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## UNIT 2 STAGES OF GROWTH AND GROWTH PATTERN

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### Learning Objectives

Once you have read this unit, you will:

- be able to understand the concepts of growth and development;
- be acquainted with stages of growth;
- appreciate normal growth curve pattern, normal growth variation or variation from normal growth; and
- get to know about ethnic and gender differences in growth curves.

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## 2.0 INTRODUCTION

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Primates generally have a slow reproductive turnover and drawn-out life histories. As part of this pattern, the pace of growth from birth to adulthood is retarded and in monkeys, apes and humans, at least, it is possible to recognize special features of the growth curve associated with the attainment of sexual maturity [(puberty), (characteristics were once supposed to be unique to humans but other primates were later found to have them as well)]. The distinctive form of the human growth

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curve was first established in the eighteenth century. Sexual differences in the curve, originally denied, were confirmed in the 1880's, but the evolutionary significance of its shape only became clear after 1950 (Jaiswal, 2013).

The velocity, speed, or pace of development mirrors the kid's state at a specific time being than does real tallness, which relies generally upon how much the child has developed all through life. The blood and tissue concentrations of those substances that change with age are subsequently bound to go with the speed or velocity than the distance curve. In certain conditions, acceleration of growth rather than its velocity may reflect physiological events; the increase in secretion from the endocrine glands at adolescence, for example, is seen most clearly in an acceleration of growth.

The velocity of growth in height decreases from birth onwards, yet, this, decline or decrease is interfered or interrupted shortly before the end of the growth period. At this time, from 13 to 15 year of age in the boy, there is a marked acceleration of growth-the adolescent or pubertal growth spurt. A slight increase in velocity, the mid growth spurt, may also occur between about 6 and 8 years, providing a second peak on the general velocity curve. After maturity the matured boy or girl becomes the important member of the society.

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## 2.1 UNDERSTANDING GROWTH AND DEVELOPMENT

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Understanding the growth and development of the human organism requires an understanding of nature and nurture, and the complex interplay between the two. The terms growth and development are actually two different terms having separate meanings, but most of the time they are used interchangeably. This creates a lot of confusion. Terminologically, growth means increase and enlargement of the body or some parts of the body, i.e. the cases where the body becomes heavier, larger, longer etc. It is a change in the organism which can be observed and measured in the physical sense denoting an increase in size, length, weight, proportion etc. Therefore, all changes in quantitative form which could be objectively observed and measured come into the domain of growth. On the other hand, development refers to the qualitative changes. These are the changes in kind, structure or organization- a complex process of integrating many structures and functions, which may not be observable or measurable outwardly. Thus, growth can be one of the components of development process or development in its quantitative aspect can be termed as growth.

### Check Your Progress 1

- 1) Write short notes on understanding Growth and Development.

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## 2.2 STAGES OF GROWTH

The stages or phases of growth have been classified in different ways or manners by different scholars. A simple classification of the postnatal period includes four stages like early childhood, later childhood, adolescence and puberty; or, early childhood, middle childhood, late childhood and adolescence.

A detailed classification, proposed by R.L. Scammon as early as in 1930, is given below to have a good idea of the stages growth.

**Table 2.1: Stages of Growth**

Prenatal	Ovum		(first 2 weeks)		
	Embryo		(from 2 to 8 weeks)		
	Fetus		(from 2 to 10 lunar months)		
Postnatal	Infancy	Neonatal	(first 2 weeks)		
		Infancy	(from 2 weeks to 1 year)		
	Childhood	Early		(from 1 to 6 years)	
		Middle		(from 6 to 9 or 10 years)	
		Late	Boys		(from 9-10 to 13-16 years)
			Girls		(from 9-10 to 12-15 years)
	Puberty	boys		(around 14 years)	
		girls		(around 13 years)	
	Adolescence	boys		(from 14 to 20 years)	
		girls		(from 13 to 18 or 20 years)	
	Maturity			(from 18-20 to 60 years)	
Senility			(after 60 years)		

*Source:* Scammon, 1930

Thus, the two major periods of growth are prenatal and postnatal. This is true not only for human but also for all placental mammals. We are not going to follow strictly this classification of Scammon while discussing the stages of growth. Of the two major periods of growth, first, we are going to have some idea about the prenatal period, and postnatal period will be discussed under five subheads, namely, infancy, childhood, adolescence, maturity and senescence.

### Check Your Progress 2

2) Name the major periods of growth.

