
UNIT 5 GROWTH PATTERN AND NUTRITIONAL REQUIREMENTS

In this unit you will learn that the nutrient needs of your body vary throughout the life-span with the degree and speed of growth and development that is taking place in your body.

Structure

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5.0 OBJECTIVES

Having studied this unit you will be able to

- describe the pattern of growth from childhood upto adulthood
- relate nutrition to growth
- indicate the critical periods in terms of individual development and
- list the food requirements in relation to body size.

5.1 INTRODUCTION

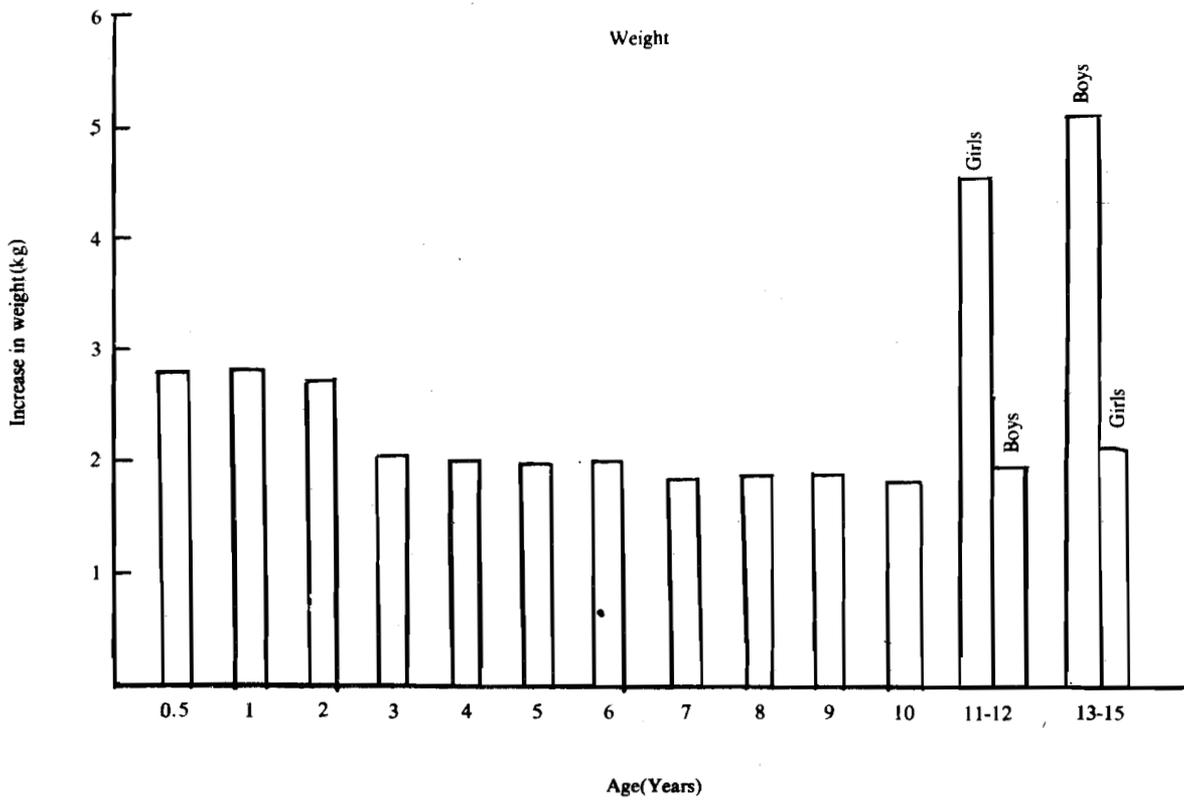
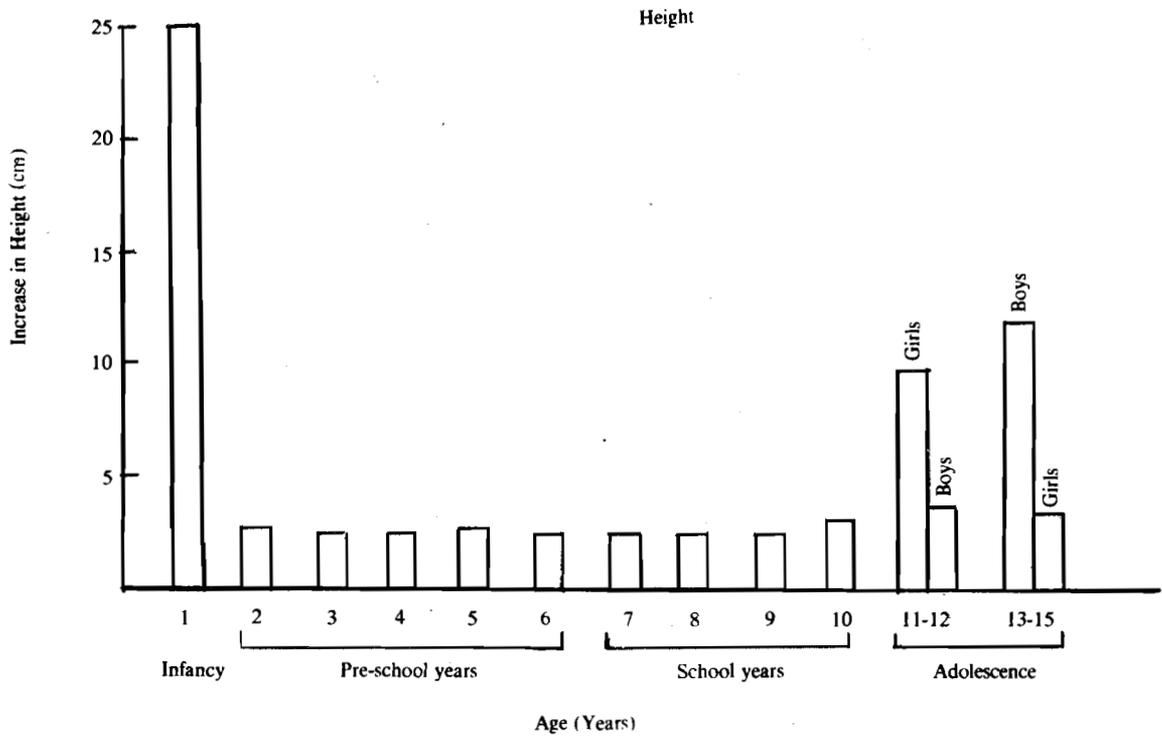
In the preceding units you learned about a balanced diet and how your body obtains the nutrients it needs to function well. In all these units, especially Units 2 and 3 you would have noticed that infants and children have different needs from adults. Although the principles of nutrition apply throughout the lifespan, you have to give the emphasis to provide enough food and care for the younger age groups.

