary and Feeding Habits of infants in Various Socio-Economic Groups". Indian Pediatrics. Vol.X, No.4, p. 238.
Biswas, Joyce, M.C., Mukherji & Jacob Thomas, 1969	"Height and Weight curves for Boys and Girls - Rural West Bengal". Health School Singur. Johns Hopkins University CMRT, Calcutta. 17.
Birch, Herbert, G., 1972	"Malnutrition, Learning and Intelligence". American Journal of Public Health. Vol.62 p. 755.
Boerma, A.H., 1971	Key Note Address, Proceedings of the First Asian Congress on Nutrition (1971) Edited by P.J. Tulpule, Kamala, S., and Jaya Rao, Nutrition Society of India, Hyderabad, India, pp. 5-9.
Bornstein Annika 1973	"Breast feeding in Tanzania". Nutrition Newsletter. Vol.II, No.3, p. 10.
Brozek, Josef, 1956	"Body Measurements and Human Nutrition Wayne University Press, Detriot, Michigan, p. 111.
Cameon, G.A., 1969	"The Heights and Weights of Children in Relation to Socio Economic Status". Philippine Journal of Nutrition. Vol.XXII, No.1, p. 11.
Cameron, Margaret and Yngve Hofvander 1971	"Manual on feeding Infants and Young Children". PAG of UN, New York, pp. 4,6,7, 8,9,10,11,12 & 15.
Candau, M.G., 1971	WHO Chronicle No.25, pp. 441-444.
Cravioto, J., 1970	"Complexity of factors involved in Protein Calorie Malnutrition". Malnutrition is a Problem of Ecology Basel & Karger, New York, p.17.
Crabioto, J., Delicardie, E.R., Pinero, J., Lindora, M Arroyo, M., Alcalde, E. 1971	"Mental Development and malnutrition" Proceedings of the Nutrition Society of India, No.12, p. 192.

Delmundo, F., and Adio, A., 1970. "Lactation and Child Spacing as observed among 2102 rural Filipino mothers". Philipines Journal of Paediatrics, Vol.1[illegible], No.2, pp. 129-132.

Devadas, R.P., 1972 Problems of Nutrition of the Child in the Tropics. Archieves of Child Health. Vol.14, No.4, pp. 155-159.

Devadas, R.P., 1972 "Nutrition in Tamil Nadu", Sangam Publishers, Madras, pp 39-40.

Devadas, R.P., Nirmala K.Murthy, M.J. Elizabeth and P.S. Vasantha, 1973 "Nutritional status and Nutrient intake of Children in the Age groups of 0-30 months in a Rural area". The Indian Journal of Nutrition and Dietetics. 10, p. 173.

Dobbing, John, 1971. "Effect of Nutrition on the Development of the Nervous System". Proceedings of the Nutrition Society of India, NIN India, No.10, pp. 177-178.

Dobbing, J., 1973 "Undernutrition and the Developing Brain" Maternal and Child Care, Vol.VII, No.73, p. 88.

Dugdale, A.E., 1971 "An Age independent Anthropometric index of nutritional status". The American Journal of Clinical Nutrition, Vol.24, No.2, pp. 174 - 176.

Dugdale, A.E., 1971 "The effect of the type of feeding on weight gain and illnesses in infants". American Journal of Clinical Nutrition. Vol.24, No.9, p. 423.

Dutta, Banik, N.D., Krishna and Mansaia 1970 "Longitudinal Growth Pattern of Children During Preschool Age and its Relationship with Different Socio-economic Classes". Indian Journal of Pediatrics Vol.37, p. 438.

Dutta Banik, N.D., Westland, R., Falkner, Frank, 1969 Growth Pattern in children with Congenital Heart Disease. Indian Journal of Pediatrics Vol.36 No.255, p. 112.

Mosien, Joseph, C. 1970 "Malnutrition in Africa-Need and Basis for Action". Malnutritionis a Problem of Ecology: A Conference. Basel and Karger, New York, p. 65.

Falkner, Frank, Susina, R. Chopra, J., P.Gyorgy, Jelliffe, D.B., Jelliffe, F., John McKigney, M.Read & A.F.Roche, 1972.	"The creation of growth Standards - A Committee Report", American Journal of Clinical Nutrition, Vol.25, No.2, pp. 218,220.
Fao, 1964	"Third World Food Survey". Freedom from Hunger Campaign, Italy, No.11, pp. 45-48, 51.
FAO, 1970	"Lives in Peril" Protein and the Child, FAO, Rome p. 25.
Fryer, B.A., Lamkin, G.E., Vivian, V.M., Sppought, E.S. and Fox, H.M., 1972	Growth of Preschool Children in the North Central Region, Journal of American Dietetic Association, Vol.60, No.1, pp. 30.
Gellis, S.S. 1972	"Year Book of Pediatrics" Year Book Medical Publishers, Chicago, p.21.
Ghai, O.P., 1973	"Child Health and Community Development". Indian Pediatrics. Vol.X, No.7, p. 599.
Ghosh, Shanti Bhargava, S.K. and Bhargava, V., 1971.	"Growth Pattern of Babies in Delhi Area in the First Year of Life". Proceedings of the Nutrition Society of India, NIN, India, No.10, pp.82,85.
Gokulanathan, K.S. and Verghese, K.P., 1969	"Socio Cultural Malnutrition". Journal of Tropical Pediatrics, Vol.15, No.3, pp. 118-124.
Gopalan, C. and Narasinga Rao, B.S., 1971	"Nutritional Constraints on Growth and Development in current Indian Dietaries". Proceedings of the Nutrition Society of India, NIN, India, No.10, p.111.
Gopalan, C., 1971	"Kwashiorkor and Marasmus". Evolution and Distinguishing Features". Pediatric Problems in Developing Countries. Edited by Thirumala Rao, Orient Longmans New Delhi, pp.167-180.
Gopalan, C., and Vijayaraghavan, K., 1971	'Nutrition Atlas of India", National Institute of Nutrition, Hyderabad, India, pp. 49, 51, 134, 135, 136, 137, 146.

Gordon, J.E., and M.S. Scrimshaw, 1972. "Field Trial of a Newly Developed Food for Prevention of Malnutrition". World Review of Nutrition and Dietetics Vol.15, Karger and Basel, New York, 256 - 257.

Graham, George, G., 1972 "Environmental Factors Affecting The Growth of Children". The American Journal of Clinical Nutrition Vol.25, No.11, p. 1188.

Gurney, J.M., 1969 "Field Experience in Abeokuta, Nigeria with Special Reference to Differenciating Protein and Calorie Reserves", Journal of Tropical Pediatrics, Vol.15, p. 225.

Guzman, M.A., 1968 "Malnutrition-learning and Behaviour" MIT Press, Cambridge, p.42.

Guzman, Virginia, B. and Victor, O. Tantengco, 1972 "Effect of Nutrition and Illness on the Growth and Development of Filipino Children in a Rural Setting". Philippine Journal of Nutrition, Vol.XXV, No.2, p.91.

Gupta, V.P., I.C.Tewari, S.M., Marwah and N. L.Murthi, 1972 "Mid Upper Arm Circumference in Infants". Indian Journal of Pediatrics Vol.39, No.290, p.65.

Gyorgy, P., and O.L.Kline, 1970 "Malnutrition is a Problem of Ecology" Basel & Karger, New York, p. 219-220.

Hegsted, D.M., 1972 "Deprivation Syndrome of PCM". Nutrition Review, Vol.30, p. 51.

ICMR, 1972 "Growth and Physical Development of Indian Infants and Children". Technical Reports Series No.18, ICMR, New Delhi, pp. 1,22,25,26

Jackson, R.L.,and R.Nair, 1970 "Maternal and Child Nutrition", Pediatric Problems in Developing Countries Edited by Thirumalai Rao, Orient Longmans, Delhi, p.46.

Jelliffe, D.A. 1965 The Assessment of the Nutritional Status of the Community, WHO, Geneva,

Jelliffe, D.B., June, 1967 — "Detection of Early Protein Calorie Malnutrition". The Journal of Tropical Pediatrics". Vol.13, pp. 67-69.

Jelliffe, D.B., 1968 — "Breast milk and the world protein gap". Clinical Pediatrics, Vol.14, pp. 47-49.

Jelliffe, D.B., 1968 — "Infant Nutrition in the Sub-tropics and Tropics". WHO Geneva, pp. 143-144.

Jelliffe, D.B., 1969 — "Emergency feeding of Young children" Journal of Pediatrics, Vol.75, pp. 153-154.

Jelliffe, E.F.P. and Jelliffe, D.B., 1969 — "The Arm circumference as a public Health index of protein Calorie Malnutrition in early childhood". Journal of Tropical Pediatrics., Vol.15, pp. 177-260.