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## 2.3 PRENATAL GROWTH

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Prenatal development includes all the changes that take place in the womb of the mother. Therefore it is also called “intra-uterine development” where the uterus is the internal environment for growth.

Prenatal development covers the period from fertilization to birth. It comprises of three distinct stages:

- ❖ The period of the zygote: i.e. from fertilization to end of two weeks.
- ❖ The period of the embryo: i.e. from 2 weeks to 2 lunar months.
- ❖ The period of the fetus: i.e. from end of 2<sup>nd</sup> months till birth.

Although the velocity of growth in body length is greater at birth than at any later period, in fetal life the velocity is greater still. Its peak is reached at about the eighteenth week of postmenstrual age (Age in the fetal period is typically figured from the first day of the last feminine or menstrual period—a normal of about fourteen days i.e. 2 weeks preceding genuine prior to actual fertilization—but is usually the only easily located landmark of pregnancy).

Growth in fetal weight follows a similar general example, then again, except that the peak velocity is arrived at later, usually at the thirty-fourth postmenstrual week. From about 36 weeks to birth at 40 weeks, the pace or rate of growth eases or slows down, maybe in light of the fact that the space accessible in the uterus is getting completely involved or becoming fully occupied.. The growth of twins hinders prior when their joined or combined weight is approximately the weight of 36 week singleton fetus. Birth weight and birth size reflect the maternal environment more than the child’s genotype and the hindering component empowers a genetically large child or hereditarily huge kid creating in the uterus of a small mother to the delivered successfully. Directly after birth, the growth rate increases again, particularly in genetically large children, and the rate of weight gain reaches its peak at the age of approximately 2 months.

The velocity of growth in length is not very great during the first 2 months of fetal life, the period of the embryo. During this period, there is differentiation (‘regionalization’) of the originally homogeneous fetus into regions such as the head and arms, and histogenesis, the differentiation of cells into specialized tissues such as muscle or nerve. At the same time, each region is moulded, by differential growth of cells or by cells migration, into a definite shape. But the major part of it is completed by the eighth postmenstrual week and by then the embryo has assumed a recognizably human appearance compared and that of the child, is expected generally to cell multiplication. The proportion of cells going through division turns out to be less as the fetus gets elder, and hardly any, new muscle cells or nerve cells (aside from neuroglia, the cells surrounding the neurons themselves) appear after the sixth month of fetal life (Jaiswal, 2013).

The muscle cells and nerve cells of the fetus contrast in appearance from those of the child or adult. Both have almost no cytoplasm around the core. In fetal muscle, there is more intercellular substance and a lot higher extent of water than in the developed muscle. The later fetal and postnatal development of muscle comprises of developing the cytoplasm of the muscle cells; salts are fused and proteins shaped. The cells become greater the intercellular substance generally vanishes, and the convergence of water diminishes or decreases.

This cycle proceeds with effectively up to around 3 years old and gradually from that point; at youth, it quickly accelerates once more, especially in boys, as more substances are incorporated into the fibers under the influence of androgenic and growth hormones. During the same period there is an increase in the amount of DNA, indicating that further nuclei are appearing. In the nervous system cytoplasm is added, nucleoprotein bodies appear, and axons and dendrites grow. Hence, for most tissues, postnatal development is a time of advancement and broadening of existing cells, instead of the arrangement of new ones.

We can also simply explain the prenatal growth as...

The ovum of human at the time of conception is about 0.1 mm in diameter. During the first part or initial segment of this period (ovum), it resembles a homogeneous mass. During the embryonic stage, even though the pace of development is moderate, yet during this time the differentiation process or cycle in the mass to form various regions begins which later on give rise to various parts of the body. The cells are also differentiated into specialized tissues, like nerve, muscle. This process which gives definite shape to different parts is called morphogenesis. By the eighth week the embryo becomes childlike like in appearance. During fetus stage the pace of growth in length as well as weight is considerably high or impressively high. However, in length the peak is reached earlier than in weight. In the former it happens at about 18 weeks. From around 36 weeks the pace of growth of the fetus slows down generally due to the impact of the uterus of the mother (Jaiswal, 2013).

### Check Your Progress 3

3) What are the main characteristics of Prenatal Growth?

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## 2.4 POSTNATAL GROWTH

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Postnatal growth starts from the time of birth upto adulthood or the time of maturity. Postnatal period is commonly divided into the following age period:

- ❖ Neonatal;
- ❖ Infancy or babyhood;
- ❖ Childhood;
- ❖ Adolescence;
- ❖ Adulthood/ Maturity;
- ❖ Senility or old age

### 2.4.1 Neonatal Stage

Neonatal stage begins with birth and ends when the infant is approximately two weeks old. It is the shortest of all developmental period.