Young people from infancy through adolescence are growing — a characteristic that we adults do not share. All of us in a way understand what growth means. A child gets taller and grows out of the clothes you made for him. Within two decades of life, a man increases about 20 times in weight and about 4 times in height. For a child to grow, obviously you have to give it nourishment or food. In this unit we will discuss the growth of children from birth until adolescence and their food requirements at different stages.

5.2 NORMAL GROWTH IN CHILDREN

Growth comprises increase in size of the body as well as development and maturation of the organs and systems of the body. Whereas increase in size is visible externally, the development of organs and systems takes place internally and cannot be seen. Even so,

Figure 5.1 Growth of Children at Different Ages



this development is essential for normal growth and continues through childhood till adolescence.

Each organ or part of the body consists of millions of tiny cells. Each cell is so small that it can be seen only with a microscope. The cell is the smallest functional unit of the body. It is these cells which need all the nutrients from the food, in order to perform the various functions.

When growth occurs, the number of cells in the body along with the size of the cells increases. Thus one increases in height and weight and becomes more capable of performing increasingly complex tasks. Along with the increase in cells, blood volume also increases so that each and every part of the body gets all the essential nutrients.

Let us now look at the changes in weight, height and discuss the specific systems of tissues like bones and muscles. Babies gain in both weight and height very rapidly in the first two years of life. Usually the infant will double its birth weight in 4 to 5 months and triple it by the first year. Its height will increase by about 25 cms in the first year. Obviously the first year of life is a period of rapid and intensive growth.

By age two, most children are already half as tall as they will be as adults. It is difficult to visualize this, is not it? Individual body parts grow at different rates. The shape of child's body changes as he grows. The head of a two-year old is one-fourth his total body length but in an adult like you the head is only about one-eighth or one-tenth of your total height.

Between 2 and 10 years of age, you will see that the child settles down to a slower but steady addition of 5 to 6 cms in height and about 2 kg per year in weight (Figure 5.1). You will not see much difference in the weights and heights of boys and girls until they are about 10 years old. In the school-going years you will see that the child's face changes from being round and plump to a more definite shape.

When the child reaches about eleven or twelve years of age, growth is more than it was in the previous years. Notice in Figure 5.1 that the weights and heights of girls will increase around 11 to 13 years of age, whereas the growth spurt in boys occurs later around 13 to 16 years of age. Most of us reach our adult height in the late teens.

Look at a boy in his teens. You will see that his hands and feet have grown large before he has reached his adult height. In fact, the hands and feet grow to adult size before the arms and legs. During adolescence the shape of the jaw and features also change.

5.3 DEVELOPMENT OF BONES, MUSCLES AND FAT

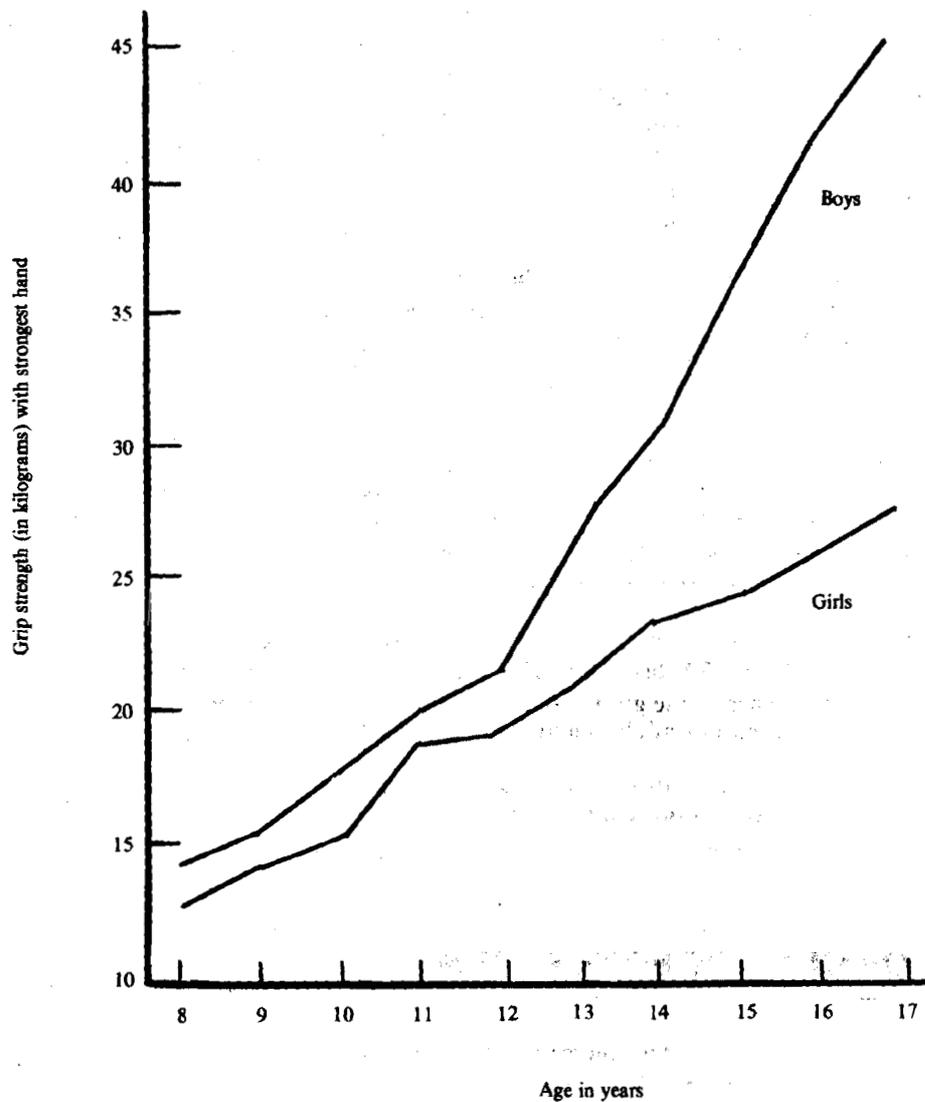
i) Bones : Bones change in three ways : they increase in number, become longer and harder. In parts of the body like the wrist, hand, ankle, and foot, the number of bones increase. For example in an adult's wrist like yours, there are nine bones. A year old child has only three bones in its wrist. Obviously the remaining six bones develop during childhood. Bones not only must grow but they also need to harden. Complete hardening takes place in the late teen years.

