NUTRITIONAL PROFILE OF SELECTED NURSING MOTHERS IN COIMBATORE CITY

By

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CHAPTER	TABLES OF CONTENTS	PAGE
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF APPENDICES	
I	INTRODUCTION	1
II	REVIEW OF LITERATURE	8
	A. Nutritional Demands During Lactation	8
	B. Nutritional Status of Nursing mothers in India	10
	C. Studies on Breast milk	12
	D. Nutritional status of the exterogestate foetus as affected by maternal nutrition.	21
	E. Information on infant weaning foods	24
	and F. Birth spacing and Family Planning.	27
III.	EXPERIMENTAL PROCEDURE	
	1. Recording Data on the nursing mothers	29
	A. Selection of the area	30
	B. Selection of the Nursing mothers	30
	C. Assessing the nutritional status of the nursing mothers	30
	a. Recording the food and nutrient intake of the nursing mothers	
	b. Clinical picture of the nursing mothers.	
	c. Analysis of blood for serum retinol and haemoglobin levels.	
	D. Quantifying the breast milk out put.	

CHAPTER	TABLE OF CONTENTS	PAGE

LIST OF TABLES

No.	LIST OF FIGURES	PAGE
I	Breast milk output of selected Nursing mothers. (Teenage-adult)	51
II	Relationship between amenorrheal period and length of breast feeding.	55
III	Mean height of the breast fed and non breast fed infants.	58
IV	Mean weight of the breast fed and non breast fed infants.	59

No.	LIST OF APPENDICES	PAGE
I	Questionaire to study the Nutritional profile of selected Nursing mothers and their infants in Coimbatore city.	89
II	Questionaire for family and individual food consumption survey-weighment method.	98
III	Procedure for estimation of serum retinol	99
IV	Procedure for estimation of Haemoglobin.	101
V	Milk Analysis:	103
	a. Procedure for total solids	103
	b. Procedure for Energy estimation	105
	c. Procedure for protein estimation	108
	d. Procedure for Fat estimation	113
	e. Procedure for calcium estimation	116
	and f. Procedure for Iron estimation	118
VI	Weighment calculation for the Nursing mothers.	120
VII	Individual serum retinol values of the selected nursing mothers	130
VIII	Individual Haemoglobin values of the selected Nursing mothers.	131
IX	Weight and height of the selected Nursing mothers.	135
X	Milk output of the Nursing mothers.	140
XI	Values of Nutrient composition of breast milk of the nursing mothers.	142
XII	Anthropometric measurements of the 0-12 months of non-breast fed infants.	
XIII	Anthropometric measurements of infants in 0-12 months of life.	147

I INTRODUCTION

India is the second most populous and the seventh largest country in the world, with a density of population 177 per square ~~with~~ kilometre (India 1976). It has been estimated that the growth and fertility rate is about 2.5% which means that by 1981 India would cross a population figure of 700 million. Something needs to be done now and urgently to arrest such a high rate of population growth, if we are to advance any further in our socio economic conditions - country as a whole. Realising this the government of India has been engaging itself in many kinds of family planning activities. Limitation of birth rate and proper birth spacing have been the two main objectives of family planning programme in India according to Bhalla et al (1974).

However it has now been realized that family planning will not be accepted in developing countries until a significant reduction in infant mortality has been achieved (NAC 1975), because people are afraid that their children may die and by having many children at-least a few may survive. This 'Child Survival Hypothesis' holds that once infant mortality declines, parents will perceive that fewer pregnancies only are necessary to achieve the desired limited family size.

Against such a hypothesis, the survival rates among the infantsc are alarmingly low. Infant mortality rates are estimated to be around 69/1000 live births by Gopalan et al (1971) which is still much higher than that obtained in technologically advanced countries like Sweden (13.3), Japan (18.5), United stated (23.4) and Australia (18.2).

In this context of limiting the family size and reducing the infant mortality breast feeding assumes great importance.

The biological link between the mother and the child continues even after birth through breast feeding up to weaning. The psychological boundaries between the mother and the child are blurred and the mothers in many cultures especially in the developing countries view their babies much more as an extension of themselves according to Ramalingaswami (1976).

Nursing the child is an extremely ancient physiological process, long antedating placental gestation. In the opinion of Jelliffe (1976), human milk is highly protective against infant malnutrition and the associated infective diarrhoeas. All mammalian milks meet the highly specific physiological needs of each species to ensure its optimum growth and development. Recent studies of Jelliffe (1976)

indicate that there is truth in the old wives tale that breast feeding has a contraceptive child spacing effect which is related to the anovulatory effect of prolactin and other hormones secreted by the anterior pituitary in response to the baby's sucking. On a world wide basis lactation contraception probably has a numerically greater rate of protection from pregnancy, measured in women-months per year, than has currently been achieved by technological devices.

Jelliffe (1976) has pointed out the anti-infective properties of it due to its contents of I gA, lactoferrin and Lysozyme, anti-allergic properties due to the absence of beta-lactoglobulin and serum bovine albumin. The difference in financial cost of breast feeding and bottle feeding are very large. On an individual family basis the cost of formula can be compared with the extra nutrients needed by the lactating women that is 500 calories and 20 g. of protein which would mean 25-50% of the family's earning in a low income group.

Thus the advantages of using breast milk weigh much heavier than the contra indications unless the mother is not in a position to do so. However the prevalence of lactation has declined in poorly nourished as well as adequately fed communities. This is because of insufficient emphasis and

understanding by health professionals, changing role of urban women, pressures of commercial advertising, the belief that bottle feeding is the modern way and adoption of cultural attitude in which the female breasts are felt to have an exclusively esthetic and erotic role without any nurturing function.

This leads to disastrous results in the form of a rising incidence of early marasmus and diarrhoeal disease, because bottle feeding is attempted by poorer women without sufficient funds to purchase adequate quantities of formula and reasonable home hygiene. Thus breast milk is the safest food for every young infants who could be nursed at the breast and is probably the best method of providing gratification and a sense of security to the babies.

The first and the foremost step in successful breast feeding is maintaining at an optimal level the nutritional status of the mother. The nutritional status of the exteregestate infants in the first year of life depends on the local methods of infant feeding through the foetal stores, the maternal diet in pregnancy and on the mothers own nutritional status.

After birth, the child still may be fed from the mother's body, the food now being produced by the mammary glands

instead of being supplied through the blood stream, as before birth. As the baby gains in weight and becomes increasingly active, the food supply from the mother must increase (Anderson 1972).

The well being of the infant depends to a considerable extent on the diet of its mother during pregnancy and lactation. The nursing of the child makes extra demands on the mother, and her requirements of protein, vitamins and minerals are increased as a consequence. Hence lactation makes a great demand on the maternal organism than even pregnancy.

Hence it becomes essential to ensure the health of the surviving infant and its mother by disseminating information on the benefits of breast feeding, countering commercial pressures toward artifical feeding and by establishing employment policies to enable the mothers, breast feed their infants. There is an associated need for nutritional protection of nursing mothers and the extero-gestate through the post weaning period, NAC (1975).

The starting point towards improving the nutritional status of the nursing mothers is to know what they eat so that emphasis could be placed on areas of foods which are

essential but not consumed. It might also be interesting to note the amount and adequacy of breast milk, since data along these lines are lacking (Rao 1974) Jelliffe (1976) opines that the figure of 850 ml/day quoted often is too high and hence more studies are needed to find out the correct volume of breast milk. It might also be worth finding out the age until which breast milk could be considered as a sole food for the exterogestate foetus, as judged by the baby's weight gain. This might throw some light on the contro-versial question asto how long the child could be solely breast fed and what is the right time for the introduction of weaning foods. Some recent investigations in poorly nourished communities into the adequancy of breask milk as the sole food for the extero-gestate foetus have shown periods of only 3-4 months rather than six months known to be the case with well nourished breast feeding mothers and previously reported from many developing countries (Jelliffe 1976).

Considering the rapid decline in lactation, it might be useful to study the impact of lactation on the health of the infants. The present study aims at

1. Finding out the food consumption patterns of nursing mothers and the resulting nutritional status.
2. Volume and composition of breast milk

3. Health status of infants who are breast fed as against non-breast fed.

and 4. The problem of lactation amenorrhea. It is hoped that this study would through some light on the need for breast feeding and related aspects.

II REVIEW OF LITERATURE

The literature pertaining to this study on 'Nutritional Profile of selected nursing mothers and their infants in Coimbatore city' is dealt with under the following headings:

1. Nutritional demands during lactation.
2. Nutritional status of nursing mothers in India.
3. Studies on Breast milk.
4. Nutritional status of the exterogestate foetus as affected by maternal nutrition.
5. Information of infant weaning foods
6. Birth spacing and Family Planning.

1. Nutritional demands during lactation:

Rao (1974) carried a survey on expectant and nursing mothers of low income group and found that their diets were grossly different in protective foods as well as in staple cereals. According to him on an average, a nursing women in India subsists on diets which supply about 1800 calories, 45g of protein, 18.20mg of iron and 200-300mg of calcium per day.

Devadas (1972) exhorts that during lactation, the nutrition requirements of the mother increase progressively

over her pregnancy need, with two exceptions; her calcium requirement is unaltered and her need for iron returns to that of her pre-pregnant status. Additional calories and nutrients are required by the mother for milk production which should increase steadily on the needs of the fast growing baby. Unless a mother has a substantial diet, she will produce milk at the expense of the caloriesand nutrients her body requires; she may not be able to produce milk adequate in quantity and quality for her baby, and she may loss weight and health. The ICMR Nutrition Expert Committee (1971) assumes the average amount of milk in nursing women in India and other developing countries to be 600 milli litres. According to this estimate the nutritional requirements of nursing mothers have been suggested by various expert Committees.

WHO Expert Committee(1973) assumes the optimal daily milk output of an average mother to be 850 ml. This would mean an extra requirement of 600 k. calories 1022 g. protein, 240 mg calcium, 0.25 to 3.1 mg iron, 420 mg vit. A., 22 to 44 mg ascorbic acid, 1.6 mg Niacin, 0.52 mg riboflavin 0.12 mg thiamine, 9.0 mg folic acid and 0.2 mg Vitamin B 12.

The mean protein requirement of Indian women during nursing is around 60 g per day or 1.5g per kg/day(ICMR, 1971). In practice, the average protein intake of nursing mothers of the low socio economic group is only around 40g per day according to Kalpakam (1972). Sehring (1970) suggests that substitutes for human milk are cereal based foods and other baby foods animal or vegetable based for infants and young children.

Atkinson (1970) suggests that the dietary requirements of calcium for woman during lactation is 3 g per day. It would appear however, that even this level of intake does not prevent skeletal loss. The three women selected by Donelson et al (1970) shows negative calcium balances during lactating periods despite an adequate calcium intake by the mothers.

Against such great demands exhibited during lactation, we find that the nutrition of the nursing mother is the least cared for.

2. Nutritional status of Nursing mothers in India:

Gopalan (1970) and Bhavani Belavady (1960) say, that the dietary intake of the Nursing mother was inadequate.

Madhavan (1961) and Gopalan (1963) observe that in the low socio economic group of the Indian population, the nursing women used garlic, tamarind and cotton seed in the dietaries with the belief that they acted as galactogogues. Belavady et al (1963) made a study of these customs in the Nilgiri hill tribes. The toda mother was usually not allowed milk during early lactation, and was given certain glactogogues instead.

Bourne (1965) collected data on the nutrient intake of 160 women of one week in the 2nd and 3rd month of the nursing period and for another one week, seven months later when the breast feeding had ceased, though the average consumption of calories, animal protein and thiamine was in accordance with the recommendations, intake of calcium, iron, riboflavin and vitamin C was relatively low assuming a level over 15 per cent deficit against recommended allowances.

Swaminathan (1971) points out that a majority of women in developing countries suffer from malnutrition. Malnutrition could be alliviated by improving food distribution and the economic, social, educational and cultural status of the people, and also by controlling population and eradication of communicable diseases.

Devadas and Mangalam (1970) opine, that because of low socio economic status the amount they could spend on food was deficient. Except iron, their diets were deficient in calories and all other nutritents.

The kind of diet consumed by the mother is important not only in view of maintaining her health but also for the health of the infant because studies that are available indicate that the volume of breast milk is affected by the poor nutritional status of the nursing mothers as revealed in the next chapter.

3. Studies on breast milk:

a. Techniques for measuring the milk yeild.
b. Volume of breast milk
c. Length of breast feeding
d. Composition of breast milk.

a. Techniques for measuring the milk yield:

Two techniques exist for measuring the milk yield by the mother. (1) to weigh the child before and after each feed known as test feeding techniques, (2) to empty the breast by hand or mechanically. (FAC/WHO 1967).

Both techniques have their drawbacks. In the first the quantity measured represents that taken by the child and not that secreted, which may be larger. This techniques does not allow the taking of samples for determinations. In the second method it is difficult to ensure that the breast is completely empty. Both methods suffer from the disadvantage that their application requires a set feeding schedule, the introduction of which may influence the milk output, particularly if the mother is accustomed to feed the infant on demand. It appears necessary to make observations for atleast a week to minimize the psychological effects of such procedures.

Janz demeeyer and Close (1967) have described the many factors that may influence the volume of milk production. They include the age and weight of the infant, age of mother parity, and the state of health of the mother along with individual variations.

b. Volume of breast milk:

Richard (1975) found that, women with very inadequate diets or frank malnutrition have a reduced milk volume and the energy content of the milk may be lowered by a decline in the lipid constituents. Jelliffe (1976) estimated

the amount of daily milk secretion of the Swedish women, at the sixth month on 12 mothers, and found the volume to be 756 ± 140 ml. Gopalan et al (1958) conducted a serial study of the output of milk right from the first week of lactation to nearly two years of lactation in 14 poor Indian mothers. The study revealed that the mothers secreted between 450 to 600 ml of milk per day, till the end of the first year of lactation after which the put decreased to 150 ml daily.

Someswara Rao et al (1959) carried out a cross sectional study on 184 women who belonged to the low economic groups and were in different stages of lactation. The yield of milk ranged between 530ml and 730ml daily during the first year of lactation.

The National Research Council (1957) of the U.S.A. reports that the output of milk increases from about 500ml daily after the first week or two of lactation, to about 1000ml in the fifth month. This increased out put of milk continues up to the 12th month and then becomes lower.

Ghopra (1972), Feisen (1972) and Gupta et al (1974) suggest that milk production is affected by oral contraceptives. Prolactin is considered to be an important factor. Gopalan (1958) found that in lactating women who became pregnant,

a marked diminution in the out put of breast of milk, as low as even one ml occured after the commencement of pregnancy.

Gopalan (1958) studied the effect of the galactagogues like garlic, cotton seed and tamarind on the yield of milk. There was no significant increase in the yield of milk due to any of these galactagogues.

As the volume of breast milk reduces the mother feels the inadequacy of breast milk, which, indirectly affects the length of breast feeding.

C. Length of breast feeding:

Saxama and Garg (1968) say that about 20 per cent of upper class mothers never breast fed their babies. The usual duration of breast feeding on 6 months to one year. The number of breast feedings depended mainly on baby demand.

Narayanan et al (1974) report that among the Harijans (low income) breast feeding continued for two to three years. In the Reddiars(middle income) 47 per cent babies were weaned by the age of 6 months. Bensal et al (1973) point out that 66 per cent babies were breast fed upto 18 months.

Madhavi (1972) explains that breast feeding was continued as long as possible in a sample she studied. About 3.7 per cent children were breast fed upto the age four years, only 3.7 per cent children were weaned before age 2 years, that too probably because of mothers ill health or next pregnancy.

Matha et al (1972) putsforth that in a group of 400 infants, 91 per cent of mothers gave the neonates a prelacteal feed. Breast milk was considered adequate upto 6 months. There after, the nutritional disorders showed up and increased. Prolonged breast feeding, poor knowledge of infants diets and delayed weaning were major causes of nutritional disorders of children.

Patri et al (1973) state that breast feeding in Guetemala lasts for a year or more, whereas infant weaning occours during the first 3 months. John (1973) estimates that 21.4 per cent of them breast fed for 3 months and 9.7 per cent of them fed for 6 months.

Ghosh et al (1976) opine that breast feeding in the Delhi mothers is being curtailed rather early by a significant number of mothers. Literate or older mothers tend to breast feed their infants for a shorter time compared to illiterate

and young mothers. The illiterate mothers on the other hand tend to continue breast feeding for unduly prolonged periods. The supplementation with liquid feeds is rather early but the introduction of semisolids and solids is delayed unduly in a majority of the children. Mothers educational status seem to have a profound influence on infant feeding practices.

Salber et al (1971) find that a greater percentage of women of the higher social classes breast feed than those with lesser education and in the lower social strata. Sand et al (1973) interviewed 2000 mothers and found that soon after birth 32 per cent of the infants were wholly or partly breast fed and that 70 per cent of these infants had been weaned by 3 months of age, mothers who stopped working before delivery exhibited a greater tendency to breast feed.

Gopalan (1973) explains that all mothers in malnourished communities breast feed their children for prolonged periods sometimes extending to 2 years. This practice is attributable not only to cultural but also to economic factors.

Klachenberg et al (1969) explain that the duration of breast feeding was related to sex of the infant, age of the mother and social class. According to these authors males were breast fed longer than females. Surveys conducted

by Margaret (1975) show that only 28 per cent of babies were breast fed even soon after birth and in most cases this was not continued beyond the first month.

Balavady et al (1960) studied the breast feeding practices among four tribes of the Nilgiris in South India. The study shows that among these tribes breast feeding was continued for periods extending upto 2 years. Gopalan et al (1971) carried out a survey on the breast feeding practices in higher socio-economic groups. It was found that only 22 per cent of the mothers investigated had been able to feed their infants for atleast 6 months. This breast feeding differs with different sects, educational level of the mothers and their responsibilities outside their home. Under these circumstances it becomes necessary to know something about the composition of breast milk, as affected by the volume of milk, length of breast feeding and nutritional status of the mother.

d. Composition of breast milk:

Venkatachalam et al (1962) observe that protein supplementation to nursing mother decreased the concentration of vitamin A in serum without influencing the concentration of vitamin A in milk.

Gopalan (1963) points out that the protein supple-

mentation to a group of 15 mothers immediately after the birth of the child did not show any difference in the yield of milk between the supplemented and unsupplemented groups.

Ma (1976) points out that the colostrum was available from seven mothers of low socio-economic status and three of higher group. Average protein in the first group was 4.5g/100ml. and in the 2nd 5.25g/100ml, Fat was 1.7% and lactose values were lower than in transitional and mature milk. It is known that human colostrum differs from mature milk.

Gopalan (1961) suggests that the extent to which calorie intakes influence the composition of milk remains a relatively unexplored field, partly because of the preoccupation of nutritionists with protein supplementation.

