M.SC SEM II ELECTIVE PAPER II GROWOTH AND NUTRITION

Department of Anthropology lucknow university lucknow
Dr Aishwarya Awasthi

Growth And Nutrition Development of the human body is the process of growth to maturity. The process begins with fertilization, where an egg released from the ovary of a female is penetrated by a sperm cell from a male. The resulting zygote develops through mitosis and cell differentiation, and the resulting embryo then implants in the uterus, where the embryo continues development through a fetal stage until birth. Further growth and development continues after birth, and includes both physical and psychological development, influenced by genetic, hormonal, environmental and other factors. This continues throughout life: through childhood and adolescence into adulthood.

Growth and development begin at conception and end at maturity. They are unique characteristics of children and any obstacle in this process at any stage can possibly result in aberration of growth and development. The period of Pre-natal growth is virtually important to the child's future well-being yet it is the period about which inevitably we know the least. Growth is defined as an increase in size of an individual due to increase in number and size of the cell, resulting in an overall increase. This increase can be seen, appreciated and measured accurately (Desai & Mukerjee, 1999).

Growth is an essential feature of life. This distinguishes him or her from an adult. The process of growth starts from the time of the conception of fertilized ovum and continues until the child grows into a fully matured adult.

The terms 'growth' and 'development' are often used together. These are not interchangeable because they represent two different facets of the dynamics of change i.e. those of quantity and quality. Growth and development usually proceed concurrently but may not always be interrelated. The term growth denotes a net increase in the size or mass of tissues. It is largely attributed to the multiplication of cells and increase in the intracellular substance. Hypertrophy or expansion of cell size contributes to a lesser extent to the process of growth. While development specifies maturation of function, it is related to the maturation and myelination of the nervous system and indicates acquisition of a variety of skills for optimal functioning of the individual.

Growth and development are affected by genetic and environmental factors. Genetic factors include phenotypes, characteristics of parents, race, sex, biorhythm and maturation, genetic disorder, chromosomal abnormalities, gene mutation and children of the multiple pregnancies.

Environmental factors include prenatal period – in this period the foetus grows in the maternal environment *in utero*. The genome of the mother influences the foetal growth. This probably explains why the progeny usually shows greater similarity to the mother in respect of somatic development, physiological and biochemical maturation. Infection of mother also results in poor growth of the foetus. Average birth weight of infants also depends on mother’s nutritional supplement. Some drugs which are used during pregnancy also effect the growth of infants. Infant's birth growth and weight also depends on hormones (Ghai, 1996). Environmental factors is also affect the postnatal period. The growth in the postnatal period is affected by nutrition, socio- economic level, natural resources, climate, emotional and cultural factors.

Growth and development of children is a continuous and orderly process. The sequence and pattern of growth in children is comparable but the rate of growth is not always uniform. Physical growth follows a sigma shaped curve. The increment of growth over a unit time is not always equal. There are specific periods in child's life, when the rate of growth accelerates, decelerates or there is a steady buildup of body tissues (Ghai, 1996).

In the prenatal period the growth of the foetus is fast in the first half of gestation while is slowed down till birth. Thus, in the early postnatal period the velocity of growth is high during the first few months. There is steady rate of growth during mid-childhood. A second phase of accelerated growth occurs during puberty. Growth decelerates for some time after that, and then ceases altogether after maturity.

Growth pattern of every individual is unique. There are racial differences in growth mainly in body proportions. Africans have longer legs and arms, narrower hips as compared to shoulders. Chinese have larger arms to legs and broader hips. Japanese have larger trunk to legs. Indian and Europeans are comparable in spite of dissimilar environment. Afro–American are taller than Americans. But Asians are shorter than Europeans.

Before birth

Fertilization occurs when the sperm successfully enters the ovum's membrane. The chromosomes of the sperm combine with those of the egg to form a single cell, called a zygote, and the germinal stage of embryonic development commences.[1] The germinal stage refers to the time from fertilization, through the development of the early embryo, up until implantation. The germinal stage is over at about 10 days of gestation.[2]

The zygote contains a full complement of genetic material, with all the biological characteristics of a single human being, and develops into the embryo. Briefly, embryonic development have four stages: the morula stage, the blastula stage, the gastrula stage, and the neurula stage. Prior to implantation, the embryo remains in a protein shell, the zona pellucida, and undergoes a series of rapid mitotic cell divisions called cleavage.[3] A week after fertilization the embryo still has not grown in size, but hatches from the zona pellucida and adheres to the lining of the mother's uterus. This induces a decidual reaction, wherein the uterine cells proliferate and surround the embryo thus causing it to become embedded within the uterine tissue. The embryo, meanwhile, proliferates and develops both into embryonic and extra-embryonic tissue, the latter forming the fetal membranes and the placenta. In humans, the embryo is referred to as a fetus in the later stages of prenatal development. The transition from embryo to fetus is arbitrarily defined as occurring 8 weeks after fertilization. In comparison to the embryo, the fetus has more recognizable external features and a set of progressively developing internal organs. A nearly identical process occurs in other species.