Jelliffe, D.B. and Jelliffe, E.F.P., 1970 — The effect of famine on the function of the family and society". Proceedings of Swedish Foundation, Saltjobaden, pp. 54-68.

Jelliffe, D.B., 1970 — "Evaluation of Nutrition Related Village Improvement Programmes". Malnutrition is a problem of Ecology. A Conference Basel & Karger, New York, p. 162.

Jelliffe, D.B., 1971 — "Anthropometry Independent of Precise Age". American Journal of Clinical Nutrition, Vol.24, No.10, pp.1577-1579.

Jelliffe, D.B., 1971 — "Commerciogenic Malnutrition - Time for a Dialogue?." Food Technology Vol.25, pp. 55-56.

Jelliffe, D.B. and Jelliffe, E.F.P., 1971 — "The Uniquances of human milk". American Journal of Clinical Nutrition Vol.28, No.8, pp. 968-1024.

Jelliffe, D.B., 1973 — "Nutrition in Early Childhood". World Review of Nutrition and Dietetics. Vol.16, Karger & Basel, pp. 6,8, and 10.

Liang, P.H., T.T. Mie, T.Jan, O.H. and Gick, L.T. 1967 — Evaluation of mental development in relation to Early Malnutrition. American Journal of Clinical Nutrition Vol.20, p. 1290, No.12, Dec. 1967

Linares, F.A., Sinisterra, L., Mickay, A.C. and Mickay, H.L. 1972 — "Anthropometric Measurements in the Assessment of Nutritional Status". Summaria IX International Congress of Nutrition. Mexico, Abstract and Short Communications, Mexico pp. 24-25.

Losy, M.L., 1971 — "Computers, Multivariate Analysis and the Assessment of Nutritional Status". Proceedings of the 6th symposium on Nutrition and Health in the Near East American University of Beirut 1971.

Malina, Robert, M. 1971. — "Skinfolds in American Negro and White Children". Journal of the American Dietetic Association. Vol.59, No.1, pp. 54-55.

Malina, Robert, M., 1972 — "Weight, Height and Limb Circumferences in American Negro & Children" - Longitudinal Observations over a oneyear period". The Journal of Tropical Pediatrics and Environmental Child Health. Vol.18, No.4, pp. 280, 281.

Manocha, Johan, L. — "Malnutrition and retarded human development". Charles Thomas, Illinois, U.S.A., pp. 48-50.

Marr, Jean, S. — "Individual Dietary Survey: Purposes and Methods". World Review of Nutrition and Dietetics. Vol.13, pp. 105-109.

Mata, Leonardo, Juan J. Urrutia and Aaron Lechtig, 1971 — "Infection and Nutrition of Children of low socio economic rural Community". The American Journal of Clinical Nutrition. Vol.24, No.2, pp. 249-250.

Mathen, K.K., 1969 — "Studies on Growth and Development in Children". Indian Journal of Pediatrics. Vol.36, No.254, p.60.

Mayer, Jean, 1972 — "Human Nutrition - Its physiological, Medical and Social aspects". Charles C. Thomas, Illinois, USA, p. 257.

Mehta, M.J. and Betkerur, U.M. 1973 — "A Study of the Growth Pattern in the First Years of life in Surat". Indian Journal of Pediatrics. Vol.40, No.306, p. 255.

McCance, R.A., 1971 — "The Effect of Malnutrition on Growth Metabolism and Final Form". Proceedings of the Nutrition Society of India. NIN, India, No.10, pp. 111.

McLaren, D.C., and Pellett, P.L., 1970 — "Nutrition in the Middle East". World Review of Nutrition and Dietetics. No.12, p. 45-47.

McLaren, D.S., 1973 — "Undernutrition" World Review of Nutrition and Dietetics. Vol.16, p. 82.

McNamara, Robert, S., 1973 — "The Environmental Dilemma". Span. Vol.XIV, No.3, p. 30.

Meredith, M. V., 1935 — "The Rythem of Physical Growth University of Iowa Studies". Iowa.

Miladi, S., 1971 — "Causes of Childhood Malnutrition" Proceedings of the 6th Symposium on Nutrition and Health in Near East American University of Beirut, p.65.

Mitchell, Helen, C. 1967. — "The Effect of Malnutrition on Development and Behaviour". Recent Advances in Nutrition. Syracuse University, New York, p. 20.

Mohanta, K.D., Panda, J.N., and Praharaj, K.C., 1972. — "Anthropometric Measurements of Children of eastern Orissa". Indian Journal of Paediatrics. Vol.38, No.289, p.12.

Monckeberg, F., 1969 — "Nutrition and Mental Development" Papers at the Conference of Nutrition and Human Development, at East Lansing Michigan.

Montagu, Ashley, M.F.1960 — "A Hand Book of Anthropometry". Charles C. Thomas, Illinois, p.3.

Newman Charlotte, Shankar Hari and Uberoi, I.S., 1969 — "Nutritional and Anthropometric Profile of Young Rural Punjabi Children". Indian Journal of Medical Research, Vol.57, No.6, p. 1147.

Nutrition Review., 1952 — "Assessment of Growth and Development in Children". Nutrition Review., Vol.10, No.9, pp. 266-268.

Nutrition Society of India. The Task Force on Nutrition Report, 1973 — Proceedings of the Nutrition Society of India, Hyderabad, India, No.13, p.2.

Oldham, J.S., 1971 — "Obstetrics Symposium - Artificial Feeding". Journal of Post Graduate General Practice. Vol.5, No.10, p.1217.

Oppe, Thomas, E, 1972. — "The Ideal Infant Food" Nutrition Vol.27, No.5, pp. 275-276.

Owen, George, M., 1973 — "The Assessment of Recording of Measurement of Growth of Children - Report". Pediatrics, Vol.51, No.3, p. 461.

Pachuria, Saroj and S.M. Marwah, 1970 — "An Anthropometric Study of the New Born in Varanasi". Indian Journal of Pediatrics. Vol.37, No.265, p . 68.

Rajalaxmi, R. and C.V.Ramakrishnan, 1972 — "Nutrition and Brain Function". World Review of Nutrition and Dietetics Vol.15, Karger and Basel, London, pp. 15, 35, 85.

Rao, Someswara, 1962 — "Malnutrition and Food Habits" Report of an international and inter-professional Conference - Edited by Anne Burgess and R.F.A. Dean, Tavistock Publications, London, pp. 30.

Rao Visweswara, K.1967 — "Patterns and Trends in Food Consumption in India". Journal of Nutrition and Dietetics, Vol.4, No.1, p.79.

Reddy, Vinodini, 1973 — "Milk in Human Nutrition" Some recent findings" Nutrition. Vol.7 No.3, p.17.

Robson, P.J.M., Bolton and A.S. Dugdale, 1973 — "The Nutrition of Malayasian Aboriginal Children". American Journal of Clinical Nutrition, Vol.26, No.1, pp. 95-100

Rosso, P., Julia Hormazabal, and Myron, Winick, 1970 — "Changes in Brain Weight Cholesterol, Phospholipid and DNA. Content in Marasmic Children". American Journal of Clinical Nutrition, Vol.23, No.10, pp. 1275-1279.

Sabry, Z.I., 1973 — "Assessment of Nutritional Status - The Survey as a Technique". Canadian Journal of Public Health, Vol.64, No.3, pp. 265-267.

Salud, Rosita, L.A., Salamat, B.V., Roxas, S.M. Tinio and M.D. Quison, 1972 — Studies on Breast Milk of Some Normal Filipino Mothers. Philliping Journal of Nutrition. Vol.XXV, No.3, p. 193.

Scrimshaw, Nevin and John Gordon, 1971 — "Malnutrition, Learning And Behaviour". Proceedings of the International Conference MIT Press, pp. 271-275. Cambridge.

Seth, C. 1972 — "Better Nutrition for Children". Amrath Kind, Vol.16, No.11, p. 346.

Shank, Robert, E., 1971 — "The Ecology of Malnutrition - Examples of Host Factors" Proceedings Western Hemisphere Nutrition Congress III, Futura Publishing Co., New York, p. 253.

Sikri, S.D., 1972 — "A comparative study of height and weight of goverament and public school children of Punjabi population". Indian Journal of Medical Research Vol. 60, No.3, pp. 49-50.

Sims, Laura, S., Beatrice Paolucci and Portia Morris 1972 — "A theoritical Model for the study of nutritional status - An Ecosystem Approach". Ecology of Food and Nutrition. Vol.1, No.3, pp. 197-198-204

Singh, Meenakshi, K., 1969 — "Some anthropometric measurements in South Indian School Boys". Indian Journal of Pediatrics. Vol.36, No.257, p. 205.

Srikantia , S.H. and Ogananda Sastri, 1971 — "Observations of malnutrition and mental development". Proceedings of the nutrition Society of India, Hyderabad, India, No.12, p. 216.