Khurana et al (1970) found breast milk iron declining with the lactation period. Mean iron contents in colostrum transitional and mature milk is 132.2± 59, 120.6 ± 25 and 109±21mg per cent respectively and a protein value of 1.460 g per cent. Dietary intake, socio economic status and maternal parity did not alter the breast milk iron and protein composition in this study. This view is endorsed

by Rao and Gopalan (1962) and Kalavady (1967). Venkatachalam (1975) suggests that the fat content of the breast milk might be related to the fat intake of the mother similar observations have been made by Dean (1970).

Deb (1976) pointed out that Calcium levels ranged in most of the cases from 20 to 27 mg/100ml, phosphorous levels varied from 15 to 20 mg/100ml and there was not a great difference between the socio economic groups and time of lactation.

Mocosh et al (1973) observed no increase on supplementation in the Vitamin content of milk of women who had already been taking a diet with good amounts of vitamin A. On the other hand Kon and Mawson (1973) have studied the effects of supplementation to the mother in different stages of lactation on the concentration of vitamin A. Mothers supplemented with vitamin A in the form of cod-liver oil or vitamin capsuls had higher concentration of vitamin A in their milk as compared to unsupplemented mothers. Milk samples in different stages of lactation were analysed by Peter (1975) for all the proximate principles, vitamins and minerals. Thiamine was higher in the 1st month after

delivery than in the later stages of lactation. There was no correlation between the Iron content of milk and the Haemoglobin levels of mothers.

Thiamine, Riboflavin and ascorbic acid supplementation increases the breast milk levels, which does not occur rapidly with vitamin A according to Deodhar et al (1964).

Thus it seems that the content of fat and the water soluble vitamins may be affected by the type of nutrition the mother receives and this may have its own effects on the extero gestate infant.

4. Nutritional status of the exterogestate foetus as affected by maternal nutrition:

Qureshi et al (1973) report that a daily supplement of iron and folic acid provided to women in the latter half of their pregnancies improved their body weights and the birth weights of their babides. Further dietary supplementation produced a significant increase in the birth weights.

Pachuria and Marwah (1971) Barua (1973) explain that the nutritional status of the mother, especially the quantum of calories, protein and calcium consumption

during the third trimester of pregnancy affected the child's birth weight. The per capita income, unit expenditure on food and per capita consumption pattern of the family also affected the birth weight.

Srivastava (1971) observed that mothers between 25 and 29 years delivered 46.6 per cent babies with birth weights over 3000g. only 4.5 per cent babies, born to these mothers were below 2000 g. 13.4 per cent babies, born to mothers below age 20 had birth weights below 2000g. 11.3 per cent babies, born to mothers between 35 and 39 years also had birth weights below 2000 g.

Pachuria and Marwah (1970) are of the view that maternal age was a decisive factor parity was subsidary. A positive correlation was observed between maternal weight and the baby's birth weight. Gestational age of the neonate affected its birth weight, to the exclusion of all other factors. Saigal and Srivastava (1969), Banik et al (1969) indicate that, birth weights of babies were directly related to maternal nutrition and the socio economic status of the family.

Prasad (1974) says a women's nutritional status during pregnancy and the length of gestation were important in determining the extent of fetal growth. In 36 new born-

babies

significant correlation was observed between maternal serum protein and cord serum protein and between the creatinine content of liquor amni and baby's birth weight.

Gopalan (1971) estimates the mean birth weight of infants of the low socio economic group to be about 2.8kg, while that of infants of the high socio economic group was about 3.1 kg.

Ghosh et al (1971) point out that weight and height gain in Indian Infants slow down after 5-6 months of the infants life. This is due to inadequate nutrition when the breast milk becomes less in quantity and proper supplementation of the infants diet is lacking.

A group of Gautamalan workers (1973) show that when all other important variables are controlled it can be proved in an under-nourished population that maternal dietary supplementation critically affects infant birth weight.

Dan and Sharma (1973) report that boys were ahead of girls in motor development after age three years and in adaptive behaviour development around age 5 years. Girls were superior in language and social development attainments. Light weight children usually walked earlier than heavy

children, however, heavy children were ahead in motor development. These depend upon maternal nutrition to a great extent.

These decreased values in birth weight and the slow growth process could be to some extent alliviated if proper weaning foods are given to these children. The next chapter deals with the kind of weaning foods given to the infants.

5. Information of weaning Foods:

Seth and Ghai (1971) point out that they one year 36.8 per cent of the urban, 4.5 per cent semi urban and 2.1 per cent rural children were completely weaned from the breast. ICMR Technical Report (1974) putsforth the details of a survey of 21,870 households in six different regions of India. Tea, Coffee and porridge made from cereals or millets were commonly favoured weaning foods. All mothers believed that cow's milk, bread and biscuits were the best weaning foods. Some reasons for introducing supplementary foods were insufficiency of breast milk, mothers working outside the home, or medical advice.

Sethi et al (1973) report that among 100 children, aged three to 40 months, all children had been weaned by age one year and cow's milk was the mainstay of their nutrition. Other supplementary foods were introduced at

age six months. The commonest were orange or sweet lime juice mixed vegetable or tomato soup, rice, gruel etc. Bhandari and Patel (1973) point out that at age one year, only 25 per cent infants were solely breast fed. Solid foods, mainly carbohydrates, had already been introduced.

Jelliffe (1976) advises that the first foods added to the child's diet after 4 months can be in the liquid form, Buffaloe's or cow's milk, mashed vegetables like potatoes, tender beans, carrot and green leafy vegetables can be sagely given. Many mothers add too much water to milk this making it less hutritions.

Roshan et al (1974) point out that a weaning mixture (Kuzanthai Arundhu) based on sorghum, Bengal gram dhal, groundnuts, and Jaggary was evaluated through a feeding trial for six months, on young children of 15 to 36 months. There was a significant increase in weights and heights in children who were reciwing the weaning mixture when compared to a similar group of children in the control group, who did not receive any supplement.

Narayanan et al (1974) explain, in the Harijan families, solid foods like rice, idli, ragi conjee, bread were served to children only after two years, Among the Reddiars, 73 per cent children, after age one year were weaned with rice, fish, mutton or eggs.

Bensal et al (1973) say weaning with liquid and solid foods began before child age six and 12 months respectively. Devadas et al (1974) report, a low cost ready to eat infant weaning food (30g roasted maize flour, 20g roasted gram flour, 10g roasted ground nuts and 20g Jaggery containing 305 calories and 11.46g protein) was fed to 100 children, age six months to three years, for one year which resulted in significant improvement of their nutritional status.

According to Ghosh et al (1971) the growth pattern of American and Indian infants differ considerably after 5-6 months of life. American infants start getting supplementary foods after 2-3 months of life while Indian infants derive most of the nutrients from mothers milk or cow's milk both of which are inadequate in quantity as well as quality after 5-6 months.

Burgess (1970) points out that human milk is usually given for only a few weeks as a sole food. By contrast 2/3 of the world's population that of southest Asia, Africa and Latin America, breast feed beyond one year. Other foods are introduced sparingly and these are mainly cereals and roots of low nutritive value. The immediate cause of protein-calorie deficiency is the cessation of breast feeding and deprivation of good quality food. Similar observations have been made by Kuti (1975).

Dubash (1976) putsforth that in India, as in many other countries of the world, the diets of weaned infants of low socio-economic groups consist predominantly of starchy foods which are poor in protective nutrients. This spectra of malnutrition is a constant threat to normal development (Cravioto et al 1973) and even greater attention must be accorded to the nutritional needs of these growing infants. The best substitute for breast milk and certainly the most commonly used are cow's milk, modified buffalo's milk and commercially prepared infant milk formulae. The supplementation of the milk formulae with iron and vitamins has been emphasized by Filer (1972).

Even with the limited weaning foods available, if the number of children are limited by spacing the birth intervals properly a lot could be achieved towards improving the nutritional status of the infants.

6. Birth spacing and Family planning :

John (1974) points out an inverse relationship between family size and nutritional status. Nearly 70 per cent of all cases of malnutrition are seen in children of birth order of 4 and above and restriction of family size

to 3 children will serve to eliminate atleast two thirds of the total amount of malnutrition seen among children in poor communities in India.

Bhalla (1975) exhorts that limitation of birth rate and proper birth spacing have been the two main objectives of the Family Planning Programme in India.

Khan (1973) reports that 20-39 months was the most favourable birthspacing in women. With increasing birth interval the mean birth weight also increased.

Sethna (1970) explain that spacing of 2 to 2½ years showed the highest mean birth weight.

Kumar (1974)says, family planning could be considerably augumented if it was integrated with maternal and child welfare services and the couples themselves selected the contraceptives suited to their needs.

Jelliffe (1973) says, the degree of protection from lactation amenorrhea is undoubtedly decreasing because of reduced breast-feeding, increased bottle feeding,supplementation, urbanization, modernization and increased availability of milk powers unforhumately all too often from poor medical and nursing guidance.

III. EXPERIMENTAL PROCEDURE

The experimental procedure for the study includes following aspects.

I. Recording data on the nursing mothers.

- A. Selection of the area
- B. Selection of the nursing mothers
- C. Assessing the nutritional status of the nursing mothers
  1. Recording the food and nutrient intake of the nursing mothers.
  2. Clinical picture of the nursing mothers
  3. Analysis of blood for serum retinol and haemoglobin levels.
- D. Quantifying the breast milk out put
- E. Analysis of breast milk for Total solid energy, protein, fat, calcium and Iron
- F. Recording the weight and height of the nursing mother.
- G. Recording lactation of amenorrheal period.

II. Growth performance of the extrogestate.

- A. Anthropometric measurements of infants in the first year of life.
- B. Physical and motor development of infants.
- C. Recording the health status of infants.
- D. Recording the weaning foods given.

I. Recording data on the nursing mothers:

A. Selection of Area

Two villages namely Goundampalayam and Valandipalayam were selected for conducting the study. Rural Nursing mothers who were attending the Kuppuswamy Naidu Memorial Hospital for women and children were also taken.

B. Selection of the nursing mothers:

Nursing mothers in the age of 18-35 and ceeperative were selected as subjects for the present study. A total of 270 nursing mothers were available for the study. Care was taken to see that all the nursing mothers were residents of Coimbatore City through out the study period, co-operative and available for the investigator. Forty mothers chosen as sub-sample were kept under continuing systematic surveillance for a period of six months. The rest of the sample was studied crosssectionally.

C. Assessing the nutritional status of the nursing mothers:

1. Recording the food and nutrient intake of the nursing mothers:

To assess the nutritional status of the nursing mothers a three day food weighment survey was carried out for a subsample of twenty mothers with the help of a proforma prepared by the

investigator specially for this purpose. The proforma is given in Appendix II. To ensure accuracy the investigator was with the families almost all the time through the period of food weighment. Three families were taken at one time, and all the raw foods taken for cooking were weighed out and the total cooked weight of the food recorded. Food was consumed by the nursing mother and the remaining items of the food were weighed again to find out the exact amount of food consumed by the nursing mothers. Raw equivalents for these food items were then calculated. The nutrients available from the food intake was calculated using the Food Composition Tables of ICMR (1971).

2. Clinical picture of the nursing mothers:

A clinical examination was carried out on all the nursing mothers with the help of a trained doctor.

3. Analysis of blood for serum retinol and haemoglobin levels:

Estimation of serum retinol levels:

Serum retinol is reduced only after a prolonged serve dietary deficiency. So a low serum level of retinal reflects not only the current short term deficiency also long term shortage and vitamin from storage depots. Three milli litres of blood was drawn from twenty co-operative nursing mothers. The samples were analysed for serum retinal

content by spectrophotometric method. Neeld and Pearson (1963). Procedure for Serum Retional given in Appendix XII.

Estimation of Haemoglobin:

Haemoglobin levels are of great practical value in assessing the nutritional status of nursing mothers according to Jelliffe (1966). Haemoglobin Values were found for ten nursing mothers who were co-operative and helpful. Estimation was carried out by cyanmet-haemoglobin method (Cart wright 1958) by obtaining 0.2ml of blood by finger prick methods given in the Appendix IV.

D. Quantifying breast milk out put:

Studies on the volume of breast milk are notoriously difficult to undertake, because of interference with the emotionally labile let down reflex and problems of measuring through out the 24 hours. However quantification of breast milk was undertaken on the 40 nursing mothers who were co-operative, at the sixth month of lactation. It has been observed that the breast milk out put is maximum around the sixth month of lactation. The infant was weighed before and after all feedings in one day, and the total weight computed. This was repeated twice. The breast milk out put of teenage mothers and that of adult mothers were computed separately for purpèses of comparison.

5. Analysis of breast milk for Total Solid Energy, Protein, Fat, Calcium and Iron:

Breast milk of selected ten mothers was analysed for total solid energy, protein, fat, calcium, and Iron. Estimation of protein was done by microkjeldahl method (Hock and Oser 1971) Estimation of energy was done with the help of a Bomb calorimeter according to the method suggested by (Patwardhan 1960). Lipids present in the breast milk was analysed according to the method suggested by Davies (1934). The calcium content and iron content of breast milk was found out by adopting the procedure published by Hart and Fisher (1971). Procedure and methods given in Appendix V.

6. Recording the weight and height of the nursing mothers:

It has been stressed time and again that the nursing mother loses her weight due to the burden of lactation. This weight reduction may be proportional to the quantity of the diet the mother consumes. Hence in the present study the investigator undertook to study the weight pattern of the nursing mothers included in the longitudinal study. Weight was recorded at different stages of lactation with the help of a beam balance and recorded to the nearest 250g.

Height was recorded with the help of a fibre glass tape fixed to a wall of uniform surface area. Height was measured nearest to 1cm.

II. Growth performance of the exterogestate foetus:

A. Anthropometic measurements of infants in the first year of life.

The following anthropometric measurements of the infants were recorded for all the exterogestate infants and the measurements were done continuously at the end of each month for 6 months on the selected forty infants.

a. Crown heel length
b. Weight
c. Head circumference
d. Chest circumference
e. Mid-arm circumference

a. Crown heel length:

Crown heel length was recorded with the help of an infanto-meter a specially prepared measuring board provided with two wooden cross-pieces, one fixed and the other capable of sliding (Jelliffe 1966). The infant was placed on the table with legs compeletely stretched and head positioned in

such a way that a line drawn from the infra-orbital margin to the auditory meatus was perpendicular to the horizontal surface. The fixed cross-piece of measuring board just touched the heels to give the crown heel length (Jelliffe 1966) Venkatachalam and Singh, 1962) Length was taken nearest to 1 cm.

b. Weight:

Weight was recorded with the help of a Detecto beam balance nearest to 0.01 kg. The balance was checked with standard weights everytime before use, for accuracy. (Jelliffe, 1966, Pachuria and Marwah, 1970, and Gupta, 1971).

c. Head circumference:

Head circumference was measured using a soft fibre glass tape passing round the supercilliary ridges infront and occipital protrusion behind (Jelliffe 1966) Dessilva and Baptist, (1969) and Myers (1973).

d. Chest circumference:

Chest circumference was taken with the same fibre glass tape. A helper held the baby lightly so that the thorax did not present any skin folds. The measurements, of the girth of the thorax were taken at the level of the xiphisternum and in a place

at right angles to the vertebral column below the inferior angle of the scapula. Sufficient tension was applied to enable the tape to rest against the perimeter of the thorax without slipping (Venkatachalam 1962, pachuria and Marwah 1970)

e. Mid-arm circumference:

The arm girth was measured at the level midway between the acromial and olecranon process with the arm hanging freely relaxed with the tape applied at right angles to the long axis of the humerus (Jelliffe 1966) Malina 1972 and Myers 1973).

B. Physical and Motor development of infants:

The various milestones in the development of the child namely fixing of the eyes, following objects, smiling, recognising the mother oral exploration, sitting in the support, transport of the object, tonic neck reflex, Head midplane with symmetric posture and complete head control were observed and carefully recorded by the investigator herself and the exact period of acquiring that skill was checked with the mother.

c. Recording the health status of the infants :

The health status of all the infants included in the study was recorded with respect to the signs of mal-nutrition exhibited, presence of worms and reported sickness since birth. The clinical signs of mal-nutrition were recorded with the help of a trained physician. For finding out the presence of worms, the faeces of the infant were collected and analysed for the presence of cysts or worms in the Municipal health laboratory situated near the college. Any history of repeated sickness since birth were enquired and recorded by oral questions.

D. Recording the weaning foods given:

Weaning foods like glaxo, Farex, Amulspray, grapes, and Ragi malt were given to the infants in the study was recorded.

IV RESULTS AND DISCUSSION

The results and discussion pertaining to this study are presented under the following headings:

I. Background information pertaining to the nursing mothers

II. Nutritional status of the nursing mothers as assessed by

1. Mean food and nutrient intake of the nursing mothers
2. Clinical picture of the nursing mothers
3. Mean serum vertinol and Haemoglobin levels
4. Mean weight and height pattern of the nursing mothers, participating in the longitudinal study.

III. Breast milk output by selected nursing mothers.

IV. Composition of breast milk with respect to selected nutrients.

V. Relationship between amenorrheal period and length of breast feeding.

VI. Growth performance of the exterogestate infants.

1. Anthropometric measurements of infants in the first year of life.
2. Physical and motor development of the infants.
3. Other Details regarding the infants.

a. Health status of the infants

a. Signs of malnutrition

b. Presence of worms

c. Reported sickness of the infants

b. Weaning foods given to the infants.

I. Background information pertaining to the nursing mothers:

A total of two hundred and seventy mothers could be contacted during the study period. Out of the two seventy families surveyed, it was noted that there was a declining trend in the joint family system. Eighty nine per cent of the families were from nuclear families against only 11 per cent from the joint families.

Table I presents the educational level of the nursing mothers.

TABLE I

EDUCATIONAL LEVEL OF NURSING MOTHERS

S.No.	Level of Education	Number	Percentage
1	Elementary	82	30.4
2	High School	84	31.1
3	College	38	14.0
4	Illiterate	66	24.5
	Total	270	100

It is evident from Table I that one fourth of the female population under consideration was illiterate and the rest had varying degrees of education upto college level. More and more studies on the nutritional status of population groups stress the fact that mothers should be aware of the importance of good nutrition and adding protective foods. Though there are many methods by which one could learn the facts of nutrition, education still plays a dominant role. Hence educating our mothers is of prime importance.

The sex ratio of the families selected for this study revealed the fact that for every thousand men there were 976 women. Differential mortality by sex accounts for the decreasing number of females over the period of 1961-71. In 1971 there were 932 females to 1000 males against 941 in 1961 according to Jain (1974). Such a decline is supposed to be due to maternal mortality or poor health of nursing mothers. The sex ratio is slightly high in the present study as against that of Jain (1974).

The main occupation of the heads of the families were agriculture, business, daily wage earners, teachers, tailors and coolies. There were more of agriculturists, business men and teachers in the higher educated families and the

rest of the population consisted essentially of wage earners and coolies.