It is a time when changes are very rapid. Many critical events can occur in this period: Feeding patterns are established, bonding between parents and infant begin. The risk for infections that may become more serious are higher and many birth or congenital defects are first noted.

### 2.4.2 Infancy Stage

Infancy lasts from two weeks to one year of life. It is true foundation period of life characterized by rapid change in bodily systems, psychological development and neuromuscular organization. During infancy stages growth is extremely quick or very rapid. More than 50 % of birth length and 200 % of birth weight occur during the first or primary year of life (Jaiswal, 2013).

From this period the rate of growth decreases sharply. It has been found that growth during infancy (during the first year of growth) is more rapid than at any other period during postnatal life. Birth length represents approximately 1/4 of the total stature against 1/8 in the adult. Cranial capacity is about 1/2 of the adult (Jaiswal, 2013).

Premature (baby born prior to 37 weeks gestation) babies have low birth weight. Low birth weight is associated with socio-economic conditions also (Jaiswal, 2013).

### 2.4.3 Childhood

Childhood usually ranges from the finish of infancy stages up to the beginning of adolescence. Infants in this way achieve childhood prior to arriving at adolescence.

On the basis of distance and velocity curves the pattern of growth during childhood can be obtained. That pattern may be regarded as the standard for a particular population and the growth pattern of the children of that population can be predicted accordingly. Both heredity and environment play their respective role in physical growth. Therefore, the hereditary growth potential of a child may be influenced by various environmental factors which include nutrition, state of health, socio-economic condition of parents, psychological well-being and the like. There are population variations in the pattern of growth (Jaiswal, 2013).

The early childhood is the period of eruption of deciduous or milk teeth. All milk teeth are erupted during this period. The permanent dentition also shows its beginning. The rounded body form continues to persist. The head in relation to the trunk continues to predominate, but in lesser degree. During this period the growth is relatively more in width than in height.

During the period of middle childhood (7 to 10 years) permanent teeth, though, not all, erupt and the rounded forms disappear. The size of head increases slightly. The linear growth of the body takes place rapidly. The thorax begins to become oval in transverse section. The waist line becomes definable. At about 7 and 8 years a nominal acceleration in the rate of growth occurs. It may be termed as mid-growth spurt.

The late childhood phase of growth stage starts from the prepubertal period and continues upto the time of puberty. Puberty normally occurs around 14 years (between 13 and 16 years) in boys and around 13 years (between 12 and 15

years) in girls. Sexual morphological differentiation normally begins during this phase. The rate of growth decreases during childhood. It becomes negligible towards the end of the late childhood phase. But a notable increase in growth velocity, known as the adolescent growth spurt, is observed which, however, is associated with the onset of sexual maturation (Jaiswal, 2013).

#### 2.4.4 Adolescence

Adolescence is the threshold of adulthood. It extends from twelve years to generally eighteen to twenty years i.e. it starts from the time of puberty and continues up to the onset of adulthood. The adolescence period extends from the time of puberty upto around 18 to 20 years (or 6 years following puberty). The acceleration of growth at adolescence causes many anatomical changes almost in all parts of the body. Sexual maturation takes place during this period.

This period may be divided into prepuberal and puberal phases. The pre-puberal phase lasts for about two years. During this time, the increase of weight is retarded. Height increases by the lengthening of the legs. The thorax becomes narrow; the trunk becomes short; legs and arms become long (Jaiswal, 2013).

During puberal period sexual organs are matured. The body proportions are changed. Secondary sexual characters appear. In girls the first menstruation marks the beginning of ovarian activity. But in boys it is difficult to ascertain precisely the time of maturation of the testes. The most obvious secondary sexual characters in girls are the development of breasts, appearance of auxiliary and pubic hair. In boys also pubic hair, beard and moustache show appearance. Moreover, the voice changes. In other words, differentiation in primary and secondary sexual characteristics or sexual qualities denotes the adolescence period (Jaiswal, 2013).

#### 2.4.5 Maturity or Adulthood

The term adult means grown to full size and strength or matured, Adults are therefore individuals who have completed their growth and are ready to assume their status in society as full grown individuals. The discontinuance or cessation of growth of stature is viewed as an indication or sign of maturity. Height ceases to grow when the long bones, *e.g.*, tibia, fibula etc., lose their capacity to increase in length. Usually, males attain the adult height at about 21 years of age and females at 18 years of age.