Srikantiah, S.D. and Leela Iyengar	"Effect of nutrient supplement during late pregnancy on birth weight of infants". Proceedings of the nutrition Society of India, Hyderabad, India, No.11, p.27.
Stini, William, A., 1972	"Malnutrition body size and proportion". Ecology of Food and Nutrition, Vol.1, No.2, pp. 121. 123.
Swaminathan, M.C., 1971	Observation on growth and development of under nourished children of Andhra Pradesh. Proceedings of the Nutrition Society of India. National Institute of Nutrition, Hyderabad, No.10, p.149.
Thits, L. J., 1972	"Infantile overnutrition and its possible ill effects". Nutrition Vol.26, No.6, Nutrition, pp. 359.
Tanner, J.M., 1969	"Growth of children in Industralised countries with special reference to the Secular Trend". Symposia of the Swedish Nutrition Foundation VII Nutrition in preschool and School age. Editor Gunnar Blix, Almqvist & Wiksells, Uppsala, p.9.
Tanner, J.M. 1971	Growth and its regulation in the healthy child. Proceedings of the Nutrition Society of India, NIN, India, No.10, pp. 54-55.
United States Department of Health Education and Welfare, 1971	"Ten State Nutrition Survey in the U.S.". Preliminary Report to Congress p.2.
UNICEF, 1972	"Malnutrition and Disease - A vicious Circle", Unicef News Issue No.74 p.4.
Venkatachalam, P.S. and Rebello, L.M., 1971	Nutrition for Mother and Child. Indian Council of Medical Research. Special Report Series No.41, National Institute of Nutrition, p.23.
Vijayaraghavan, K., 1970	Growth of Indian Children. Nutrition Vol.5, No.3, p.17.

Villarjos, Victor, M., Osborne, J.A., Paynef, J. and Arguedas, J.A., 1972 — "Heights and weights of children to urban and Rural Costa Rica". Journal of Tropical Pediatrics and Environmental Child Health, Vol.17 No.1, pp. 32.

Wakhlu Indu, 1972 — Nutritional anthropometry. Archieves of Child Health. Vol.14, No.2, pp. 72-73.

WHO, 1970 — Nutritional Status of Populations", A Manual of Anthropometric Appraisal of Trends. WHO/NUTR/70, 129, WHO, Geneva, p.3.

WHO, 1970 — "Activities in the field of protein Calories malnutrition". Nutrition/ 70.1 Agenda item 8-10. U.N. Protein Advisory Group Meeting, New York, p.2.

WHO, 1972 — "Human Development and Public Health". Technical Report Series No.985, Geneva, p.26.

WHO, 1972 — 'Human Development and Public Health" WHO, Technical Report Series No.485 pp.44.

WHO, 1972 — "Nutrition" - A Review of WHO programme. WHO Chronicle, Vol.26, No.4, pp. 161-165.

Winick, Myron, 1969 — Malnutrition and brain development Journal of Pediatrics, Vol.75, p.15.

Young, Boutourtine, M. 1970 — "Socio Economic Factors in Child Development", Malnutrition is a problem of Society A Conference: Basel & Karger New York, pp. 45-44.

APPENDICES

APPENDIX I

QUESTIONNAIRE TO STUDY THE HEIGHTS AND WEIGHTS OF INFANTS
(With Reference to Feeding Habits)

Date:

1. Name of the Head of the family:

2. Address:

3. Number of Members:

Serial No.	Name	Relation to head	Marital Status	Age	Education	Occupation Main	Occupation Subsidiary	Income per month

4. Amount of money spent on food Rs.

5. How old is your baby? months: days:

6. Birth order of the baby

7. Is your baby (i) Breast fed

(ii) Artificially

(iii) Combination of both

(iv) Any others

8. If artificially fed, specify the quantity, dilution and number of times fed:

Quantity	Dilution	Number of times fed	Time interval

9. Has your baby been weaned?

Yes: No:

If 'Yes', state the name or type of weaning foods given and the age of weaning:

Weaning Foods	Reasons for choosing the foods	Reasons for weaning

10. Mention the number of times the food is given and the quantity -

Number of times 1 Quantity 1

2 2

3 3

11. Do you think your baby gets enough food 'YES' 'NO'

12. Has your baby started on solid foods?

Yes: No:

If 'Yes', Does your baby take

a) Vegetarian food

b) Non-vegetarian food

c) Mixed food

13. History of illness:-

Illness	Age at which afflicted	Duration of illness	Treatment

14. Height (in cms.)

15. Weight (in kg.)

16. Head circumference (cms.)

17. Chest circumference (cms)

18. Arm girth

19. Skin fold measurement

20. Condition of eyes

a. Xerosis conjunctiva b. Xerosis cornea

c. Angular conjectivitis d. Any others (specify)

21. Conditions of hair - a. Discoloured & dry

b. Sparse & brittle

22. Oedema of dependent parts - (a) Absent, (b) Slight, (c) Moderate, (d) Severe

23. General Appearance (a) Healthy & Cheerful (b) Sickly & fretful

24. Any other abnormalities:-

APPENDIX II

FREQUENCY DISTRIBUTION OF HEIGHTS (GIRLS)
Cms.

Newborn

39.5 – 41.5	2
41.5 – 43.5	5
43.5 – 45.5	19
45.5 – 47.5	40
47.5 – 49.5	51
49.5 – 51.5	42
51.5 – 53.5	32
53.5 – 55.5	5
55.5 – 57.5	3
57.5 – 59.5	2
	201

1st month

40.5 – 45.5	5
45.5 – 50.5	12
50.5 – 55.5	21
55.5 – 60.5	11
60.5 – 65.5	0
65.5 – 70.5	1
	50

2nd month

47.5 – 52.5	11
52.5 – 57.5	25
57.5 – 62.5	13
62.5 – 67.5	2
67.5 – 72.5	0
	50

3rd month

47.5 – 52.5	9
52.5 – 57.5	17
57.5 – 62.5	24
62.5 – 67.5	4
	54

4th month

47.5 – 52.5	1
52.5 – 57.5	11
57.5 – 62.5	28
62.5 – 67.5	7
67.5 – 72.5	3
72.5 – 77.5	1
	51

5th month

49.5 – 54.5	2
54.5 – 59.5	14
59.5 – 64.5	38
64.5 – 69.5	13
69.5 – 74.5	0
74.5 – 79.5	2
	69

6th month

47.5 – 52.5	3
52.5 – 57.5	5
57.5 – 62.5	28
62.5 – 67.5	47
67.5 – 72.5	13
72.5 – 77.5	2
	92

7th month

47.5 – 52.5 –	1
52.5 – 57.5 –	3
57.5 – 62.5 –	13
62.5 – 67.5 –	27
67.5 – 72.5 –	7
72.5 – 77.5 –	2
	53

8th month

52.5 – 57.5 –	3
57.5 – 62.5 –	10
62.5 – 67.5 –	30
67.5 – 72.5 –	22
72.5 – 77.2 –	2
	67

9th month

42.5 – 48.5 –	
48.5 – 52.5	
52.5 – 57.5	
57.5 – 62.5	
62.5 – 67.5	
67.5 – 72.5	
72.5 – 77.5	
77.5 – 82.5	

10th month

52.5 – 57.5 –	1
57.5 – 62.5 –	4
62.5 – 67.5 –	29
67.5 – 72.5 –	37
72.5 – 77.5 –	14
77.5 – 82.5 –	1
	86

11th month

57.5 – 62.5 –	1
62.5 – 67.5 –	15
67.5 – 72.5 –	27
72.5 – 77.5 –	7
77.5 – 82.5 –	2
	52

12th month

52.5 – 57.5 –	1
57.5 – 62.5 –	5
62.5 – 67.5 –	17
67.5 – 72.5 –	36
72.5 – 77.5 –	12
77.5 – 82.5 –	1
	70

FREQUENCY DISTRIBUTION OF HEIGHTS BOYS
(mm)

Newborn

39.5 – 44.5 –	9
44.5 – 49.5 –	112
49.5 – 54.5 –	90
54.5 – 59.5 –	3
	214

1st month

40.5 – 45.5 –	2
45.5 – 50.5 –	16
50.5 – 55.5 –	22
55.5 – 60.5 –	6
60.5 – 65.5 –	3
65.5 – 70.5 –	0
70.5 – 75.5 –	1
	50

2nd month

34.5 – 39.5 –	1
39.5 – 44.5 –	0
44.5 – 49.5 –	1
49.5 – 54.5 –	9
54.5 – 59.5 –	31
59.5 – 64.5 –	4
64.5 – 69.5 –	3
69.5 – 74.5 –	0
74.5 – 79.5 –	2
	50

3rd month

46.5 – 51.5 –	1
51.5 – 56.5 –	8
56.5 – 61.5 –	25
61.5 – 66.5 –	11
66.5 – 71.5 –	8
	51

