UNIT 14 INFANTS AND PRESCHOOL CHILDREN

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14.1 INTRODUCTION

In this unit we will be studying about one of the crucial phases of human growth and development i.e. infancy to preschool years. This phase is extremely significant from a nutritional point of view as during this stage, the vulnerability for various diseases increases, hence emphasizing the role of proper nutrition and care from the parents or caregivers. Undeniably, the most interesting, innovative and challenging phase in human feeding is meeting nutritional needs of infants and children, both qualitatively and quantitatively. The caretaker or the parent has to be imaginative, patient, interesting and devote undivided attention in feeding this age group. This period helps to build lifelong behavioural food habits and physiological growth patterns. Hence, this stage is very critical and of utmost importance. We will find a detailed discussion on this critical period including the nutritional needs and the dietary considerations for infants and children in this unit.

Objectives

After studying this unit, you will be able to:

- describe the physical and physiological changes that occur during growth from infancy to preschool years,
- discuss the nutritional needs during infancy and preschool age,
- explain the benefits of exclusive breast-feeding,
- appreciate the need to introduce complementary feeding from 6 months onwards,
- comment on the kind, quality and amount of complementary foods for young children and link it with the nutritional recommendations,
- identify nutritionally adequate snack foods for preschool children, and
- counsel parents and caregivers to take care of infants and preschoolers in health and disease.

14.2 GROWTH AND DEVELOPMENT

Infancy is a period of rapid growth. During the first year of life, the infant grows and develops far more rapidly than at any other time in life. This is accompanied by a number of important physiological changes. Let us get to know what these changes are.

14.2.1 Physiological Changes

Let us briefly understand some of these changes as they bear important relationship to the care and development of infants. Some of these important changes can be briefly discussed under the following heads:

- Changes in physical development
- Changes in mental development
- Changes in gastrointestinal system
- Development of excretory system
- Changes in body composition
- Changes in feeding behaviour

Let us review each of these and begin our discussion with the changes in their physical growth and development.

- *Changes in Physical Development*

It seems that all infants do is to sleep and hardly Seed. Inspite of this observation, a well-fed and cared infant doubles its birth weight within 4 to 6 months of life and triples within the first year, The birth weight of a normal infant should be more than 2.5 kg. Average birth weight of Indian infants ranges from 2.7-2.9 kg. A well nourished mother delivers baby weighing between 3.2-3.3 kg, which is comparable to NCHS standards.

Similarly, infants typically increase their length by 50% in the first year. At birth, their length is 50 cm which increases to 75 cm by the first year. It is imperative to monitor weight either by serially recording weight on growth charts or approximately @ 200 g/week in first three months; 150 g/week from 4-6 months; 100 g/week in 7-9 month and 50 g/week till one year.

Beyond the first year, growth of the child slows down. It takes 5 years more for the weight at one year to double. The child continues to gain height but the rate is not constant. During the second year, the increase in height is 10 cm and in weight is 2.0 lo 2.5 kg. During 3-6 years, the growth continues steadily. Have a look at Table 14.1. The annual gain in height is 6-7 cm and weight is 1.5-2.0 kg. Large variations are seen, as growth has no calendar and occurs in spurts.

Table 14.1: Heights and weights of well-to-do Indian children (Mean and Standard Error)

Age	Boys				Girls			
	Height (cm)		Weight (kg)		Height (cm)		Weight (kg)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
1+	80.07	0.78	10.54	0.35	78.09	0.84	9.98	0.35
2.t	90.01	0.84	12.51	0.30	87.93	0.90	11.67	030
3+	98.36	0.54	14.78	0.21	2 1	0.59	13.7	0.22
4+	104.70	0.40	16.12	0.18	104.19	0.49	15.85	0.22
5+	113.51	1.30	19.33	1.34	112.24	0.85	18.67	041
6+	118.90	0.47	22.14	0.30	117.73	0.54.	21.56	0.36

SE: Standard Error

Source: ICMR, 1990.

During physical growth, the nutrient needs are high and when any nutrient is limiting at a critical phase of growth and development, the growth of the body as a whole slows down or even stops. Flattening of weight for 3-4 months indicates a danger of developing malnutrition.

Since the baby's head grows rapidly during foetal years and first year of life, by the time the child is 2 years old, the head circumference achieves nearly 2/3rd of its final size. The brain grows faster around the time of the birth than at any other time of life. To accommodate this brain growth, the infant's head is larger in proportion Io the rest of the body. After 18-24 months of age, the rest of the body eventually grows and head circumference to height ratio continues to fall.

- *Changes in mental development*

There is evidently an increase in the brain size. There is a rapid increase in the number of brain cells in the first 5-6 months after birth. Thereafter, the cell division declines but continues till the second year of age. By the age of 10 years, many children have a brain weight of an adult. The effect of nutrition on brain development and IQ are difficult to determine and as the child starts going to school, this relationship is even more difficult to ascertain.

- *Changes in gastrointestinal tract*

A full term baby has the ability to digest simple proteins, carbohydrates and emulsified fats. In first 3-4 months, the production of starch-splitting enzymes is not satisfactory. The usual yardstick to introduce starchy foods to infants is when their weight doubles, which, in most well-nourished population, is around 4 months of age. The disaccharidases, including lactase, are secreted adequately at birth. Some infants have inadequate lactase activity and can develop lactose intolerance. Milk protein intolerance is also seen in infants. You will learn more about this later in GIT disorders,

- *Development of excretory system*

The filtration rate of kidney is low and infants find it difficult to eliminate high concentration of solutes. However, by the end of the first year, the functional capacity of the kidneys becomes fully developed.

Changes in body composition

The weight gain comprise of growth in the muscle, organ tissue, adipose and skeletal structure. One compartment of body which registers fall is *body water.* The infant at birth has 75% body water which declines to 60% of the weight by the end of first year. This value is closer to that of an adult. However, these is a tremendous increase in absolute amount of water. Hence, depletion of water due to conditions like vomiting or diarrhoea can prove to be fatal in infants.

The infants synthesize lean tissue hence there is an increase in body nitrogen from 2% at birth to 3% at first year.

The skeletal system continues to gradually increase till adolescence. The infant is born with 12-15% body fat. This rises to 23% at 12 months and declines to 18% at 6 years of age. Hence, there is a net increase in body fat also.

Let us now see how these changes can ultimately lead to changes in the feeding behaviour of the infants.

Changes in feeding behaviozir

On maturation of neuro-muscular system, the body is able to coordinate sucking, swallowing and breathing. Till about three months, the baby moves tongue up and down and if a solid food is placed on the tongue, the food is pushed out (extrusion reflex), Between 3 to 4 months, the tongue movement changes and the child is able to swallow. By 6 months, the baby is able to chew.

The psycho social changes determine the feeding pattern. An infant identifies with his mother but a preschooler develops a sense of individuality and imagination. Preschooler is in a period of sex identification and hence boys imitate father and girls imitate mother. Hence, parents should inculcate and display healthy attitudes at mealtime.

Having learnt about the physiological changes, let us next learn about the tool which can be used to monitor the growth of the child i.e. growth monitoring.

14.2.2 Growth Monitoring

In third world countries, about half the children are short and underweight for their age. Inadequate nutrient intake is the main reason. Inadequate nutrient intakes occur due to **a** number of causes. Although breast-feeding is universal in India, many mothers do no not exclusively breast feed their infants during the first six months. Introduction of foods , other than breast milk earlier than 6 months of age, often prepared under not very satisfactory hygienic conditions, causes diarrhoea and malnutrition in the children. Introduction of appropriate complementary foods in adequate amounts is often delayed to one year and beyond. **As** amount of breast milk secreted reduces after 6 months of lactation, sole reliance on breast milk beyond this period is inadequate and the child develops malnutrition. Growth monitoring is a tool that helps to ***identify*** *growth [altering at an early stage and helps to institute corrective measures so that malnutrition can he* ***avoided.*** What is growth monitoring?

In growth monitoring, weight is plotted against age accurately on the growth chart. Refer to Figure 14.1 which is a growth chart used in a health centre. Growth charts are available with all paediatricians, health workers, anganwadi worker and health centers. The growth chart depicts vaccination schedule, birth history, general guidelines, disease history and one year weight record with guidelines of infant feeding, as you may have noticed in Figure 14.1. These growth charts are recorninended to regularly record weight, height etc, till 6 years of age.