Embryonic development

Main article: Human embryonic development

Human embryonic development refers to the development and formation of the human embryo. It is characterised by the process of cell division and cellular differentiation of the embryo that occurs during the early stages of development. In biological terms, human development entails growth from a one-celled zygote to an adult human being. Fertilisation occurs when the sperm cell successfully enters and fuses with an egg cell (ovum). The genetic material of the sperm and egg then combine to form a single cell called a zygote and the germinal stage of prenatal development commences.[1] The embryonic stage covers the first eight weeks of development; at the beginning of the ninth week the embryo is termed a fetus.

The germinal stage refers to the time from fertilization through the development of the early embryo until implantation is completed in the uterus. The germinal stage takes around 10 days.[4] During this stage, the zygote begins to divide, in a process called cleavage. A blastocyst is then formed and implanted in the uterus. Embryonic development continues with the next stage of gastrulation, when the three germ layers of the embryo form in a process called histogenesis, and the processes of neurulation and organogenesis follow.In comparison to the embryo, the fetus has more recognizable external features and a more complete set of developing organs. The entire process of embryonic development involves coordinated spatial and temporal changes in gene expression, cell growth and cellular differentiation. A nearly identical process occurs in other species, especially among chordates.

Fetal development A fetus is a stage in the human development considered to begin nine weeks after fertilization. In biological terms, however, prenatal development is a continuum, with many defining feature distinguishing an embryo from a fetus. A fetus is also characterized by the presence of all the major body organs, though they will not yet be fully developed and functional and some not yet situated in their final location.

Maternal influences

The fetus and embryo develop within the uterus, an organ that sits within the pelvis of the mother. The process the mother experiences whilst carrying the fetus or embryo is referred to as pregnancy. The placenta connects the developing fetus to the uterine wall to allow nutrient uptake, thermo-regulation, waste elimination, and gas exchange via the mother's blood supply; to fight against internal infection; and to produce hormones which support pregnancy. The placenta provides oxygen and nutrients to growing fetuses and removes waste products from the fetus's blood. The placenta attaches to the wall of the uterus, and the fetus's umbilical cord develops from the placenta. These organs connect the mother and the fetus. Placentas are a defining characteristic of placental mammals, but are also found in marsupials and some non-mammals with varying levels of development.[7] The homology of such structures in various viviparous organisms is debatable, and in invertebrates such as Arthropoda, is analogous at best.

After birth

Infancy and childhood

Childhood is the age span ranging from birth to adolescence.[8] In developmental psychology, childhood is divided up into the developmental stages of toddlerhood (learning to walk), early childhood (play age), middle childhood (school age), and adolescence (puberty through post-puberty). Various childhood factors could affect a person's attitude formation.[8]

Prepubescence

Neonate (newborn)

Infant (baby)

Toddler

Play age

Elementary school age, may coincide with preadolescence

Puberty

Puberty is the process of physical changes through which a child's body matures into an adult body capable of sexual reproduction. It is initiated by hormonal signals from the brain to the gonads: the ovaries in a girl, the testes in a boy. In response to the signals, the gonads produce hormones that stimulate libido and the growth, function, and transformation of the brain, bones, muscle, blood, skin, hair, breasts, and sex organs. Physical growth—height and weight—accelerates in the first half of puberty and is completed when an adult body has been developed. Until the maturation of their reproductive capabilities, the pre-pubertal physical differences between boys and girls are the external sex organs.

On average, girls begin puberty around ages 10–11 and end puberty around 15–17; boys begin around ages 11–12 and end around 16–17. The major landmark of puberty for females is menarche, the onset of menstruation, which occurs on average between ages 12 and 13;[14][15][16][17] for males, it is the first ejaculation, which occurs on average at age 13. In the 21st century, the average age at which children, especially girls, reach puberty is lower compared to the 19th century, when it was 15 for girls and 16 for boys. This can be due to any number of factors, including improved nutrition resulting in rapid body growth, increased weight and fat deposition, or exposure to endocrine disruptors such as xenoestrogens, which can at times be due to food consumption or other environmental factors. Puberty which starts earlier than usual is known as precocious puberty, and puberty which starts later than usual is known as delayed puberty.

Notable among the morphologic changes in size, shape, composition, and functioning of the pubertal body, is the development of secondary sex characteristics, the "filling in" of the child's body; from girl to woman, from boy to man.