4th month

48.5 – 53.5 –	1
53.5 – 58.5 –	11
58.5 – 63.5 –	33
63.5 – 68.5 –	12
68.5 – 73.5 –	3
	60

5th month

51.5 – 56.5 –	2
56.5 – 61.5 –	21
61.5 – 66.5 –	30
66.5 – 71.5 –	11
71.5 – 76.5 –	3
	67

6th month

52.5 – 57.5	5
57.5 – 62.5	15
62.5 – 67.5	30
67.5 – 72.5	20
72.5 – 77.5	2
	70

7th month

51.5 – 56.5	2
56.5 – 61.5	10
61.5 – 66.5	22
66.5 – 71.5	30
71.5 – 76.5	7
	81

8th month

62.5 – 67.5	30
67.5 – 72.5	35
72.5 – 77.5	5
	70

9th month

55.5 – 60.5	2
60.5 – 65.5	10
65.5 – 70.5	36
70.5 – 75.5	28
75.5 – 80.5	1
	78

10th month

55.5 – 60.5	1
60.5 – 65.5	18
65.5 – 70.5	53
70.5 – 75.5	55
75.5 – 80.5	5
	132

11th month

61.5 – 66.5	8
66.5 – 71.5	18
71.5 – 76.5	22
76.5 – 81.5	4
	52

12th month

61.5 – 66.5	10
66.5 – 71.5	33
71.5 – 76.5	29
76.5 – 81.5	6
	78

APPENDIX III

FREQUENCY DISTRIBUTION OF WEIGHTS-GIRLS (kg)

Class intervals	New born	1 month	2month	3month	4month	5month	6month	7month	8month	9 month	10month	11month	1
0.5 – 1.5	4	1	0	0	0	0	0	0	0	0	0	0	0
1.5 – 2.5	65	4	1	2	1	0	0	0	0	0	0	0	0
2.5 – 3.5	126	25	4	8	0	8	0	0	0	0	0	0	0
3.5 – 4.5	6	18	25	25	18	8	8	5	6	2	2	0	1
4.5 – 5.5	-	2	20	16	19	25	27	15	16	12	9	11	6
5.5 – 6.5	-	-	2	3	8	25	29	20	27	28	34	1	16
6.5 – 7.5	-	-	-	-	3	3	17	10	24	21	25	17	25
7.5 – 8.5	-	-	-	-	2	3	1	4	6	15	14	10	19
8.5 – 9.5	-	-	-	-	-	1	0	1	0	1	4	1	2
9.5 – 10.5	-	-	-	-	-	-	0	0	0	0	0	0	-
Total	201	50	50	54	51	69	92	53	79	79	86	52	70

Frequency Distribution of Birth Rate

Northern

1.2 – 1.7	5
1.7 – 2.2	28
2.2 – 2.7	87
2.7 – 3.2	72
3.2 – 3.7	15
3.7 – 4.2	7
	214

1st month

1.7 – 2.2	4
2.2 – 2.7	8
2.7 – 3.2	14
3.2 – 3.7	12
3.7 – 4.2	4
4.2 – 4.7	2
5.2 – 5.2	2
4.7 – 5.2	2
5.7 – 6.2	1
6.2 – 6.7	1
	60

2nd month

2.4 – 2.9	2
2.9 – 3.4	10
3.4 – 3.9	18
3.9 – 4.4	8
4.4 – 4.9	4
4.9 – 5.4	3
5.4 – 5.9	2
5.9 – 6.4	1
6.8 – 6.9	0
6.9 – 7.4	0
7.4 – 7.9	1
9.9 – 8.4	1
	50

3rd month

3.2 – 3.7	4
3.7 – 4.2	8
4.2 – 4.7	12
4.7 – 5.2	15
5.2 – 5.7	4
5.7 – 6.2	4
6.2 – 6.7	3
6.7 – 7.2	1
7.2 – 7.7	1
	51

4th month

3.4 – 3.9	3
3.9 – 4.4	10
4.4 – 4.9	8
4.9 – 5.4	13
5.4 – 5.9	11
5.9 – 6.4	7
6.4 – 6.9	5
6.9 – 7.4	0
7.4 – 7.9	3
	60

5th month

3.8 – 4.3	1
4.3 – 4.8	11
4.8 – 5.3	7
5.3 – 5.8	8
5.8 – 6.3	20
6.3 – 6.8	10
6.8 – 7.3	6
7.3 – 7.8	1
7.8 – 8.3	3
	67

6th month

3.3	3.8	1
3.8	4.3	5
4.3	4.8	2
4.8	5.3	7
5.3	5.8	15
5.8	6.3	12
6.3	6.8	11
6.8	7.3	9
7.3	7.8	6
7.8	8.3	2
		70

8th month

4.5	5.0	1
5.0	5.1	4
5.5	6.0	3
6.0	6.5	20
6.5	7.0	13
7.0	7.5	16
7.5	8.0	6
8.0	8.5	5
8.5	9.0	2
		70

7th month

4.4	4.9	7
4.9	5.4	7
5.4	5.9	9
5.9	6.4	18
6.4	6.9	12
6.9	7.4	16
7.4	7.9	10
7.9	8.4	1
8.4	8.9	1
		81

9th month

4.4	4.9	3
4.9	5.4	3
5.4	5.9	10
5.9	6.4	8
6.4	6.9	17
6.9	7.4	16
7.4	7.9	9
7.9	8.4	8
8.4	8.9	3
8.9	9.4	1
		78

10th month

4.4 – 4.9 –	6
4.9 – 5.4 –	3
5.4 – 5.9 –	6
5.9 – 6.4 –	18
6.4 – 6.9 –	25
6.9 – 7.4 –	19
7.4 – 7.9 –	25
7.9 – 8.4 –	18
8.4 – 8.9 –	9
8.9 – 9.4 –	4
9.4 – 9.9 –	0
9.9 –10.4 –	0
10.4 –10.9 –	1
	132

12th month

4.9 – 5.4 –	1
5.4 – 5.9 –	4
5.9 – 6.4 –	9
6.4 – 6.9 –	11
6.9 – 7.4 –	16
7.4 – 7.9 –	14
7.9 – 8.4 –	13
8.4 – 8.9 –	5
8.9 – 9.4 –	1
9.4 – 9.9 –	1
9.9 –10.4 –	2
10.4 –10.9 –	1
	78

11th month

2.6 – 3.1 –	1
3.2 – 3.6 –	0
3.6 – 4.1 –	0
4.1 – 4.6 –	2
4.6 – 5.1 –	1
5.1 – 5.6 –	3
5.6 – 6.1 –	3
6.1 – 6.6 –	8
6.6 – 7.1 –	6
7.1 – 7.6 –	12
7.6 – 8.1 –	7
8.1 – 8.6 –	5
8.6 – 9.1 –	1
9.1 – 9.6 –	1
9.6 –10.1 –	2
	52

APPENDIX IV

FREQUENCY DISTRIBUTION OF HEAD CIRCUMFERENCE GIRLS (cm)

New Born

27.5 - 29.5	8
29.5 - 31.5	23
31.5 - 33.5	71
33.5 - 35.5	65
35.5 - 37.5	23
37.5 - 39.5	10
39.5 - 41.5	1
	201

1st month

29.5 - 31.5	4
31.5 - 33.5	8
33.5 - 35.5	19
35.5 - 37.5	16
37.5 - 39.5	2
39.5 - 41.5	1
	50

2nd month

31.5 - 33.5	7
33.5 - 35.5	1
35.5 - 37.5	20
37.5 - 39.5	20
39.5 - 41.5	1
41.5 - 43.5	1
	50

3rd month

29.5 - 31.5	2
31.5 - 33.5	2
33.5 - 35.5	3
35.5 - 37.5	17
37.5 - 39.5	21
39.5 - 41.5	6
41.5 - 43.5	3
	54