Another important sign of adulthood is reproductive maturity. During adolescence reproductive maturity begins, but not completed. The average girl is not capable of reproduction until 14 years of age or older, though onset of puberty may take place earlier. Because after menarche there is a period of one to two years of adolescent sterility, when ovulation does not occur. In case of boys also, though they begin producing sperm during puberal phase at about 14.5 years of age, their development is not complete. They still show more resemblances to the children than to the adults in respect of psychological and physiological conditions and also in physical appearance. On average adult males are heavier and taller than adult females (Jaiswal, 2013).

Adulthood is the longest period of the lifespan i.e. a period of more or less stability. Childhood and adolescence are the period of growing up whereas adulthood is the time for settling down. The period is further divided into:

- Early adulthood: it extends from the age of 18-20 years to 40 years.
- Middle adulthood: it extends from the age of 40 years to 60 years.
- Late adulthood or Senility: it extends from the age of 60 years to till death.

### 2.4.6 Senescence

After the active phase of the life-span, decline process starts resulting in an old age or senescence. After the prime period of adulthood senescence starts. The aging pattern shows great individual variation. The aging time also differs from person to person and society to society, because environment plays an important role. During this period numerous molecular and cellular changes happen. Organism changes are also there. These progressions or changes are quantifiable and can be depicted or described, yet these don't display a particular example any specific pattern or well-defined sequence. It appears there is no biologic arrangement or plan for aging / maturing process. A multi-causal mechanism is associated with this cycle.

The processes of growing old are scientifically studied in a special branch, called Gerontology. Because of aging the tissues do not renew and as a result cells show senile involution. The memory declines. Aged persons need more time to learn and to react. The speed of conduction in motor nerves shows a decline. Systolic blood pressure increases. Peripheral resistance and circulation time in the cardiovascular system show an increase. The range of accommodation of the eye lens declines. There is reduction of density of long bones and vertebrae, and therefore, height and sitting height show decrease. Arm span circumference of forearm and that of calf diminishes. Vital capacity and muscle tone declines (Jaiswal, 2013).

#### Check Your Progress 4

- 4) Explain in brief about Postnatal Growth.

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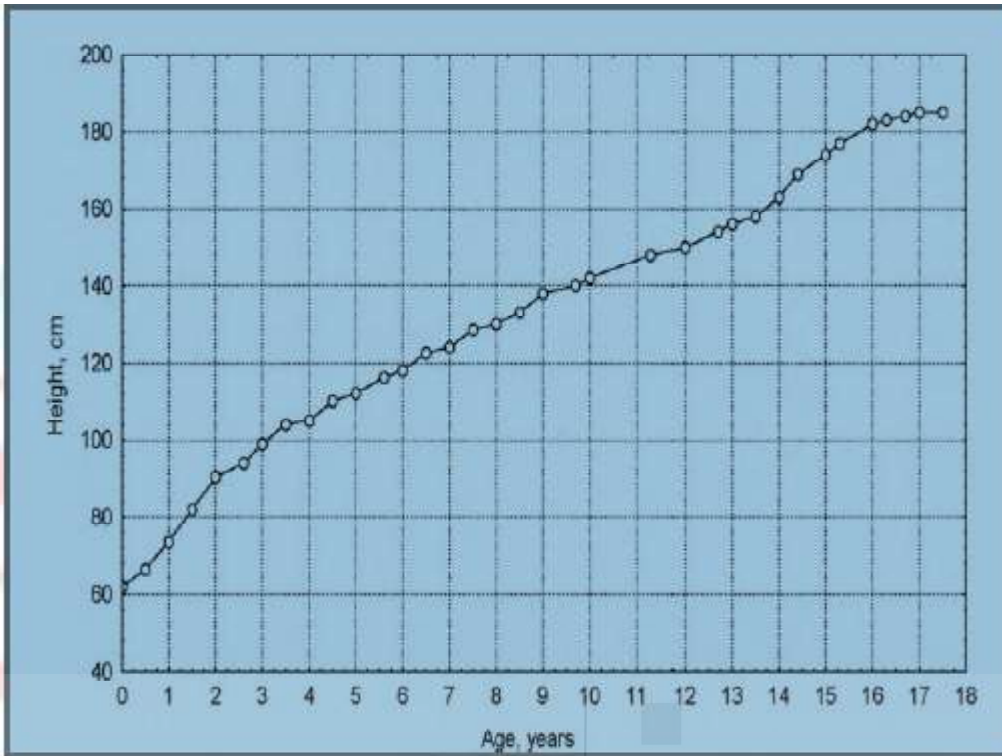
## 2.5 NORMAL GROWTH CURVES PATTERN

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Growth is measurable, and therefore, anthropometry plays a very important role in the study of growth. The measurements or the values at successive ages are plotted in a graph to obtain growth curves. Usually two types of growth curves are drawn, namely Distance Curve and Velocity Curve.