Adulthood

Biologically, an adult is a human or other organism that has reached sexual maturity. In human context, the term adult additionally has meanings associated with social and legal concepts. In contrast to a "minor", a legal adult is a person who has attained the age of majority and is therefore regarded as independent, self-sufficient, and responsible. The typical age of attaining adulthood is 18, although definition may vary by legal rights and country.

Human adulthood encompasses psychological adult development. Definitions of adulthood are often inconsistent and contradictory; a person may be biologically an adult, and have adult behavior but still be treated as a child if they are under the legal age of majority. Conversely, one may legally be an adult but possess none of the maturity and responsibility that may define an adult, the mental and physical development and maturity of an individual is proven to be greatly influenced by the circumstances in which they exist.

Growth is an exceedingly regular process but periods of slow growth are followed by others of rapid increase. In order to know the pattern of growth of different segments of the body, it requires to measure such dimensions as stature, weight or breadth of shoulders or any other dimension at different age intervals and then graphs are plotted in the form of curves for the specific measures against age. Such a curve tells us at a glance the distance travelled by the child along the road to maturity. A more vertical distance curve between certain age levels indicates quick growth during the period, *e.g.* in case of stature it is noted that the children grow quickly during the first two years of life which is called **early infantile growth spurt**. After this the stature increases slowly and steadily until 13 or 14 years of age, then, there is a sudden acceleration of the growth in most of the body dimensions. This is called **adolescent spurt**. After this growth slows until it finally stops. Such a pattern of growth in stature is followed by all normal children. They, however, differ in the exact speed at which they are growing at any given age and also in adolescent spurt. This however does not give any information about the velocity of the travel at any particular time. The shape of the curve may possibly give some idea. In order to know the velocity, it is necessary to find out the actual gain in weight and height or any other dimension over a certain period of time and then construct a graph using such data instead of actual measurement. The velocity of growth may show acceleration or deceleration.

The term growth velocity or growth rate refers to the increase in a given parameter in a specified period of time. Its unit in case of stature will be cm per year. Thus growth velocity can be calculated by dividing “distance growth” i.e. the distance between two successive measurements of the stature or any other dimension by the time (in years) spent between the two measurements.

On the basis of the calculation of velocity between successive pairs of measurements, we can construct a “growth velocity curve” for any individual. Such velocity curve describes the child’s growth much more clearly than the “distance curve” and is typical of normal children. Its unusual variation may be an indication of abnormal growth pattern.

Most of growth studies normally aim at observing in detail the growth of an individual or setting up standard, giving the normal variation of a parameter in children at different age levels. Depending on objectives of the study there are two basic methods of studying human growth:

Longitudinal study Sometimes these two approaches can be combined in a mixed or semi- longitudinal study which may be called as the third method for studying growth.

Cross-sectional study.

n medical research, social science and biology, a **cross-sectional study** (also known as a **cross-sectional analysis**, **transverse study**, **prevalence study**) is a type of observational study that analyzes data from a population, or a representative subset, *at a specific point in time*—that is, cross-sectional data.

In economics, cross-sectional studies typically involve the use of cross-sectional regression, in order to sort out the existence and magnitude of causal effects of one independent variable upon a dependent variable of interest at a given point in time. They differ from time series analysis, in which the behavior of one or more economic aggregates is traced through time.
In medical research, cross-sectional studies differ from case-control studies in that they aim to provide data on the entire population under study, whereas case-control studies typically include only individuals who have developed a specific condition and compare them with a matched sample, often a tiny minority, of the rest of the population. Cross-sectional studies are descriptive studies (neither longitudinal nor experimental). Unlike case-control studies, they can be used to describe, not only the odds ratio, but also absolute risks and relative risks from prevalences (sometimes called *prevalence risk ratio*, or PRR).[1][2] They may be used to describe some feature of the population, such as prevalence of an illness, or they may support inferences of cause and effect. Longitudinal studies differ from both in making a series of observations more than once on members of the study population over a period of time.

Cross-sectional studies involve data collected at a defined time. They are often used to assess the prevalence of acute or chronic conditions, but cannot be used to answer questions about the causes of disease or the results of intervention. Cross-sectional data cannot be used to infer causality because temporality is not known. They may also be described as censuses. Cross-sectional studies may involve special data collection, including questions about the past, but they often rely on data originally collected for other purposes. They are moderately expensive, and are not suitable for the study of rare diseases. Difficulty in recalling past events may also contribute bias.

Advantages

The use of routinely collected data allows large cross-sectional studies to be made at little or no expense. This is a major advantage over other forms of epidemiological study. A natural progression has been suggested from cheap cross-sectional studies of routinely collected data which suggest hypotheses, to case-control studies testing them more specifically, then to cohort studies and trials which cost much more and take much longer, but may give stronger evidence. In a cross-sectional survey, a specific group is looked at to see if an activity, say alcohol consumption, is related to the health effect being investigated, say cirrhosis of the liver. If alcohol use is correlated with cirrhosis of the liver, this would support the hypothesis that alcohol use may be associated with cirrhosis.