The bones of a newborn are very soft, and gradually harden as the child grows. The most prominent spot where you can see this softness is the top of the baby's head. The four pieces of bone that form the top of the skull have not yet joined together at that spot. There are other such spots on the baby's skull. This is nature's way of providing room for the brain to grow. Now look at the skull of a two-year old. The skull is hard and there is not much softness at the top of the skull.

You must have seen that an infant can work himself into all sorts of postures. He can suck his toes, or put his foot behind his head. This very lack of stiffness makes it difficult for a baby to sit up straight or hold its head erect. As the child's bones harden, it will be able to sit up straight. The child's bones not only harden but also grow in length.

ii) Muscles : Soon after birth, a baby has virtually all the muscles he will have as an adult. What changes during childhood and adolescence, is the length and thickness of the

Figure 5.2: Grip strength of Boys and Girls at various ages



Both boys and girls get stronger over the years of childhood and adolescence, but boys show a much larger change, particularly at puberty. Some of this might be caused by greater exercise by boys at this age, but some of it seems to be due to the effects of hormones

muscles. Like bones, muscle tissue increases steadily until adolescence when the increase is rapid. Look at Figure 5.2. It shows you the strength of muscles in boys and girls over the school years and during adolescence. You can see that boys have much more muscle and strength than girls after adolescence.

iii) **Fat** : You must have observed that most babies are chubby and have a roundish face. This is because the baby has quite a lot of fat. Some of this fat was laid down when the baby was in its mother's womb, and some was deposited during the first six to nine months of infancy. As the child begins to walk, run and play, especially in the school years, you will see that the child becomes leaner. This is because the child is now using up its fat stores.

In the adolescent period, the body again starts laying down more fat. At this age, you will also observe a difference between the sexes. From the beginning, girls have more fat than boys do. In adolescence, girls develop more fat cells of bigger size than those of boys.

5.4 DEVELOPMENT OF OTHER INTERNAL ORGANS

Increase in height and weight involves many changes internally which are evident externally. But there are some enormously important changes in organs that you cannot observe. If these important organs do not grow as they should, a child's life would be affected because his body would not be able to function at its best. These critical organs are the brain, liver, kidney and hormonal glands.

i) **Brain, Liver and Kidney** : Most of the growth of the brain has already occurred when the baby was in its mother's womb. This is why a baby's head is quite large compared to the rest of his body. By the time it reaches its fifth birthday, 99 per cent of its brain growth will be completed. The nervous system also grows rapidly during the first two years but growth is completed during adolescence.