Growth may be considered as a form of motion. An object may move from one point to another covering a distance. This distance can be measured. Similarly, a part of the body grows from one age to the next. This increment can be measured and can be shown in a curve. This type of curve is called distance curve (Tanner, 1962).

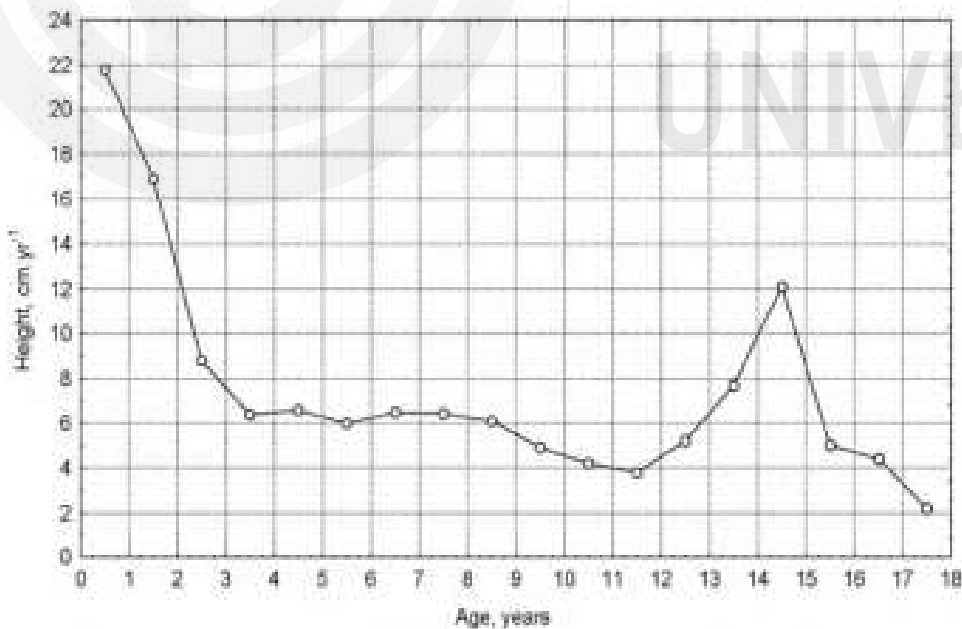




**Fig 2.1: Distance Curve. Growth in height from birth to 18 years, 1759-77**

*Source:* Tanner, 1962

Again, during movement the object may not move at the same speed all through. In the same manner, the velocity or rate of growth may not be the same during different stages of growth. This can be obtained from velocity curve. In this connection it may be noted that different parts of the body do not grow at the same rate during different periods of growth (Tanner, 1962).