Seventy five per cent of the ladies had been given in marriage even before the age of twenty. Many hazards in pregnancy and lactation are precipitated by the simultaneous teenage growth demands, experienced by these young mothers.

II. Nutritional status of the nursing mothers:

1. Food and Nutrient intake of the nursing mothers:

Table II presents the mean food intake of the selected sub-sample of ten mothers.

TABLE II

MEAN FOOD INTAKE OF NURSING MOTHERS

S.No.	Food Stuffs	Amount in grams ICMR	Allowance 1971
1	Cereals	628	575
2	Pulses	55	65
3	Green leafy vegetables	37	150
4	Other vegetables	74	100
5	Roots and tubers	64	100
6	Fruits	53	30
7	Milk	120	225
8	Fats and oils	16	60
9	Sugar and Jaggery	39	60
10	Meat and fish	0	30
11	Eggs	0	30
12	Ground nut	7	40

From Table II it is clear that as has been observed by many nutritionists in the past (Pasricha 1958, Umapathy et al 1976) that there is a preponderance of cereals, but protective foods like greens, vegetables and milk are inadequate when compared against the recommended allowances of ICMR (1971). The consumption of pulses, fats and oils

and sugar and jaggery were also inadequate in the present study. Table III presents the mean nutrient intake of the selected nursing mothers of whom the food weighment survey as conducted.

TABLE III

MEAN NUTRIENT INTAKE OF THE NURSING MOTHERS

S.No.	Details	Energy K. Cals	Protein g	Calcium m.g.	Iron mg.	Retinol µg	Thiamine mg	Riboflavin mg.	Vit.C mg.
1	Mean intake by by nursing mothers	2961	65	575	28	381	1.78	0.83	10.5
2	ICMR Recommended allowances	2900	65	1000	30	1150	1.5	1.6	30.0

In these selected nursing mothers the intake of energy and protein seemed to be adequate, through the quality of protein available is questionable in the absence of animal foods and inadequate milk or its products. The intake of calcium retinol, riboflavin and vitamin C were inadequate when compared against the recommended allowances of ICMR (1971).

Considering the low absorption rates of iron intake of this mineral also seems to be inadequate. Individual Nutrient Calculations are given in Appendix VI.

While conducting the food intake survey it became evident that foods like ginger, fruits, milk and groundnut were specially included in their diet as they were nursing. This probably tells us the fact that the non lactating mother's diet may be still worse.

Certain foods like Ice cream mango, jackfruit, egg, brinjal and drumstick were not consumed by the mothers as they thought that these may harm the health of the child. Further research needs to be done on the validity of their statements regarding these foods.

2. Clinical picture of the nursing mothers:

Table IV presents the results of the clinical examination conducted on the mothers.

TABLE IV

CLINICAL PICTURE OF THE NURSING MOTHERS

S.No.	Symptoms observed in the mother	Number	Percentage
1	Anaemia	80	29.6
2	Oedema	52	19.3
3	Night blindness	104	38.5
4	Angular stomatitis	80	29.6
5	Bleeding gum	28	10.4
6	Others	85	31.5
7	No deficiency symptoms	76	28.1
		270	100

It is noteworthy that out of the 270 mothers who were subjected to clinical examination only 76 did not have any clinically observable deficiency symptoms. All the rest had some deficiency or other and in most cases it was a problem of multi-deficiency rather than single symptom. Night blindness, angular stomatitis and anaemia were the ones most frequently observed. This might be due to the low intake of retinol and B-complex vitamins and iron, by these nursing mothers.

3. Mean serum retinol:

Table V presents the serum retinol levels of selected twenty mothers who were willing to give blood for the estimation.

TABLE V

SERUM RETINOL LEVELS OF NURSING MOTHERS

Group	Mean serum Vitamin A content of selected mothers / 100 ml.
Nursing mothers in the present study	49.1
Venkatachalam and Belavady (1962)	25.2
Harper (1974)	20.64
ICNND (1963)	80.00

Mean serum values of 40μg/100ml are considered low in expectant mothers according to ICNND (1963), values between 40-79μg/100ml are considered medium risk and above 80 as low risk. Considering these values of ICNND the nursing mothers in the prdsent study face a medium risk in having serum retinol levels as 49 μg/100ml. Similar values have been given as guide lines for adequacyby Oomen (1964) National

nutrition survey and Mclaren (1966). Still lower values of 25.2 µg/100 ml of serum retinol have been obtained by Venkatachalam and Belavady (1962). Individual serum ratinol values are given in Appendix VII.

Table VI presents the mean haemoglobin levels of nursing mothers in the present study.

TABLE VI

MEAN HAEMOGLOBIN LEVELS OF NURSING MOTHERS

S.No.	Haemoglobin in g/100ml	Percentage
1	8-9.9	26
2	10-11.9	46
3	12-14.9	28
		100

Measurement of haemoglobin is adirect means of estimating iron insufficiency because of the ultimate role of the element in this molecule according to Samberlich et al (1976) The WHO (1971) criteria for the diagnosis of anaemia is 12g/100ml for non-preganant women.

It is obvious from table VI that only 28 per cent had a haemoglobin value which is 12g/100ml or over, the rest 72 per cent of subjects had levels below 12g, 26per cent of whom had levels below 10g which is a grave situation. Individual Haemoglobin values are given in Appendix VIII.

4. Mean weight and height pattern of the nursing mothers:

Forty of the total nursing mothers who were followed for a period of six months depicted the following weight picture in the process of lactation. Table VII presents the weight pattern.

TABLE VII

WEIGHT PATTERNS OF THE NURSING MOTHERS

S.No.	Age range in years	Mean initial weight of the mother in kg	Weight after 6 months of feeding in kg.
1	15-20	42.0	41.6
2	21-35	46.1	45.8

For a total period of six months the teenage nursing mothers had lost a weight equivalent to 1.4 kg and the adult mothers had lost 0.3 kg in the study period. The extra weight

loss in the teenage mother could be accounted for by her double demands. It has been observed by Venkatachalam et al (1960) and other workers that there is a weight reduction in the nursing mother while nursing the child, as the demands for energy and protein are in the order of 100000 calories and 1g/kg/body wt/day of protein in the first six month period of life of the infant (FAO/WHO, 1973).

Among the forty selected mothers who were followed the teenage mothers has shown mean increments of 1.00m. in the period of six months studied against nil in the adult mothers. This emphasises the fact that the mothers are growing still and need to be given special attention. Individual weight and height of the nursing mother are given in Appendix IX.

III. Breast milk output by selected nursing mothers:

Studies on estimation of breast milk are scanty because of the difficulties involved in collection Jelliffe (1976). Table VIII presents the volume of breast milk secreted at the sixth month after delivery, by the selected 40 mothers.

TABLE VIII

OF THE
BREAST MILK OUTPUT, SELECTED NURSING MOTHERS

Groups	Breast milk output volume in ml.	Percentage of mothers
Teenage mothers	500-600	43
	601-700	42
	701-750	15
Adult mothers	500-600	18
	601-700	36
	701-750	48

It is evident from Table VIII that the percentage of teenage women showing a breast milk output of only 500-600 ml/day were 43 per cent against 18 per cent in the adult nursing mothers showing that amount of breast milk output. Forty eight percent of the adult mothers had a milk output as high as 701-750 ml against only 15 per cent of the mothers in the teenage group. The mean breast milk output was 617 ml in the teenage mothers and 705 ml in the adult mothers. This is compawtively low breast milk output by the teenage mothers may be accounted for by the double demand the mother has to face. In any case breast milk output by these mothers is lower than values of 850 ml reported by FAO/WHO (1973). The values of the present study are in close agreement with the values of Someswara Rao et al (1959) Jelliffe (1976). (Fig. I). Individual

BREAST MILK OUTPUT OF SELECTED

NURSING MOTHERS

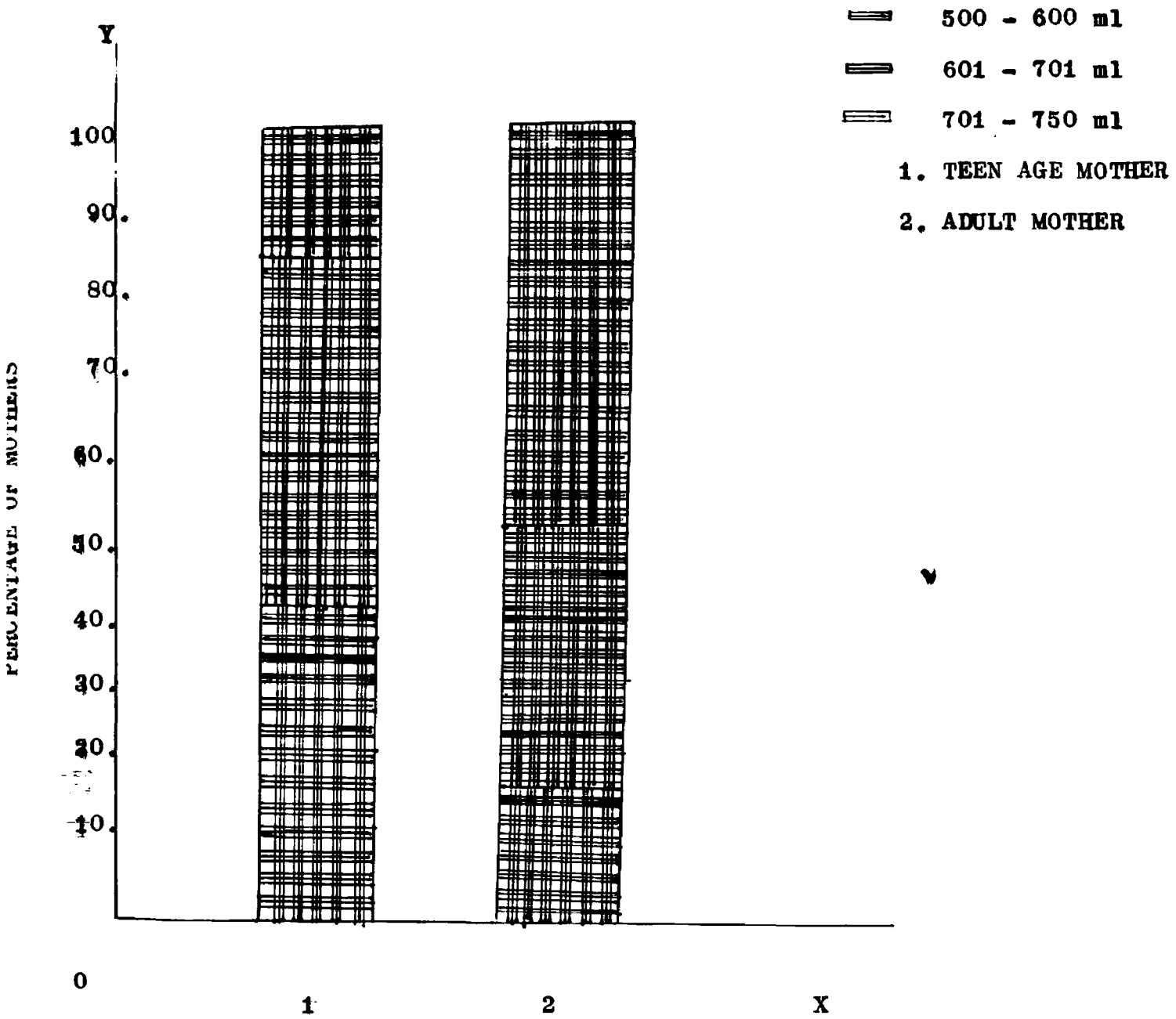

FIGURE I

milk output of the nursing mother are given in Appendix X.

IV. Composition of breast milk with respect to selected nutrients:

Table IX presents mean nutrient composition of breast milk with respect to total solids energy, protein, fat, calcium, and iron.

TABLE IX

MEAN NUTRIENT COMPOSITION OF BREAST MILK TO SELECTED NUTRIENTS

Constituents of percent		India (Belavady & Gopalan)	U.S.A. (Macy)	Australia (Wardlaw & Drat)	Britain (Konand Mawson)	ICMR values	Present study
Total solids	(g)	12.12	12.90	13.74	13 to 13.9	-	9.86
Protein	(g)	1.06	1.06	1.41	1.16	1.1	1.2
Fat	(g)	3.42	4.54	4.95	4.78	3.4	3.0
Minerals	(mg)	0.16	0.20	0.18	-	-	-
Calcium	(mg)	-	-	-	-	28-	24.58
Iron	(mg)	-	-	-	-	-	0.12
Energy	(K.cals)	-	-	-	-	65	66.2

The value obtained for all the tested nutrients in the breast milk/100ml was in close agreement with the values of

ICMR (1971). Studies on samples of human milk conducted in different parts of the world show that there are no striking difference in the composition of human milk. The percentage of total solids and fats are slightly lower in the present study. According to WHO (1966) the quality of human milk was difficult to study since it varied in composition during a single feed, during 24 hours of the day and during the entire lactation cycle. Individuals breast milk composition given in Appendix XI.

V. Relationship between amenorrheal period and length of breast feeding:

Length of breast feeding affects the anovilatory lactation amenorrheal period as per NAC (1975) and Jelliffe (1976). According to them the longer the breast feding, the longer is the amenorrheal period. An attempt was made in the present study to find out the correlation if any between anovulatory lactation amenorrheal period and the length of breast feeding. Table X presents the results obtained.

TABLE X

RELATIONSHIP BETWEEN AMENORRHEAL PERIOD AND LENGTH OF BREAST FEEDING

Mean Length of breast feeding in months	Mean amenorrheal period in months
6	4.5
12	6.75
18	8.25
24	9.00

As is obvious from Table X the amenorrheal period appears to be positively correlatdd with the length of breast feeding. As the length of breast feeding increased amenorrheal period also increased. Huber and Ulm (1962) and Potter (1955) have come accross such a correlation between breast-feeding and amenorrheal period. This means breast feeding has a three-fold advantages, that is the health of the child, the low cost and a natural means of increasing the birth spacing, which is very much needed in our country. However this has to be taken with caution in the sense, it was noted, that the mothers whose food intake was relatively better off, tended to have their amenorrheal period shorter inspite of the fact

RELATIONSHIP BETWEEN AMENORRHEAL PERIOD AND LENGTH OF BREAST FEEDING

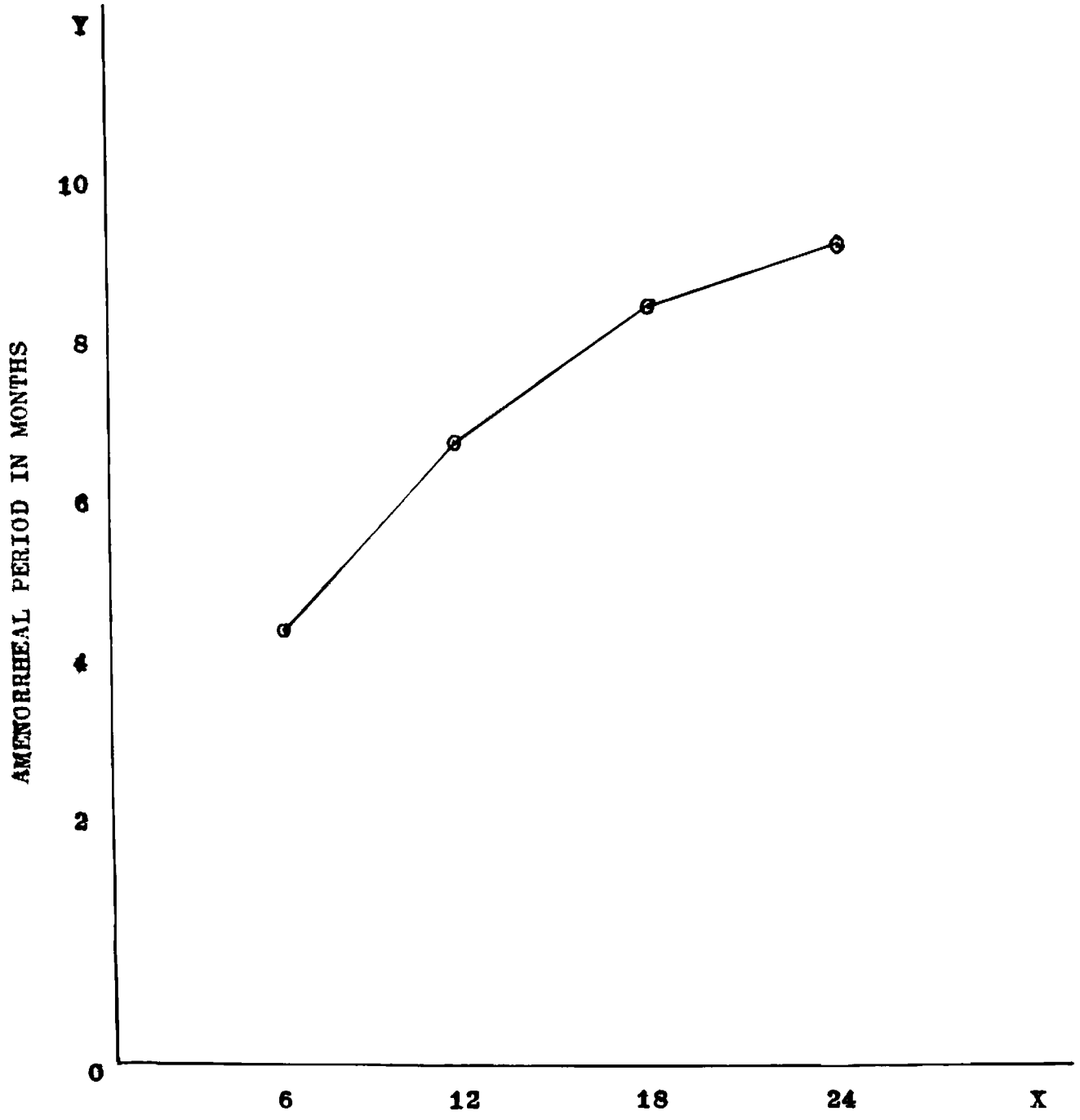

FIGURE II

they were breast feeding, than those mothers who were not so well off in their nutritional status(FIG II)This field requires further investigation with comparison between well nourished and poorly nourished mothers.

VI. Growth performance of the exterogestate foetus:

1. Anthropometric measurements of infants:

Anthropometric measurements of all the infants of the two seventy mothers were recorded and categorised according to their age. It was possible to locate 37 infants in the various age groups who were not breast fed for purposes of comparison with these breast fed infants. Table XI presents the mean height and weight of the infants.