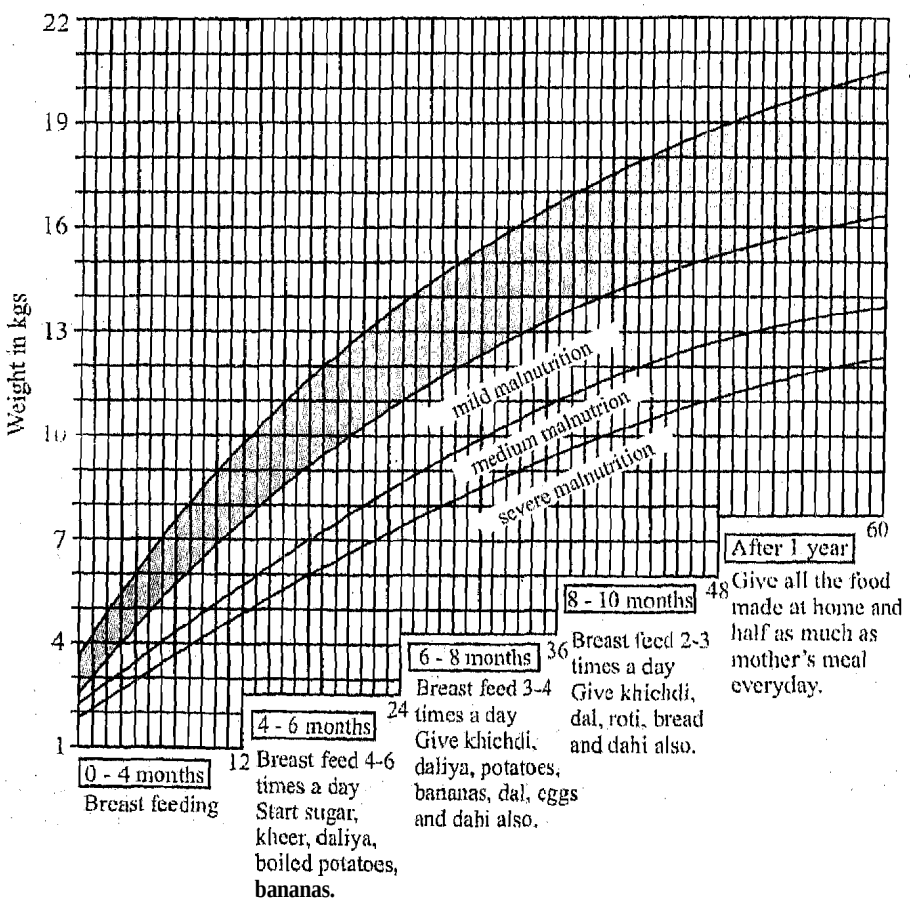

Figure 14.1: The growth chart

Interpretation of growth charts is very important for any health and nutrition professional. The *upward curve* indicates *weight gain* while *flat curve* indicates *no weight gain*. The *downward curve* indicates *weight loss* and is not desirable. Let us understand the concept of growth curves and how to interpret them with the help of an example.

Refer to Figure 14.2 which depicts the growth pattern (A and B) of two infants. From the growth pattern depicted in Figure 14.2, the growth of a child who is born on lower line of normal weight following trajectory A is most suitable. Why? Because, this upward moving curve indicates weight gain. The child following trajectory B, on the other hand, indicates growth faltering as the child has deviated from his/her own path. It is important to understand here that eveiy infant should maintain his own growth pattern. As eveiy infant has different birth weight, no weight per se is an indicator of adequate growth. If the child does not maintain that pattern (as indicative in trajectory B), the health worker should investigate medical or nutritional problem impending the predicted growth.

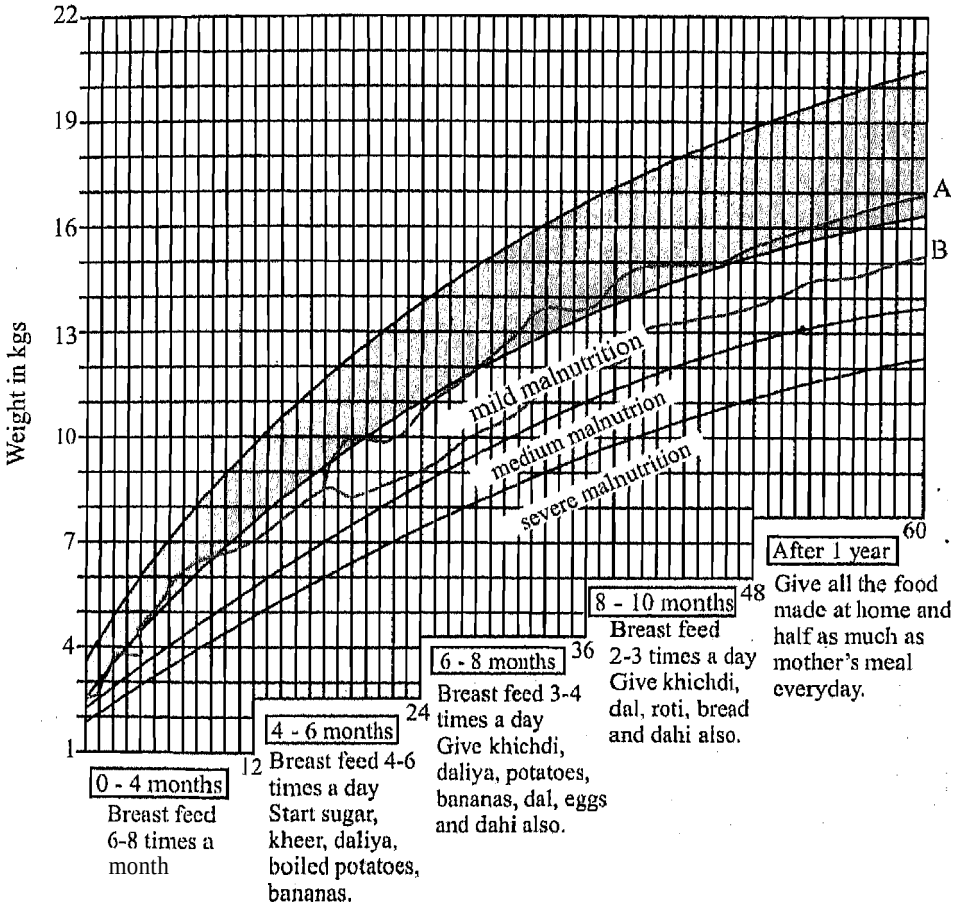

Figure 14.2: The growth curve

As part of the Integrated Child Development Scheme (ICDS), the anganwadi worker maintains this record of every child and also indicates date of immunization and disease history. Among well-to-do mothers, such cards are handed over to the mother during their postnatal clinics or at the time of discharge after delivery from the health centres/hospitals.

Besides identifying growth faltering, growth charts also provide the following information:

1) The growth is considered normal or satisfactory if the curve falls above the topmost line indicating 80% of the ideal weight for age. Refer to Figure 14.1.

2) The growth curve falling between lines indicating 1 and 2 (in Figure 14.1) shows that body weight is 71 to 80% of the ideal, This indicates Ist degree malnutrition.

3) The curve falling between 2nd and 3rd line shows 61-70% of the ideal body weight. This indicates 2nd degree malnutrition.

4) The curve falling between 3rd and 4th line shows 50-60% of the ideal body weight. This indicates 3rd degree malnutrition.

5) The curve falling below 4th line shows body weight to be below 50% of the ideal indicates 4th degree malnutrition.

The weight and height is compared with those of well-to-do Indian children as given in Table 14.1.

It takes 1-3 years for an infant to establish his own genetic growth pattern. Once this figure is established (such as height-for-age or weight-for-age), the child's measurements should then track along the curve. The first three years are crucial as malnutrition is most common and severe during this stage. Height-for-age is a measure of achieved linear growth that can be used as an index of past nutritional status. Low height-for-age is termed as ***stunting.*** In populations with a high prevalence of stunting, length-for-age at 3 months can be used to screen children at-risk for stunting by 3 years. Identification of such children is important because stunting during childhood, as you may recall studying in Unit 2, results in a reduction in adult size, which, in turn has been associated with reduced work capacity and, in women, adverse reproductive outcome.

Stunting results from extended periods of inadequate food intake, poor dietary quality, increased infections and morbidity, or a combination of these factors. It is, therefore, important to prevent infections by maintaining utmost level of hygiene and sanitation and proper immunizations status. Growth monitoring and health monitoring therefore, go hand in hand. Let us get to know about health monitoring next.

14.2.3 Health Monitoring

Infections are a major cause of malnutrition in children. For many of the preventable early childhood diseases, vaccines are now available so that these diseases of early childhood can be prevented providing a better opportunity for normal growth. These are referred as childhood immunizations, the schedule of which is given in Table 14.2. This schedule must be adhered to strictly.