**Fig 2.2: Velocity Curve. Growth in height from birth to 18 years, 1759-77**

*Source:* Tanner, 1962

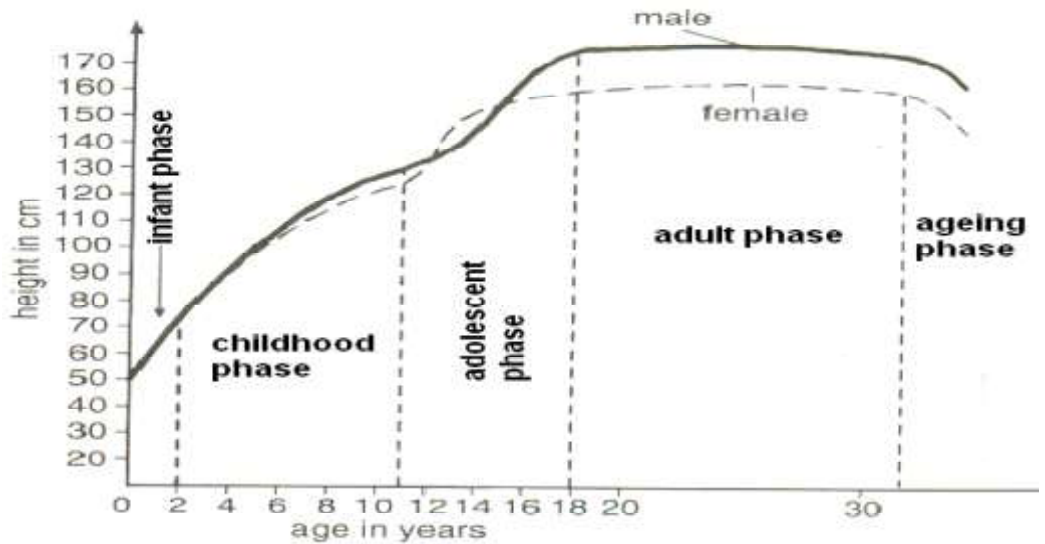


Fig 2.3: Growth Curve

Source: Cameron, and Lawrence. 2012

De Montbeillard measured the height or tallness of his son at regular intervals i.e every 6 months from his birth in 1759 until he was 18 years old in 1777. Richard E. Scammon from Department of Anatomy and the Institute of Child Welfare at the University of Minnesota plotted the diagram from these estimations or measurements and published his outcomes in 1927 in the American Journal of Physical Anthropology under the title of “The first seriatim investigation or study of human development”.

The non-human organisms share the basic sigmoid curve (s-shaped) of growth characterized by single peak. The initial period of maximum growth rate or acceleration is followed by period of deceleration in growth rate. The usual sigmoid curve is modified in case of human and is marked by two sigmoid curves, one in early life –the infant phase and the other in adolescent phase. They are separated by period of relatively slow growth rate during childhood. Subsequently, the growth curve has four particular distinct phases comparing to rapid growth in infancy, consistent or steady growth in childhood, quick or rapid growth during adolescence and moderate or very slow growth as the individual approaches adulthood. A rapid growth during childhood known as mid- growth spurt is also observed but is not a universal phenomenon. The above curve represents the general growth pattern for height, weight and some major organ systems (respiratory, digestive and urinary) of an individual, but different organs have their own pattern of growth (Verma, 2019; <http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1>)

**Check Your Progress 5**

5) Write short notes on Pattern of Normal Growth Curves.

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## 2.6 NORMAL GROWTH VARIATIONS

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Variations in normal growth represent alternative pathways that enable individual to achieve their growth potential. The general growth curve explains the growth of the body as whole and most of the system of body like skeleton system, respiratory system, digestive system, urinary system and circulatory system that includes heart and blood vessels. The S-shaped curve or sigmoid curve represents four phases of growth (Malina, et al. 2004):

- ❖ rapid growth in outset or infancy and early childhood
- ❖ steady yet constant or consistent growth during middle childhood
- ❖ rapid or fast growth during the adolescence
- ❖ slow and eventual cessation or possible suspension of growth after adolescence which proceeds or continues into third decade of life.

### 2.6.1 Canalization

Human growth and development is a complex phenomenon regulated by both, genetic and environmental factors. At conception, an individual obtains a genetic blueprint which determine the potential for achieving adult size and shape. In an unconstrained or neutral environment, individual would display an example or pattern of growth that is pretty more or less parallel or corresponding to the genetically predetermined trajectory. This phenomenon was described as “canalization” or “homeorrhexis” by British geneticist C.H. Waddington (1957). Notwithstanding, none of us has lived or been raised or brought up in a totally unconstrained environment.

### 2.6.2 Catch-Down Growth

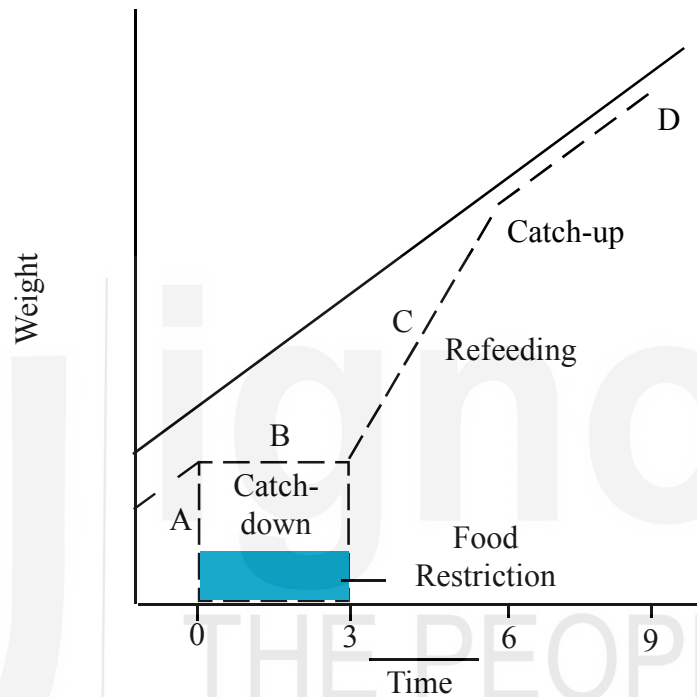
During the prenatal and postnatal life we are exposed to an array of adverse environmental factors (such as diseases, malnutrition etc) which influence the growth velocity. It either slows down, known as catch-down growth or in a more severe case would cease (Cameron 2012). The amount of deviation from the predetermined pathway depends on the frequency, duration and severity of exposure to the environmental factors. Slight exposure for short duration will cause minor change while considerable exposure for long duration in the velocity. The extent of influence is also determined by age and gender of the individual (Tanner 1978; Cameron 2012).

