Growth and development

Growth

Todd: "Growth is an increase in size."
Krogman: "Increase in size, change in proportion and progressive complexity."
Huxley: "The self multiplication of living substance." **Moss:** "Change in any morphological parameter, which is measurable."
Moyers: "Quantitative aspect of biologic development per unit of time."

"Entire series of sequential anatomic and physiologic changes taking place from the beginning of prenatal life to senility."

Development

Todd: "Development is progress towards maturity." **Moyers:** "All the naturally occurring unidirectional changes in the life of an individual from its existence as a single cell to its elaboration as a multifunctional unit terminating in death."

The terms "growth and development" are interrelated and some basic differences between the two can be appreciated. Growth is considered an anatomic phenomenon while development is a physiological and behavioral phenomenon. Growth is a change in size or quantity, i.e. growth is a measurable aspect of biologic life. Development on the other hand includes growth as well as differentiation.

The term "growth" simply means an increase in mass of life. However, the process of growth of cells and tissues is so complex that it is necessary to distinguish between different types of growth

T YPES

Growth at the Cellular Level

Cellular Hyperplasia

The phenomenon by which protein and DNA synthesis leads to an increase in cell number by mitotic division is known as cellular hyperplasia. For example, hyperplasia is seen

during stages of embryogenesis, organogenesis, and growth in utero as well as in infancy and childhood.

Cellular Hypertrophy

Here, synthesis of protein and cellular material without mitotic division leads to an increase in cell size. Thus hypertrophic growth involves an increase in the size of the specific cells that characterize a tissue without their division. For example, it is usually seen in cells which can no longer divide like nerve cells and muscle fibers.

Growth at Tissue Level

- Accretionary
- Appositional
- Interstitial
- Meristematic
- Compensatory

Accretionary

In this type of growth, there is an increase in the amount of extracellular matrix between tissue cells rather than an increase in either cell number or cell size.

Appositional

It is the specific type of growth in which new generation of cells and extracellular matrix are added to the surface of the tissue by the repeated division of cells by a cambial layer that surrounds the tissue; e.g. periosteum and perichondrium.

Interstitial

Interstitial growth is seen where multiplication and sometimes accretionary growth continues throughout the thickness of a tissue mass which consequently grows as a whole and expands from within.

Meristematic

It describes growth from a tip that contains populations of dividing cells. As division occurs, the tip moves distally leaving behind populations of cells from its earlier divisions,

e.g. growth seen in limb buds in which the progress zone first produces the cells of the shoulder and then is moved distally to produce cell populations of the arm and so on.

Compensatory

A balance is maintained between loss through wear and tear and the maintenance of functional tissue integrity. For example, the regeneration of liver to gain its approximate.

PHASES

- ***Prenatal growth:*** It is characterized by a rapid rise in
and its deficiency may be associated with defective bone cell numbers and fast growth rates.

- ***Postnatal growth:*** It lasts for about the first 20 years of
connective tissue growth. Vitamin D is also required for life and is characterized by declining growth rates and
normal bone growth. Malnutrition results in disordered increasing the maturation of tissues.

- ***Maturity:*** It is a period of stability during which body
deficient nutrient is replaced during growth period, i.e. the achieves maximum function and growth processes
"catching up" growth. are limited to the maintenance of an equilibrium state
between cellular loss and gain.

- ***Old age:*** It is a period during which functional activity There is considerable evidence that children today are growing faster than they grew in the past, for example, declines and growth processes slow down.

- ## FACTORS AFFECTING GROWTH AND MATURATION

genetic factors

The genes have the basic control of growth including rate, timing, and magnitude. However, the final outcome and growth depend on the interaction between the genetic potential and environmental factors.

a- ***Growth Hormones and Growth Factors*** Probably all of the endocrinal hormones have some influence on growth. In particular, postnatal growth is profoundly affected by the circulating concentration of growth hormone (somatotropin), growth hormone-releasing hormone, and somatostatin. All tissues respond to growth hormone and produce a proportional body growth that slows after puberty when secretion of the hormone decreases Other growth factors affecting growth are: Insulin-like growth factor - I and II (IGF-I, IGF-II) and Platelet-derived growth factor.

b- ***Nutrition.*** Vitamin C is necessary for proper bone and connective tissue growth. Vitamin D is also required for normal bone growth.

C- ***Secular Trends*** There is considerable evidence that children today are growing faster than they grew in the past, for example, studies have shown that boys of 15 years of age are 5 inches taller than the same age group some decades earlier. Such secular trend may be due to decreased illness and improve health.

D- ***Illness***

Prolonged and debilitating illness can have an adverse effect on growth. However, after the period of illness, “catch-up” growth normally brings the child back to, a predetermined growth curve.

E- ***Season and Circadian Rhythm*** Growth in height is faster in spring than in autumn, while weight increase occurs faster in autumn than in spring. Growth also shows a circadian rhythm; growth in height and eruption of teeth appears to be greater at night than in daytime due to fluctuations in the hormone release.

f- ***Psychological Stress*** Evidence shows that psychological stress can adversely affect growth by inhibiting hormone secretion.