Table 14.2: Immunization schedule – given on growth chart

At birth	BCG
8 weeks (1-1½ month)	Triple antigen (DPT) Polio: Ist dose
10 weeks (2% months)	DPT: 2nd dose Polio: 2nd dose
14 weeks (3% months)	DPT: 3rd dose Polio: 3rd dose
9 months	Measles : 1 dose
1- 1½ years 1½ years-2 years	MMR DPT: Ist booster Polio: 4th dose Typhoid/Cholera and after that whenever necessary
5 years	DT: 2nd booster
10 years	Tetanus toxoid or whenever a wound is cnused by a rusty object.

Note: 1) At five years, DT (Diphtheria and tetanus toxoid) is preferred to DPT. The medicine for whooping cough is not necessary at that age, and may result in adverse reactions.

2) Hepatitis B- Immediately after birth within 48 hours only.

Malnutrition, high infection rate, incomplete immunization and poor diarrhoea management are major cause of high infant mortality rate (IMR) and under five-mortality rate. Use of ORS and ensuring complete immunization schedule has been able to considerably reduce mortality rate.

With this, we end our discussion on the physiological changes occurring during the period of infancy and the concept of growth monitoring. Let us move on to nutrient requirements for infants and preschoolers. But before that, let us quickly recapitulate what we have learnt so far.

Check Your Progress Exercise 1

1) What is the period of infancy? What are its characteristic features?

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2) Enumerate the various physiological changes occurring during the period of infancy?

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3) Looking at the growth curve how can you ascertain that the child is developing malnutrition.

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4) What do you understand by growth monitoring? How are growth charts interpreted?

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14.3 NUTRIENT NEEDS AND RECOMMENDED DIETARY ALLOWANCES

For infants and preschoolers, satisfactory growth is a sensitive criterion of whether needs are met. 50th percentile of NCHS or growth of infants and children from well-to-do families are acceptable Indian norms. The level of intake, which ensures these growth profiles, determines their requirements. Let us briefly ascertain some nutrient needs and derive guidelines of how the RDA will be met satisfactorily. The nutritional requirements of infants are largely met by exclusive breast-feeding till 6 months, after which it is imperative to introduce complementary feeding. Let us begin with energy requirements.

Energy: Energy requirements of infants are based on the energy intake through breast milk by infants of well-nourished mothers. Based on an average intake of breast milk/day by infants of the well-nourished mothers, ICMR (1990) has recommended the energy allowances for infants, as given in Table 14.3.

Table 14.3: Energy requirements of infants (Kcal/d)

Age (Months)	Kcal/kg Body Weight	Mean Kcal/kg body weight
0 - 3	116	108
3 - 6	99	
6 - 9	95	98
Average energy needs during the first year		103

Source: ICMR, *1990.*

FAO/WHO/UNU 2004 has given the energy requirements for needs of breast-fed and formula-fed infants. Total energy expenditure (TEE) is calculated with predictive linear equation as follows:

Breast-fed:

TEE (MJ/day) = − 0.635 + 0.388 kg; n = 195, r = 0.87, see = 0.453 MJ/day (108 Kcal/day)

TEE (Kcal/day) = − 152.0 + 92.8 kg

Formula-fed:

TEE (MJ/day) = − 0.122 + 0.346 kg; n = 125, r = 0.85, see = 0.463 MJ/day (110 KcaVday)

TEE (KcaVday) = − 29.0 + 82.6 kg

The energy demand for growth constitutes up to 35% of TEE at 0-3 months and 17.5% at 3-6 months. The growth requirement should be added to TEE to give total energy requirement, as you may recall studying in Unit 2 on energy requirenlents.

Compared with earlier recommendations (FAO/WHO/UNU 1985), present values are about 12% lower in first 3 months of life, 17% lower from 3-9 months and 20% lower from 9-12 months.

For preschoolers (1-6 years), the energy requirements by ICMR (1990) is laid in two age categories i.e. 1-3 years and 4-6 years as shown in Table 14.4.

As per the guidelines laid by the FAO/ WHO/UNU Expert Consultation (1985), the energy needs of children are computed from energy needs per kg body weight. The body weight of well-to-do children is used for this computation.

Table 14.4: Energy requirements of preschoolers

Age (y)	Boys *		Girls*		Energy Requirements (Kcal/d)
	Weight (kg)	Kcal/d	Weight (kg)	Kcal/d	
1+	10.54	1096	9.98	1078	
2+	12.51	1301	11.67	1190	1240
3+	14.78	1463	13.79	1310	
4+	16.12	1531	15.85	1458	
5+	19.33	1778	18.67	1643	1690
6+	12.14	1948	21.56	1790	

Source: ICMR, 1990.

*Energy intake and weights of well-to-do Indian children.

The FAO/WHO/UNU 2004 recommendation for energy for children age 2-6 years has already been discussed earlier in Unit 2 on energy requirements, We suggest you look up sub-section 2.6.2 now for a brief review of these requirements.

Protein: Protein allowances of infants should meet both growth and maintenance requirements. Protein allowances are computed from the protein content of breast milk and the volume of milk consumed by healthy infants growing normally. In case of infants beyond six months, breast milk alone cannot satisfy protein needs. Supplementary food has to be introduced, consisting of a source of good quality protein like milk and milk products, cereal and pulse combinations, flesh foods i.e. fish, chicken etc. Hence, protein allowances for infants between 6-12 months are in terms of both milk protein and vegetable protein, each contributing almost equally to the total protein intake. Based on this, the protein allowances for infants are given by ICMR **(1990)** and are depicted in the Table 14.5.

Table 14.5: Protein requirements of infants

Age (years)	Protein Allowances (g/kg/d)	RDA (g/kg/d)
0 - 3	2.3''	
3 - 6	1.85'''	1.85 *
6 - 9	1.65''	
9 - 12	1.5**	1.65

Source: ICMR, 1990.

* In terms of milk proteins done.

** In terms of milk proteins and vegetable protein supplements, with a relative NPU of 65.

For preschoolers, the protein requirements of children of various age groups are computed by the factorial method as employed by FAO/WHO/UNU Expert Consultation (1985). The factorial value is increased by 50% to obtain the physiological requirements for growth and further 25% (mean + 2 SD) has been added to give the safe levels of intake. The RDA of protein additionally considers a NPU value of 65 for dietary proteins. Body weights of well-to-do Indian children have been used for computing their protein intakes. Long-term nitrogen balance studies have supported the values obtained by this factorial method. The RDA for proteins, along with other nutrients is given in Table 14.6.

Table 14.6: Recommended dietary allowances of various nutrients for children (ICMR, 1990)

Age (years)	Energy (Kcal/d)	Protein (g/d)	Calcium (mg/d)	Iron (mg/d)	Retinol (mcg/d)	Beta Carotene (mcg/d)
1 - 3	1240	22	400	12	400	1600
4 - 6	1690	30	400	18	400	1600

Age (years)	Thiamin (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vitamin C (mg/d)	Folic Acid (mcg/d)	Vitamin B_{12} (mg/d)
1 - 3	0.6	0.7	8	40	30	0.2 - 1.0
4 - 6	0.9	1.0	11	40	40	1.2 - 1.0

Adequately breast-fed infants receive nearly 30 g fat per day, of which 10% is linoleic acid and 1% is linolenic acid. Breast milk thus suffices the needs of EFA for infants, which is about 6 en%, Human breast milk is superior to other milk for its long chain n-6 and n-3 PUFA content that are biologically more potent.

Infants and children up to age of 2 years should consume about 40% energy from fat (i.e. 40 en%). Fat is an important part of the infant's diet because of its energy density and has a vital role in the development of the nervous system. Fat resolves a potential problem of infant's high energy needs and small gastric capacity.

The linoleic acid requirement of preschoolers is 3 en%, which can be satisfied by a minimal intake of 10 g/d of visible fat. However, more fat is needed to decrease the bulky cereal-based diets, hence upto 25 g/d of visible fat can be given. Total fat

content of the diet increases due to the invisible fat present in milk, nuts, cereals and pulses.

Calcium: The calcium requirements of young infants are computed from the calcium content of breast milk and volume of breast milk intake. Up to 6 months of life, 300 mg calcium intake is adequate. ICMR (1990) recommends 500 mg of calcium (Refer to Table 14.7) daily during the entire period of infancy. Calcium requirements in preschoolers are calculated on the basis of amount of calcium accretion during growth. There is no definite data on Indian children, as well as, the extent of absorption. The preschoolers are recommended 400 mg by ICMR (1990) (Refer to Table 14.6) which was adopted from figures from FAO/WHO.