At birth the liver and kidney are still quite immature. The liver as you may know already is your body's powerhouse. Your kidneys excrete waste matter and water that your body does not want. These two organs will be fully mature in the early years of life.

ii) **Hormonal glands** : Hormones are chemical substances which govern growth and other physical changes in your body. Thyroxine is one such substance which is secreted by the thyroid gland. You may be surprised to know that thyroxine is present in the baby's body right from the fourth month of pregnancy. This hormone also stimulates brain growth. Another hormone which is important for growth is the growth hormone which is secreted by a gland at the base of your brain. Throughout childhood these hormones govern growth. During adolescence, sex hormones are also secreted. These are critical for growth and for the development of sex characteristics which we shall discuss next.

5.5 SEXUAL MATURATION

In the teenage years, not only do you grow very rapidly in height and weight, bones and muscle, but other physical changes occur as well, bringing about sexual maturity. We can divide these changes into two groups:

a) Development of those organs and tissues necessary for reproduction. These are development of the testes and penis in boys and the uterus, (ovaries) and vagina in girls. In girls, menarche i.e. the first menstrual period is a clear single event which represents sexual maturity.

b) Other changes which you can see more easily but are not necessary for reproduction are: breast development, growth of pubic hair, hair growth in the under-arms, change in voice, etc.

 **Check Your Progress**

1 What is growth?

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2 What are the changes in weight and height of a child from birth to 1 year?

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5.6 HOW CAN YOU MEASURE GROWTH?

Having read all about growth and development you must be wondering how you can measure growth. You can judge whether a child is growing well, by comparing his weight and height with standards for weights and heights for children in Figure 5.1. To determine whether a child's growth is as it should be, we use mainly weight and height throughout childhood and adolescence. Other measurements such as mid-arm circumference, chest circumference and head circumference can also be used. However, these last three are more useful to identify malnourished children and are not useful for children after five years of age.

You can plot the child's weight and height on growth charts like the one we have shown you in Figure 5.3. On the horizontal axis you have the age of the child. On the vertical axis you have the weights in kilograms. On this chart are two lines. If your child's weight is between these two lines, on the top line or above it you can say the child is normal. If the weight is below bottom line, you need to take care because the child is underweight for his/her age.

USE THE GROWTH CHART AS A ROAD TO HEALTH

Remember that as the child grows he should put on weight and grow taller. You should also see an increase in his chest, head and mid-arm circumferences.

Activity

Record the weight of either a 4 or a 5 year old child from each of these : a low, middle and high income group family. Plot their weights on the weight chart. Record your observations on the growth status of these three children.

5.7 CRITICAL PERIODS OF GROWTH

All through this unit you have read and understood that our body grows in a set pattern with different tissues and parts of the body growing and maturing at different times. There are three periods in a child's life which are critical because intensive growth occurs. If there is any adverse influence at these times, growth will be affected and will slow down.

The three periods are:

- Prenatal period (nine months in the mother's womb) .
- First year of infancy
- Adolescence (between 12 and 18 years)