TABLE XI

MEAN HEIGHT AND WEIGHT OF THE BREAST-FED AND NON-BREAST FED INFANTS

Age in months	Mean height in cm.		Mean weight in kg.		All India Values for	
	Breast fed	Non Breast fed	Breast fed	Non breast fed	ht.in cm.	wt.in kg.
3 months	56.4	54.8	5.83	3.78	-	-
			S.D ± 1.26	S.D±0.28	-	-
6 months	63.0	61.1	7.08	4.95	-	-
			S.D ± 0.39	S.D±0.17	-	-
9 months	68.0	65.7	8.5	6.30	-	-
			S.D ± 0.1	S.D 0.83		
12 months	74.6	71.65	9.0	7.54	Boys 73.9	8.4
			S.D ± 0.47	S.D±1.01	Girls 72.5	7.8

As is evident from Table XI the mean heights and weights of the exterogestate infants who were breast fed are consistantly better off than their countreparts who were not breast fed. Similar observations were made by Vijalakshmi et al (1975). The values obtained for 12 months for the breast fed group is in close agreement with the All India Values given by Gopalan (1971)

MEAN HEIGHT OF THE BREAST FED AND NON BREAST FED INFANTS

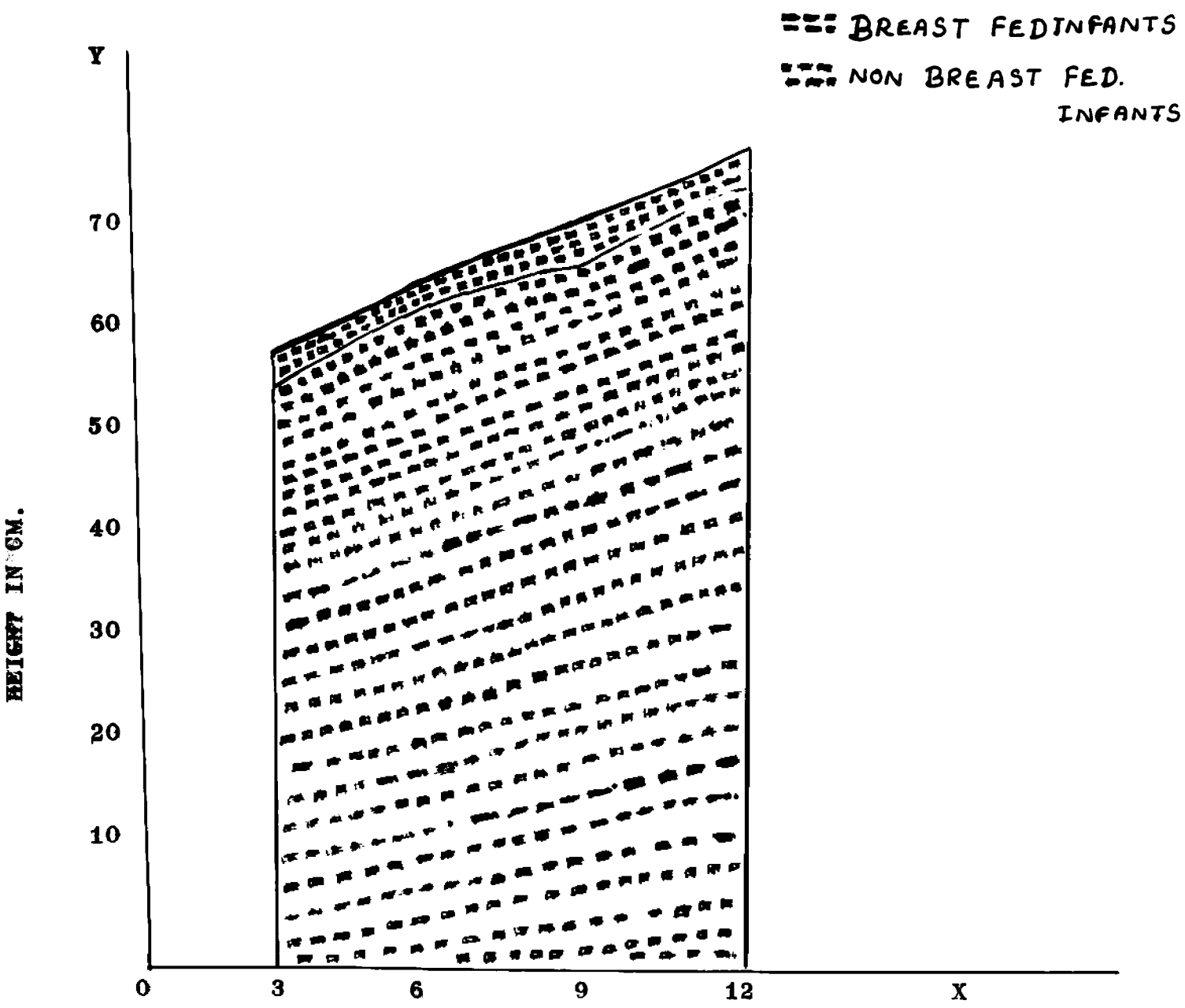

FIGURE III

MEAN WEIGHT OF THE BREAST FED AND NON BREAST FED INFANT

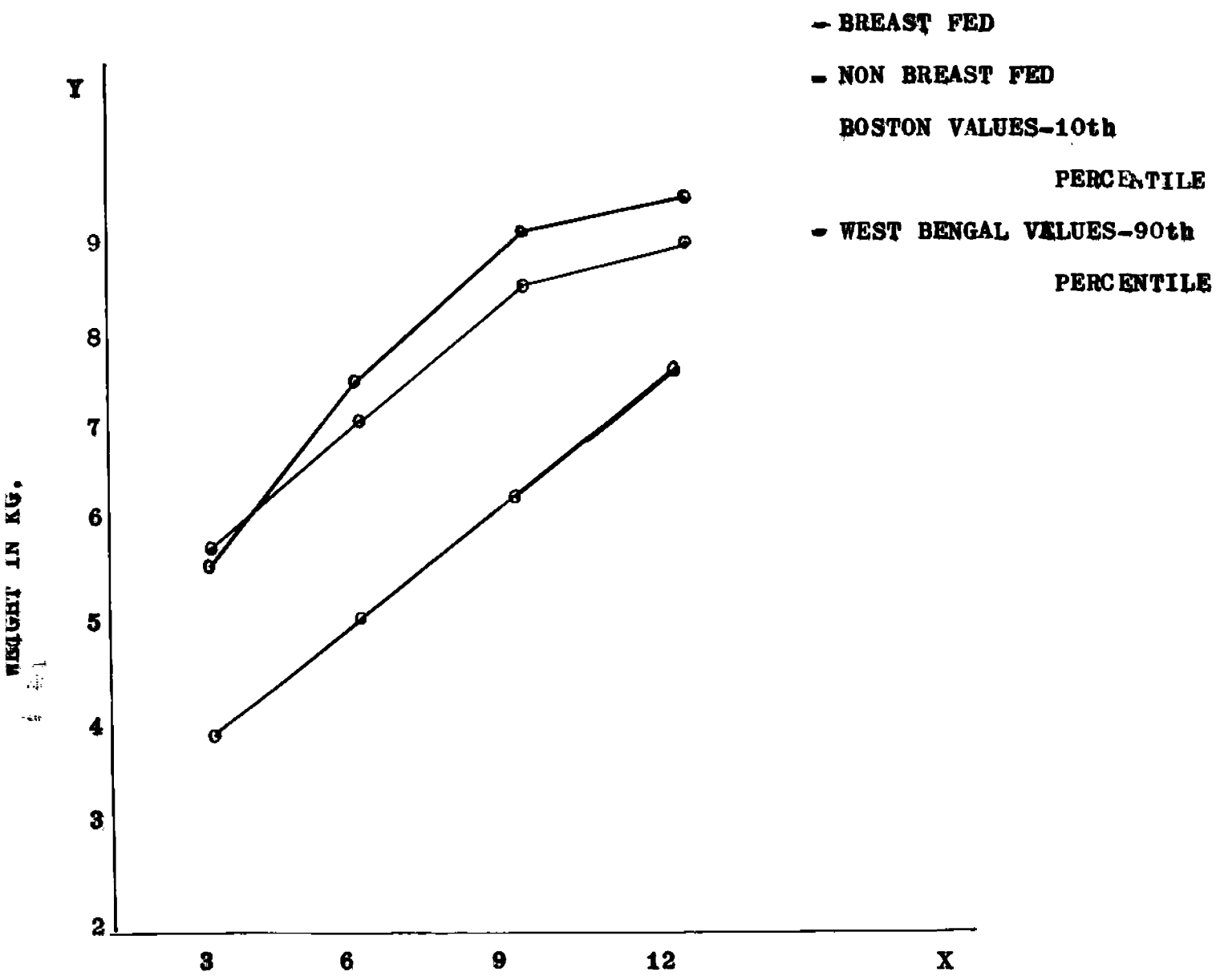

FIGURE IV

and Devadas et al (1975). The fact that the breast fed children are better-off than the non breast fed babies is very important in the present context, specially in India, because to be breast fed or not, literally decides between life and death for the vast majority of infants in developing countries according to the Protein advisory group (Fig. III and IV). 2(Height and Weight of the breast fed and non breast fed children are given in Appendix XII)2. 1.(The values between the groups indicated a statistical significance at 1% level).

Mean weight/height^2 values were calculated for these infants in all age groups and the results are presented in Table XII.

TABLE XII

WEIGHT/HEIGHT^2 RATIO FOR THE BREAST FED AND NON-BREAST FED INFANTS

Age in months	Wt/Ht^2 for breast fed	Wt/Ht^2 for non breast fed
6 months	0.001784	0.001310
9 months	0.001839	0.001459
12 months	0.001617	0.001469

Visweswara Rao (1974) and Gopal Das (1975) putsforth that Wt/Ht^2 is normally about 0015 and can be used as a simple and reliable indicator of nutritional status of children from the age group of 6 months to 5 years. It is evident from Table XII that all the infants who were non-breast fed were having the weight/height^2 ratio lower than 0.0015 which is the demarking line between the well nourished and malnourished children.

Mean head, chest and mid-arm circumference of the exterogestate infants:

Table XIII presents the mean head, chest and midram circumference of the extergestate infants.

TABLE XXII

MEAN HEAD CHEST AND MIDARM CIRCUMFERENCE (IN CM) OF THE EXTERO-GESTATE INFANTS, BREAST FED AND NON-BREAST FED

Age in months	Head circumference and S.D.		Chest circumference and S.D.		Mid arm circumference and S.D.		All India Values	
	B.F.	N.B.F.	B.F.	N.B.F.	B.F.	N.B.F.	Head circumference in cm.	Chest circumference in cm.
3 months	24.5	23.5	23.5	22.1	9.2	9.0		
S.D. ±	1.39	± 0.41						
6 months	30.0	27.6	29.5	25.2	11.1	10.2		
S.D. ±	1.92	± 0.51			±0.57	± 0.44		
9 months	32.8	32.0	34.8	30.0	12.9	12.0		
S.D. ±	2.12	± 1.19	±1.58	± 0.42	±0.84	± 0.77		
12 months	37.2	36.0	38.0	34.0	14.0	12.8		
S.D.		± 1.85		± 0.37	±0.45	± 1.38	44.4 Boys	43.3
							43.6 Girls	42.3

B.F.- Breast fed

N.B.F. - Non Breast fed.

Table XIII brings home the fact that the non-breast fed infants exhibited consistantly lower values for head, chest and mid-arm circumference than their counterparts who were breast fed.

In well nourished children the chest circumference starts to exceed the head circumference during the second six months of life and must be greater by 12 months according to Cameron and Hofwander (1971). Hence the chest/head ratio was done for both breast fed and non breast fed babies. The results indicated that by about 9th month the breast fed children's chest, circumferences crossed over the head circumference. However the ratio remained below one upto 12 months in the non-breast fed children. Cameron and Hofvander (1971) are of the view that in protein calorie malnutrition as there will be muscle and fat wasting the chest size will remain small and the ratio will be <1ess than one. The values between the groups indicated a statistical significant at 1% level. Head, chest, and arm circumference of the Breast fed and Non Breast fed children are given in Appendix XIII.

Table XIV putsforth the physical development of the infants included in the present study.

TABLE XIV

PHYSICAL DEVELOPMENT ACHIEVED BY THE BREAST-FED AND NON-BREAST FED INFANTS

Mile stones	Achievement in Month		
	Breast fed infants	Non-breast infants	Shhi and Dayol (1974)
Fixing of eyes	2.0	3.0	3.0
Smiling	2.5	2.5	2.5
Recognising mother	3.0	3.0	3.0
Following objects	4.5	4.5	3.75
Oral exploration	6.0	6.0	5.5
Sitting with support	7.0	8.0	8.75
Transport of object	7.0	7.0	6.75

The normal arm circumference of an one year old infant is around 16 cm according to Cameron and Hofvander (1971). Values obtained in the present study, are lower than this, though the breast fed infant have registered higher values than non-breast fed.

The achivement of the various physical development and coordination by the exteregestate shows that there was slight difference between the two groups, and the breast fed group seems to fair slightly better than the other. This may be due to the successful breast feeding.

Table XV presents the motor development of the infants.

TABLE XV

MOTOR DEVELOPMENT OF BREAST FED AND NON-BREAST FED INFANTS

Particulars	Breast fed	Non breast fed	Well nourished Banik	Malnourished (1973)
Tonic neck reflex	1	1	1	1
Head midplane with symmetric posture	3½	3½	3	4
Complete head control	3	3	3–4	4½–5

Table XV highlights the motor development of the infants who were breast fed and non-breast fed. The coordination is attained earlier by the breast fed infants than their counter parts who were not breast fed. These values are

comparable to those obtained by Banik et al (1973) as shown in the same table.

3. Other Details Regarding the infants:

i. Health status of the infants

a. Signs of malnutrition

b. Presence of worms

c. Reported sickness of the infants

ii. Weaning foods given to the infants

i. Health status of the infants:

a. Signs of malnutrition.

The symptoms of malnutrition present in the infants were recorded and tabulated in Table XVI

TABLE XVI

SYMPTOMS OF MALNUTRITION IN THE INFANTS

S.No.	Symptoms of malnutrition in the children	Breast fed percent	Non breast fed percent
1	Mild protein calorie malnutrition	15	54.0
2	Anemia	16	20.0
3	Xerosis of the conjunctiva	30	-
4	No obvious symptoms	39	26.0
5	Total	100	100.0

Obviously 15% of the breast fed infants were also suffering from a mild degree of malnutrition, but when compared with the non-breast fed group, which emphasises the need for breast feeding in countries like ours.

Table XVII presents the infestation of the gastro intestional tract with worms in both the groups.

TABLE XVII

PRESENCE OF WORMS IN THE INFANTS

S.No.	Presence of worms in children	Breast fed percent	Non Breast fed percent
1	Hook	10	15
2	Tape	10	10
3	Round	7	25
4	Nil	72	50
		100	100

It was disturbing to note that 27-50 per cent of the infants studied has been infected with worms of some kind of other. Considering the poor hygienic conditions in which the families and the infants live, this is not surprising. These worms would in the long run aggravate and precipitate the already existing mild form of malnutrition in these infants. Emphasis on health and hygiene on one a hand and nutrition education on the other are essential. Only such as integrated approach could solve the problems.

Reported Sickness of the infants:

The health status an individual enjoys speaks of this

nutritional status indirectly. The repeated sickness of the infants in the present study is presented in Table XVIII.

TABLE XVIII

SICKNESS OF THE INFANTS

Sickness	Percentage falling sick	
	Breast fed	Non breast fed
Diarrhoea	15	40
Common cold and fever	29	35
Constipation	16	-
Whooping cough	4	6
No serious illness	36	10

Table XVIII clearly indicated that the per cent of children falling sick are more in the non breast fed group, than in the breast fed group. The anti-infective properties of breast milk could be the only possible explanation for this difference and also the environmental hygiene. Further investigation into the immunisation, measures taken for these children indicated that almost all the children in both the groups had been given Small-pox vaccination, whereas only 42% and 48% of the children had been given triple-antigen vaccine respectively in the two groups.

2. Weaning foods given to infants:

Table XIX presents the weaning foods given by the infants.

TABLE XIX

WEANING FOODS GIVEN TO INFANTS

S.No.	Supplements given to the infants	Percentage
1	Glaxo	14
2	Farex	25
3	Amulspray	32
4	Grapes	12
5	Ragi	27

Table XIX lists the various weaning foods given to the infants in the present study. Glaxo, Farex and Amulspray are supposed to be the foods specially meant for infants. However whether these foods have all the nutrients in the required proportion is a question. Also how many mothers have the know how in the preparation of these foods and its hygenic handling. When it is a question of choice between the arti-

fical weaning foods and breast milk, it is advisable that breast milk be preferred for the following reasons putsforth by Jelliffe (1976) namely antiinfective factors, anti-allergic considerations, contraceptive, considerations and the economics involved. Also under the existing poor hygenic conditions, the transfer of milk from mother to child directly, ensures the impossibility of the enterance of any micro organisms.

Also we are only aware of the type of supplements but not the quantities. Most of the times they may be in meagre quantities and unduly diluted. In any case breast Feeding is to be preferred for a minimum period of 6 to 9 months at least.

V. SUMMARY AND CONCLUSIONS

A total of two hundred and seventy mothers were selected from two villages and Kupptiswamy Naidu memorial Hospital for women and children. The food and nutrient intake of the nursing mothers indicated that their diets were lacking in good quality protein, calcium, iron, retinol, riboflavin and ascorbic acid. The clinical symptoms observed in these women were anemia, oedema, night blindness and angular stomatitis. These symptoms confirmed the existing deficits in the diets of these women.

The serum retinol values obtained for the nursing mothers indicated that they were at medium risk with values of 49µg/100ml against 80µg/100ml considered low risk by ICNND. Twenty six percent of the nursing mothers had levels of haemoglobin lower than 10g which is indicative of anemia and a grave situation.

The mothers who successfully breast fed their infants reduced in their weights more so in the case of teenage mothers. Hence teenage pregnancy or lactation may be avoided. The mean breast milk putput was 617ml in the teenage mothers against 705 ml in adult mothers. The relative low volume of breast milk may be attributed to double demands of pregnancy.

Composition of breast milk indicated that only total solids, and fat seem to be slightly affected and among the rest of the nutrients, there are no striking differences in the composition.

Relationship between amenorrheal period and length of breast feeding indicated that as the length breast feeding increased, amenorrheal period also increased though not in the same proportion.

The growth performance of the exterogestate infants who were breast fed and non-breast fed brought out the fact that the breast fed children had recorded consistantly higher values which respect to height, weight, head chest and mid arm circumference. The weight/Ht^2 ratio indicated that all the infants of the breast fed group recorded values above 0.0015 while their counter parts recorded a value less than 0.0015 which is indicative of malnutrition. The chest/head circumference ratio revealed the fact that by about 9th month the infants crossed the value one in breast fed group whereas the non-breast fed even after 12 months remained below one, which is indicative of protein calorie malnutrition.

The results of physical and motor development of the infants were also along the same time.

The signs of malnutrition presence of worms in the gastro-intestinal tract and reported sickness of the infants indicated that the breast fed children had fewer symptoms of malnutrition and better resistance to disease than their counter parts in the non-breast fed group. Weaning foods given to the infants were essentially commercial foods given without the know how of dilution, cleanliness or quality.