4th month

30.5 - 35.5 - 3

35.5 - 40.5 - 36

40.5 - 45.5 - 12

51

5th month

35.5 - 40.5 - 39

40.5 - 45.5 - 28

45.5 - 50.5 - 2

69

6th month

35.5 - 40.5 - 43

40.5 - 45.5 - 49

45.5 - 50.5 - 0

92

7th month

33.5 - 38.5 - 3

38.5 - 43.5 - 49

43.5 - 48.5 - 1

53

8th month

36.5 - 41.5 - 44

41.5 - 46.5 - 33

46.5 - 51.5 - 2

79

9th month

38.5 - 43.5 - 68

43.5 - 48.5 - 11

79

10th month

38.5 - 40.5 - 8

40.5 - 42.5 - 43

42.5 - 44.5 - 27

44.5 - 46.5 - 8

86

11th month

39.5 - 43.5 - 34

43.5 - 48.5 - 18

52

12th month

31.5 - 36.5 - 1
36.5 - 41.5 - 11
41.5 - 46.5 - 55
46.5 - 51.5 - 3

70

Born this term

23.5 - 28.5 - 2
28.5 - 33.5 - 100
33.5 - 38.5 - 110
38.5 - 43.5 - 2

214

1st month

31.5 - 36.5 - 27
36.5 - 41.5 - 22
41.5 - 46.5 - 1

50

2nd month

32.5 - 38.5 - 22
37.5 - 42.5 - 26
42.5 - 47.5 - 2

50

3rd month

29.5 - 34.5 - 1
34.5 - 39.5 - 30
39.5 - 44.5 - 20

51

4th month

36.5 - 41.5 - 47
41.5 - 46.5 - 13

60

5th month

35.5 - 40.5 - 29
40.5 - 45.5 - 38
45.5 - 50.5 - 0

67

6th month

37.5 - 42.5 - 49
42.5 - 47.5 - 21
47.5 - 52.5 - 1

70

7th month

32.5 - 37.5 -	3
37.5 - 42.5 -	53
42.5 - 47.5 -	22
47.5 - 52.5 -	3
	81

8th month

37.5 - 42.5 -	26
42.5 - 47.5 -	44
	70

9th month

30.5 - 35.5 -	1
35.5 - 40.5 -	6
40.5 - 45.5 -	66
45.5 - 50.5 -	5
	78

10th month

38.5 - 43.5 -	55
43.5 - 48.5 -	67
	132

11th month

35.5 - 40.5 -	3
40.5 - 45.5 -	45
45.5 - 50.5 -	4
	52

12th month

39.5 - 44.5 -	42
44.5 - 49.5 -	36
	78

APPENDIX V

FREQUENCY DISTRIBUTION OF CHEST CIRCUMFERENCE GIRLS (cm)

New Born

19.5 - 24.5	1
24.5 - 29.5	19
29.5 - 34.5	52
34.5 - 39.5	29
	201

1st month

28.5 - 33.5	16
33.5 - 38.5	33
38.5 - 43.5	1
	50

2nd month

30.5 - 35.5	13
35.5 - 40.5	33
40.5 - 45.5	4
	50

3rd month

32.5 - 37.5	27
37.5 - 42.5	24
42.5 - 47.5	3
	54

4th month

29.5 - 34.5	1
34.5 - 39.5	32
39.5 - 44.5	16
44.5 - 49.5	2
	51

5th month

32.5 - 37.5	4
37.5 - 42.5	50
42.5 - 47.5	14
47.5 - 52.5	1
	69

6th month

35.5 - 40.5	44
40.5 - 45.5	46
45.5 - 50.5	2
	92

7th month

33.5 - 38.5 - 5

38.5 - 43.5 - 39

43.5 - 48.5 - 9

53

8th month

35.5 - 40.5 - 23

40.5 - 45.5 - 52

45.5 - 50.5 - 4

79

9th month

33.5 - 38.5 - 1

38.5 - 43.5 - 59

43.5 - 48.5 - 19

79

10th month

37.5 - 42.5 - 41

42.5 - 47.5 - 45

86

11th month

37.5 - 42.5 - 22

42.5 - 47.5 - 28

47.5 - 52.5 - 2

52

12th month

36.5 - 41.5 - 14

41.5 - 46.5 - 47

46.5 - 51.5 - 9

70

FREQUENCY DISTRIBUTION OF CHEST CIRCUMFERENCE

Boys (cm)

New Born

25.5 - 30.5 =	49
30.5 - 35.5 =	144
35.5 - 40.5 =	20
40.5 - 45.5 =	1
	214

1st month

24.5 - 29.5 =	1
29.5 - 34.5 =	21
34.5 - 39.5 =	24
39.5 - 44.5 =	4
	50

2nd month

28.5 - 33.5 =	3
33.5 - 38.5 =	25
38.5 - 43.5 =	21
43.5 - 48.5 =	1
	50

3rd month

34.5 - 39.5 =	30
39.5 - 44.5 =	20
44.5 - 49.5 =	1
	51

4th month

31.5 - 36.5 =	1
36.5 - 41.5 =	44
41.5 - 46.5 =	15
	60

5th month

36.5 - 41.5 =	32
41.5 - 46.5 =	33
46.5 - 51.5 =	2
	67

6th month

35.5 - 40.5 =	20
40.5 - 45.5 =	43
45.5 - 50.5 =	7
	70

7th month

34.5 - 39.5 - 7

39.5 - 44.5 - 53

44.5 - 49.5 - 16

49.5 - 54.5 - 0

91

8th month

37.5 - 42.5 - 23

42.5 - 47.5 - 41

47.5 - 52.5 - 6

70

9th month

34.5 - 39.5 - 4

39.5 - 44.5 - 46

44.5 - 49.5 - 28

78

10th month

35.5 - 40.5 - 14

40.5 - 45.5 - 90

45.5 - 50.5 - 28

132

11th month

31.5 - 36.5 - 1

36.5 - 41.5 - 9

41.5 - 46.5 - 34

46.5 - 51.5 - 8

52

12th month

38.5 - 43.5 - 23

43.5 - 48.5 - 52

48.5 - 53.5 - 3

78

APPENDIX VI

FREQUENCY DISTRIBUTION OF ARM CIRCUMFERENCE GIRLS (cm)

New Born

5.5 - 7.5 =	8
7.5 - 9.5 =	70
9.5 -11.5 =	99
11.5 -13.5 =	23
13.5 -15.5 =	1
	201

1st month

6.5 - 8.5 =	3
8.5 -10.5 =	27
10.5 -12.5 =	17
12.5 -14.5 =	3
	50

2nd month

8.5 - 10.5 =	11
10.5 - 12.5 =	26
12.5 - 14.5 =	11
14.5 - 16.5 =	2
	50

3rd month

7.5 - 9.5 =	4
9.5 -11.5 =	17
11.5 -13.5 =	27
13.5 -15.5 =	6
	54

4th month

8.5 - 10.5 =	6
10.5 - 12.5 =	20
12.5 - 14.5 =	22
14.5 - 16.5 =	3
	51

5th month

7.5 - 9.5 =	5
9.5 - 11.5 =	11
11.5 - 13.5 =	29
13.5 - 15.5 =	22
15.5 - 17.5 =	2
	69

6th month

7.5 - 9.5 -	2
9.5 - 11.5 -	10
11.5 - 13.5 -	45
13.5 - 15.5 -	33
15.5 - 17.5 -	2
	92

8th month

8.5 - 10.5 -	4
10.5 - 12.5 -	27
12.5 - 14.5 -	40
14.5 - 16.5 -	6
16.5 - 18.5 -	2
	79

7th month

7.5 - 9.5 -	1
9.5 - 11.5 -	8
11.5 - 13.5 -	23
13.5 - 15.5 -	20
15.5 - 17.5 -	1
	53

9th month

9.5 - 11.5 -	6
11.5 - 13.5 -	37
13.5 - 15.5 -	32
15.5 - 17.5 -	4
	79

10th month

9.5 - 11.5 -	13
11.5 - 13.5 -	45
13.5 - 15.5 -	25
15.5 - 17.5 -	2
17.5 - 19.5 -	1
	86

11th month

9.5 - 11.5 -	10
11.5 - 13.5 -	25
13.5 - 15.5 -	16
15.5 - 17.5 -	1
17.5 - 19.5 -	0
	52

12th month

9.5 - 11.5 -	9
11.5 - 13.5 -	29
13.5 - 15.5 -	32
15.5 - 17.5 -	0
17.5 - 19.5 -	0
	70

FREQUENCY DISTRIBUTION OF ARM CIRCUMFERENCE BOYS (cm)

New Born

3.5 - 6.5 -	2
6.5 - 9.5 -	96
9.5 - 12.5 -	113
12.5 - 15.5 -	3
	214

1st month

5.5 - 8.5 -	1
8.5 - 11.5 -	33
11.5 - 14.5 -	16
14.5 - 17.5 -	0
	50

2nd month

8.5 - 10.5 -	25
11.5 - 14.5 -	24
14.5 - 17.5 -	1
	50

3rd month

8.5 - 11.5 -	13
11.5 - 14.5 -	36
14.5 - 17.5 -	2
	51

4th month

7.5 - 10.5 -	3
10.5 - 13.5 -	39
13.5 - 16.5 -	18
	60

5th month

8.5 - 11.5 -	12
11.5 - 14.5 -	47
14.5 - 17.5 -	8
	67

6th month

9.5 - 12.5 = 30

12.5 - 15.5 = 38

15.5 - 18.5 = 2

70

7th month

9.5 - 12.5 = 26

12.5 - 15.5 = 52

15.5 - 18.5 = 3

81

8th month

4.5 - 11.5 = 3

11.5 - 14.5 = 50

14.5 - 17.5 = 17

70

9th month

7.5 - 10.5 = 4

10.5 - 13.5 = 35

13.5 - 16.5 = 38

16.5 - 19.5 = 1

78

10th month

9.5 - 12.5 = 30

12.5 - 15.5 = 95

15.5 - 18.5 = 7

132

11th month

7.5 - 10.5 = 3

10.5 - 13.5 = 28

13.5 - 16.5 = 21

52

12th month

9.5 - 12.5 = 20

12.5 - 15.5 = 51

15.5 - 18.5 = 6

18.5 - 21.5 = 1

78

APPENDIX VII

'Chi' Square Distribution

For Association between Income and "Weights and Weights"

NEWBORN BOYS

Income Weight

Income	Below Average	Average	Above Average	Total
Below 100	74	-	58	132
Above 100	31	-	51	82
Total	105	-	109	214

Income Weight

Income	Below Average	Average	Above Average	Total
Below 100	61	8	63	132
Above 100	34	7	41	82
Total	95	15	104	214

Where 'Chi' value $= \sum \left(\frac{O-E}{E}\right)^2$

O is the observed value of each cell

Where E is the expected value of each cell.