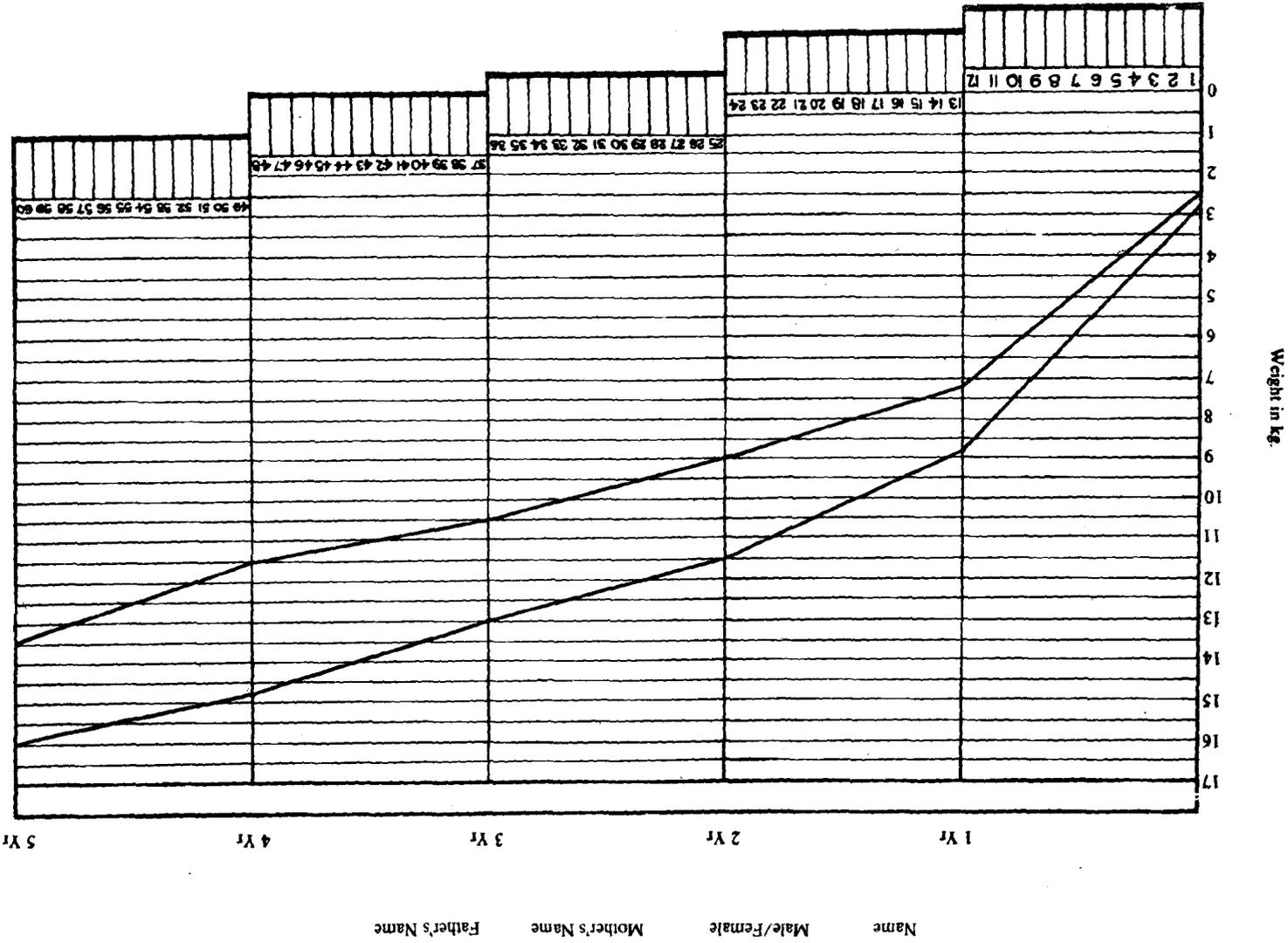


Figure 5.3 Weight Chart from Birth to 5 Years of age

Courtesy:
 1) Manual of integrated Child Development Services— National Institute of Public Cooperation and Child Development, New Delhi.
 2) Harvard growth curves: Pipes P. Nutrition in Infancy and Childhood chapter I. C.V. Mosby Co. 1977.

Prenatal period : During this time when the child is in the mother's womb for about 40 weeks, it develops from a single cell into a baby weighing about 2.5 kg. Obviously each and every part of the baby's body is growing at a tremendous pace. Among the different organs, however, the brain grows the fastest and therefore needs a lot of nutrients for growth; in fact growth in the nine months is unparalleled by growth at any other time of life. Since the baby derives its nourishment from its mother, you must ensure that she has an adequate diet. She must increase her intake of cereals, dals as well as vegetables and fruits especially from Food Group 3 referred to in Unit 3.