Thus these results high light the advantages of breast milk and encourage using this natural resource which is good for the child and good for the mother as it prolongs the amenorrheal period.

B I B L I O G R A P H Y

BIBLIOGRAPHY

(1) Atkinson, P.J.,and west,R.P. (1970) "Loss of skeletal calcium in Lactating women" The journal of obstetrics and Gynaecology of the British common wealth Volume-77,P.555

(2) Annal Report (1971) "Breast feeding survey" Foods and nutrition notes and Reviews No: 15 and 16, P. 370

(3) Anderson (1972) "Nutrition for nursing mother" Nutrition in Nursing Published by Lippincott Company, Toronto. P.135

(4) Annika Bornstein (1973) "Breast feeding in Tanzaia" Nutrition news letter Volume-11, No: 3, pp.1-8

(5) Alemberg (1973) "Lactation and Facundity" The Nutrition Factor Published by the Booking institute, Washington. PP. 39.

(6) Bhavani Belavady (1960) "Studies on Human lactation" ICMR Special Reports Published by the Nutrition Research Laboratories, Hyderabad. No. 45, P-1

(7) Bhavani Belavady (1963) "Studies on human lactation" ICMR Special Reports Published by the nutrition Research Laboratories, Hydrabad. No. 45, P.7

(8) Bhargava, S.K., (1971) "Birth weight, Gestational Age and Growth pattern in Babies with a birthweight of 2000g or less" Indian pediatrics Volume-8, P. 736

(9) Bernand L. Oser, (1971) "Protein estimation from milk" Practical physiological chemistry 13th edition. Tata McGraw hill publishing Company Ltd., New Delhi, P. 665

(10) Bharathi Devi., and Dharmadas Sarker. (1972) "A study of birth weight and birth length of Bengalore infants" Indian journal of pediatrics Volume-39, P.131

(11) Barua, (1973) "Birth weight in Assamese infants" Indian pediatrics Volume-10, P. 125

(12) Bhandari., and Patel (1973) "Dietary Feeding habits of infants in various socio-economic group" Indian pediatrics Volume-10, P. 233

(13) Bhalla, J.N., Pratibha, Rohatgi., and Maya Bhalla. (1973) "Relation of birth spacing with birth weight, morbidity and mortality of the new born" Indian journal of pediatrics Volume-41, No: 320, PP. 299-304

(14) Bensal, S. (1973) "Infant feeding and weaning Practice at Simla Mills" Indian journal of medical Research Volume-61, No.11, P. 1869

(15) Bhalla, J.N., PratiBhaRohatgi., and Maya Bhalla, (1974) "Relation of Birth spacing with Birth weight morbility and morality of the New born" Indian journal of pediatrics Volume-41, No: 320, P. 299

(16) Bhavani Belavady. (1974) "Nutrition and Economic aspects of human milk" Proceedings of Nutrition society of India No: 16, P. 37

(17) Bo VahlQuist. (1975) "Evaluation of Breast Feeding in Europe" The journal of Tropical pediatrics and environmental children Volume-21, No: 1, P. 11

(18) Brijesh., Narain., and Dubash, P.J. (1976) "Nutrition requirements of infants and Need for supplementary milk diet with infant weaning foods" Indian journal of pediatrics Volume-43, No. 343, P. 232

(19) Cart wright, G.E. (1958) "Haemoglobin estimation by Cyanmethemoglobin method" Diagnostic Laboratory Hematology PP. 34,36

(20) Department of Agriculture. (1959) "Studies on human milk" Journal of Nutrition and Dietetics Published by the united States Department of Agriculture, Washington. P. 219

(21) Derrick, B., Jelliffe. (1961) "Nutrition and economics of the modern world" Journal of American dietetics Association Volume-39, No. 2, P.129

(22) Derrick,B., Jelliffe. (1966) "Special problem in different groups" The assessment of the nutritional Status for the community Published by world health organisation, Geneva. P. 176.

(23) Derrick, B., Jelliffe. (1961) "Evaluation of infant feeding" Infant Nutrition in the sub-tropics and Tropics Published by world health Organisation, Geneva. P.22

(24) Devarajan,,and Malati Jadhav. (1973) "Classification of the new born using birth weight and gestational age as criteria" Indian pediatrics Volume-10. P.409

(25) Dan and Sharma. (1973) "Developmental milestones in a selective samplesof Lucknow Children" Indian journal of pediatrics Volume-40, P.1

(26) Datta Banik, N.D., and Kunel Saba. (1975) "The influence of maternal factors of Birth weight of the newborn" Indian journal of pediatrics Volume-42, No. 333, P. 309

(27) Derrick, B. Jelliffe. (1976) "World trends in infant feeding" Proceedings of the Nutrition Society of India No. 20, P.1

(28) Derrick, B.Jelliffe. (1976) "World trends in infant feeding" Nutrition journal Volume-10, No.4, P. 16

(29) Frederikyen (1969), Schultz (1971), Wray (1971), Berg (1973) and Taylor (1974). "High Fertility as insurance against child loss" Nutrition and Fertility inter-relationships Published by National Academy of Sciences, Washington. P.P. 18,19

(30) Food standards Committee. (1974) "Review of infant foods" The british Nutrition Foundation Bulletin No. 12, Volume-3, No. 1 P. 18

(31) Franz,W. Rosa. (1975) "Breast feeding in family planning" PAG Bulletsin Volume-5, No. 3, P.P. 24-28

(32) Gopalan, C. (1956) "Studies on Human milk" Journal of Tropical pediatrics Volume-2, P. 89

(33) Gopalan, C. (1958) "Studies on Human milk" Indian journal of medical Research Volume-46, P. 317

(34) Gopalan, C. (1958) "Studies on human milk" Journal of Tropical pediatrics Volume-4, P. 87

(35) Gopalan, C., Rama Sastri, B.V., and Bala Subramanian, S.C. (1971) "Balanced diet and Nutrient available from the food" Nutritive value of Indian Foods Published by National institute of Nutrition, Hydrabad. P.P. 30,60

(36) Gopalan, C. (1973) "Nutrition, Fertility and Reproduction" Proceedings of the Nutrition socity of India No. 14, P.P. 514,554,556

(37) Guha, K. (1973) "Relationship between length of Gestation birth weight and certain other factors" Indian journal of pediatrics Volume-40, P.44

(38) Gurinder Sethi. (1973) "Supplementary foods selected for feeding infants and preschool children by educated middle class family" Indian journal of Nutrition and Dietetics

(39) Gupta, R. (1974) "Effect of oral contraceptions on Quantity and quality of milk secretion in Human beings" Indian journal of medical research Volume-62, No. 1, P.64

(40) Gothefors,L., and Winberg, J. (1975) "Most resistance factor" The journal of Tropical Pediatrics and environmental child health Volume-21, No. 8 P. 260

(41) Hytten, F.E. (1976) "The physiology of Lactation" Journal of human Nutrition Volume-30, No.4, P. 225

(42) Hanson. (1972) "Breast milk and defence against infection in the new born" Foods and nutrition notes and reviews Volume-30, No.5 and 6, P. 92.

(43) ICMR technical Report series. (1974) "Studies on weaning and Supplementary Foods" No. 27, P. 18

(44) Indira Narayanan. (1974) "Some infant feeding and rearing practices in a rural Community in Pondichery" Indian pediatrics Volume-11, P. 667

(45) John, T.J., and Devarajan, L.V., (1973) "Polievirus Antibody in milk and sera of lactating women" Indian journal of medical Research Volume-61, No. 7, P. 1009

(46) Joint FAO/WHO Food standards Programme. (1973) "Determination of the fat Conduct ofmilk" Code of principles concerning milk and milk products, international standards and standard methods of sampling and Analysis for milk products 7th edition Published by food and Agriculture Organisation of the United Nations WHO. P. 83

(47) Khurana, V. (1970)
"Iron content of Breast milk" Indian pediatrics Volume-7, P.659
"Estimation of total protein in Breast milk of Indian mothers" P. 159

(48) Kumar, R. (1974)
"Integration of family planning with health services, Indian journal of medical Research Volume-62, No.5 P. 800

(49) Leslie Hart, F., and Harry Johnstone Fhsher. (1971)
"Dairy products" Modern Food Analysis Ruslished by springer-Verlag, New york, INC, P.P. 111, 123

(50) Lalitha Bahl. (1971)
"Study of maternal Factors in Relation to Birth weight and Gestational Age of the New born" Indian Pediatrics Volume-8, P. 707

(51) Mammen, K.C., and Jesudian, G. (1971)
"Right and Weight of south Indian Women of child bearing age and their affect on birth weight and the length of the baby" Indian Journal of medical Research Volume-59, No. 9, P.P.212,215, 229,261

(52) Mehta, M.J. (1972)
"Infant feeding habits in Surat city" Indian pediatrics Volume-9, P. 290

(53) Madhavi. (1972)
"A survey of infant feeding and weaning practices in village Fatchpur-hyderabad" Indian Pediatrics Volume-9, P. 480

(54) Mehthavi M.J. (1974) "Effect of malnutrition on the birth weight of the new born" Indian pediatrics Volume-11, P. 459

(55) Manas Kumar Chaudhuri. (1975) "Nutritional profile of calcutta Preschool children" Indian journal of medical Research Volume-63, No.2, P. 320

(56) Malini Karkel., Chikermare, A.S., and Krishnasamy, P.R. (1975) "Socio Cultural and economic Aspects of infant feeding and malnutrition" Indian pediatrics Volume-12, No. 1, P.P. 13,20, 22

(57) Margaret Russel. (1975) "Report on infant feeding" Nutrition and Food Science No. 39, P. 19

(58) National Research council. (1957) "Studies on human milk" Indian Council of medical Research No. 123, P. 187

(59) Neeld and pearson. (1963) "Estimation of serum Vitamin A (Retinol), Manual for nutrition surveys 2nd edition ICNND-National institute of health, Bethesda md. p.p. 241-242

(60) Nageshwara Rao, G., and Narasinga Rao, B.S. (1974) "Nitrogen Balance in Pregnancy and lactation in women whose protein intake in marginal" Indian journal of medical research, Volume-62, No. 11, P. 1619

(61) Pasricha, S. (1958) "Nutritional status of the Nursing mother" Indian journal of medical Research Volume-46, P. 605

(62) Potter. (1965) "Applications of field studies and to research on the physiology of human reproduction" Journal of chronical Division Volume-18, P.P. 1125-40

(63) Rajammal P. Devadas., Girija Bai, R., and Nirmala, P.S. (1966) "Studies on human milk" Journal of Nutrition and Dietetics Volume-3, P. 50

(64) Rao, P.U., and Bhavani Balavady. (1967) "Effect of Duration of Lactation and Dietary supplements on the Protein fractions" Indian journal of medical Research Volume-55, P. 74

(65) Rajammal P. Devadas. (1972) "Nutrition Programmes for expectant and Nursing mothers" Nutrition in Tamil Nadu published by sangam publishers, Madras. P. 47

(66) Raman, R.A. (1973) "Role of breast feeding in the bottle oriented" World food and Nutrition Volume-2, P.P. 121-126

(67) Rajammal P. Devadas. (1973) "Nutritional status and Nutrient intake of children in the age group of 0-30 months in the Rural area" Indian journal of Nutrition and dietetics Volume-10, No. 4, P. 28

(68) Pearson, C.A., and Mary Thwaiter. (1973) "Neonatal care in the Tropics" The Journal of Tropical pediatrics and environmental child health Volume-19, No. 2, P. 98

(69) Pralhad Rao, M. (1974) "The Indian Women" Nutrition Journal Volume-4, No. 5, P. 2

(70) Prasad, S.L. (1974) "Biochemical prediction of Fetal maturity" Indian pediatrics Volume-11, P. 65

(71) Rajammal P. Devadas. (1974) "Nutritional Evaluation of a maize based indegenous infant food "Kuzhandai Amudhu" Indian journal of nutrition and Dietetics Volume-11, P. 257

(72) Rajammal P. Devadas., Nirmala K. Murthy., and Roshan, A. (1974) "Evaluation of a weaning miture based on local foods" The Indian journal of nutrition and Dietetics Volume-11, P. 209

(73) Rosen Von Rosentein. (1975) "Evaluation of Breast feeding in Europe" The journal of Tropical Pediatrics and environmental child health Volume-20, No. 1, P. 242.

(74) Richard, N., and Gresham, E. (1975) "Nutrition for New born needing intensive care" Journal of American dietetics Association Volume-66, No. 6, P. 592

(75) Ruth Campbell. (1975) "Present-day practice in infant feeding" The British Nutrition foundation Bulletin No. 13, Volume-3 No. 1, P.P. 23-57

(76) Rajalakshmi, K., and Leela Raman. (1976) "Assessment of gestational age in Indian pregnant women" Indian journal of medical Research Volume-64, No. 2, P. 199

(77) Ramalingasami. (1976) "Postnatal development" Medicine health and human development" Swash Hind Volume-2, P.P. 34-36

(78) Raon H. Gray. (1976) "Breast feeding and maternal and child health" Cajamus Volume-9, No.4, P. 214

(79) Someswara Rao, K., Saminathan, M.S., Swarup, S., and Patwardhan, J.N., (1959) "Protein malnutrition in South India" Who Bulletin Volume-20, P. 603

(80)

(80) Saxena., and Garg, O.P. (1968) "A study of methods used for child rearing in Bikanor" Indian journal of pediatrics Volume-35, P. 342

(81) Saroj Saigal., and Srivastava. (1969) "Maternal Factors in Relation to birth weight" Indian pediatrics Volume-6, P. 773

(82) Saroj Pachuria., and Marwah, S.M. (1970) "A study of the effect of certain maternal factors on birth weight" Indian journal of medical Science Volume-24, No. 3, P. 650

(83) Saroj Kapur. (1971) "Height and weight of south Indian women of child Bearing Age and their effect on birth weight and length of the baby" Indian journal of medical research Volume-59, No. 10, P. 1480

(84) Swaminathan, M.S., (1971) "Nutrition of Nursing mothers" Indian journal of Nutrition and dietietics Volume-8, P. 22

(85) Srivastava, B.C. (1971) "The effect of various Biological Factors on Birth weight" Indian journal of pediatrics Volume-38, P. 202

(86) Saroj pachuria., and Marwah, S.M. (1971) "A study of inter related Effects of certain Nutritional Factors on Birth Weight" Journal of the Indian medical Association Volume-57, P. 172

(87) Srikandian. (1972) "Effect of Nutrient supplement during late pregnancy on birth weight of infants" Proceeding of the Nutition society of India No. 11, P. 27

(88) Sidhu., and Anand. (1972) "A study of birth weight in full term viable punjabi infants" Indian journal of Pediatrics Volume-39, P. 339

(89) Saleha Qureshi. (1973) "Effect of maternal nutrition supplementation on Birthweight of the new born" Indian pediatrics Volume-10, p. 54

(90) Srinivasan, N., Indira Varadarajan., Arvind, G., Shing wakar, Rajanaseth., Mathur, R.S., and Bhargava, V. (1975) "Analysis for aindividual shifts in height, for-age alone or combined with weight-for-age. Project peshak volume-one published by care India, New Delhi. P.P. 59-61

(91) Sharma, A. Dhatt, P.S., Verma, K.C., Harjet singh,, and Gupta, H.L. (1975) "Anthropometric measurements and physical characteristics in the assessment of neonatal maternity" Indian journal of pediatrics Volume-42, No. 333, P. 304

(92) Sloper,K. Mckean, L., and Baurn, J.D. (1975) "Factors influencing Breast feeding" Food and Nutrition Notes and Reviews Volume-32, No. 7 and 8, P. 153

(93) Santhi Ghosh (1976) "Social cultural factors effecting breast feeding and other infant feeding practices in an urban community" Indian Pediatrics Volume-13, No. 11, P. 827

(94) Thaman, O.P., and Manchanda, S.S. (1968) "Child Rearing practice in Puhjab" Indian journal of pediatrics Volume-35, P. 334.

(95) The Research and Reference Division Ministry of information and broad costing Government of India, (1976) "The land and the people" India a Reference Annual Publications Division ministry of information and broad costing Government of India P.P. 1-8

(96) Vankatachalam, P.S., and Gopalan, C. (1960) "Weight changes of the Nursing mother" Indian journal of medical Research Volume-48, P.P. 518-523

(97) Venkatachalam, P.S., and Bhavani Belavady. (1962) "Serum Values of the nursing Mothers" Journal of Pediatrics Volume-61, P. 262

(98) Vimlesh Seth., and Ghai, C.P. (1971) "Feeding habits of infants and preschool children in urban and Rural Community" Indian pediatrics Volume-8, P. 452

(99) Virender Mohan., Harcharan singh., and Surinder singh. (1974) "An epidemiological survey of infant mortality" Indian journal of pediatrics Volume-41, No. 317, P.P. 224-228

(100) Vanbalen, H., and Natabomvura, V. (1976) "Methods of Birth spacing, maternal lactation and post partum Abstinence in Relation to traditional African culture" The journal of Tropical pediatrics and environmental child health Volume-22, No. 2, P. 64

(101) WHO Expert committee (1965) "Nutrition in pregnancy and Lactation" Requirement of Vitamin A, Thiamine Roboflavin and Niacin No. 302, P. 19

(102) Walia, (1974) "Breast feeding and weaning Practices in an urban population" Indian pediatrics Volume-11, No. 3, P. 137.

APPENDICES

APPENDIX I

Questionaire to study the Nutritional profile of selected nursing mothers and their infants in Coimbatore City

1. Name: Address:

   Age: Joint/Nuclear family

2. Family Background

Members of the family	Age	Education	OCCUPATION		Income/ Month
			Main	Subsidiary	

3. Anthropometric measurements of the mother

   Weight of the mother: Weight of the father:

   Height of the mother: Height of the father:

4. Age of the mother at marriage

5. Anthropometric measurements of the infant

   Weight: Head circumference:

   Height: Chest circumference:

   Mid arm circumference:

6. Delivery Normal/Complicated:

7. Specific complication in delivery

8. Birth order of the present infant

   Sex: Male/female

   Age in Months:

9. Information regarding previous children.

No. of children Born	No. Alive	No. dead	Age at death	Reasons for Death

10. Are you aware of the family planning measures?

    No ☐ Yes ☐

11. If yes, which specific measures do you follow?

12. If no why?

13. Any after effects of using the specific family planning method?

14. What is your opinion about the Same?

15. Month lactation at the start of the study?

16. Weight of the mother during lactation?

17. Stage of lactation?

18. Amount of milk secretion?

19. Do you consume any tonics or any other supplements?

20. Space between child?

21. Details regarding breast feeding.

Birth order of the child	Duration of breast feeding	Time stepping

22. Presence of worms in the child/mother kind of worms present.

23. Signs and symptoms of malnutrition in the mother?

1. Anaemia
2. Oedema
3. Night Blindness
4. Albumineria
5. Bleeding gums
6. Angular Stomatitis
7. Other Complaints

24. Serum picture of the Nursing Mother

Folic acid levels

Haemoglobin levels

25. Signs and Symptoms of Malnutrition in the infant

1. Oedema
2. Anaemia MIId/Severe
3. Bleeding gums
4. Angular Stomatitis
5. Xeresis of the Conjective or Cornea
6. Marasmus
7. Kwashiorkor
8. Any other Signs

26. Any illness noted in the children:

Illness	Age at which it occured	Frequency	Treatment
1. Diarrhoea			
2. Fever			
3. Constipation			
4. Cold			
5. Cough			
6. Vomitting			
7. Others			

27. Details regarding immunisation measures taken

Immunisation Measures	Ist Child	IInd Child	IIIrd Child	IV th Child	Present Child
B.C.G.					
Small pox					
Vaccination					
Triple antigen					
Polio					
Any others					

28. Special foods taken during Lactation.

Foods	Yes	No	Reasons
Ginger			
Fruits			
Milk			
Groundnut			
Others			

29. Foods avoided during Lactation

Foods	Initial periods	Later on
Ice Cream		
Mango		
Jack fruit		
Others		

30. Supplements given to the infant

	At Birth		3 Month		4 Month		6 Month		1 Year		1 ½ Year	
Supplements	No. of times	Qty.	No. of times	Qty.	No. of times	Qty.	No. of times	Qty.	No. of times	Qty.	No. of times	Qty.