Phosphorus requirements are linked 'to the calcium intake and the requirements of both these minerals are·almost equal.

Table 14.7: Recommended dietary allowance of various nutrients for infants

Age (Months)	Energy (Kcal/d)	Protein (g/d)	Calcium (mg/d)	Retinol (mcg/d)	Beta Carotene (mg/d)
0 - 6	108/kg	2.05/kg	500	350	1400
6 - 12	98/kg	1.65/kg			

Age (Months)	Thiamin (mcg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vitamin C (mg/d)	Folic Acid (mcg/d)	Vitamin B_{12} (mcg/d)
0-6	55/kg	65/kg	710/kg	25	25	0.2
6-12	50/kg	60/kg	650/kg			

Source: ICMR, *1990.*

However, in all age groups, Ca: P ratio should be 1:1 except infancy when 1:1.5 is recommended.

Iron: The maintenance needs for all age groups is 14 mcg/kg body weight. For infants and preschoolers, iron needs for growth and'expansion of blood volume should be added.

In first two weeks of life, the haemoglobin falls to a normal level of 11-12 g/dl from 17-23 g/dl at birth. The iron is redistributed in the first month of infancy hence breast milk alone meets iron needs of infants. Although iron in breast milk is low, it is very well absorbed. Iron fortified complementary foods are important in maintaining the iron status of infants especially in situations where additional iron rich foods are not offered to the infant after 6 months of age. .

Breast milk may not be a rich source of iron but its iron has better bioavailability and meet the need of exclusively breast-fed infants up to 6 months. Losses of iron in infants and its turnover are not precisely known hence it is difficult to ascertain infant needs. ICMR (1990) has not suggested any allowances for infants. In usual practice, Img dietary iron/kg body weight should be met. When the bioavailability of iron in the diet is poor, the requirement is likely to be more than 1 mg per kg per day.

The iron requirements of preschoolers are 12 mg (1-3 years) and 18 mg (4-6 years), as suggested by ICMR (1990) (Refer to Table 14.5), where the requirements are computed considering their requirement for maintenance (14 mcg/kg/BW), growth and blood volume (15 mcg/kg/BW) and absorption rate of 3%.

Let us move on to the requirements of both classes of vitamins – fat soluble and water soluble. We shall begin with vitamin A.

Vitamin A: On the basis of vitamin A ingested by breast fed infants in well-nourished communities, ICMR (1990) has recommended a daily allowance of 350 rncg of retinol upto 6 months of age (Table 14.7). In the absence of specific data on infants of 6-12 months, the same level of retinol has been recommended.

In preschoolers, 400 mcg/d has been recommended up to 6 years old children (ICMR 1990, Table 14.6) from interpolation data, taking into account the growth rates at different ages and that infants require 50 mcg/kg while by adulthood, the requirements are 9.3 mcg/kg BW.

Indian infants receive about 140 mcg/d during first 6 months of age and if they draw their liver stores to meet their needs and continue on low vitamin A supplementary foods and diet in preschool years, they will show frank vitamin A deficiency. Vitamin A deficiency is a public health problem in preschoolers. Mega dose prophylaxis is given during infancy and early preschool age (upto three years) to prevent vitamin A deficiency in the preschool children in India. However, vitamin A requirements can be easily met by incorporating β-carotene and retinol-rich food sources in the diet of young children.

Other fat-soluble vitamins

ICMR (1990) does not give recommendations for vitamins D, E and K. As you already know, vitamin D is expected to be met by sunlight exposure. Up to 300 IU/d of vitamin D should be ensured for optimal skeletal growth and dentition. Vitamin K shots are recommended only in premature infants or infants born after a complicated delivery. This is to combat primarily physiologic deficiency of vitamin K in the first few days of infancy. Vitamin E intake is related to PUFA intake and is of little significance during infancy.

Next, we shall have a look at the water-soluble vitamins.

Water-soluble vitamins

Thiamin, riboflavin and niacin requirements are met through breast milk alone and solely breast-fed infants meet their requirements. Table 14.7 gives their requirements in per kg body weight (BW) basis. ICMR (1990) recommends thiamin @ 0.5 mg/ 1000 Kcal in preschoolers. Riboflavin can be calculated @ 0.6 mg/1000 Kcal and niacin @ 6.6 mg/1000 Kcal, as done for adults.

Levels of vitamin B_6 (pyridoxine) in breast milk are not adequate and infant may draw upon their stores initially. ICMR (1990) has based its recommendations on the levels of pyridoxine in breast milk of western mother.

ICMR (1990) recommends 25 rncg of folate for infants and 30 rncg (1-3 years) and 40 mcg (4-6 years) for preschoolers by interpolation data (Table 14.6). Similarly, it recommends 0.2 rncg of vitamin B_{12} for infants for normal haemopoesis. Usual breast milk content of B_{12} (0.05 mcg) does not meet infant needs. Vitamin B_{12} requirements of infants is 0.2 rncg and for adult 1.0 mcg/d. For children, it is computed from the interpolation data.

ICMR (1990) recommends 25 mg of vitamin C intake and breast-fed infants in well-nourished population received 20 mg/d. Preschoolers are recommended 40 mg due to its beneficial effect on absorption of non-haem iron. Refer to Table 14.6.

Next, we move on to the requirements of trace elements.

Trace elements

Most elements, such as zinc and iodine, hold a major significance in infant nutrition. Zinc is associated with growth while iodine with the brain growth and development.

Their significance starts since conception in the mother and should be adequately provided. There are no specific age-wise requirements (ICMR 1990) but in an adult, zinc requirement is 15.5 mg/d and iodine is 150 mcg/d (ICMR 1990).

With this, we come to an end of nutrient requirements of infants. Let us now move on to the next section on diet and feeding patterns. But first we shall revise what we have learnt so far by answering the check your progress exercise 2 given herewith.

Check Your Progress Exercise 2

1) Body weight of well-to-do Indian children have been used for computing their energy and protein intakes. Justify .the statement giving appropriate examples.

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2) Which nutrients are of considerable importance during:

Infancy .....

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Preschool Years .....

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3) Which trace elements hold major significance in child nutrition and why?

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14.4 DIET AND FEEDING PATTERNS

In this section, we will learn about diet and feeding patterns of infants and the pre-schoolers. The discussion has been sub-divided into 0-6 months, 6-12 months and pre-schoolers, keeping in mind their age-specific requirements for various nutrients.

It is well accepted that breast milk is best food for an infant. It is nature's provision to satisfy the needs of the infant for growth and development including emotional development. Even a poorest mother is able to nurse her child satisfactorily at least during the first few months. WHO recommends a normal mother to exclusively breast feed till 6 months of age,

14.4.1 Feeding 0-6 Months Infant

The term exclusive breast feeding is used when all fluids, energy and nutrients are provided by breast milk, with the possible exception of small amount of medicinal supplements. Exclusive breast-feeding means that not even water is given. Breast milk provides enough water even for the hot summer months. If water supplements

are given, they may prove harmful as it may be unhygienic, as well as, reduce sucking of the breast, which may diminish breast milk output. Sucking is an important reflex for milk release and ensures adequate production, as you may recall studying earlier in Unit 13. Several advantages of breast milk have been established. Let us briefly enlist them.

Advantages of breast milk

1) Breast milk is a simple and natural method of feeding. It is hygienic, inexpensive and available at all times at the right temperature for the baby. Mother need not worry about how much milk the baby needs as long as the baby feels satisfied and is growing well. Exclusive breast feeding till 6 months ensures normal growth and development.

2) Nutritionally, breast milk has an advantage of being low in protein and high in lactose content than any other milk, which the body can handle. Human milk has a protein-lactalbumin, which is better digested than casein present in high amounts in cow's milk. Human milk has more vitamin C and is not destroyed by heating as in cow's milk. Iron and calcium is better available as compared to cow's milk.

3) Colostrum is rich in nutrients and anti-infective factors. Colostrum is secreted in first 2-3 days. It is a thick and yellowish liquid. It develops natural immunity in the child against various infections. Besides antibodies, it is rich in nutrients and hence should never be discarded. In addition, it has a laxative effect and tones gut for movement.

4) Diseases and death among breast-fed infants is much lower than the formula fed infants. Breast-feeding protects against diseases such as diarrhoea and upper respiratory tract infections. The bifidus factor in breast milk promotes natural gut flora. This gut flora and low pH of breast milk inhibits the growth of pathogens: Breast milk has immunoglobulins (IgA), lactoferrin, lactoperoxidase and complements, which protect the infant against several infections. Antibodies to E. *coli* and some viruses are found in breast milk, which protects their gut mucosa. Breast-feeding also protects infants from allergic reactions and colitis.