First year : You already know how rapidly a baby grows in infancy. During this time, its internal organs like the brain, heart, liver, stomach and kidneys are growing and maturing. For example at birth, the capacity of a baby's stomach is only 2 tablespoons, at 2 weeks it increases to 4 and by three months the capacity will have increased to 8 tablespoons.

Since the infant depends entirely upon its mother for nourishment, it is important that a nursing mother has a well balanced diet. The quantity of milk she produces and the amount of nutrients present in her milk depends on what she eats and how much. This in turn will affect the baby's growth and health.

Adolescence : During the school years, you know that growth is slow and steady. During the teen years, there is another spurt in growth when the child grows taller and puts on weight. In fact the child will reach his adult stature. Final development and maturation of all organs occurs especially with regard to the reproductive organs.

5.8 NUTRITIONAL REQUIREMENTS VIS-A-VIS BODY SIZE

Growth is a major factor which influences food needs of children and adolescents. The child's diet also determines how well a child can grow. The first intensive period of growth is the prenatal period. Therefore, at this time, the mother's needs are higher than before. For some nutrients the increase in requirements may be a hundred per cent above her basic needs. She needs to consume more cereals, pulses and protective fruits and vegetables as well as items from Group 5 referred to in Unit 3. Unit 8 will also give you information about fulfilling these needs.

During the growth spurt a child needs more food in relation to its body size than it does as an adult. Look at how much a one year old eats. It is approximately half of what is eaten by an adult man. Since infants are fed mother's milk, the nursing mother needs to increase her intake of foods from Groups 1, 2 and 3 referred to in Unit 3. In the intervening years between infancy and adolescence, the child's food intake gradually increases as he grows. You may have seen that a 2 year old child eats one chapati, whereas an eight year old will eat two or two and a half at meal-times.

The next growth spurt, as you know, occurs in adolescence. At this time boys will grow more than girls and so their requirements are proportionately greater. You need to give them more cereals, dals or meat/fish/egg/milk as well as vegetables and fruits especially the protective ones. Once the growth spurt in adolescence is over, food needs decrease. In girls who were undernourished, it has been observed that menarche is delayed. Once an adolescent crosses his/her eighteenth year, his/her requirements will be the same as that of an adult.

Check Your Progress

3 How can you tell whether a child is growing normally?

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4 Which are the intensive periods of growth? Why are they critical?

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5.9 LET US SUM UP

Growth means increase in size as well as maturation of the whole body and its various organs. Throughout life, there are 3 intensive periods of growth, prenatal, infancy and adolescence. Children need more food when they are growing rapidly. You can measure growth by taking child's height and weight. Other measurements like head circumference, chest and mid-arm circumference are also used.

5.10 GLOSSARY

Adolescence : Period of years between the beginning of puberty and maturity. In humans it is between 11 and 15 years for girls and from 14 to 18 years for boys.

Growth : Generally denotes an increase in physical size of the human body as a whole, or any of its organs, parts or tissue. This begins at conception and continues upto adulthood.

5.11 ANSWERS TO CHECK YOUR PROGRESS

- 1 Growth is increase in size as well as maturation of different organs and systems of the body.
- 2 A child will double its birth weight in 4 to 5 months and triple it by the first year. Its height will increase by about 25 cms in the first year.
- 3 You can tell whether a child is growing normally by comparing his weight and height with standards for weight and height for children.
- 4 The intensive periods of growth are prenatal period, first year of life and adolescence.

During the prenatal period, growth is the fastest as compared to any other time of life, especially of the brain. During the first year, the physical growth as well as growth of the internal organs like brain, heart, liver, stomach and kidney take place.

During adolescence another growth spurt takes place when the child becomes taller and heavier. At this time the final development and maturation of all the organs takes place, especially the reproductive organs.