31. Mile stones (Developmental and Functional Maturity)

Mile Stones	1st month	2nd month	3rd month	4th month	5th month	6th month
Fixing of Eyes						
Smiling						
Cooing						
Laughing						
Head control						
Recognising mothers						
Following objects						
Recognising Family						
Oral exploration						
Supine to prone						
Sitting with support						
Transfer of object						
Sitting with out support						
Crawling						
Speech						

32. Motor Development (Age in weeks)

Particulars	1st	2nd	3rd	4th	5th	6th
1. Tonic neck reflex attitude						
2. Head midplane with symmetric posture						
3. Complete head control						

APPENDIX II

FAMILY AND INDIVIDUAL FOOD CONSUMPTION SURVEY-WEIGHMENT METHOD

Name of the investigater: Door No:

Name of the head of the family: Address:

Name of the subject: Date:

Age of the Subject:

FOOD CONSUMPTION

Name of the Meal	Menu	Weight of total raw ingredients used by the family (g)	Weight of total cooked food consumed by the family (g)	Amount of cooked food consumed by the individual (g)	Raw equipment used by the individual (g)
(1)	(2)	(3)	(4)	(5)	(6)

APPENDIX III

ESTIMATION OF SERUM VITAMIN A (RETINOL)

The extraction procedure was done, following the method of Neald and pearson (1963) and the solution was read at 348 µg (in ultra violet region) following the procedure given by NIN (1971).

Preparation of solution:

Stock Vitamin A solution:

344 mg of Vitamin A acetate (300g) of Vit. A was dissolved in chloroform and made up to 100 ml. 1 ml of stock contains 3000 g of retinol.

Method:

1 ml of serum was placed in a test tube. An equal volume of alcoholic potassium hydroxide was added. 1.5ml of N Hexane was added to the serum alcoholic pottasium hydroxide in the test tube. The test tube was stoppered and contents were shaken well for 45 seconds. It was centrifuged for 10 minutes at a speed of 3000 revolution/minute. The supernatent was evaporated to dryness in a 40°C water bath. The residue was immediately taken up in one ml. of chloroform added 2 ml of chlorofom again and the O D of the solution was measured at 348 mg in the spectrophotometer.

The solution in now transferredto a soft glass tube, with a stopper and irradiated with U.V. light (the lamp should be turned on 10 minutes before use) The tube should be kept at a distance of 20 cm. for the lamp. The O.D. at 348 mg is again read and the difference in O.D is taken as a measure of vitamin A in the solution.

Intermediate Standard:

0.1 ml of stock standard is diluted to 100 ml.

:.0.1 ml = 3 r, 0.2 ml =.6r, 0.3ml=9r, and 0.4 ml=12r.

Woring standard:

Each intermediate was again diluted to 10 ml. From that 1 ml will give 0.3r, 0.6r, 0.9r and 1-2 respectively.

CALCULATION:

Opitcal Density x corresponds to y r of vitamin A.

'A' ml of the diluted serum will contain Y.r of Vitamin A.

:.'B' ml of the serum contain= $\frac{YxB}{A}$ r of Retinol.

:.100ml of the serum contain= $\frac{YxBx100}{A}$ r of Retinol.

Result:

: 100 ml of the Serum contain $\frac{Y \times B \times 100}{A}$ r of Retinol.

APPENDIX IV

ESTIMATION OF HAEMOGLOBIN BY CYANMETHAEMOGLOBIN

Method:

(1) Exactly 5 ml of Drabkin's diluent solution is measured into a dry test tube.

(2) Exactly 0.02 ml of blood is transferred from a standard haemoglobin pipette into a diluent solutions. Usual care in filling an cleaning of lefated haemoglobin pipette must be observed.

(3) The pipette is rinsed 3 times with the diluent solution, without allowing the formation of air bubbles in the solution.

(4) The blood and the diluent are mixed by rotating the tube.

(5) 10 mts time is allowed for the formation of the cyanmethaemoglobin.

(6) 0.5 ml of the diluent solution is used as blank.

(7) With green filter No: 540 the readings are taken in a photo electric colorimeter.

Cyanmeth haemoglobin Calibration:

(1) Total blood Iron is determined by wong's method.

This determination would give absolute amount of haemoglobin.

(2) Exactly 0.02 ml of the known blood sample is measured into 5,7.5 10,12.5 and 15 ml respectively of diluent solution and mixed. These solutions are now equipment to 100,67,50,40 and 3% that of the original solution.

(3) The intensity of the colour read using given 540 filter.

(4) A standard graph is drawn with these values. The Hb concentration of the unknown samples is read from this.

Wong's method:

70.2 mg of Ferrous ammoniumsulphate is made up to 100 ml. Take 10 ml and again make up to 100 ml. This is the working standard.

APPENDIX V

MILK ANALYSIS

Sampling of milk for Analysis:

The samples for analysis were collected after an interval of 4-6 hours after the morning feed, by complete manual expression of both breasts. All mothers were allowed their usual morning meal 3 hours before the time of collection of samples. It was not possible under the prevailing conditions to collect 24 hour samples of milk.

Chemical methods:

The following determinations were carried out on the milk samples. Total solids, Energy, protein, Fat, Calcium and Iron.

Methods of Analysis:

Total solids:

By weighing: (AOAC Method)

Weighed 5 g of prepared sample into a weighed flat bottomed dish not over 5 cm in diameter, a platinum dish of this shape and size is preferable, heated on a steam-bath

10-15 minutes, exposing the maximum surface of the bottom of the dish to live steam. Then heated for 3 hours in an air oven at 98-100°C cooled in a desicator, weighed quickly and reported the percentage of residue as total solids.

ESTIMATION OF ENERGY BY BOMB CALORIMETER

AIM:

To estimate the amount of calories present in 100 ml of milk.

Procedure:

Took 2000 g of distilled water in a completely dried oval bucket which forms apart of the calorimeter. Prior to weighing the water should be brought to a temperature 3°C to 3.5°F below that of the calorimeter Jacket. The water may be measured volumetrically instead of by weighing, if this is always done at the same temperature. Kept the filled bucket with the long axis of the oval in line with the operator. Grasped the bomb well between thumb and fore finger and lowered the bomb into water taking care to avoid disturbing the contents. Set the bomb with its feet spanning the locating boss and turn so that the electrode terminal is near the insulting igniting wire. Attached the thurst terminal to the bomb electrode and shake back into the bucket all drops of water adhering to the fingers. Run the motor for 5 minutes to attain thermal equilibruim, but do not record temperature during this period.

Took the temperature as soon as equilibrium is indicated by a slow uniform rise and read and record the calorimeter temperature to the nearest point at one minute interval

for exactly 5 minutes. Pressed the button and ignition unit to fired the charge at the start of 6 minutes recording the time and temperature at the firing point. After firing, when the mercury starts to rise record the temperature at one minute intervals the until the difference between the successive readings has been constant for 5 minutes.

After compeleting the reading, stopped the mator, removed the belt and lift the covers from the Jacket, wipped the thermometer bulb with a clean cloth to remove any water and set the covers on the support stand. Lifted the bomb out of the bucket and relieve all residual pressure.

After releasing the pressure remove the serew cap, lifted out the bomb head and place it on the support stand. Carefully remove all unburnt pieces of fuse wire from the bomb electrodes, streighten them and measure their combined length in centimeters. Substract this length from the initial to centimeters and take this as the net amount of wire burnt.

Calculation:

Initial temperature of water = t_1°F

Final temperature of water = t_2°F

∴ Rise in temperature = (t_2-t_1) T°F.

Initial length of the wire = $l_1$cm.

Remaining length of the wire = 12cm.

∴ Burnt wire of length = (l_1-l_2)=L cm.

Energy equivalent for the Calorimeter in calories per degree = 1348 calories

∴ Calories for T°F rise of temperature
1348xT= X calories

Energy equivalant for the wire in calories/degrees = 2.3 calories

∴ Fuse wire correction 2.3XL calories =ycalories

A ml of milk give = (x-y) K.cals

∴ 100 ml of milk give = $\frac{(x-y)x100}{A}$ K. cals.

Result: 100 ml of the milk give = $\frac{(x-y)x100}{A}$ K. calories

ESTIMATION OF PROTEIN IN MILK

Total Nitrogen content:

Aim:

To estimate the total Nitrogen in milk.

Procedure:

3 or 5 ml of milk were taken in separate kjeldahl flasks and digested with 5 ml of concentrated sulphuric acid and a pinch of selenium dioxide as a catalyst. Digestion was completed by the addition of a drop of perchloric acid. Cooled the flasks and the contents were made upto 100ml with distilled water. Along with this 5 ml of concentrated sulphuric acid alone was digested and treated similarly. This was used as blank.

5 ml of the blank were taken in the distilling flask of the kjeldahl's apparates and then added 6 ml of 40% NaoH and washed with distilled water. 5ml of boric acid were taken in a conical flask and a drop of mozusagaindicator was added and kept under the condenser. Steam was generated. Steam enters and drives out the ammonia formed which in turn is absorbed by the boric acid. Steam is passed for 5-10 minutes until the solution in the conical flask is blue in colour. The conical flask is lowered and the tip of the condenser is washed with water.

The broic acid solution containing the liberated ammonia was titrated against N/70 sunphuric acid. The end point is the appearance of pale pink colour.

The experiment was repeated with, 5 ml of the digested sample solutions. From the titre values calculated the total Nitrogen content of the milk.

Calculation:

Volume of N/70 sulphuric acid required for blank	= x ml.
Volume of N/10 sulphuric acid required by experiment	= y ml.
Experiment-Blank	= (y-x)
1 ml of N/70 sulphuric acid	=0.2mg of N_2
:.(y-x) ml of N/70 sulphuric acid	=0.2x (y-x)mg of N_2
:.5ml of the digested sample contains	=0.2x (y-x)mg of N_2
:.100 ml of the digested sample contains	$=\frac{0.2x\ (y-x)x100}{5}$ mg. of N_2

Non Protein Nitrogen content:

Aim:

To estimate the amount of non protein Nitrogen content in milk.

Procedure:

5 ml of the milk was taken in a test tube. The test tube is heated in the boiling water bath for half an hour. Centrifreged. The supernatant is removed, The protein is precipated using 15% TCA. The supernatent is concentrated on a water bath and is transferred to a kjeldahl flask. Add 5 ml of concentrated sulphuric acid and is digested. The digestion is completed by the addition of a drop of perchloric acid. The digested sample is made up to 100 ml. 5 ml of concentrated sulphuric acid is kept along with this as a blank and is made upto 100 ml.

5 ml of the blank were taken in the distrilling flask of the kjeldahl's apparatus and then added 6 ml of 40% sodium hydroxide and washed with distilled water. 5 ml of the boric acid were taken in a conical, flask and a drop of mozuzaga indicator was added and kept under the condenser. Steam was generated. Steam enters and drives the ammonia formed which inturn is is absorbed by the boric acid. Steam is passed for 5-10 minutes until the solution in the conical flask is blue in colour. The conical flask is lowered and the top of the condenser is washed with water.

The boric acid solution containing the liberated ammonia was titrated against N/70 sulphuric acid. The end point is the appearance of pink colour. The experiment was repeated with 5 ml of the digested sample solutions of milk. From the titre values calculated the nitrogen content of milk.

Calculation

Volume of N/70 Sulphuric acid required by blank	= x ml.
Volume of N/70 Sulphuric acid required by experimental solution	= y ml.
(Experiment-Blank)	= (y-x)
1 ml. of N/70 sulphuric acid	= 0.2 mg of N_2
:.(y-x) ml of N/70 Sulphuric acid	=0.2x(y-x) mg of N_2
5 ml of the digested sample contain	=0.2x(yx) mg of N_2
:.100 ml of the digested sample contain	$=0.\frac{2x(yx)}{5}x100$ mg of N_2

Result:

Protein content of milk = (Total Nitrogen content − Non Protein Nitrogen content) × 6.25g of N_2

"DETERMINATION OF FAT CONTENT OF MILK"

AIM:

To estimate the amount of fat present in 100 ml of milk.

Principle of method:

The fat content is gravimentically determined by extraction of the fat from an ammoniacal alcoholic solution of milk with diethyl ether and light petroleum, evaporation of the solvents and weighing of the residue, according to the principle of Rose-Goettlieb.

Procedure:

Preparation of the sample:

Bring the sample to a temperature of 20°C mix thoroughly to ensure a homogenous mixture of the fat throughout the sample. Do not agitate so vigorously as to cause fwthing of the milk or churning of the butter fat. If it is found difficult to disperse the cream layer, warm slowly to 35-40°C with careful mixing and incorporating any cream adhering to container. Cool the sample quickly to room temperature.

Determination:

Dried the flask in the oven for 0.5 to 1 hour. Allowed the flask to cool to the terperature of the balance room and weigh the cooled flask to the nearest 0.1 mg.

Inverted bottle containing the prepared sample 3 or 4 times and immediately weigh to the nearest 1 mg directly in, or by difference into, the extraction apparatus, 10-11 g of the well mixed sample, o Added 1.5 ml ammonia (25.1) or an equivalent Volume of stronger solution, and mix well.

Added 10 ml enthanol and mixed the liquids gently but thoroughly in the inclosed apparatus.

Added 25 ml diethyl ether, close the apparatus and shook vigorously and invert repeatedly for 1 ml cooled, if necessary, in running water.

Removed the stopper carefully and added 25 ml light petroleum using the 1st few millilitres to rinse the stopper and inside of the neck of the apparatus closed by replacing the stopper and shook and invert repeatedly for 30 seconds.

Allowed the apparatus to stand until the upper liquid layer has become clear and is distinctly separated from the aqueous layer. Alternatively perform the separation by the use of a suitable centrifuge.

Heated the flask, placed on its side, for one hour in the oven, allowed to cool to the temperature of the balance room as before and weighed the nearest 0.1 mg.

Calculation:

The mass in grammes, of fat extracted as m_1-m_2, and the fat content of the sample, in 1% by mean is where $\frac{m_1-m_2}{s} \times 100$

M_1 = mass in g of flask M with fat.

M_2 = mass in g of flask M.

S = massing of test portion

ESTIMATION OF CALCIUM

Aim:

To estimate the amount of calcium present in the milk.

Principle:

The calcium is precipitated as the oxalate directly from the milk and after washings the precipitate is dissolved ith acid and titrated against permanagement.

Procedure:

5 ml of the milk was deproteinized by the addition of equal volume of 10% TCA Centifuged. From that took 10 ml of the supernatent and added 1 ml of 4% ammonium oxalate. Mixed well and allowed to stand overnight.

The precipitate calcium was centrifuged the next day and the supernatent fluid was removed without disturbing the precipitate. Added 3 ml of 2% ammonia down the sides of the tube and mixed the precipitate well. This was repeated 2 to 3 times until the washed solution gave no precipitate the calcium chloride solution. This was made done to remove the excess of ammonium oxalate. Finally added 2 ml of approximate normal sulphuric adid and mixed well. This was warmed by placing the tube in a beaker of almost boiling to complete the precipitation of oxalate. Removed the tubes and the hot contents (70°-75°) were titrated with 0.01N pottassium

permanaganate to a faint pink colour which persisted for about a minute. As blank titrated 2 ml of the sulphuric acid to the same end point. The difference between the titre values given the volume of 0.01N pottassium permangnate required to titrate the calcium oxalate preciptated.

S.No.	Solution	Burette Reading		Volume of 0.01N pottassium permanganate	Indicator
		Initial	Final		
1	Blank	x	y		Self indicator
2	Filrate	x_1	y_1		

Calculation:

(Experiment-Blank) = $(y_1-x_1) - (y-x)$ ml

1 ml of N/100 potassium permangnate = 0.2 mg of ca

∴10 ml of the filtrate contain = (y_1-x_1) $(y-x)$x0.2 mg of ca.

These 10 ml of come from 5 ml of milk.

∴ 100 ml of the milk contains $= \frac{(y_1-x_1)-(y-x)x0.2x\ 100}{10}$ mg of calcium

Result:

Calcium present in 100 ml of milk = $\frac{(y_1-x_1)-(y-x)\ x02\ 100}{10}$ mg of calcium

ESTIMATION OF IRON IN MILK

Aim:

To estimate the amount of Iron in Milk.

Principle:

A sample of milk is digested with concentrated sulphuric acid to get the iron in the free from in the presence of Potassium per sulphate. The digests is then deproteinized with sodium tungstate solution. Centifuged and then a known amount of the supernatent is treated with potassium thiocyanate. The colour developed is then estimated colorimetrically at 540 .

Standard Ferrous solution:

Prepared a standard Iron solution containing 100 µg of iron per ml. Dissolve 70.2 mg of Ferrous ammonium sulphate in 100 ml of water.

Working standard:

Diluted 10 ml of the stock standard to 100 ml with distilled water. So that 1 ml of this solution contain 10 µg of Iron.

Procedure:

5 ml of the milk was deporteinised with equal volume of 10% TCA and centrifuged. From that 2 ml of the filtrated used for the analysis.

1 to 5 ml of the working standard were taken in different tubes. Added 0.3 ml of concentrated sulphuric acid and 0.4 ml of saturated pottassium per sulphate solution to each of the tube. Finally added 1.6 ml of potassium thio cyanate and made up the volume of each to 10 ml with distilled water, 2 ml of the filtrate was taken. Then added 0.4 ml of saturated potassium per sulphate solution and 1.6 ml of 2 N potassium thiocyanate and the volume is made up to 10 ml with distilled water. Then the intensity of the colour develope was read at 540 mμ in a colorimeter with in 10 minutes. The ferrous content of the milk can be calculated from these values.