Disadvantages

Routine data may not be designed to answer the specific question.
Routinely collected data does not normally describe which variable is the cause and which the effect. Cross-sectional studies using data originally collected for other purposes are often unable to include data on confounding factors, other variables that affect the relationship between the putative cause and effect. For example, data only on present alcohol consumption and cirrhosis would not allow the role of past alcohol use, or of other causes, to be explored.
Most case-control studies collect specifically designed data on all participants, including data fields designed to allow the hypothesis of interest to be tested. However, in issues where strong personal feelings may be involved, specific questions may be a source of bias. For example, past alcohol consumption may be incorrectly reported by an individual wishing to reduce their personal feelings of guilt. Such bias may be less in routinely collected statistics, or effectively eliminated if the observations are made by third parties, for example taxation records of alcohol by area.

Weaknesses of aggregated data**[**

Cross-sectional studies can contain individual-level data (one record per individual, for example, in national health surveys). However, in modern epidemiology it may be impossible to survey the entire population of interest, so cross-sectional studies often involve secondary analysis of data collected for

another purpose. In many such cases, no individual records are available to the researcher, and group-level information must be used. Major sources of such data are often large institutions like the Census Bureau or the Centers for Disease Control in the United States. Recent census data is not provided on individuals, for example in the UK individual census data is released only after a century. Instead data is aggregated, usually by administrative area. Inferences about individuals based on aggregate data are weakened by the ecological fallacy. Also consider the potential for committing the "atomistic fallacy" where assumptions about aggregated counts are made based on the aggregation of individual level data (such as averaging census tracts to calculate a county average). For example, it might be true that there is no correlation between infant mortality and family income at the city level, while still being true that there is a strong relationship between infant mortality and family income at the individual level. All aggregate statistics are subject to compositional effects, so that what matters is not only the individual-level relationship between income and infant mortality, but also the proportions of low, middle, and high income individuals in each city. Because case-control studies are usually based on individual-level data, they do not have this problem.

Economics

In economics, cross-sectional analysis has the advantage of avoiding various complicating aspects of the use of data drawn from various points in time, such as serial correlation of residuals. It also has the advantage that the data analysis itself does not need an assumption that the nature of the relationships between variables is stable over time, though this comes at the cost of requiring caution if the results for one time period are to be assumed valid at some different point in time.

An example of cross-sectional analysis in economics is the regression of money demand—the amounts that various people hold in highly liquid financial assets—at a particular time upon their income, total financial wealth, and various demographic factors. Each data point is for a particular individual or family, and the regression is conducted on a statistical sample drawn at one point in time from the entire population of individuals or families. In contrast, an intertemporal analysis of money demand would use data on an entire country's holdings of money at each of various points in time, and would regress that on contemporaneous (or near-contemporaneous) income, total financial wealth, and some measure of interest rates. The cross-sectional study has the advantage that it can investigate the effects of various demographic factors (age, for example) on individual differences; but it has the disadvantage that it cannot find the effect of interest rates on money demand, because in the cross-sectional study at a particular point in time all observed units are faced with the same current level of interest rates.

Longitudinal Methods

A **longitudinal study** (or **longitudinal survey**, or **panel study**

It) is a research design that involves repeated observations of the same variables (e.g., people) over short or long periods of time (i.e., uses longitudinal data). It is often a type of observational study, although they can also be structured as longitudinal randomized experiments.

Longitudinal studies are often used in social-personality and clinical psychology, to study rapid fluctuations in behaviors, thoughts, and emotions from moment to moment or day to day; in developmental psychology, to study developmental trends across the life span; and in sociology, to study life events throughout lifetimes or generations; and in consumer research and political polling to study consumer trends. The reason for this is that, unlike cross-sectional studies, in which different individuals with the same characteristics are compared,[2] longitudinal studies track the same people, and so the differences observed in those people are less likely to be the result of cultural differences across generations. Longitudinal studies thus make observing changes more accurate and are applied in various other fields. In medicine, the design is used to uncover predictors of certain diseases. In advertising, the design is used to identify the changes that advertising has produced in the attitudes and behaviors of those within the target audience who have seen the advertising campaign. Longitudinal

studies allow social scientists to distinguish short from long-term phenomena, such as poverty. If the poverty rate is 10% at a point in time, this may mean that 10% of the population are always poor or that the whole population experiences poverty for 10% of the time.