NEWBORN GIRLS

Income	Below Average	Average	Above Average	Total
Income Height				
Below 100	62	-	64	126
Above 100	31	-	44	75
Total	93	-	108	201
Income Weight				
Below 100	50	10	66	126
Above 100	23	1	51	75
Total	73	11	117	201

'Chi' Square Distribution for Heights

GIRLS

Income/Height 1-6 months

Income	Below Average	Average	Above Average	Total
Below 100	114	-	85	199
Above 100	81	-	88	169
Total	195	-	173	368

Income/Height 7-12 months

Income	Below Average	Average	Above Average	Total
Below 100	190	-	46	236
Above 100	143	-	40	183
Total	333	-	86	419

GIRLS

1-6 months Income Height

Income	Below Average	Average	Above Average	Total
Below 100	93	5	101	199
Above 100	77	2	90	169
Total	170	7	191	368

7-12 months Income Height

Income	Below Average	Average	Above Average	Total
Below 100	143	6	87	236
Above 100	103	7	73	183
Total	246	13	160	419

BOYS

Income/Height 1-6 months

Income	Below Average	Average	Above Average	Total
Below 100	80	-	104	184
Above 100	84	-	80	164
Total	164	-	184	348

Income Height 7-12 months

Income	Below Average	Average	Above Average	Total
Below 100	144	4	142	286
Above 100	92	28	126	218
Total	236	68	268	504

BOYS

Income/weight 1-6 months

Income	Below Average	Average	Above Average	Total
Below 100	73	3	108	184
Above 100	83	4	77	164
Total	156	7	185	348

Income Weight 7-12 moths

Income	Below Average	Average	Above Average	Total
Below 100	154	6	126	286
Above 100	106	7	105	218
Total	260	13	231	504

APPENDIX VIII

ANALYSIS OF VARIANCE TABLES TO TEST VARIANCE BETWEEN PARITY AND SEXES.

('F' RATIO TEST)

Sex/Parity/Weight Numbers

Sex	1-3	4-7 & above	Total
Boys	47	48.9	48	143.9
Girls	49	49.5	48	146.5
Total	96	98.4	96	290.4

Sex/Parity/Weight/Numbers

Sex	1-3	4-7	& above	Total
Boys	2.6	2.7	0	5.3
Girls	3.0	2.7	0	5.7
Total	5.6	5.4	0	11.0

Where F ratio = $\frac{n_1 s_1^2}{n_1 - 1} = s_2^2$ and $\frac{n_2 s_2^2}{n_2 - 1} = F^2$

Where degree of freedom = $V_1 = n_1 - 1$

$V_2 = n_2 - 1$

Sex/Parity/Height 1-6 months

Sex	1-3	4-7	8& above	Total
Girls	59.9	60.8	60.5	180.4
Boys	58.0	61.0	60.7	180.7
Total	118.9	121.0	121.2	371.1

Sex/Parity/Height 7-12months

Sex	1-3	4-7	8& above	Total
Girls	61.8	64.0	62.0	187.8
Boys	69.0	67.0	67.0	203.0
Total	130.0	129.0	129.0	390.0

Sex/Parity/Height 1-6 months

Sex	1-3	4-7	8& above	total
Girls	4.6	4.7	4.8	14.1
Boys	4.4	4.8	0	9.2
Total	9.0	9.5	4.8	23 .3

Sex/Parity/Height 7-12 months

Sex	1-3	4-7	8 & above	Total
Girls	6.2	6.1	0	12.3
Boys	7.2	7.2	6.6	21.0
Total	15.4	13.4	6.6	33.3

APPENDIX IX

FREQUENCY DISTRIBUTION OF BREAST FED AND COMBINATION FED INFANTS

HEIGHTS (cm) GIRLS

B. Stands for Breastfed

C. Stands for Combination fed.

1st month

	B	C
40.5 - 45.5	5	0
45.5 - 50.5	13	0
50.5 - 55.5	19	2
55.5 - 60.5	9	2
60.5 - 65.5	0	0
65.5 - 70.5	1	0
	46	4

2nd month

	B	C
47.7 - 52.5	8	7
52.5 - 57.5	13	4
57.5 - 62.5	12	12
62.5 - 67.5	2	2
	35	25

3rd month

	B	C
47.5 - 52.5	11	0
52.5 - 57.5	24	1
57.5 - 62.5	11	2
62.5 - 67.5	0	2
67.5 - 72.5	0	0
	46	5

4th month

	B	C
47.5 - 52.5	1	0
52.5 - 57.5	5	8
57.5 - 62.5	12	16
62.5 - 67.5	4	5
67.5 - 72.5	1	2
72.5 - 77.5	0	1
	21	30

5th month

	B	G
49.5 – 54.5 –	1	1
54.5 – 59.5 –	7	7
59.5 – 64.5 –	13	25
64.5 – 69.5 –	2	11
69.5 – 74.5 –	0	0
74.5 – 79.5 –	0	2
	23	46

6th month

	B	G
47.5 – 52.5 –	1	0
52.5 – 57.5 –	1	2
57.5 – 62.5 –	5	8
62.5 – 67.5 –	4	23
67.5 – 72.5 –	1	6
72.5 – 77.5 –	0	2
	12	41

8th month

	B	G
47.5 – 52.5 –	0	3
52.5 – 57.5 –	0	5
57.5 – 62.5 –	12	25
62.5 – 67.5 –	20	22
67.5 – 72.5 –	5	8
72.5 – 77.5 –	1	1
	37	65

9th month

	B	G
52.5 – 57.5 –	1	5
57.5 – 62.5 –	2	10
62.5 – 67.5 –	6	30
67.5 – 72.5 –	3	22
72.5 – 77.5 –	0	2
	12	67

	B	C
43.5 – 48.5 –	1	0
48.5 – 52.5 –	0	0
52.5 – 57.5 –	0	0
57.5 – 62.5 –	0	4
62.5 – 67.5 –	1	28
67.5 – 72.5 –	3	30
72.5 – 77.5 –	2	9
77.5 – 82.5 –	1	0
	8	71

10th month

	B	C
52.5 – 57.5 –	0	1
57.5 – 62.5 –	1	5
62.5 – 67.5 –	4	25
67.5 – 72.5 –	3	31
72.5 – 77.5 –	3	11
77.5 – 82.5 –	0	1
	11	75

11th month

	B	C
57.5 – 62.5 –	0	1
62.5 – 67.5 –	4	11
67.5 – 72.5 –	2	25
72.5 – 77.5 –	1	6
77.5 – 82.5 –	0	2
	7	45

12th month

	B	C
52.5 – 57.5 –	1	0
57.5 – 62.5 –	1	2
62.5 – 67.5 –	5	12
67.5 – 72.5 –	6	30
72.5 – 77.5 –	5	7
77.5 – 82.5 –	0	1
	18	52

Boys Height

1st month	B	G
40.5 - 45.5	2	0
45.5 - 50.5	12	.
50.5 - 55.5	22	.
55.5 - 60.5	5	1
60.5 - 65.5	0	3
65.5 - 70.5	—	—
70.5 - 75.5	0	1
	45	5

2nd month	B	G
134.5 - 39.5	1	0
39.5 - 44.5	0	0
44.5 - 49.5	1	0
49.5 - 54.5	9	0
54.5 - 59.5	25	4
59.5 - 64.5	3	1
64.5 - 69.5	2	0
69.5 - 74.5	0	0
74.5 - 79.5	1	1
	42	8

3rd month	B	G
51.5 - 56.5	6	3
56.5 - 61.5	10	1
61.5 - 66.5	7	4
66.5 - 71.5	1	7
	24	27