### 2.6.3 Catch-Up Growth

However, even after being pushed off the trajectories, there exists an ability to stabilize and return to a predetermined growth curve when conditions improve. During such recovery phase, initial growth velocity is above that of normally expected for children of his/her age or even of his/her skeletal maturity and decline as the child recovers. This rapid increase or quick expansion in growth velocity following a short term period or momentary time of starvation or illness was termed as catch-up growth by Prader et al. (1963).

The “catch-up” phenomenon also describes the relatively rapid postnatal growth observed in infants born with low birth weight due to intrauterine growth restriction. Catch-up growth is usually considered in terms of weight or height,

but it is important to consider the type of tissue deposited in the body. For example, several prospective studies have observed the progressive deposition of more body fat during childhood and adulthood after a period of catch-up growth during infancy. This leads to differences in body composition relative to infants not exhibiting catch-up growth (Reilly et al. 2005, McCarthy et al. 2007). Catch up growth may totally reestablish the situation to normal or it may be insufficient to do so. If it is incomplete, the individual does not achieve the same adult height that would have been achieved when there was no growth impairment. This depends on the extent to which conditions are optimized during recovery (McCarthy, et al. 2013).



**Fig 2.4. Canalization: Catch up and catch down growth**

*Source:* Verma, D. 2019; <http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1>

**Check Your Progress 6**

6) What are the different types of variation from normal growth.

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**2.7 GROWTH CURVES AND ETHNIC AND GENDER DIFFERENCES**

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Growth and development is the key indicator of biological maturity. There are two basic determinants of development i.e. heredity and environment. A

complicated mixture of heredity and environment influences, probably acts throughout the whole period of growth. The rate of maturation is sensitive to environmental influences at both the individual and population levels. Population differences i.e ethnic and gender differences in the rate and timing of growth reflect differences in nutrition, environment, socio-economic status and genetics. Secular trends in growth have also been observed among populations undergoing rapid social and economic transitions (Tim, et.al, 2014). Assessment of growth is crucial in child care. India is in a phase of nutrition transition and thus it is vital to update growth references regularly.

Rapid economic and social transition in India has influenced growth patterns of children especially in urban areas. Recent Indian studies suggest that there is a trend towards increase in height, especially in boys and an increase in obesity in both genders (Khadilkar, et.al, 2007; Khadilkar, and Khadilkar, 2004; Ranjani, et.al, 2016). Government of India has accepted the World Health Organization (WHO) 2006 growth standards for monitoring growth of under 5 children since 2010. However, many global as well as Indian studies suggest that these standards remain aspirational and a lot of children get diagnosed as undernourished and stunted when they may be growing appropriately for the given population (Ramchandran, et.al, 2011; Kerac, et.al, 2011).

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## 2.8 SECULAR TREND

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Secular trend is the trend that is observed in a span of several generations. Secular trend in human growth is the progressive pattern of change (over successive generation) in the age at which physical and behavioral milestones are achieved. It has been found that overall economic conditions of world have improved in last 100 years. Children of industrialized countries have acquired a larger body and taller stature more quickly than before; they went to the path of sexual maturity more rapidly than their counterparts in other underprivileged countries. This trend is referred as “The Secular Trend”.

It is revealed by several studies done by different scholars like Roche, (1979); Loesch et.al, (2000); and Arztl, (1990) on the growth pattern of children of some countries, e.g., Germany, England, Poland, Norway, Sweden, North America etc., that the children of these countries show a marked tendency to become progressively larger in size, i.e., becoming taller and heavier, at all ages. This sort of trend is known as secular trend. Nobody knows for certain when this trend started. But the available records indicate that during the last 100 years this phenomenon is happening (Jaiswal, 2013). The secular trend in age at menarche has also been noted. These study shows that among the girls of those countries mentioned above, the age at menarche was gradually decreasing from 1880 to 1980.