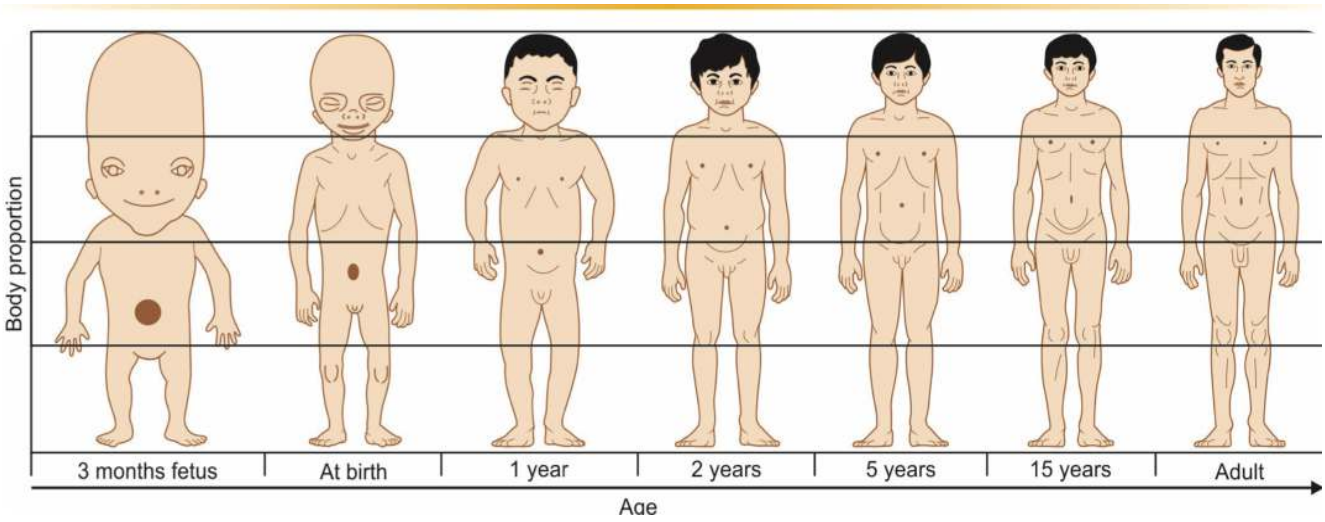
. BASIC TENETS OF GROWTH

Pattern

Pattern of growth in human is allometric. There is a difference in the relative rates of growth between one part of the body and another. Different parts and organs of the body grow at different times and to different extents. is termed as "differential growth."

Differential growth in humans is reflected in:

Cephalocaudal gradient of growth



In fetal life, at around 2–3 months of intrauterine life, the head is nearly one-half of the total embryonic life.

Scammon's curve.

Lymphoid Curve

I. The lymphoid curve includes the thymus, pharyngeal and tonsillar adenoids, lymph nodes, and intestinal lymphatic masses.
II. .Lymphoid tissues grow rapidly to reach 200% of adult size between 10 and 15 years of age. This is an adaptation to protect children from infections. Later their size is reduced from 200% to 100% at adult life.
III. The reduction in the size is due to the physiologic involution of the lymphoid tissues.

Neural Curve

I. Neural curve includes brain, spinal cord, optic apparatus-related bony parts of the skull, upper face, and vertebral column.
II. Neural curve rises strongly during childhood with the neural tissues growing very rapidly in the early years of life
III. Brain is nearly 90% its adult size by 8 years of age. Growth in size is accompanied by growth in internal structure, enabling the 8-year-old child to function mentally at nearly the same level as an adult.

General Curve

I. General curve/somatic tissues include musculature, bony skeleton, respiratory and digestive organs, kidneys, liver, spleen and blood volume.
II. The general tissues show an "S-shaped" growth curve.
III. The curve rises steadily from birth to five years of age and then a plateau from 5 to 10 years of age followed by acceleration during puberty, and then finally, it slows down in adulthood.

Genital Curve

The genital curve includes the primary sex apparatus (ovary and testis) and all secondary sex characters/traits.

Effect of Scammon's Growth in Facial Region

I. The maxilla follows neural growth pattern and its growth ceases earlier in life
II. Skeletal problems of the maxilla should be treated earlier than that of the mandible. For example, growth modification procedures (face mask) should be given earlier in life (6 years) to promote growth of maxilla.
III. Mandibular growth follows general growth pattern. Its growth occurs until about 18–20 years in males. Growth modification treatment (chin cup) should be extended until cessation of mandibular growth so as to prevent relapse of class III malocclusion due to continued growth of mandible.

Variability is the law of nature and human growth is no exception. No two individuals show the same increment of growth at a particular age. It can be appreciated in a standard growth chart that there is variability in height and weight measurements between different children. Some children are average growers. Some are genetically tall while others are genetically short. Causes of variability in growth include heredity, sex, nutrition, racial differences, exercise, climate, and socioeconomic and psychological factors. Girls gain their maximum length earlier than boys.

The end of part 1

Best wishes.