5) Cow's milk contains lactoglobulin and serum bovine albumin, which may cause allergy to some infants.

6) Breast-feeding establishes mother-infant contact and promotes mother-child bonding. While the mother gets feeling af satisfaction and achievement in carrying and feeding her baby, it gives an emotional security to the infant.

7) It prolongs birth interval by fertility control. Lactational amenorrhoea prevents onset of another pregnancy thus helping in natural spacing. This time gap helps uterus to contract to normal size arid regain normal shape. The fat laid down during pregnancy is mobilized and utilized during lactation. Breast-feeding also protects against breast cancer.

8) In addition to nutrients and anti-infective factors, breast milk has special components such as growth factors, enzymes and hormones. Many essential components are in concentrated amounts in colostrum as compared to mature milk hence lactation within 2 hours of birth should be initiated.

India has a National Code for Protection and Promotion of Breast-feeding. The basic guidelines are highlighted next.

Guidelines for breast-feeding

1) Follow demand feeding of the baby instead of a fixed schedule.

2) Initiate breast-feeding within 2 h after a normal delivery and 4-6 hours after a cesarean delivery.

3) Avoid honey, glucose and water supplements, dilute milk formula, as these could be sources of infection and impede sucking reflex of baby.

4) Mother herself should avoid tobacco, alcohol and consumption of drugs during lactation.

5) Mother should not breast-feed in case of breast abscess, cracked nipples, fevers, serious diseases, anaemia, tuberculosis etc. However, in HIV/AIDS, the mother is recommended to breast-feed even though she transmits the disease. HIV/AIDS baby is medicated and needs medical attention. On the other hand, if baby is not breast-fed, morbidity and mortality is high in these infants.

6) Mother should maintain utmost hygiene especially of breast, nipples and handling baby while feeding. She should nourish herself well with iron, calcium and vitamins **A** and B complex supplements, as their levels' improve in her milk.

7) Mother should maintain a correct posture, alveolar position and breathing space while breast-feeding.

8) Infants should be exclusively breast fed till 6 months of age. Breast-feeding can continue till 1-2 years but complementary foods should start by 6 months especially to meet iron needs and energy needs for rapid growth needs.

9) Complete immunization should be reinforced even if the child has fever, restlessness etc. After immunization, breast-feeding should continue. Breast-feeding should also continue even if there is diarrhoea.

10) Breast-feeding must be continued essentially up to 2 years.

Sometimes exclusive breast-feeding cannot be sustained. Working mothers join their duty in the fourth month and exclusively breast-feeding stops. Although infant needs of almost all nutrients is met from breast milk alone but in absence of breast milk, other milk can be given. Giving undiluted homogenized, pasteurized, toned milk, that has been boiled at home is a relatively inexpensive option. Buffalo's milk can be given by initially diluting in the ratio of 2:1. The alternate caregivers may over dilute the milk, which can cause undernutrition. The usual challenge in alternate milk is water quality, hygiene and handling and milk allergies. Cow milk has been well documented for causing allergies worldwide. Heat-treated milk formulae have shown better tolerance but are expensive and their over-dilution is the major cause of malnutrition. Nutrient composition of different milk is given in Table 14.8.

Table 14.8: Nutrient composition of different milks/100 g

Milk	Energy (Kcal)	Protein (g)	Carbohydrate (g)	Fat (g)	Calcium (mg)	Vitamin C (mg)
Breast Milk	65	1.1	7.4	3.4	28	3.0
Cow's Milk	67	3.2	4.4	4.1	120	2.0
Buffalo's Milk	117	43	5.0	6.5	210	1.0
Toned Milk	58	3.2	4.7	3.0	118	

Source: ICMR, 1989.

Whenever the baby is fed on animal milk, supplements of iron and vitamin C should be provided. Animal milk does not have this in adequate amount, Heat-treated milk formulae may be fortified. In many cases if the infants have doubled their birth weight, solid foods which are cereal based and supplemented with vitamin C or iron, are introduced around 6 months. The usual cereal is rice, which is known to be least allergic. Needless to say that weaning off breast around 6 months is driven more due to circumstances than need of the infant. Thus, the period during which other foods or liquids are provided along with breast milk is considered the period of *complementary feeding.* Any nutrient-containing foods or liquids other than breast milk given to young children during the period o complementary feeding are defined as *complementary* foods.

Here we would like to emphasize that the infant needs to be preferably fed with sterile 'katori' and 'spoon' instead of bottle-feeding, which causes nipple confusion,

Further, maintaining sterile, hygienic bottle and teats is more difficult than katori. Due to nipple confusion, the infant does not accept effortful sucking from the breast. Hence, on introduction of bottle feeding, the breast milk production gradually falls. It is important for mothers to continue breast-feeding as long as possible.

14.4.2 Feeding 6-12 Months Infant

As the infant grows older, mother's milk alone is not sufficient to meet his increasing needs. This could be seen in few infants between 4-6 months by the downward slope in the growth curve. Especially if for some reason, mother's milk is insufficient, the infant is then *weaned.* Weaning is *a process of gradually introducing foods other than breast milk.* Weaning foods are those foods, which are used during the gradual transition of the infant from breast-feeding to a normal diet. It may start with the introduction of other milk but the best option is to continue breast milk and give other solid foods in liquid and semi solid consistency.

The introduction of complementary foods/weaning foods ensures fulfillment of nutritional requirements and gradually introduces the child to family eating pattern. By the time the child is one year old, he should get used to eating the normal family diet. See Box 14.1 for the amounts to be given to an infant. The supplementary foods, which can be given to the child from time to time, are given in Table 14.9.

Read the information presented in Box 14.1 carefully. You will find information related to balanced diet for infants.

Box 14.1	**Balanced Diet for Infants**
The infants 6-12 months can eat in a day's diet : 30-45 of cereal, 15 g pulse, 200-500 ml of animal milk (if breast-fed then 200 ml top milk is recommended), 50 g roots and tubers, 25 g green leafy vegetables, 25 g other vegetables, 100 g fruit, 25 g sugar, 10 g fat. Adding extra fat in dal khichri is a recommended practice to ensure 40 en% of fat for infant's growth and decreasing bulk in diet.	

Source: ICMR, 1998.

Next, some handy points related to infant feeding are highlighted.

Points to be kept in mind:

- Introduce only one food at a time, giving only small amounts at first
- Increase variety slowly
- Introduce all food groups
- Give an extra dash of fat in one or two items
- Do not use excessive fat, salt and sugar
- Prepare bland and non flavoured items
- Consistency should be gradually built from liquid to semi-solid and then to solid
- P ticle size of gruels should be built gradually from homogenized khichri, to well mash to a thick khichri
- To reduce consistency of bulky gruels, addition of amylase rich flour (ARF) after cooling – the gruel has to be warm – decreases consistency and increases intake. Use of ARF and fat help to increase intake to meet energy and protein needs adequately
- Quantity should be gradually increased
- If the child dislikes or is disinterested, discontinue the food for some time and re-introduce later. Do not force-feed. No food is indispensable or best.
- Parents should avoid personal prejudices, likes and dislikes in front of children. Rather they should eat a variety of foods and encourage children to do the same.
- Identify intolerance and immediately discontinue. Cow's milk, egg white soyabean etc. are known to cause allergies. Cereals which cause least allergy are rice and the pulse which causes best tolerance is moong dal.

- Avoid fiber. Whole legumes and raw vegetables with their high fibre content are foods recommended for adults but not for infants.
- Some complementary foods need special preparation such as ARF or mashed potato or banana. It is also possible to feed from family pot, for example rotis mashed in dals before spicing etc. Consistency is important, so sieving, mashing etc. may be recommended separately. Degree of cooking may be more for infant feeding. Due care should be given in handling and sanitation while feeding infants.