When longitudinal studies are observational, in the sense that they observe the state of the world without manipulating it, it has been argued that they may have less power to detect causal relationships than experiments. However, because of the repeated observation at the individual level, they have more power than cross-sectional observational studies, by virtue of being able to exclude time-invariant unobserved individual differences and also of observing the temporal order of events.[3] Some of the disadvantages of longitudinal study are that they take a lot of time and are very expensive. Therefore, they are not very convenient.[4]

Longitudinal studies can be retrospective (looking back in time, thus using existing data such as medical records or claims database) or prospective (requiring the collection of new data)

Cohort studies are one type of longitudinal study which sample a cohort (a group of people who share a defining characteristic, typically who experienced a common event in a selected period, such as birth or graduation) and perform cross-section observations at intervals through time. However, not all longitudinal studies are cohort studies, as longitudinal studies can instead include a group of people who do not share a common event.

Longitudinal studies do not require large numbers of participants (as in the examples below). Qualitative longitudinal studies may include only a handful of participants, and longitudinal pilot or feasibility studies often have fewer than 100 participants.

Growth spurt

The adolescent growth spurt is a rapid increase in the individual's height and weight during puberty resulting from the simultaneous release of growth hormones, thyroid hormones, and androgens.[42] Males experience their growth spurt about two years later, on average, than females. During their peak height velocity (the time of most rapid growth), adolescents grow at a growth rate nearly identical to that of a toddler—about 10.3 cm (4 inches) per year for males and 9 cm (3.5 inches) per year for females. In addition to changes in height, adolescents also experience a significant increase in weight (Marshall, 1978). The weight gained during adolescence constitutes nearly half of one's adult body weight. Teenage and early adult males may continue to gain natural muscle growth even after puberty.

The accelerated growth in different body parts happens at different times, but for all adolescents, it has a fairly regular sequence. The first places to grow are the extremities—the head, hands and feet—followed by the arms and legs, then the torso and shoulders.[44] This non-uniform growth is one reason why an adolescent body may seem out of proportion.

During puberty, bones become harder and more brittle. At the conclusion of puberty, the ends of the long bones close during the process called epiphysis. There can be ethnic differences in these skeletal changes. For example, in the United States of America, bone density increases significantly more among black than white adolescents, which might account for decreased likelihood of black women developing osteoporosis and having fewer bone fractures there.

Another set of significant physical changes during puberty happen in bodily distribution of fat and muscle. This process is different for females and males. Before puberty, there are nearly no sex differences in fat and muscle distribution; during puberty, boys grow muscle much faster than girls, although both sexes experience rapid muscle development. In contrast, though both sexes experience an increase in body fat, the increase is much more significant for girls. Frequently, the increase in fat for girls happens in their years just before puberty. The ratio between muscle and fat among post-pubertal boys is around three to one, while for girls it is about five to four. This may help explain sex differences in athletic performance.

Pubertal development also affects circulatory and respiratory systems as an adolescents' heart and lungs increase in both size and capacity. These changes lead to increased strength and tolerance for exercise. Sex differences are apparent as males tend to develop "larger hearts and lungs, higher systolic blood pressure, a lower resting heart rate, a greater capacity for carrying oxygen to the blood, a greater power for neutralizing the chemical products of muscular exercise, higher blood hemoglobin and more red blood cells".

Despite some genetic sex differences, environmental factors play a large role in biological changes during adolescence. For example, girls tend to reduce their physical activity in preadolescence and may receive inadequate nutrition from diets that often lack important nutrients, such as iron. These environmental influences, in turn, affect female physical development

DEVELOPMENT

Development refers to qualitative and quantitative changes and acquisition of variety of skills for functioning optimally in social situations. Further, development is a continuous process from birth to maturity. It depends on maturation and myelination of brain, unless that has occurred, no amount of practice can make the child learn any skill.

Although severe disorders can be recognized in infancy, it is not possible to diagnose speech impairment, hyperactivity or emotional disturbances before the age of 3-4 years and learning disabilities are rarely recognized before children start their schooling. If one can diagnose developmental delay in early stage of growth, the intervention can reduce long term sequelae.

Developmental delay is said to exist, if the child does not reach developmental milestones at the expected age i.e. broad variation among normal children.

Although the delay may occur due to a biological factor such as chromosomal disorder or an environmental factor such as uterine environment. The primary model for pathogenesis of developmental delay is a transactional one in which the process of development is viewed as an interaction between the child and environment in which each can have profound effect on the other.

The first part of the development is head control, which is observed in ventral suspension, prone and supine position. The remaining phase of development can be observed either in sitting or standing position. The areas of observation of behavioral development includes gross motor activity such as fine motor and vision, hearing and speech , social behavior and play.