4th month	B	G
48.5 - 53.5	1	0
53.5 - 58.5	6	5
58.5 - 63.5	8	25
63.5 - 68.5	4	8
68.5 - 73.5	0	3
	19	41

5th month

	B	C
51.5 – 56.5 –	1 –	1
56.5 – 61.5 –	12 –	9
61.5 – 66.5 –	12 –	17
66.5 – 71.5 –	1 –	10
71.5 – 76.5 –	0 –	3
	26 –	40

6th month

	B	C
52.5 – 57.5 –	1 –	2
57.5 – 62.5 –	7 –	8
62.5 – 67.5 –	15 –	17
67.5 – 72.5 –	7 –	13
72.5 – 77.5 –	– –	2
	28 –	42

7th month

	B	C
51.5 – 56.5 –	1 –	1
56.5 – 61.5 –	2 –	8
61.5 – 66.5 –	10 –	22
66.5 – 71.5 –	6 –	24
71.5 – 76.5 –	0 –	7
	19 –	62

8th month

	B	C
62.5 – 67.5 –	6 –	24
67.5 – 72.5 –	9 –	28
72.5 – 77.5 –	0 –	3
77.5 – 82.5 –	0 –	0
	15 –	55

9th month

		S	C
55.5	- 60.5 -	0	- 2
60.5	- 65.5 -	2	- 8
65.5	- 70.5 -	5	-31
70.5	- 75.5 -	9	-20
75.5	- 80.5 -	-	- 1
		16	-62

10th month

		S	C
55.5	- 60.5 -	0	- 1
60.5	- 65.5 -	5	-46
65.5	- 70.5 -	6	-46
70.5	- 75.5 -	11	-44
75.5	- 80.5 -	0	- 8
		22	-110

11th month

		S	C
61.5	- 66.5 -	0	- 5
66.5	- 71.5 -	5	-15
71.5	- 76.5 -	3	.19
76.5	- 81.5 -	1	- 5
		9	- 45

12 th month

		S	C
61.5	- 66.5 -	2	- 8
66.5	- 71.5 -	10	- 25
71.5	-76.5 -	7	- 22
76.5	-81.5 -	1	- 5
81.5	-86.5 -	-	- -
		20	-58

APPENDIX X

FREQUENCY DISTRIBUTION OF WEIGHTS OF BREAST FED AND COMBINATION FED INFANTS GIRLS

1st month

	B	C
0.5 - 1.5	1	0
1.5 - 2.5	4	0
2.5 - 3.5	23	2
3.5 - 4.5	16	2
4.5 - 5.5	2	0
	46	4

2nd month

	B	C
1.5 - 2.5	1	0
2.5 - 3.5	4	0
3.5 - 4.5	20	3
4.5 - 5.5	19	1
5.5 - 6.5	1	1
	46	5

3rd month

	B	C
1.5 - 2.5	0	2
2.5 - 3.5	5	3
3.5 - 4.5	14	11
4.5 - 5.5	9	7
5.5 - 6.5	1	2
	29	25

4th month

	B	C
1.5 - 2.5	1	0
2.5 - 3.5	0	0
3.5 - 4.5	3	10
4.5 - 5.5	7	12
5.5 - 6.5	2	6
6.5 - 7.5	3	0
7.5 - 8.5	0	2
	21	30

5th month

	B	C
2.5 - 4.5	6	10
4.5 - 6.5	16	30
6.5 - 8.5	1	5
8.5 -10.5	0	1
	23	46

6th month

	B	C
3.5 - 4.5	3	5
4.5 - 5.5	12	15
5.5 - 6.5	13	26
6.5 - 7.5	8	9
7.5 - 8.5	1	0
	37	55

7th month

	B - C
3.6 - 4.5	3 - 2
4.5 - 5.5	3 - 10
5.5 - 6.5	5 - 15
6.5 - 7.5	0 - 10
7.5 - 8.5	0 - 4
8.5 - 9.5	1 - 0
	12 - 41

8th month

	B - C
3.5 - 4.5	2 - 4
4.5 - 5.5	4 - 12
5.5 - 6.5	1 - 26
6.5 - 7.5	4 - 20
7.5 - 8.5	1 - 5
	12 - 67

9th month

	B - C
3.5 - 4.5	0 - 2
4.5 - 5.5	1 - 11
5.5 - 6.5	3 - 25
6.5 - 7.5	1 - 20
7.5 - 8.5	3 - 12
8.5 - 9.5	0 - 1
	8 - 72

10th month

	B - C
3.5 - 4.5	0 - 2
4.5 - 5.5	1 - 8
5.5 - 6.5	3 - 31
6.5 - 7.5	5 - 13
7.5 - 8.5	2 - 12
8.5 - 9.5	0 - 4
	11 - 75

11th month

	B - C
4.5 - 5.5	1 - 10
5.5 - 6.5	3 - 10
6.5 - 7.5	3 - 14
7.5 - 8.5	0 - 10
8.5 - 9.5	0 - 1
	7 - 45

12th month

	B - C
3.5 - 4.5	1 - 1
4.5 - 5.5	3 - 3
5.5 - 6.5	4 - 12
6.5 - 7.5	7 - 13
7.5 - 8.5	1 - 13
8.5 - 9.5	2 - 0
	13 - 52

Boys

1st month

	B	C
1.2 - 1.7	0	0
1.7 - 2.2	4	0
2.2 - 2.7	8	0
2.7 - 3.2	14	1
3.2 - 3.7	11	0
3.7 - 4.2	4	0
4.2 - 4.7	2	0
4.7 - 5.2	2	0
5.2 - 5.7	0	2
5.7 - 6.2	0	1
6.2 - 7.7	0	0
	45	5

2nd month

	B	C
2.4 - 2.9	1	1
2.9 - 3.4	10	0
3.4 - 3.9	18	0
3.9 - 4.4	5	3
4.4 - 4.9	4	0
4.9 - 5.4	1	2
5.4 - 5.9	1	1
5.9 - 6.4	1	0
6.4 - 6.9	0	0
6.9 - 7.4	0	0
7.4 - 7.9	1	0
7.9 - 8.4	0	1
	42	8

3rd month

	B	C
3.2 - 3.7	2	2
3.7 - 4.2	2	6
4.2 - 4.7	7	5
4.7 - 5.2	6	5
5.2 - 5.7	3	1
5.7 - 6.2	2	2
6.2 - 6.7	2	4
6.7 - 7.2	-	4
7.2 - 7.7	-	1
	24	27

4th month

	B	C
3.4 - 3.9	2	1
3.9 - 4.4	4	6
4.4 - 4.9	8	5
4.9 - 5.4	2	11
5.4 - 5.9	2	9
5.9 - 6.4	5	2
6.4 - 6.9	0	3
6.9 - 7.4	0	0
7.4 - 7.9	1	4
	19	41

5th month

	B - C
3.8 - 4.3 -	1 - 8
4.3 - 4.8 -	3 - 4
4.8 - 5.3 -	3 - 3
5.3 - 5.8 -	5 - 13
5.8 - 6.3 -	7 - 6
6.3 - 6.8 -	4 - 4
6.8 - 7.3 -	2 - 1
7.3 - 7.8 -	0 - 2
7.8 - 8.3 -	1 - 0
	26 - 41

7th month

	B - C
4.4 - 4.9 -	2 -5
4.9 - 5.4 -	1 -6
5.4 - 5.9 -	5 -4
5.9 - 6.4 -	6 -12
6.4 - 6.9 -	2 -10
6.9 - 7.4 -	2 -14
7.4 - 7.9 -	1 -9
7.9 - 8.4 -	- 1
8.4 - 8.9 -	- 1
	19 -62

6th month

	B - C
3.3 - 3.8 -	0 - 1
3.8 - 4.3 -	0 - 5
4.3 - 4.8 -	1 - 1
4.8 - 5.3 -	2 - 5
5.3 - 5.8 -	8 - 7
5.8 - 6.3 -	4 - 3
6.3 - 6.8 -	6 - 5
6.8 - 7.8 -	3 - 6
7.3 - 7.3 -	2 - 4
	29 - 42

8th month

	B - C
4.85- 5.0 -	0 - 1
5.0 - 5.5 -	2 - 2
5.5 - 6.0 -	0 - 3
6.0 - 6.5 -	3 - 17
6.5 - 7.0 -	2 - 11
7.0 - 7.5 -	6 - 10
7.5 - 8.0 -	0 - 6
8.0 - 8.5 -	2 - 3
8.5 - 9.0 -	0 - 2
	15 - 55