Table 14.9: Complementary foods for infants

Infant's Age	Foodstuff	Form in which given	Amount to be given	Type of Supplement	Child can do
4-6 months	Fruit Juices	Juice mixed with a little sugar (avoid sour)	Start with 1 to 2 tsps and increase to about 30 to 50 ml	Liquid	• Rooting reflex • Sucking reflex • Swallowing • Extrusion reflex
	Green Leafy vegetables	Soups in milk (Avoid fibre)	Start with 1 to 2 tsps and increase to about 50 ml	Liquid	
5-6 months	Cereals	Cooked in water or milk	Cook about 2 tsps of cereal in a cup of milk or water, for example suji kheer, rice kheer, phirni etc.	Semi-solid	• Extrusion reflex disappears • Learns to reach mouth with hand
6-7 months	Egg yolk	Half boiled egg yolk	Start with ½ tsp and increase to 1 yolk.	Semi-solid	• Sits with balance
	Starchy vegetables and fruits	Boiled and mashed potato with butter or milk	Start with a small amount and increase to ½- ¾ katori	Semi-solid	• Moves food from the front of tongue to back
	Pulses	Mashed banana with milk			
7-8 months	Vegetables and pulses	Well cooked vegetables, thin khichri (small particle sue)	Starting with small amounts, increase quantity gradually 2-3 katori	Semi-solid	• Learns rotary chewing • Tooth eruption
10-12 months	Whole egg including the egg white. Meat, vegetables, fruits	Soft boiled egg, scrambled egg, custard,	One egg, Biscuits, Banana, chopped fruit,	Semi-solid	• Coordinates hand to mouth • Able to bite and chew
		Well cooked raw or cooked (chopped) meat, vegetable or fruit	Starting with small quantities increase the amount.	Solid like to bite and chew (soothe gums)	• Holds cup without help • Feeds self

Feeding Schedule in Infancy

1) Milk feed 5-6 timeslday. Continue breast-feeding. Exclusive breast-feeding up to 6 months even during illness. Follow demand feeding.

2) 6 months: Start complementary feeding; feed 3-4 timeslday, For example, porridge: twice/day, vegetable – once/day, fruit – once/day.

3). 6-9 months: Continue breast-feeding, modify farnily pot; feed 4-5times/day e.g. family diet – twicelday, commercial premixes or home made multi grain mixes including amylase rich foods (ARF) – twicelday, vegetablelfruits– once a day.

4) 9-12 months: Continue breast-feeding, feed farnily food; Feed 5-6 timeslday e.g. family food twicelday, instant mix – twicelday, fruits/vegetables – once a day.

Source: WCD. Govt. of India.

Let us now move on to know the feeding patterns and nutrient requirements of preschoolers.

14.4.3 Feeding Preschoolers

The word preschool children, you may be aware, is used for children less than six years of age. After the first year, there is a sustained growth in childhood, which is not as rapid as in infancy yet the growth needs are high. Growth occurs in spurts; nevertheless children should grow @ 6-7 cm/year in height and 1.5-3 kg/year in weight. Further, the preschool years are characterized by increased physical activity. Physical activity, you know, influences energy needs. Due to these physiological conditions, children during this period, in fact, are most susceptible to malnutrition. Situations that promote malnutrition also favour a high incidence of infectious diseases, which in turn further contribute to the malnutrition. For many children, *under five – and particularly* ***those*** *under three* – years of age who live in these conditions, being sick or convalescing from diarrhoea or a respiratory infection is part of "normal life", because they experience this several times a year, with each episode lasting two to 15 days and requiring up to twice that time to achieve full recovery, provided that an intervening new episode of disease does not interrupt the recovery process. Infections of this nature often result in negative energy balance resulting from poor appetite, decreased absorption of nutrients during diarrhoeal episodes and increased metabolic rate, particularly in febrile processes. This leads to chronic mild wasting (i.e. low weight-for-height) and stunting (i.e. low height-for-age), which may be prevented, ameliorated or corrected if adequate care and food are available, especially in the periods between infectious episodes when appetite has been re-established. If, on the contrary conditions do not improve, the status quo of mild malnutrition is maintained, the possibility for catch-up growth is reduced and the consequences of malnutrition will continue. Thus, the preschool period is the challenging period in normal nutrition.

Interestingly, this is also the time when eating habits get established among preschoolers. The family determines the feeding habits of children. Colour, flavour, texture, shape, stories appeal to make food choice among children. Food pfeferences and total food intake fluctuates and change from time to time. Appetite is erratic. ***So*** then considering these factors how do we ensure proper nutrition and eating habits during these vulnerable years? Let's find out.

A nutritionally adequate diet is essential for optimal growth and development. Children below the age of five years should be given less bulky foods, but rich in energy and protein (such as cereal pulse coinbinations, legumes, pulses, eggs, meat etc.). Vegetables including green leafy vegetables and seasonal fruits should be part of their daily menu. Care should be taken that ingredient from all food groups get included in child's diet as recommended by ICMR in Table 14.10.

Table 14.10: Suggested food groups intake (g/day)

Food Groups	1-3 years	4-6 years
Cereals and Millets	120	210
Pulses	30	45
Milk	500	500
Roots and Tubers	50	100
Green Leafy vegetables	50	50
Other vegetables	50	50
Fruits	100	100
Sugar	25	30
Visible fats	20	25

Source: ICMR, 1990.

Note: Children 1-6 year consumes ½-¾ the amount of cereals, pulses and vegetables as compared to sedentary woman but has an extra cup of milk.

The other points to be kept in mind while feeding a preschooler are highlighted next.

Points to Keep in Mind

1) Do not force-feed the child.
2) Children naturally eat a variety of foods. Their sensory-specific satiety ensures that they tire of even their own favourite food.
3) Change the form. If milk is disliked, make kheer, kulfi or custard. Cocoa and chocolate flavouring is not the best choice but can give variety.
4) Good quality proteins should be given to ensure growth. A mix of vegetable proteins is recoinmended in those who do not opt for flesh foods. Give less bulky foods but rich in energy and proteins. Pulses, nuts, milk and milk products and eggs are recommended.
5) Encourage child to eat all food groups. Encourage vegetables, green leafy vegetables, and fruit in any form in daily diet.
6) New foods should be introduced one at a time. "Have a bite and taste" is a good policy. They are mostly' wary of any new food.
7) Snacks have a special place in preschooler's diet. They are finger foods, easy to handle and eat independently. Care should be taken to make snacks, which are not fried and oily. Innovative methods of low fat snacks preparation should be tried. This helps in preventing faulty food habits formed at this age.
8) Prevent inclusion of junk foods, which provide only energy. Too many sweets biscuits, baked products like cakes and pastries, which have refined flour and sugar can cause dental caries.
9) Avoid nibbling. Have a 5-6 meal pattern, Keep gap of 3 hrs. and encourage physical activity and play to prevent obesity.
10) Tiffin to a preschooler needs special care and attention. Prefer simple meals, which are Liked even if they are cold. They should be adequate in proteins, vitamins and minerals needed for growth, for example, pea paneer pulao, sprout upma, paneer patty, carrot burfee etc, Select foods rich in vitamin A, iron, calcium and zinc.
11) Meals should be attractive and served with care and personal attention.

12) Fried food, highly spiced, and highly flavoured foods are not liked. They are not eaten in adequate amount. Well cooked, bland but interesting meals are appetizing.

13) Too much attention at mealtime only makes child resort to unfair means of achieving their ends. On the other hand child left unattended but engrossed on a TV channel has no eating habit. Healthy mealtime environment of the family helps in good eating habits.

14) Parent's personal prejudices and dislikes should not affect child's feeding pattern. If caregivers dislike a food it should still be given to the toddler. Caregiver's personal choices should not be thrusted upon the child.

So that was an exhaustive list. Before we end our study here we would like you to carry out an activity given next. This will help you in understanding the feeding of preschoolers better.

Activity:

Plan a tiffin for a preschoolers providing 1/4th days requirement of energy, protein, vitamin, calcium and iron.

Also do look up the check your progress exercise 3 given herewith to consolidate your understanding of the topic further.

Check Your Progress Exercise 3

1) Discuss the advantages of breast milk.

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2) What precautions must be followed when foods other than mother's milk are introduced in the infant's diet?

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3) What do you understand by the term complementary feeding? List any five nutritionally adequate supplementary weaning foods.

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4) Enumerate five points to be kept in mind while feeding:

a) Infants

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b) Preschoolers

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5) Rohan is an 8-month old boy. What should be his feeding schedule?

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With a thorough knowledge about the nutrient needs of infants and preschoolers, next we shall focus on the national programmes targeting infants and preschoolers.

14.5 NATIONAL PROGRAMMES TARGETING INFANTS AND PRESCHOOLERS

Infants and preschoolers are the vulnerable sections of the society. To give them due coverage, some national programmes are targeted towards them. These national initiatives are briefly outlined below. You may have already learnt about these initiatives in the Public Nutrition Course (MFN-006).

a) Integrated Child Development Scheme (ICDS)

b) Vitamin A Deficiency (VAD)

c) Immunization Programme

d) National Nutritional Anaemia Prophylaxis Programme

These programmes have the objective of bringing down under-5 mortality. Under Integrated Child Development Services (ICDS), preschoolers receive food supplements, nutrition and immunization. Vitamin A deficiency (VAD) is a public health problem among preschoolers. Prophylactic dose of 1 lakh IU is given at 9 months along with measles vaccine and then 2 lakh IUs are given at 18 months and thrice at 6 monthly intervals till 36 months of age i.e. at 18, 24, 30 and 36 months of age. This activity is supported by UNICEF and for better coverage; it has been linked to ICDS and Universal Child Immunization Programme.