Nutrition

Food is a major concern of mankind beginning from the time of conception and extending through the entire life span of individual. Humans need a wide range of nutrients to perform various functions of the body so as to lead a healthy life. The nutrients include proteins, fat, carbohydrates, vitamins and minerals. These nutrients are chemical substances, which are present in the food we eat daily. Food supplies the energy for physical activity and other metabolic needs of the body. Nutrients are necessary for maintaining growth of the individual and for repair of worn out and ageing tissue. Basic constituents for synthesis of digestive juices, enzymes and hormones are derived from food.

The epidemiological and scientific consideration of nutrition is of interest not only to physiologists and physicians but also to sociologists-anthropologists, economists and political leaders of the state, because effect of the nutrition gap on the development of individual and community may have major socio-economic and political implications.

According to Murthy (1995), “nutrition is the science of foods the nutrients and the other substances there in: their action, interaction and balance in relationship to health and disease”. Nutrition can also be defined as “food at work in the body”.

We know that good nutrition is a basic component of health, growth and development of an organism, although function of age are determined by genetic factors and influenced by the environment. Among these factors nutrition is the most important factor effecting growth.

Nutritional status is the condition (state) of health of an individual as influenced by the utilization of nutrients in his body. Good nutrient is the term applied to that quality of nutrition in which the essential nutrient in correct amount and balance are utilized to promote the highest level of physical and mental health through one's life.

Food can be obtained from animal as well as plant kingdom, from organic as well as inorganic sources. Food is classified according to the composition of nutrients and the functions they serve in the body.

NUTRIENT COMPONENTS

Proteins

Protein is the food obtained either from the animal or from vegetable sources. The protein of animal origin generally have higher content of essential amino acids (polypeptides of protein comprise nitrogen containing amino acids). These are therefore, classifieds as biologically complete protein. Protein from vegetables sources are often biologically incomplete protein. Legumes have high amount of protein. It is the important constituent of the tissues and cells of the body. They form the important component of muscle and other tissues and vital body fluids like blood. The proteins in the form of enzymes and hormones are concerned with a wide range of metabolic processes in the body; proteins as antibodies help the body to defend against infection.

Energy

Energy is required for physical activity of daily life when individual is in state of complete rest, energy is expanded for basal metabolism. Carbohydrates, fats and proteins in the food are the chief sources of energy for man. The energy obtained from the food is usually expressed in terms of thermo-chemical kilo-calories. These are often loosely referred to as kilocalories or simply calorie. WHO (1985) has listed energy requirements of infants and children.

Energy requirements of infants and children (Ghai, 1996)

Age	Kcal /kg	Kj/kg
Up to 2 months	116	485
2 – 3 months	109	456
3 – 4 months	103	431
4 – 5 months	99	414
5 – 9 months	95	400
9 – 12 months	112	470
	Boy (kcal/kg)	Girl (kcal/kg)
1 – 2 year	1200	1140
2 – 3 year	1400	1310
3 – 4 year	1560	1440
4 – 5 year	1690	1540
5 – 6 year	1810	1630

Fat

Fats are concentrated sources of energy. Deficiency of essential fatty acids in the diet may result in reduced growth rate, infection, skin disorders. Presence of fat in the diet is important for the absorption of fat soluble vitamins like vitamin A and carotene present in the diet. Apart from these functions, some fats, particularly those derived from vegetable sources provide what is known as "essential fatty acids" (EFA) which has vitamins like functions in body. These EFA are also important for the structure and function of cells.

Carbohydrates

Carbohydrates are also a concentrated source of energy. They are made up of polysaccharides (starch cellulose), disaccharides (sucrose, lactose & maltose) and monosaccharides (glucose, fructose, galactose, ribose, deoxyribose). Carbohydrates provide energy, contribute to taste and texture of foods and preserve foods. Excessive carbohydrate consumption is associated with dental caries, obesity, heart disease & cataract. Starch is a complex carbohydrate made up of glucose units. Glucose derived from starch and other sugars present in the diet is the main source of energy in the body.

Fiber

With little nutritional value fibers are considered as an essential component of carbohydrates. It is now recognized that this substance is necessary for normal functioning of alimentary system.

Minerals

Another nutritional component the minerals include calcium. Most natural food contain small amount of calcium. Milk , Milk products and millet like Ragi are rich source of calcium. Infants require only 400 – 600 mg of calcium per day. An intake of 500 – 800 mg per day is adequate for the body needs from the age of 1 to 10 years. Thereafter, during the pubertal spurt of growth, calcium requirement is higher in the range of 1000 to 1200 mg per day. Adults require about 800 mg of calcium per day. During pregnancy and lactation additional 400 mg of calcium is required per day.

Vitamin, Iodine, fluorine, Zinc, magnesium, copper chromium sodium, *etc*. are the other components of nutrition

Functional Classification of Nutrient Components:

Body building food – protein, minerals.

Energy giving food – fat, carbohydrates.

Regulatory food – water, roughage.