What are the reasons behind the secular trend? There is no definite answer. We have already noted that nutrition, state of health, environment, socio-cultural conditions, etc., are associated with growth. Therefore, could better nutrition, improved facilities, desirable environmental conditions, marriage distance in terms of geography as well as mating outside the groups etc., be the reasons? (Jaiswal, 2013).

**Check Your Progress 7**

7) Define the concept of Secular Trend.

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**2.9 SUMMARY**

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Primates generally have a slow reproductive turnover and drawn-out life histories. Understanding the growth and development of the human organism requires an understanding of nature and nurture, and the complex interplay between the two. The terms growth and development are actually two different terms having separate meanings, but most of the time they are used interchangeably. The stages or phases of growth have been classified in different ways or manners by different scholars. A simple classification of the postnatal period includes four stages like early childhood, later childhood, adolescence and puberty; or, early childhood, middle childhood, late childhood and adolescence. Prenatal development includes all the changes that take place in the womb of the mother. Postnatal growth starts from the time of birth upto adulthood or the time of maturity. Infancy lasts from two weeks to one year of life. Childhood usually ranges from the finish of infancy stages up to the beginning of adolescence. Adolescence is the threshold of adulthood. It extends from twelve years to generally eighteen to twenty years i.e. it starts from the time of puberty and continue up to the onset of adulthood. After the active phase of the life-span, decline process starts resulting in an old age or senescence. Growth is measurable, and therefore, anthropometry plays a very important role in the study of growth. The measurements or the values at successive ages are plotted in a graph to obtain growth curves. Usually two types of growth curves are drawn, namely distance curve and velocity curve. Human growth and development is a complex phenomenon regulated by both, genetic and environmental factors. Growth and development is the key indicator of biological maturity. There are two basic determinants of development i.e. heredity and environment. Secular trend is the trend that is observed in a span of several generations. Secular trend in human growth is the progressive pattern of change (over successive generation) in the age at which physical and behavioral milestones are achieved.

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## 2.11 ANSWERS TO CHECK YOUR PROGRESS

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- 1) The terms growth and development are actually two different terms having separate meanings, but most of the time they are used interchangeably. Terminologically, growth means increase and enlargement of the body or some parts of the body, i.e. the cases where the body becomes heavier, larger, longer etc. On the other hand, development refers to the qualitative changes. These are the changes in kind, structure or organization- a complex process of integrating many structures and functions, which may not be observable or measureable outwardly. Thus, growth can be one of the components of development process or development in its quantitative aspect can be termed as growth. Refer to section 2.1
- 2) The two major periods of growth are prenatal and postnatal.
- 3) The ovum of human at the time of conception is about 0.1 mm in diameter. During the first part or initial segment of this period (ovum), it resembles a homogeneous mass. During the embryonic stage, even though the pace of development is moderate, yet during this time the differentiation process or cycle in the mass to form various regions begins which later on give rise to various parts of the body. The cells are also differentiated into specialized tissues, like nerve, muscle. This process which gives definite shape to different parts is called morphogenesis. By the eighth week the embryo becomes childlike like in appearance. During fetus stage the pace of growth in length as well as weight is considerably high or impressively high. However, in length the peak is reached earlier than in weight. In the former it happens at about 18 weeks. From around 36 weeks the pace of growth of the fetus slows down generally due to the impact of the uterus of the mother.
- 4) Postnatal growth starts from the time of birth upto adulthood or the time of maturity. Post natal period is commonly divided into the following age period:



Neonatal; Infancy or babyhood; Childhood; Adolescence; Adulthood/ Maturity; and Senility or old age. Refer to section 2.4

- 5) Growth is measurable, and therefore, anthropometry plays a very important role in the study of growth. The measurements or the values at successive ages are plotted in a graph to obtain growth curves. Usually two types of growth curves are drawn, namely Distance Curve and Velocity Curve. Refer to section 2.5
- 6) Variations in normal growth represent alternative pathways that enable individual to achieve their growth potential. The general growth curve explains the growth of the body as whole and most of the system of body like skeleton system, respiratory system, digestive system, urinary system and circulatory system that includes heart and blood vessels. Refer to section 2.6
- 7) Secular trend in human growth is the progressive pattern of change (over successive generation) in the age at which physical and behavioral milestones are achieved. Refer to section 2.8



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