National Nutritional Anaemia Prophylaxis Programme addresses iron and folate deficiency anaemia (IDA). Preschoolers receive 20 mg Fe and 100 mcg folate daily. Deworming of preschoolers is advised. Preschool children have been one of the target groups to receive IFA tablets under National Anaemia Prophylaxis Programme. Both access and intake of IFA tablets by children have been poor and there had been a very little impact on the reduction of anaemia in childhood. The objective even in 10" plan is that infant is born with adequate weight and nutrient store, if iron-folate tablets (one tablet a day containing 100 mg elemental Fe and 500 mg folate) are given to pregnant and lactating women for 100 days. Further, it also helps mothers not to become anaemic.

The diarrhoea1 management strategies have had a major impact on less than 5 mortality rate. The distribution of ORS packets and necessary advice at health centers has made diarrhoeal management more effective. The anganwadi workers also store iron-folate tablets and ORS packets for distribution as and when required in villages. Mothers are counseled that the infants should continue to receive breast-feeding and older children should not go on starvation therapy during diarrhoea1 episode. Rehydration therapy through home made beverages and rehydration fluid is taught. Hygiene and principles of sanitation are reinforced for complete management.

In 2001, National Nutrition Mission (10^{th} plan 2002-2007) has been announced to bring about a rapid reduction in undernutrition, reduction/elimination of micronutrient deficiencies viz. iron, iodine and vitamin A. Utilizing PMGY funds BPL families can take-home food supplements for children 6-36 months of age from the anganwadi.

Nutrition education by anganwadi workers and ANM's are promoted. The goal is to bring down the prevalence of underweight children less than 3 years from current 47% to 40% and reduce prevalence of severe undernutrition in children of 0-6 years by 50%.

Next, let us get to know about the problems of infant and preschoolers nutrition.

14.6 PROBLEMS OF INFANTS AND PRESCHOOLERS NUTRITION

In spite of all nutrition interventions, there are some of the common yet life threatening problems which need to be looked at. So let us begin our discussion on these, starling with the diarrhoea1 diseases.

- *Diarrhoea*

We have just covered control and strategies in diarrhoea management in the above section. Crawling, unclean hands, improper self-cleanliness, teething and playing in mud are usual causes of a diarrhoeal episode. Electrolyte and fluid replacement therapy goes a long way in speedy recovery. Diarrhoea due to lactose intolerance or milk protein allergies may require switching to soy-based or lactose-free formulae. During diarrhoea, breast-feeding should continue. You will cover management of lactose intolerance and milk protein allergy in chapters of therapeutic nutrition.

Let us understand how birth weight of an infant acts as one of the predisposing factors leading to various diseases.

Low birth weight infants (LBW)

One-third of the babies born in India are of low birth weight, less than 2.5 kg. A LBW infant has an inadequate mineralized skeleton, poorly developed muscles, low iron stores and metabolic inability like insulin resistance, poor fat oxidation and low metabolic rate. As age advances and there is catch up or rapid weight gain, there are high chances of obesity and diabetes. This partly explains three times higher risk to CHD among Indians.

It is, therefore, crucial to ensure proper care and nutrition for these infants to help them stay on their optimal course of growth. Measures would include, keeping the babies warm, feeding colostrums, breast-feeding exclusively for the first six months, and providing iron supplementation (liquid iron) as these infants have poor iron stores at birth. Additionally, all immunizations must be given on time, .

Undernutrition (Chronic Energy Deficiency, CED)

This is a major problem in India. Undernutrition, you may recall reading earlier in Unit 2, is caused by a less than adequate intake of nutrients, most of which are related to energy intake. This has led to the term *chronic energy deficiency*. The common way to think of undernutrition is in terms of *body weight* and *height*. The consequences of an inadequate energy intake, is reduced body size. *Stunting,* we learnt results from *extended period of inadequate food intake, poor dietary quality, increased morbidity or a combination of these factors,* The prevalence of stunting (i.e. low stature-for-age) is generally highest during the *second and third year* of life. Stunting during childhood has serious implications. It results in reduction in adult size, which in turn, has been associated with reduced work capacity and in women, adverse reproductive outcome. It is alarming to note that most of the deficit in height that occurs as an adult has already taken place during the first two years and it remains largely irreversible during the rest of the life time.

Considering these ill effects, in the year 2001, National Nutrition Mission was set to reduce undernutrition (CED) and reduce or eliminate micronutrient deficiencies. The mission would coordinate the National Nutrition Policy to strengthen the existing programmes, research and development, natural calamities. The strategies suggested are:

1) Nutrition education through all modes, especially by anganwadi workers and ANMS to promote universal b east-feeding and exclusively, for example, monttis, which can continue till 24. Introduction of semisolids from family pot at six months and giving complementary more food to preschool children, pregnant and lactating women at least 2 times/week.

2) Take home food supplements for 6-36 months from anganwadi.

3) Vitamin A prophylaxis dose at 18, 24, 30 and *36* months by anganwadi workers and ANMS.

4) Organize immunization on a fixed date at least once a month.

5) Anganwadi workers can also keep IFA tablets and ORS packets.

6) Promote universal use of iodized salt.

7) All 0-6 years to be weighed four times in a year and grade III and IV are identified to get double ratios as take home food supplements.

8) Weigh all pregnant and lactating women and identify those who less than 40 kg and provide them with food grains.

9) Weigh all adolescent girls at least 4 times/year and those weigh less than 35 kg to get foodgrains.

10) Organize child health clinics at anganwadi lo screen for anaemia, vitamin A deficiency and iodine deficiency.

The goal is to bring down prevalence of underweight children less than 3 years from 47 to 40 percent and reduce severe under nutrition in less than 6 years by *50* percent.

- *Overnutrition/Obesity*

An infant is never put on a reducing diet. The chances of obesity are least if an infant is exclusively breast-fed till 6 months. In 6-12 months, excessive feeding of fat and sugars can lead to an upward shift of growth curve and if it overshoots the normal, only visible fat and sugar intake needs to be controlled. In infancy, diets with 40 en% are recommended. Low fat diets (<30 en %) to preschoolers has been recommended in fear of early onset of heart diseases. However there is no such evidence that normal weight preschoolers should reduce their fat intake in order to prevent heart disease. If there is a family history of dyslipidemias or heart diseases, children should be screened and treated accordingly. There is no advantage in recommending low fat diets to all in order to prevent heart diseases. By 2 years of age, fat intake should not exceed 30 en% and contribution of saturated fats, should not be more than 10 en%. This is in accordance with the adult diets. Consistent moderation is the best strategy instead of restricted diet, as fat is needed for growth and development of organs and brain. High fat, fried foods, creamy desserts, empty calories should definitely be discontinued to prevent obesity. Childhood obesity tracks into adulthood but obesity in infancy and adulthood are not particularly related.

- *Vegetarianism*

Protein quality of the vegetarian diets can be improved by proper diet planning, However, under free-living conditions, vegetarianism can limit protein intake of good biological value, iron, B_{12}, calcium and zinc intake. Vitamin D can be met by sunlight exposure. Vegetarianism per se leads to bulky diets. Special care and meal planning is needed to meet the needs of these nutrients adequately.

- *Infants of HIV/AIDS Mothers*

It is recommended to continue breast-feeding even if the disease will continue to be transmitted. If these infants are not breast-fed, they will have a high morbidity and mortality. They, however, need specific medication and medical supervision.

- *Nutrient Deficiency Disorders*

Protein Energy Malnutrition (PEM), iron deficiency anaemia (IDA) and vitamin A deficiency (VAD) are still the major public health problems affecting large number of preschoolers in our country. We have already described these conditions in the Public Nutrition Course (MFN-006) in Unit **3.** Here, a brief recapitulation follows.

PEM affects 60-70% children of low income group in our country. Recent National Family Health Survey (NFHS) data reveal that about 70% children below **3** years of age are anaemic and vitamin A deficiency is also rampant. Night blindness, bitot spots and nutritional blindness figures are still of public health concern.