THE FUNCTIONS OF FOOD

Physiological Functions

Foods provide materials for tissues building growth body repairs mainly thorough proteins and minerals.

Food provides energy to the body through mineral nutrients like carbohydrates and fats (lipids)

Protective foods are essential for safe guarding the body against disease.

Regulatory foods are needed for the normal working of the body.

Psychological Function

Food satisfies certain emotional needs of human beings.

It is well known fact that eating provides an outlet for the stresses and strains of life.

Food is also a sign of security to many

Socio-cultural Functions

Food habits which have existed among a given racial group for centuries may be the reason for their reluctance to accept any suggested changes.

Food plays an important role during social meetings both formal & informal.

Food consumed by an individual should be wholesome and should fulfill the physiological, psychological and social needs of the human beings.

Feeding & Weaning

In most developing countries of Asia, Africa and Latin America breast- feeding of infants is practically almost universally accepted except by a small proportion of urban elites or working mothers. However, due to sustained campaign in favour of breast feeding it has become popular with many mothers in Europe & North America. A well nourished mother can usually provide enough nutritional input for her baby to maintain its normal rate of growth during the first four to six months of life without any detriment to her own health, physique or figure. A poorly nourished mother may also be able to breast feed her infant in the initial months but the growth rate of their infants is generally lower. Breast milk is the ideal food for new born and is associated with several advantages.

Lower risk of infection.

Metabolic effects.

Low risk of allergy.

Digestion of fats and supply of fat free fatty acid.

Economic factor.

Emotional factor

Weaning Food

The human milk in appropriate quantity alone cannot provide all the energy and protein required for maintaining an adequate velocity of growth for the infants after four months of age. It is, therefore, necessary to introduce more concentrated energy dense nutritional supplements by this age. Infants also require iron supplements or iron containing food supplement after the age of 5 to 6 months. It prevents iron deficiency or anaemia. So that weaning means accustoming the infants to nourishment other than the mother's milk. Weaning is a difficult period in the infant's life because if the food supplements or substitutes are not adequate in quantity and quality then the child becomes malnourished. Unhygienic feeding practices may result in enteric infections and diarrhea.

Malnutrition and Deficiency Diseases

Every individual requires an adequate supply of nutrients in suitable proportion for normal growth and development. Malnutrition means disordered nutrition, which may be due to excessive nutrition (over nutrition) or deficient nutrition (under nutrition). There is therefore a high incidence of nutritional deficiency diseases among the poorer sections especially in the vulnerable group of infants and mothers.

"Malnutrition can be defined as a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients, which can manifest into over nutrition or under nutrition or an imbalance" (Murthy, 1995).

Malnutrition can be hazardous to the physical, physiological, behavioral, mental and emotional well being of individual. A mal-nourished child will be below normal height and weight as compared to normal child. He will have low resistance and susceptibility for infectious diseases.

Major nutritional Deficiency problems seen in children particularly in South Asia :

Protein energy malnutrition.

Iron deficiency anemia.

Endemic goiter and related iodine deficiency diseases.

Nutritional blindness due to vitamin A deficiency.

Intra uterine nutritional deprivation secondary to maternal malnutrition.

Protein Energy Malnutrition (PEM)

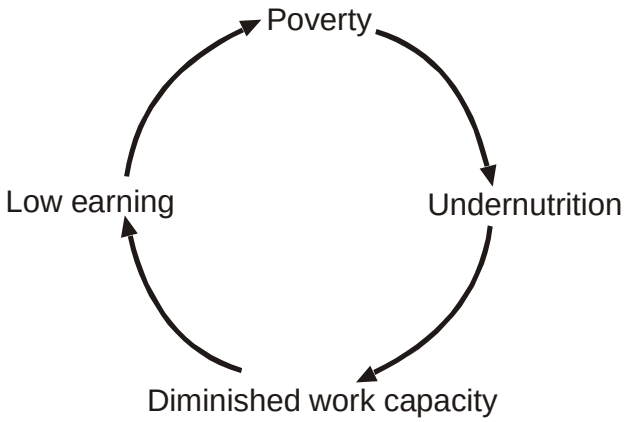
Undernutrition is widely recognized as a major health problem in the developing countries of the world. The frequency of undernutrition can not be easily estimated from the prevalence of commonly recognized clinical syndromes of malnutrition such as marasmus & kwashiorkor. However, this constitutes only the tip of the iceberg. Cases with mild to moderate under nutrition are likely to remain unrecognized because clinical criteria for their diagnosis are difficult to interpret accurately.

Under nourishment is often diagnosed by comparing the weight, height and mid arm circumference of an individual on anthropometric terms for corresponding age in that community. Children who receive less food do remain small in stature. The prevalence of underweight cannot be judged solely by the amount of food consumed by an individual in the recent past. Human body has a remarkable capacity to adjust its metabolism to meet some variations in the daily intake of food. Unless nutritional deprivation is severe and prolonged short term deficit may not produce any significant physiological disturbance.