Calculation:

Keltt reading X corresponds to Y r of Iron.

1.2 ml of the filtrate solution contain y r of Iron.

1.12 ml of the filtrate solution contain $\frac{yx12}{2}$ r of Iron

These 12 ml come from 5 ml of milk.

100 ml of milk contain $\frac{yx12x100}{2x5}$ r of Iron

Result:

100 ml of milk contain $\frac{yx12x100}{2x5x1000}$ r of Iron.

APPENDIX VI

WEIGHMENT CALCULATION FOR THE NURSING MOTHER

Food stuff	Amount in gm.	Energy k.cal.	Pr g.	Calcium mg.	Iron mg.	Carotene µg	Thiamin mg.	Riboflavin mg.	Vit.C mg.
Rice	200	692.0	12.8	18	8.0	-	0.41	0.10	-
Ravi	340	1182	38.4	53.4	5.3	-	0.41	0.10	-
Dhal	50	167.5	11.2	36.5	2.9	66	0.23	0.00	-
Chillies	20	6	0.6	6	0.24	35	0.04	0.08	22
Cabbage	50	13.5	0. 9	19.5	0.4	600	0.03	0.04	62
Onion	50	23.6	0.7	16	0.46	6	0.03	0.008	0.8
Brinjal	50	12	0.7	9	0.5	37	0.02	0.05	6
Milk	100	117	4.3	210	0.2	213	0.04	0.10	-
Jaggery	50	146	0.2	-	5.7	84	0.01	0.02	-
Sugar	50	100	0.05	6	-	-	-	-	-
Oil	10	90	-	-	-	-	-	-	-
		2870	67	374.4	24	1041	1.22	0.60	90.8

Retionl $\frac{1041}{4}$ 260.

(2)

Food stuff	Amount g.	Energy k.cal.	Pr g.	Calcium mg.	Iron mg.	Carotene µg	Thiamin mg.	Riboflavin mg.	Vit C mg.
Rice	610	2111	39	55	24	-	1.26	0.30	-
Block gramdhal	35	60	4	17	1.6	6.5	0.08	0.06	-
Redgramdhal	70	235	16	51	4	92	0.31	0.13	-
Chillies	40	12	1.2	12	0.4	125	0.08	0.17	45
Beans	135	210	11	26	2.4	169	0.45	0.25	36
Onion	40	22	2.2	5	0.9	-	0.03	0.05	0.5
Tomato	150	30	1.3	72	0.6	526	0.06	0.09	41
Banana	50	58	0.6	8	0.5	39	0.02	0.04	3
Coconut	50	23	0.7	16	0.5	6	0.03	0.008	0.2
Milk	150	176	6.4	3.5	0.3	320	0.06	0.15	1.5
Sugar	50	199	0.05	6	-	-	-	-	-
Oil	10	90	-	-	-	-	-	-	-
		3226	82.4	272	35	1282	2.5	1.3	127

Retinol= $\frac{1282}{4}$ = 320.5

(3)

Food stuff	Amounts g.	Energy k. cal.	Pr. g.	Calcium mg.	Iron mg.	Carotene µg	Thiamine mg.	Riboflavin mg.	Vit C mg.
Rice	600	2076	38	54	24	-	1.26	0.10	-
Black gram-dhal	15	49	3.0	22	1.3	5	0.06	0.05	-
Dhal	50	167	11.1	36	2.9	66	0.22	0.09	-
Agthikeerai	50	47	4.2	565	1.9	2700	0.10	0.04	85
Knolkol	50	8	0.3	8	0.15	8	0.02	0.03	40
Chillies	20	1	0.1	1.5	0.1	8.8	0.01	0.02	5
Carrot	50	24	0.5	40	1.1	945	0.02	0.01	1.5
Onion	30	20	0.6	13	0.4	5	0.03	0.01	0.7
Tomato	100	20	00.9	48	0.4	351	0.12	0.06	27
Banana	50	58	0.6	8.5	0.5	39	0.02	0.04	3.5
Milk	300	351	12.9	630	0.6	6.40	0.12	0.30	3
Sugar	50	199	0.05	6	-	-	-	-	-
Oil	10	90	-	-	-	-	-	-	-
		3110	72	1432	33.4	4467	1.98	0.75	166

Retinol1117

(4)

Food stuff	Amounts gm.	Energy k.gms.	Protein gm.	Calcium mg.	Iron mg.	Carotene µg	Thiamin mg.	Riboflavin mg.	Vit C mg.
Rice	550	1903	35.2	49.5	22	-	1.16	0.06	-
Black gram-dhal	15	49	3	22	1.3	5	0.06	0.95	-
Chillies	10	0.7	0.07	0.7	0.03	4.4	0.005	0.01	255
Beans	30	40	2.2	14	0.7	10	0.10	0.04	7
Dhal	25	84	5.6	0.2	2.5	33	0.11	0.05	-
Onion	15	10	0.3	6.5	0.2	2.5	0.01	0.01	0.35
Potato	125	111	2	198	0.9	30	0.12	0.01	21.5
Amaranth	50	22	2	12.5	12.7	2260	0.06	0.15	1.5
Tomato	60	12	0.5	12.6	0.3	210	0.06	0.03	2655
Milk	150	178	6.4	315	0.3	320	0.06	0.15	1.5
Curds	100	80	3.1	149	0.2	136	0.25	0.16	1
Oil	5	45	-	-	-	-	-	-	-
Sugar	20	79	0.01	2.4	-	-	-	-	-
		2584	60	818	40	3511	1.95	0.74	90

Retinol 755 = $\frac{3511}{4}$

(5)

Food stuff	Amount g.	Energy k. cals.	Pr. gm	Calci- um mg.	Iron mg.	Carote- ne µg	Thia- min mg.	Ribofla- vin mg.	Vit C mg.
Rice	320	1107	20.4	29	1.4	-	0.07	0.16	-
Ravi	100	348	10.4	16	1.6	.	0.12	0.03	-
Keerai	285	23	2.1	262	0.9	1250	0.05	0.02	1.7
Drumstick	50	13	1.8	15	2.6	55	0.01	0.03	5.5
Dhal	50	168	11.2	36.4	2.8	66	0.22	0.1	-
Onion	60	40	1.2	26	0.8	10	0.06	0.02	1.4
Chillies	20	1.4	0.14	1.5	0.06	8.8	0.01	0.02	5
Banana	60	63.8	0.66	9.4	0.5	42.9	0.02	0.04	3.9
Milk	150	175	6.4	315	0.3	320	0.06	0.15	1.5
Curds	50	30	1.6	74	0.1	66	0.12	0.08	0.5
Oil	20	180	-	-	-	-	-	-	-
Sugar	30	119	0.1	3.6	-	-	-	-	-
		2245	54	242	24	1219	2.15	0.65	69

Rations = 305 = $\frac{1219}{4}$

(6)

Food stuff	Amounts gm	Energy k.cl.	Pr. gm.	Calcium gm.	Iron gm.	Carotene µgm.	Thiamin mg.	Riboflavin mg.	Vit C mg.
Rice	500	1730	32.0	45.0	20.0	-	1.05	0.25	-
Chillies	16	4	0.4	4.8	0.2	26.3	0.03	0.06	16.7
Onion	35	21	0.6	14	0.4	5	0.03	0.01	0.7
Tomato	120	24	2.1	57.6	0.5	421	0.14	0.07	32.4
Banana	60	70	0.7	10.2	0.5	46.8	0.03	0.05	4.2
Coconut	25	111	1.1	2.5	0.4	.	0.01	0.02	0.2
Tamarind	15	42.5	0.47	25.5	2.7	9.0	-	0.01	0.5
Butter milk	100	15	0.8	30	0.8	-	-	-	-
Milk	150	176	6.4	315	0.3	312	0.06	0.15	0.15
Sugar	20	80	0.02	2.02	2.4	-	-	-	-
		2269	43.9	507.5	25.9	777	1.40	0.62	55

Retiomi $\frac{777}{4} = 194$

(7)

Food stuff	Amount g.	Energy k. cals	Protein g.	Calcium mg.	Iron mg.	Carotene µg	Thiamin mg.	Riboflavin mg.	Vit C mg.
Rice	550	1903	35.3	49.2	22	-	1.16	0.08	-
Dhal	50	168	11	37	2.9	66	0.23	0.10	-
Onion	25	18	0.4	11	0.3	3.5	0.02	0.01	0.5
Chillies	25	7.5	0.7	0.5	0.3	44	0.06	0.10	28
Tamarind	80	226	2.4	136	8.8	48	-	0.06	2.4
Buttermilk	100	15	0.8	30	0.8	-	-	-	-
Cabbage	25	7	0.4	10	0.2	300	0.10	0.02	31
Milk	20	23.4	0.86	42	0.04	44	0.01	0.02	0.2
Jaggery	20	76.6	0.1	10	0.2	-	-	0.01	1
		2444	52	322	36	536	1.48	0.40	63

Retinol 135 = $\frac{537}{4}$

(8)

Food Stuff	Amount g.	Energy k.cals	Protein g.	Calcium mg.	Iron mg.	Carotene µg	Thiamin mg.	Riboflavin mg.	Vit C mg.
Rice	750	2595	45	75	30	-	1.42	2.24	0
Dhal	100	334	22	72	6	132	0.44	0.18	-
Chillies	25	7.5	0.7	7.5	0.3	44	0.05	0.10	25
Onion	40	22.2	2.2	5	0.9	-	0.03	0.05	0.5
Potato	80	77.6	1.3	8	0.56	19.2	0.08	0.96	13.6
Tamarind	40	113	1.2	68	4.4	24	-	0.03	0.28
Tomato	25	5	0.2	12	0.1	88	0.3	0.01	7
Coconut	50	222	2.2	5	0.8	-	0.01	0.08	0.2
Milk	20	23.4	0.86	42	0.04	44	0.01	0.02	0.2
Jaggary	20	76.6	0.1	10	0.2	-	-	0.01	1
Oil	15	135	-	-	-	.4	-	-	-
		3606	75	302	43	351	2.3	1.5	52

Retinol $88_{.5} = \frac{351}{4}$

(9)

Food stuff	Amount g.	Energy K.cal.	Protein g.	Calcium mg.	Iron mg.	Carotene µg.	Thiamin mg.	Riboflavin mg.	Vit C mg.
Rice	650	2144	38.8	65.5	26	-	1.21	0.10	-
Horse gram	100	321	22	287	8.4	71	0.42	0.2	-
Onion	40	22	2.2	5	0.9	-	0.03	0.05	0.05
Chillies	15	7.5	0.7	7.5	0.3	44	0.05	0.10	28
Tamarind	10	28	0.3	17	1.1	6	-	0.01	0.3
Tomato	120	24	1.0	58	0.5	420	0.14	0.07	6
Milk	40	47	1.7	92	0.08	84	0.02	0.04	0.04
Jaggary	50	191	0.2	40	5.7	84	0.01	0.02	-
Oil	10	90	-	-	-	-	-	-	-
		2826	67	562	42.98	711	1.88	0.68	35.2

Retinol 178= $\frac{711}{4}$

(10)

Food stuff	Amount g.	Energy k. cals	Protein g.	Calcium mg.	Iron mg.	Carotene µg.	Thiamin mg.	Riflavin mg.	Vit C mg.
Rice	650	2149	38.8	65.5	28	-	1.21	0.19	-
Dhal	200	668	44.4	144	11.6	264	0.88	0.36	-
Chillies	20	1.4	0.14	1.5	0.06	8.8	0.01	0.02	5
Onion	60	40	1.2	26	0.8	10	0.06	0.02	1.4
Tomato	100	20	0.9	48	0.4	351	0.12	0.06	5
Milk	25	29	1.1	52	0.05	52	0.01	0.02	0.25
Jaggery	25	95	0.1	20	2.8	42	0.005	0.01	-
Oil	15	135	-	-	-	-	-	-	-
		3137	87	357	42	728	1.3	0.68	12

Retinol 182 = $\frac{728}{4}$

APPENDIX VII

INDIVIDUAL VALUE OF THE SERUM VITAMIN A OF THE NURSING MOTHERS

S.No.	Adult serum Vitamin A Values in µ	Teenage serum vitamin A values in µ
1	18.75	30
2	55	37
3	58	38
4	48	
5	55	
6	58	
7	41	

APPENDIX VIII

HAEMOGLOBIN LEVEL OF THE NURSING MOTHERS

S.No.	Haemoglobin in g/100 ml.	S.No.	Haemoglobin in g/100ml.	S.No.	Haemoglobin in g/100ml.	S.No	Haemoglobin in g/100 ml.
1	8.9	41	12.2	21	12.0	61	8.7
2	8.8	42	8.9	22	12.0	62	13.0
3	11.9	43	12.1	23	8.5	63	11.2
4	13.0	44	12.5	24	10.2	64	11.6
5	12.3	45	12.0	25	8.0	65	9.0
6	10.4	46	10.0	26	9.5	66	12.0
7	11.8	47	13.0	27	12.0	67	12.0
8	8.8	48	12.9	28	7.8	68	13.0
9	11.0	49	9.8	29	8.2	69	13.0
10	12.2	50	12.0	30	14.0	70	13.0
11	10.4	51	12.0	31	9.0	71	11.15
12	8.9	52	12.0	32	19.0	72	8.0
13	12.6	53	13.0	33	12.0	73	12.5
14	10.4	54	12.0	34	10.0	74	13.0
15	12.2	55	12.3	35	8.5	75	8.9
16	9.5	56	11.0	36	4.7	76	10.15
17	12.0	57	8.2	37	9.6	77	8.67
18	12.4	58	12.0	38	10.7	78	9.2
19	12.5	59	10.9	39	11.2	79	10.5
20	12.9	60	13.0	40	12.0	80	12.0

Contd.....

S.No.	Haemoglobin in g/100 ml.	S.No.	Haemoglobin in g/100ml.	S.No.	Haemoglobin in g/100ml.	S.No.	Haemoglobin in g/100 ml.
81	13.0	103	12.0	124	8.7	147	12.0
82	11.5	104	9.5	125	12.2	148	8.8
83	12.4	105	8.2	126	5.8	149	14.0
84	12.6	106	7.8	127	8.5	150	11.8
85	12.3	107	13.0	128	12.5	151	13.0
86	12.2	108	12.0	129	9.8	152	13.0
87	13.0	109	9.86	130	12.0	153	9.5
88	12.8	110	8.2	131	12.1	154	11.6
89	13.0	111	8.4	132	12.8	155	12.0
90	11.9	112	10.0	133	12.9	156	14.0
91	12.3	113	14.0	134	9.8	157	13.0
92	12.5	114	8.6	135	12.8	158	12.8
93	12.0	115	13.0	136	8.7	159	12.5
94	9.5	116	13.0	137	11.8	160	13.0
95	11.9	117	8.4	138	12.8	161	13.1
96	12.0	118	9.8	139	12.7	162	8.0
97	12.0	119	11.2	140	13.0	163	8.3
98	8.8	120	12.0	141	12.0	164	12.0
99	10.8	121	12.0	142	12.2	165	12.2
100	8.9	122	12.3	143	12.1	166	10.8
101	11.2	123	13.0	144	9.2	167	12.0
102	8.2	124	12.0	145	10.5		

Contd .....

168	8.5	184	10.3	201	10.5
169	8.5	185	12.0	202	12.7
170	12.8	186	8.2	203	12.5
171	12.8	187	12.5	204	12.4
172	13.0	188	12.0	205	8.5
173	12.5	189	8.9	206	14.0
174	12.0	190	12.5	207	8.9
175	13.0	192	13	208	8.0
176	8.1	1933	8.2	209	12.0
177	11.8	194	8.9	210	14.0
178	12.0	195	8.8	211	12.0
178	8.8	196	12.0	212	10.2
179	18.0	197	12.8	213	11.5

214	12.0	226	12.0	240	13.0	254	10.8
215	10.8	227	10.8	241	10.8	255	11.3
216	12.6	228	12.0	242	11.5	256	11.2
217	12.5	229	12.0	243	8. 2	257	12.2
218	12.8	230	13.2	244	8.6	258	9.9
219	11.0	231	12.0	245	13.0	259	11.9
220	12.3	232	12.0	246	8.2	260	10.2
221	11.9	233	12.0	247	11.2	261	12.8
222	12.4	234	13.0	248	13.0	262	12.0
223	12.2	235	12.0	249	10.0	263	10.8
224	11.5	236	11.8	250	8.9	264	12.0
225	8.3	237	13.0	251	11.2	265	12.0
		238	12.0	252	11.2	266	9.0
		239	12.0	253	9.6	267	10.2
						268	13.0
						269	10.0
						170	10.0

APPENDIX IX

WEIGHT AND HEIGHT OF THE NURSING MOTHERS

S.No.	15-21		22-35		S.No.	15-21		22-35	
	Weight in kg.	Height in cm.	Weight in kg.	Height in cm.		Weight in kg.	Height in cm.	Weight in kg.	Height in cm.
1	43	150	48	150	19	48	158	47	160
2	42	150	44.5	150	20	50	162	43	157
3	41	150	45	155	21	49	150	55	160
4	37	155	40.5	153	22	43	155	44	155
5	50	155	45	150	23	40	155	44	150
6	43	150	45	150	24	40	160	44	150
7	36.5	155	45	150	25	41	155	44	154
8	50	155	48	153	26	40	150	45	158
9	53	153	51	160	27	42	150	46	159
10	45	150	52	151	28	42	132	46	168
11	44	140	48	145	29	40	155	43	150
12	38	144	50	152	30	40	155	43	152
13	44	150	44	155	31	42	152	51	159
14	48	155	46	160	32	42	155	44	150
15	45	150	51	160	33	40	160	44	157
16	46	155	50	150	34	40	155	49	159
17	45	151	48	155	35	41	155	43=	155
18	45	155	51	160	36	40	150	46.5	157

Contd .....

37	48	145	49	159	49	42	150	170	155
38	50	160	51	158	50	44	158	47	155
39	43	150	46	157	51	52	160	52	162
40	42	150	49	162	52	45	160	52	162
41	45	152	47	157	53	46	150	43	148
42	46	158	48	160	54	43	155	48	152
43	41	152	44	150	55	44	150	49	155
44	42	149	47	160	56	42	150	47	154
45	47	155	45	150	57	42	150	47	155
46	43	158	46	156	58	42	159	49	155
47	43	152	47	156	59	41	155	40	160
48	40	145	42	155	60	39	143	46	150
					61	45	140	49	158
					62	49	150	52	160
					63	48	148	48	155
					64	43	150	49	160

65	47	160	46	157	86	44	155	43	155
66	46	150	45	150	87	43	150	48	150
67	45	155	41	155	88	42	148	47	155
68	45	147	44	160	89	49	155	53	150
69	42	147	43	159	90	48	158	54	155
70	48	160	53	162	91	43	152	45	155
71	43	152	41	155	92	49	150	49	152
72	47	155	44	155	93	45	160	44	150
73	49	150	44	154	94	44	155	48	160
74	40	150	45	155	95		4	45	155
75	41	152	47	160	96			45	150
76	47	150	43	152	97			49	160
77	47	150	50	150	98			45	155
78	49	150	42	155	99			49	160
79	42	150	42	155	100			45	160
80	58	150	44	150	101			44	156
81	47	145	45	158	102			51	159
82	44	150	42	150	104			48	160
83	48	147	44	160	105			45	155
84	49	151	47	160	106			46	160
85	46	150	42	155	107			48	150

Contd.....

