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## Physiology of Growth

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## Physiology of growth

The commencement of human growth physiology includes the dynamic period with cleavage of the zygote and ending with completion of adolescence marked by the end of long bone growth. The definition of growth as per the scientists like Todd, Huxley, Meridith is the process of physical maturation resulting in an increase in size of the body and various organs occurring by multiplication of cells and increase in the intracellular substance.

**Growth:** Increase in the number and size of the cells of an organ. Growth per se refers to an increase in the physical size, as the child grows to adulthood. The phases of growth include prenatal, infancy, childhood, and adolescence

**Development:** Refers to maturity i.e improvement in capability of tissue Terms growth and Development are interdependent, so termed together signify a process of maturation, both in quality and quantity

**Differentiation:** Means transformation of homogeneous group of cells into different types each type differing with another histologically and physiologically

**Hypertrophy:** Growth of Individual cell, Increase in the size of the cells

**Hyperplasia:** Increase in the number of cells

The phases of growth include prenatal, infancy, childhood, and adolescence. Growth of different parts of body does not follow a uniform pattern. Scammon used tissue and organ weights at each age to characterize growth of the body into four basic curves – the general curve (physical dimensions), neural, genital and lymphoid.

**General growth Curve:** After birth there are 4 distinct phases of growth / growth periods which include

Period of rapid growth infancy

Slow progressive growth 3-12yrs

Pubertal growth spurt

Slow growth 20 to 30yrs

Growth chart used as tool for tracking child's physical growth and development. This helps in ensuring whether child is gaining proper weight, height and head circumference.

Precocious puberty: puberty that starts before age 8 in girls and 9 in boys. Delayed puberty: In females, lack of breast development by 13 years or a lack of menarche by 16 years. In males, lack of testicular enlargement by 14 years or more than 5 years between testicular enlargement and completion of puberty

Following illness or starvation in children there is a period of Catch-up growth. Growth rate is greater than normal. The accelerated growth usually continues until the previous growth curve is reached. Then slows to normal and continues as earlier.

**Neural growth Curve** involves, brain, spinal cord and visual apparatus growth. 66% of neural growth occurs by the end of 1 year, 80% by 2yrs and almost fully developed by 5 years.

Measurement of head circumference is a very good indicator of proper brain growth. This pattern of neural growth- "Small body benefits from large brain" is a good example of evolutionary adaptation.

**Lymphoid growth Curve:** Rapid growth in childhood. By the age of 8-10yrs- size of tonsils and adenoids are larger than adult size and decline in size after that.

**Reproductive growth Curve:** Gonads and accessory organs of reproduction remain dormant until puberty. Remarkable growth occurs at the time of puberty. Gonads required for the preservation of species, so this function can wait till organism can preserve self.

The process of growth is influenced by various factors like hormonal, genetic, nutritional and environmental factors.

#### **Hormonal effects:**

Various hormones affect growth and development which includes Growth Hormone(GH), somatomedins, thyroxine, insulin, androgen and estrogen, adrenocortical hormones. Growth in utero is independent of fetal GH though plasma GH is elevated in newborns. Subsequently, average resting levels fall but spikes of growth hormone secretion are larger, especially during puberty. The various abnormalities of growth hormone include dwarfism, gigantism and acromegaly. Dwarfism: Short stature can be due to GRH deficiency, Growth hormone deficiency and deficient secretion of IGF-I or growth hormone receptor gene

mutation (Laron dwarfism). Other causes for dwarfism are Achondroplasia, gonadal dysgenesis, psychosocial dwarfism (Kaspar Hauser syndrome) and constitutional delayed growth.

Achondroplasia is a common form of dwarfism in humans having disorder of bone growth with short limbs with a normal trunk. It is an autosomal dominant condition due to mutation in gene for Fibroblast growth factor receptor 3 (FGFR3).

Secretion of IGF-I is stimulated by GH after birth and its concentration in plasma rises during childhood, peaks at the time of puberty and then declines to low levels in old age. IGF-II plays an important role in growth of fetus before birth. Thyroxine has widespread effects in tissue differentiation and maturation. It influences ossification of cartilage, growth of teeth, contours of face, and proportions of body. In addition, thyroid hormones have marked effects on brain development. Thyroxine has permissive action to that of GH. Hypothyroid from birth or before leads to Cretinism. Cretins are dwarfed and have infantile features, potbellies and protruding tongues. Have mental retardation, motor rigidity, and deaf-mutism. Worldwide, congenital hypothyroidism is one of the most common causes of preventable mental retardation. Insulin and GH interact synergistically to promote growth. Growth is appreciable only when large amounts of carbohydrate and protein are supplied with insulin. Androgens & Estrogen: Growth spurt at puberty is due to protein anabolic effect of androgens and also due to an interaction between sex steroids, GH and IGF-I. Androgens and estrogens initially stimulate growth but estrogens terminate growth faster by epiphyseal closure. Adrenocortical hormones at normal levels have permissive action on growth but glucocorticoids at pharmacologic doses slows growth. Other Factors affecting Growth are genetic factors, nutritional factors chronic illness, emotional factors, environmental factors and socio-economic factors.

Overall growth is a complex phenomenon with different tissues and organs growing in different patterns under the proper hormonal balance with multiple factors influencing.

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