9th month

	B - C
4.4 - 4.9	-0 - 3
4.9 - 5.4	-0 - 3
5.4 - 5.9	-2 - 8
5.9 - 6.4	-1 - 7
6.4 - 6.9	-6 - 11
6.9 - 7.5	-2 - 14
7.4 - 7.9	-3 - 6
7.9 - 8.4	-3 - 6
8.4 - 8.9	-0 - 3
8.9 - 9.4	-0 - 1
	16 - 62

10th month

	B - C
4.4 - 4.9	-0 - 6
4.9 - 5.4	-1 - 2
5.4 - 5.9	-2 - 4
5.9 - 6.4	-4 - 14
6.4 - 6.9	-3 - 22
6.9 - 7.4	-3 - 12
7.4 - 7.9	-2 - 21
7.9 - 8.4	-2 - 16
8.4 - 8.9	-0 - 9
8.9 - 9.4	-0 - 4
9.4 - 9.9	-0 - 0
9.9 -10.4	-0 - 0
10.4 -10.9	-0 - 0
	21 - 111

11th month

	B - C
2.6 - 3.1	- 0 - 1
3.1 - 3.6	- 0 - 0
3.6 - 4.1	- 0 - 0
4.1 - 4.6	- 0 - 2
4.6 - 5.1	- 0 - 1
5.1 - 5.6	- 0 - 3
5.6 - 6.1	- 2 - 2
6.1 - 6.6	- 1 - 7
6.6 - 7.1	- 0 - 6
7.1 - 7.6	- 4 - 8
7.6 - 8.1	- 2 - 5
8.1 - 8.6	- 1 - 4
8.6 - 9.1	- 0 - 1
9.1 - 9.6	-- 0 - 1
9.6 -10.1	- 0 - 2
	9 - 43

12th month

	B - C
4.9 - 5.4	- 0 - 1
5.4 - 5.9	- 1 - 3
5.9 - 6.4	- 1 - 8
6.4 - 6.9	- 3 - 8
6.9 - 7.4	- 5 - 11
7.4 - 7.9	- 6 - 8
7.9 - 8.4	- 3 - 10
8.4 - 8.9	- - 5
8.9 - 9.4	- - 1
9.4 - 9.9	- 1 - 0
9.9 -10.4	- - 2
10.4 -10.9	- - 1
	20 - 58

't' ratio to test the difference between two sample means

$$t_1 = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{(n-1)} \; \frac{S_2^2}{}}}$$

where x_1 & x_2 are the means of the breast fed and combination fed infants

S_1^2 & S^2_2 the square of the standard deviation of the two groups

APPENDIX XI

CALCULATION OF WEIGHT/HEIGHT RATIO

$$\text{Weight/Height ratio} = \frac{\text{Weight of individual infant}}{\text{Height of individual infant}}$$

CALCULATION OF COEFFICIENT OF CORRELATION BETWEEN HEIGHTS AND WEIGHTS OF GIRL INFANTS

Weights	39.5 - 44.5	44.5 - 49.5	49.5 - 54.5	54.5 - 59.5	59.5 - 64.5	64.5 - 69.5	69.5 - 74.5	74.5 - 79.5	79.5 - 84.5
0.5 - 1.5	3								
1.5 - 2.5	11	52	6	3					
2.5 - 3.5	2	64	86	12	2				
3.5 - 4.5		2	27	68	25	10	1	1	
4.5 - 5.5		3	6	31	68	38	9	2	1
5.5 - 6.5		2	2	13	62	100	32	3	0
6.5 - 7.5				2	29	60	44	6	0
7.5 - 8.5			1	1	5	26	23	10	1
8.5 - 9.5					1	5	23	2	
	16	123	128	130	192	240	132	24	2

CALCULATION OF COEFFICIENT OF CORRELATION BETWEEN HEIGHTS AND WEIGHTS OF BOY INFANTS

Weights	39.5 44.5	44.5 49.5	49.5 54.5	54.5 59.5	59.5 64.5	64.5 69.5	69.5 74.5	74.5 79.5
1.0-2.0		10	8					
2.0-3.0	9	97	67	5				
3.0-4.0	1	23	34	38	3	3		
4.0-5.0		2	8	38	46	12	4	
5.0-6.0		1	3	16	74	49	9	1
6.0-7.0			3	10	56	97	30	5
7.0-8.0			1	3	29	68	63	14
8.0-9.0				1	7	13	40	17
9.0-10.0					2	1	10	7
10.0-11.0							3	3
	10	132	124	121	227	243	159	47

Coefficient of Correlation

$$r = \frac{\frac{\Sigma xyfxy}{N} - \left(\frac{xfx}{N}\right)\left(\frac{yfy}{N}\right)}{\sqrt{\left(\frac{x^2fx}{N}\right) - \left(\frac{xfx}{N}\right)^2}\sqrt{\left(\frac{y^2fy}{N}\right) - \left(\frac{yfy}{N}\right)^2}}$$

where,

x = weight of the Girls or Boys

y = height of the Girls or Boys

f = frequency

N = Total number of observations.

APPENDIX XII

CALCULATION OF CHEST HEAD RATIO

$$\text{Chest/Head ratio} = \frac{\text{Chest Circumference}}{\text{Head Circumference}}$$

Done for each of the 2039 samples individually

••••••••••

APPENDIX XXII

FREQUENCY DISTRIBUTION OF WEIGHT OF GIRLS IN THE LONGITUDINAL STUDY

Weight in Kilograms	August	September	October	November	December	January
4.0 - 4.5	11	4	0	3		
4.5 - 5.0	20	22	15	5	7	3
5.0 - 5.5	18	15	22	23	18	10
5.5 - 6.0	3	11	15	14	22	31
6.0 - 6.5				7	5	8

FREQUENCY DISTRIBUTION OF HEIGHT OF GIRLS IN THE LONGITUDINAL STUDY

Height in cms.	August	September	October	November	December	January
55 - 60	34	24	18	3		
60 - 65	18	28	34	49	49	43
65 - 70	-	-	-	-	3	9

FREQUENCY DISTRIBUTION OF HEAD CIRCUMFERENCE OF GIRLS IN THE LONGITUDINAL STUDY

Head Circumference in cms.	August	September	October	November	December	January
35 - 40	51	44	36	26	15	7
40 - 45	1	8	16	26	36	44
45 - 50	-	-	-	-	1	1

FREQUENCY DISTRIBUTION OF CHEST CIRCUMFERENCE OF GIRLS IN THE LONGITUDINAL STUDY

Chest Circumference in cms.	August	September	October	November	December	January
33.5 - 38.5	52	49	14	4	2	-
38.5 - 43.5	-	3	38	48	50	52

FREQUENCY DISTRIBUTION OF ARM CIRCUMFERENCE OF GIRLS IN THE LONGITUDINAL STUDY

Arm Circumference in Cms.	August	September	October	November	December	January
8.5 - 10.5	1	-	-	-	-	-
10.5 - 12.5	46	34	21	28	-	-
12.5 - 14.5	5	18	31	24	51	48
14.5 - 16.5	-	-	-	-	1	4

APPENDIX XIV

FREQUENCY DISTRIBUTION OF WEIGHT OF BOYS IN THE LONGITUDINAL STUDY

Weight in Kilograms	August	September	October	November	December	January
4.0 - 4.5	1	-	-	-	-	-
4.5 - 5.0	30	12	-	-	-	-
5.0 - 5.5	17	30	24	-	-	1
5.5 - 6.0	-	6	21	25	4	11
6.0 - 6.5	-	-	3	23	29	4
6.5 - 7.0	-	-	-	-	15	25
7.0 - 7.5	-	-	-	-	-	7

FREQUENCY DISTRIBUTION OF HEIGHT OF BOYS IN THE LONGITUDINAL STUDY

Height in Cms.	August	September	October	November	December	January
55 - 60	26	17	15	3	1	-
60 - 65	22	31	33	42	19	9
65 - 70	-	-	-	3	18	36
70 - 75	-	-	-	-	-	3

FREQUENCY DISTRIBUTION OF HEAD CIRCUMFERENCE OF BOYS IN THE LONGITUDINAL STUDY

Head circumference in Cms.	August	September	October	November	December	January
35 - 40	39	39	35	19	2	2
40 - 45	9	9	13	29	39	39
45 - 50	-	-	-	-	7	7

FREQUENCY DISTRIBUTION OF CHEST CIRCUMFERENCE OF BOYS IN THE LONGITUDINAL STUDY

Chest Circumference in Cms.	August	September	October	November	December	January
33.5 - 38.5	40	38	38	18	-	-
38.5 - 43.5	8	10	10	30	48	47
43.5 - 43.5	-	-	-	-	-	1

FREQUENCY DISTRIBUTION OF ARM CIRCUMFERENCE OF BOYS IN THE LONGITUDINAL STUDY

Arm Circumference in Cms.	August	September	October	November	December	January
10.5 - 12.6	32	32	28	28	-	-
12.5 - 14.5	16	16	20	20	48	48