108	44	148	45	160	125	44.5	151
109	43	149	44	155	126	41	150
110	48	160	43	150	127	45	155
111	41	150	47	160	128	50	150
112	45	158	48	158	129	39	147
113	45	146	42	155	130	47	152
114	47	150	45	150	131	44	147
115	42	148	46	160	132	42	150
116	48	151	49	158	133	47	155
117	47	152	48	156	134	46	150
118	44	155	44	158	135	47	152
119	44.5	154	48	160	136	55	160
120	43	155	48	152	137	51	155
121	47	160	49	155	138	49	155
122	45	160	45	155	139	49	150
123	46	158	49	158	140	48	150
124	43	157	43	152	142	49	158
					143	50.5	150
					144	48.	155
					145	43	154
					146	45	155
					147	48	150
					148	45	155
					149	44	152
					150	48	160

Contd.....

151	45	148
152	49	160
153	52	158
154	52	160
155	45	160
156	42	138
157	45	160
158	46	159
159	49	159

APPENDIX X

INDIVIDUAL MILK OUTPUT OF THE NURSING MOTHERS

S.No.	Adult milk output in ml.	Teenage milk output in ml.
1	520	550
2	540	450
3	550	500
4	600	650
5	510	750
6	540	650
7	610	770
8	620	
9	605	
10	680	
11	690	
12	680	
13	660	
14	650	
15	650	
16	640	
17	640	
18	700	
19	710	
20	710	
21	770	
22	740	

23	760
24	780
25	790
26	780
27	760
28	740

APPENDIX XI

INDIVIDUAL VALUE OF THE MILK COMPOSITION OF THE NURSING MOTHERS

S.No.	Total solids in (g)	Energy (k.cals)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)
1	9.1	67.04	1.24	3.0	20.86	0.25
2	8.4	65.86	1.24	3.2	21.81	0.20
3	12.1	69.83	1.07	3.1	22.60	0.25
4	9.9	68.92	1.32	2.8	27.55	0.25
5	9.7	64.10	1.07	2.9	29.39	0.27
6	10.7	60.88	1.24	3.0	24.25	0.30

APPENDIX XII

ANTHROPOMETRIC MEASUREMENTS OF THE 0-12 MONTHS OF NON BREAST FED CHILDREN

(1) Anthropometric measurements of the 0.3 months of Non Breast fed Children.

S.No.	Weight in kg.	Height in cm.	Head circumference in cm.	Chest circumference in cm.	Arm circumference in cm.
1	4.0	55	19	18.5	7.9
2	3.8	55	18	17.5	7.5
3	3.3	52	18.5	19	11.0
4	3.7	54	17.5	18.5	10.0
5	3.9	56	19	17.5	8.5
6	5.0	57	18	18.5	7.5

(2) Anthropometric measurements of the 4-6 months of Non Breast fed children.

S.No.	Weight in kg.	Height in cm.	Head circumference in cm.	Chest circumference in cm.	Arm circumference in cm.
1	5.0	61	26	27	9.6
2	4.8	60	25.5	26	10.2
3	4.7	62	27	27.5	10.0
4	5.2	61	26.5	27	10.8
5	4.9	62	26	27.5	10.2
6	5.1	60.5	27	27	9.8

(3) Anthropometric measurements of 7-9 months of Non Breast fed children.

S.No.	Weight in kg.	Height in cm.	Head circum-ference in cm.	Chest circum-ference in cm.	Arm circum-ference in cm.
1	5.5	64	28.5	29.0	11.5
2	6	65	27.5	29.5	11.0
3	5.5	67	27.0	30.0	11.2
4	6.5	62	28.0	30.5	11.2
5	5.8	64	28.5	29.0	11.3
6	5.7	66	29.0	29.2	11.6
7	6.2	71	30.0	29.3	11.8
8	6.5	66	29.5	29.4	9.8
9	7.3	70	28.5	29.0	11.4
10	6.7	75	28.0	29.3	12.2
11	5.0	67.6	28.4	29.0	11.0
12	5.4	67.6	28.4	29.0	11.0
13	7.0	64.0	28.4	29.2	11.2
14	5.5	58	29.5	29.6	11.0
15	5.2	52	30.0	29.5	11.2
16	5.4	60	31.5	29.0	11.3
17	6.5	58	30.0	29.5	11.5

(4) Anthropometric measurements of the 10-12 months of Non Breast fed children.

S.No.	Weight in kg.	Height in cm.	Head Circumference in cm.	Chest circumference in cm.	Arm circumference in cm.
1	7.3	69	37.0	37.5	12.0
2	7.0	68	36.3	37.3	13.0
3	7.0	70	36.0	37.0	13.5
4	9.3	74	36.5	36.5	13.6
5	7.0	74	37.0	37.0	13.0
6	9.0	73	36.0	36.5	13.2
7	7.7	74.2	38.0	38.0	13.5
8	6.0	71.0	37.5	37	12.0

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

$$t = \bar{X}_1, \bar{X}_2$$

$$\sqrt{\frac{s_1^2 n_1^3 + s_2^2 n_2^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}{n_1 + n_2 - 2}}$$

Where $\bar{X}_1$ and $\bar{X}_2$ are the means of the breast fed and non-breast fed infants.

s_1^2 and s_2^2 the square of the standard deviation of the two groups.

APPENDIX XIII

ANTHROPOMETRIC MEASUREMENTS OF INFANTS IN 0-12 MONTHS OF LIFE

(1) 0-3 months of children.

S.No.	Weight in kg.	Height in cm.	S.No.	Weight in kg.	Height in cm.
1	4.0	60	22	4.8	61
2	6.2	50	23	5.2	55
3	6.1	65	24	6.4	62
4	6.0	55	25	6.6	63
5	5.0	65	26	6.8	64
6	6.0	60	27	7.1	66
7	4.8	60	28	7.3	68
8	6.7	70	29	7.5	72
9	6.5	70	30	7.7	71
10	7.2	75	31	7.9	81
11	6.2	62	32	8.1	62
12	6.4	64	33	8.3	60
13	5.4	66	34	6.4	59
14	5.6	64	35	6.5	57
15	5.8	63	36	6.7	56
16	6.4	64	37	6.9	53
17	6.2	66	38	7.2	52
18	6.5	63	39	7.4	54
19	6.6	58	40	7.6	53
20	7.1	57	41	6.4	52
21	7.0	56	42	6.2	51

Contd .....

43	5.8	56.4	67	4.8	61
44	5.7	56.6	68	5.2	55
45	5.6	55.4	69	6.4	62
46	5.4	56.4	70	6.6	63
47	5.4	56.4	71	6.8	64
48	5.5	56.7	72	7.1	66
49	5.3	57.8	73	7.3	68
50	4.0	57.6	74	7.5	72
51	6.2	60	75	7.7	71
52	6.1	50	76	7.9	81
53	6.0	65	77	8.1	62
54	6.0	55	78	8.3	60
55	5.0	65	79	6.4	59
56	8.0	60	80	6.5	57
57	4.8	62	81	6.7	56
58	6.7	70	82	6.9	53
59	6.5	70	83	7.2	52
60	7.2	75	84	7.4	54
61	6.2	62	85	7.6	53
62	6.4	64	86	6.4	50
63	5.4	66	87	6.8	59
64	5.6	64			
65	5.8	63			
66	6.4	64			

Contd.....

88	4.2	56	93	6.8	53
89	4.5	55	94	6.9	52
90	4.3	55	95	7.0	50
91	4.9	50	96	7.1	60
92	5.1	48	97	5.9	62
			98	5.8	61
			99	6.6	62
			100	6.1	64
			101	6.2	66
			102	6.5	63
			103	6.6	58
			104	7.1	57
			105	7.0	56
			106	4.2	56
			107	4.3	55

0-3 months children head, chest mid arm circumference.

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.	S.No.	Head circumference in cm.	Chest circumference in cm.	Midarm circumference in cm.
1	23	21	9.0	21	22	23.5	8.8
2	24	22.5	8.5	22	23.5	21	8.7
3	22	24	8	23	24	22.5	2.6
4	24	22	8.0	24	23	23.5	8.8
5	24	22	8.0	25	25	22	8.2
6	23	21.5	9	26	27	23	8.4
7	22	23	9.5	27	29	24	8.3
8	21	24	10	28	28	25	8.8
9	21.5	22.5	10.2	29	27.5	20	8.2
10	22	25	10.0	30	26.5	20.5	8.3
11	23.5	24	9.5	31	24.5	20	8.4
12	22	22	9.6	32	25	22	9.0
13	23.5	24	9.8	33	24	21	9.2
14	22	25	9.9	34	22	23	9.4
15	24.5	23	10.0	35	23	22	9.3
16	24	22	9.8	36	24	21	9.4
17	23.5	23	9.7	37	22	23	9.2
18	22	25	9.6	38	23	21	8.8
19	23	23	8.5	39	22.5	22	8.7
20	22	25	9.4	40	23	22.5	8.6

Contd....

S.No.	Head circum ference in cm.	Chest circum ference in cm.	Mid arm circum-ference in cm.	S.No.	Head circumference in cm.	Chest circumfer ence in cm.	Mid arm circum-ference in cm.
41	24	21	9.0	63	22	22	8.6
42	23	22.5	8.5	64	23.5	21	8.1
43	22	24	8.2	65	24	2323.5	8.8
44	24	23	8.4	66	22	21.5	8.6
45	24	24	8.5	67	21	22	8.8
46	23	22	7.5	68	21.5	22	8.4
47	22	21	8.0	69	21.5	22	8.4
48	21	22	9	70	23	24	8.3
49	22	20	9.5	71	24	25	8.7
50	21.5	21	10.	72	25	25	8.6
51	22	20	10.2	73	24	24	8.8
52	23.5	22	10.0	74	23	25	9.0
53	21.5	22	9.5	75	23	24	9.2
54	22	21	10	76	24	23	9.4
55	23.5	24	10.2	77	25	22	9.0
56	22	23	10.0				
57	23	21	10.2				
58	24	22	9.5				
59	21	20	9.6				
60	22	23	9.8				
61	21	22	9.9				
62	23	22	10.0				

Contd.....

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.	S.No.	Head circumference	Chest circumference in cm.	Mid ar circumference in cm.
78	21.5	25	9.4	89	22.5	23	8.0
79	23	21	9.8	90	23.5	23.5	8.2
80	23	23	10.0	91	22.5	23	8.4
81	22.5	24	9.8	92	22	21.5	8.3
82	22	22	9	93	23.5	22	8.2
83	21.5	21	8.5	94	24.5	22.5	8.1
84	22	21.5	8.0	95	22.5	21	8.2
85	21.5	22	8.1	96	22	21	8.4
86	22	21.5	8.8	97	22	21	8.6
87	23	23	8.2	98	21	20	10.0
88	24	22.5	8.3	99	23	22	9.9
				100	21	20	10.0
				101	22	21.5	9.8
				102	21.5	22.5	9.7
				103	22	22.5	9.8
				104	21.5	22	9.5
				105	22	23	9.4
				106	23	24	9.6
				107	24	23	9.8

(2) 4-6 months children height and weight.

S.No.	Weight in kg.	Height in cm.	S.No.	Weight in kg.	Height in cm.
1	7.4	68	22	7.5	63
2	7.5	63	23	7.4	62
3	7.3	64	24	7.3	68
4	7.2	66	25	7.0	63
5	7.0	65	26	6.0	64
6	6.8	64.5	27	6.6	65
7	7.0	63.5	28	6.7	64.5
8	7.1	64.5	29	6.7	66.0
9	6.8	66.5	30	5.8	63.3
10	7.1	64.5	31	6.9	64.2
11	6.5	66.5	32	6.9	65.6
12	6.9	64.0	33	6.8	66.5
13	6.7	65	34	6.7	67.0
14	7.4	64.5	35	6.9	69.0
15	7.3	63.5	36	6.8	70.0
16	7.1	67.5	37	6.4	65.0
17	7.4	66.5	38	6.5	64.0
18	7.3	64.5	39	6.6	63.0
19	7.2	63.5	40	6.9	67.5
20	7.0	62.5	41	7.0	63.5
21	6.9	63.0			

Contd.....

S.No.	Weight in kg	Height in cm.	S.No.	Weight in kg.	Height in cm.
42	6.8	64.0			
43	7.5	66.0			
44	7.1	65.0			
45	7.2	64.5			
46	7.3	66.5			
47	7.0	64.5			
48	6.9	66.5			

(2) 4-6 months children head, chest and mid arm circumferences

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm-circumference in cm.	S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.
1	28	28	10.2	23	23	29.5	10.3
2	29	29	10.4	24	22	27	11
3	28	28	11	25	24	24	11.2
4	27.5	27	11.5	26	26	25.5	11.3
5	26	28.0	11.8	27	25	25	11.2
6	24	24.5	11.2	28	24	24.5	11.4
7	25	25.5	11.8	29	23	23.5	11.6
8	26	27.5	11.6	30	22	21.5	11.7
9	28	29	11.8	31	23	24	11.9
10	27	28.5	11.4	32	25	25.5	10.4
11	25	29	10.3	33	27	27.5	10.5
12	26	30	10.2	34	23	24	11
13	28	30.5	10.4	35	25	26	11.5
14	29	28.5	26.5	36	26	25	11.2
15	25	26	10.4	37	25	26	11.4
16	24	26.5	10	38	26.5	27.5	11.1
17	30	29.5	11	39	24	25	11.2
18	30.5	29.5	11.5	40	23	24.5	11.3
19	31.5	30.5	11.2				
20	30	30.5	11.2				
21	31.5	28	11.1				
22	32.5	29.5	11.2				

Contd.....

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid circumference in cm.
41	27	28	11.3
42	26	28.5	11.8
43	29	29	11
44	25	28	11.6
45	29	29	11.3
46	27	27.5	11.7
47	26	26.5	11
48	25	26	11.2

(3) 7-9 months children height and weight

S.No.	Weight in kg.	Height in cm.	S.No.	Weight in kg.	Height in cm.
1	8.7	68	22	8.8	70
2	8.2	70	23	8.6	72
3	8.1	72	24	8.5	69
4	8.0	69	25	8.4	69
5	7.9	67	26	7.9	70
6	8.5	68	27	8.0	68
7	8.5	71	28	8.1	70
8	8.6	72.5	29	8.2	72
9	8.8	73.5	30	8.7	69
10	8.9	74.5	31	8.2	66
11	8.6	75.0	32	8.1	65
12	8.4	64.0	33	8.0	68
13	8.8	68	34	7.9	71
14	8.6	70	35	8.4	70
15	8.4	72	36	8.5	72.5
16	8.7	69	37	8.6	73.5
17	8.2	67	38	8.8	74.5
18	8.1	68	39	8.9	64.0
19	8.0	71	40	8.4	68.0
20	7.9	72.5	41	8.2	70
21	8.2	73.5	42	8.3	71
			43	8.4	69.5
			44	8.6	68.5
			45	8.7	74

Contd.....

S.No.	Weight in kg.	Height in cm.	S.No.	Weight in kg.	Height in cm.
46	8.4	68	54	8.6	73
47	8.6	70	55	8.3	71
48	8.7	72	56	8.4	72
49	8.6	69	57	8.7	70.5
50	8.3	67	58	8.2	74.5
51	8.4	68	59	8.1	73
52	8.4	68	60	8.0	72
53	8.5	69			

(3) 7-9 months children, Head Chest and mid arm circumference

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.	S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.
1	31.5	32	12.6	22	36	34	11.4
2	32	31.5	12.5	23	39	38	13.5
3	33	35	12.4	24	34	35	13.8
4	34	34	12.0	25	36.5	37	13.5
5	33	33.5	13.5	26	31.5	32	12.0
6	35	32	13.8	27	30	31	12.4
7	36	36	13.5	28	31	32	12.5
8	38	31	11.4	29	30	30	12.6
9	39	38	12.5	30	30	31	13.0
10	40	34	13.5	31	31.5	30	12.9
11	32	34	13.6	32	30.5	32	12.9
12	35	36	13.7	33	31.5	34	12.4
13	34	35	12.4	34	32	34	12.8
14	33	31	12.7	35	33	35	12.7
15	35	34	12.8	36	34	26	12.4
16	36	34	12.4	37	33	34	13.4
17	32	34	12.9	38	35	36	12.4
18	31	33	12.9	39	35	38	13.7
19	34	31	22.0	40	38	36	13.6
20	35	34	12.2	41	39	38	13.5
21	34	35	12.3	42	39	40	13.2
				43	40	41	14.3

Contd....

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.	S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.
44	35	32	13.2	55	40	41	14.3
45	33	35	13.4	56	35	37	12.8
46	34.5	36	12	57	34	36	12.v
47	32	33	12.5	58	33	34	13.5
48	33.5	34	13.5	59	35	33	12.5
49	33	33	14	60	36	37	11
50	28.5	32.5	14				
51	31.5	34.5	14.5				
52	30.0	34.5	14.5				
53	32.5	33	12.8				
54	33	34	12.9				

(4) 10-12 months children Head, chest, and mid arm circumference.

S.No.	Head circumference in cm.	Chest circumference in cm.	Mid arm-circumference in cm.	S. No.	Head circumference in cm.	Chest circumference in cm.	Mid arm circumference in cm.
1	37	37	15.2	22	42	36	14.5
2	39	39	15.2	23	36	37	14.7
3	40	40.5	15.4	24	41	41	14.6
4	40.5	41	14.8	25	36	42	14.7
5	40	42	14.7	26	38	44	14.8
6	41	40	14.6	27	32	43	14.6
7	36	31	14.5	28	33	38	15.8
8	34	35	24.7	29	35	37	15.4
9	33	34	14.8	30	33	30	15.5
10	32	31	14.9	31	32	32	15.4
11	37.5	36	32	32	32	14.9	15.5
12	33	32	30	33	35	14.7	15.3
13	34	33	31	34	34	14.7	15.4
14	40	40	41	35	36	14.8	15.5
15	37.5	38	39	36	37	15.0	15.2
16	33	34	33	37	38	15.2	15.4
17	34	33	32	38	39	15.2	15.4
18	33	32	31	39	40	15.1	15.3
19	32.5	31.5	32	40	41	15.2	15.4
20	33	34	34	41	42	15.2	15.3
21	32	31	32	42	44	15.2	15.4

Contd....