Two major causes of severe PEM are diluted milk formulae and infections, especially diarrhoea in poor communities living under unsanitary conditions. Severe PEM needs hospital intervention. The treatment is also, rehydration with ORS. When diarrhoea subsides, feeding at the rate of 3-4 g protein/kg BW and 170-200 Kcal/kg BW is initiated. Most hospitals use milk-based formulae. Dry skimmed milk (DSM) powder is better tolerated but due to low energy content, the targets are difficult to meet. A formulae containing 90 g dried skimmed milk (DSM) + 70 g sugar + 50 g vegetable oil in one litre water provides 100 Kcal and **3** g protein1100 ml. The children are given 100-150 ml/kg BW and the amount depends on how well it is tolerated. Sugar and oil amounts are increased, if more energy density is needed. Milk tolerance is indicated by watery diarrhoea in which case it should be substituted with cereal. Older children however accept solid foods. Oil is added to the mixed cereal-based diets to increase energy density in preschoolers suffering from PEM, Vitamin and mineral supplements are strongly recommended as PEM is always associated with multi vitamin and mineral deficiency.

Anaemia in preschoolers is present primarily due to poor iron content of diets, infections and worm infestations. Milk is a poor source of iron, preschoolers who are poor on diet and primarily consume milk and cereals do not meet their iron needs. Green leafy vegetables, whole pulses, especially Indian bengal gram and soyabean are rich sources. Nuts, dates, organ meat may be included as rich sources. Iron supplements are recommended.

As for vitamin A deficiency, requirement of vitamin A is the most easy to meet as it is abundantly present in green and yellow vegetables and fruits, whole milk. Children largely like vitamin A-rich foods but ignorance of mother and caregivers or lack of adequate supervision can cause its deficiency. One tea spoon of red palm oil, or small amounts of less than 10 gm of fresh leaves can meet the day's requirement of vitamin A of preschool children. The Government has a prophylaxis programme, as you may already be aware, which provides one teaspoonful of oil-miscible vitamin A syrup containing 200, 000 IU of vitamin A once every six months to children between the age of 9-36 months.

With this, we end our study on the problems of infants and preschoolers.

Check Your Progress Exercise 4

1) Enlist a few national nutritional programmes targeting infants and preschoolers.

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2) 'Stunting during childhood has serious implications'. Elaborate on the statement.

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3) Enumerate any five strategies to reduce undernutrition in infants.

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4) Discuss the preventive treatment of PEM.

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14.7 LET US SUM UP

In this unit, we learnt about the various aspects related to the growth and development of infants and preschoolers. We had a brief insight on their nutritional requirements starting with energy, the proximate principles, vitamins and minerals. We also got to know about the diet and feeding patterns. Here we got some handy tips about this nutrition as well. We also learnt about the benefits of exclusive breast-feeding and different stages at which different types of foods to be given,

In case of preschoolers, we learnt why this stage is crucial from nutritional standpoint. We saw that how parents and caretakers can participate in forming/developing the food choices of children. Here also we got to know about handy tips on how to feed preschoolers keeping in mind their special needs, likes and dislikes and imitation behaviours.

Finally, we had a look at the nutrition intervention programmes launched by Government of India to meet nutrition and health objectives particularly for these age-groups, We also had a brief discussion on the common nutritional problems that need to be looked into along with their preventive measures.

14.8 GLOSSARY

ARF : amylase rich flour, prepared by germinating, drying and powdering wheat grains.

Bifidus Factor : a component of breast milk that promotes the growth of *lactobacillus bifidus*, a harmless bacteria in baby gut.

Bioavailability : the relative ability of nutrients in foods to be properly digested and absorbed.

Development : the process associated with the growth of tissues and organs to take on complex functions.

Exclusive breast-feeding : entails not even giving honey or water supplements and other animal milk.

Extrusion reflex : before 4-5 months, the baby is not able to suck.

If a solid food is placed on tongue; these movements push the food out. By 6 months, the infant overcomes this and can transfer food inside the mouth.

Growth : biological growth occurs by cell multiplication.

Infant : a child in the first year.

Low birth weight infant : infants born on term but have weight <2,500 g.

Premature infants : infants born before full term of gestation i.e. less than 38 weeks.

Stunting those children whose height-for-age is –2 SD. It indicates long term malnutrition.

Wasting those children whose welight-for-height is – 2SD. It indicates acute under-nutrition.

Under weight : those children who have low (–2 SD) weight for age. It indicates both chronic and acute undernutrition.

Weaning foods foods, which are used during the gradual transition of the infant from breast-feeding to a normal diet.

14.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Infancy is the period from birth till one year. Its characteristic features are that it is a period of rapid growth, an increase in the body size accompanied by a number of physiological changes.

2) Changes in physical development, changes in mental development, changes in gastrointestinal system, development of excretory system, and changes in body composition are a few physiological changes occurring during infancy..

3) Flattening of the growth curve indicates a danger of developing malnutrition.

4) Growth monitoring is a serial, regular measurement of growth, which enables mothers to visualize growth, or lack of it, and obtain specific, relevant and practical guidance to ensure continued adequate growth and health of their children. The upward curve indicates weight gain while flat curve indicates no weight gain. The downward curve indicates weight loss and is not desirable.

Check Your Progress Exercise 2

1) Look up section 14.3 and answer on your own.

2) During infancy, the nutrients of considerable importance include energy, protein, iron and vitamin C. During preschool years, energy, protein, iron, vitamin A.

3) Iron is one major trace element of major significance in child nutrition. Write the reason for this based on your own understanding.

Check Your Progress Exercise 3

1) Breast milk is a simple and natural method of feeding. It is hygienic, inexpensive and available at all times at the right temperature for the baby. Nutritionally, breast milk has an advantage of being low in protein and high in lactose content than any other milk, which the body can handle. Look up the other advantages highlighted in sub-section 14.4.1 and write the answer on your own.

2) Supplements of iron and vitamin C should be provided. Animal milk does not have this in adequate amount. Heat-treated milk formulae may be fortified. The

infant needs to be preferably fed with sterile 'katori' and 'spoon' instead of bottle-feeding, which causes nipple confusion. It is best to avoid bottle-feeding, but if absolutely necessary, maintaining sterile, hygienic bottle and teats is important.

3) Complementary feeding is a process of gradually introducing foods other than breast milk. Weaning foods are those foods, which are used during the gradual transition of the infant from breast-feeding to a normal diet. It may start with the introduction of other milk but the best option is to continue breast milk.

Vegetable soup; cereal porridge, boiled vegetables and pulses; whole egg; fruit juice with added sugar.

4) a) Look up sub-section 14.4.1 and 14.4.2 and answer on your own.

b) Look up sub-section 14.4.3 and answer on your own.

5) Continue breast-feeding, modify family pot; feed 4-5times/day ex family diet-twicelday, commercial mix – twice/day, vegetable/fruits – once a day.

Check Your Progress Exercise 4

1) The national nutritional programmes include: ICDS, VAD, Immunization, IDA and Diarrhoea Control.

2) Stunting during childhood has serious implications. It results in reduction in adult size, which in turn, has been associated with reduced work capacity and in women, adverse reproductive outcome. It is alarming to note that most of the deficit in height that occurs as an adult has already taken place during the first two years and it remains largely irreversible during the rest of the life time.

3) Any five of the following:

- Nutrition education.
- Take home food supplements for 6-36 months from anganwadi.
- Vitamin A prophylaxis dose at 18,24,30 and 36 months by anganwadi workers and ANMS.
- Organize immunization on a fixed date atleast once a month.
- Anganwadi workers can also keep IFA tablets and ORS packets.
- Promote universal use of iodized salt.
- All 0-6 years to be weighed four times in a year and grade III and IV are identified to get double ratios as take home food supplements.
- Weigh all pregnant and lactating women and identify those who less than 40 kg and provide them with food grains.
- Weigh all adolescent girls at least 4 times/year and those weigh less than 35 kg to get foodgrains.
- Organize child health clinics at anganwadi to screen for anaemia, vitamin A deficiency and iodine deficiency.

4) Rehydration with ORS. When diarrhoea subsides, feeding at the rate of 3-4 g protein/ kg BW and 170-200 Kcal/ kg BW is initiated. Most hospitals use milk-based formulae. Dry skimmed milk (DSM) powder is better tolerated but due to low energy content, the targets are difficult to meet. A formulae containing 90 g DSM + 70 g sugar + 50 g vegetable oil in one litre water provides 100 Kcal and 3 g protein/100 ml. The children are given 100-150 ml/kg BW and the amount depends on how well it is tolerated. Sugar and oil amounts are increased, if more energy density is needed. Oil is added to the mixed cereal-based diets to increase energy density in preschoolers suffering from PEM. Vitamin and mineral supplements are strongly recommended as PEM is always associated with multi vitamin and mineral deficiency.