Nutritionally deprived children don't thrive well or gain weight. Nutritional status of a child is an indicator of nutritional profile of the entire community. The studies of National Nutritional Monitoring Bureau (In India) have indicated that there has been a steady decline in the incidence of severe protein energy malnutrition (Gomez classification < 60 % of standard) from 18 to 20.8 to 8.5% less than from the year 1976 onwards.

The World Development Report (1993) and state of world's children (UNICEF, 1996) indicate that in India PEM frequency is higher than China, Latin America & other Asian countries and Islands. In India 5.6 million children lost their lives as a result of protein energy malnutrition. The percentage of preschool children affected by malnutrition is 65% (age 24 – 29 months), 27% in age of 12 – 23 months is higher than China, Pakistan and Sri Lanka.

Commonest cause of malnutrition is poverty. The poor cannot purchase adequate amount of food of the desired quality for meeting their and their family's nutritional requirements. This deprivation adversely affects their capacity for physical work & endurance. They earn less and this starts as vicious cycle of poverty



In the new social milieu, competing demands for non-vegetarian food expenditure, such as on housing, clothing and entertainment have gone up significantly often at the cost of the expenditure on food.

Clinical manifestation of malnutrition depends on the security and duration of malnutrition deprivation, the age of the undernourished subject, relative lack of different proximate principles of food & the presence and absence of associated infections. In India & many other developing countries the major limiting factor in the diet of preschool children is energy. Lack of protein in the diet is more often due to low intake rather than a qualitative defect in the diet.

Nutritional marasmus & kwashiorkor are two extreme forms of malnutrition. Under nutrition conditions are in the form mild to moderate. If the dietary intake is deficient for a short period the body adopts its metabolism to compensate for the deficit to some extent. This is called mild nutrition condition. If the food deficit persists for a longer period of time, the malnourished subject converses his energy by curtailing the physical activity. Moderately malnourished children appear more slow and less energetic. If the nutritional deficit continues for long, growth of the child is affected. With prolonged deprivation height is also stunted. Chest circumference normally exceeds the head circumference by the age of one year. But it may not do so till much later in malnourished children. The weight of child is reduced and appears disproportionate with the long body, thin limbs and unduly large head. As the nutritional deficit exaggerates with onsets of infections the child may become marasmic or develop kwashiorkor.

Marasmus

The body weight is less than 60% of the expected weight for the age. The skin appears dry and inelastic and is prone to be infected. The hair is hypo-pigmented. The baby appears alert but is often irritable.

Kwashiorkor

There are three essential clinical features of kwashiorkor. The edema starts in the lower extremities and later involves upper limbs and face. Muscles of the upper limbs are wasted but the lower extremities appear swollen. The face appears moon shaped & puffy.

OTHER NUTRITIONAL DEFICIENCIES

Vitamin A deficiency

The clinical sign of vitamin A deficiency vary with the age (Mclaren 1963) Main deficiency signs are :

Conjunctival xerosis.
Bitot spots
Corneal xerosis
Keratomalacia.
Xerosis of skin.
Follicular hyperkeratosis.

Thiamine deficiency (Vitamin B)

The classical deficiency syndrome of thiamine-beriberi has been eradicated from the country in older children. It is of two types :

Dry Beriberi – affects the nervous systems. Its systems includes irritability, fatigue, emotional disturbance, headache, difficulty in standing from sitting position, reduced appetite, indigestion.

Wet Beriberi is characterized by palpitation, tachycardia, dyspnea and edema.

Riboflavine Deficiency (B2) – Clinical Features

Glossitis.

Cheilosis.

Nasolobial dyssebacia.

Circumcorneal vascularization and keratitis.

Watering of eyes.

Photophobia.

Blurring of vision.

Niacin deficiency (Vitamin B complex group)

The clinical signs of Vitamin B-complex deficiency :

Pellagraus dermatosis.

Scarlet & Raw tongue.

Atropic lingual Papillae.

Tongue Fissuring.

Molar & supra orbital Pigmentation.

Vitamin C Deficiency (Scurvy)

Scurvy is usually seen between 6 months and 7 years of age. Initial symptoms are usually vague and include irritability tachypnea, digestive disturbance and loss of appetite. Other features of severe deficiency include :

Sponge and bleeding gums.

Pelichae

Echymoses.

Follicular hyperkeratosis.

Intramuscular or subperiosteal haematomy.

Vitamin D deficiency (rickets)

Rickets is a disease of growing bones and its incidence is particularly high between 4 – 18 months. Skeletal deformities are the most striking feature of rickets.

One of the early sign of rickets is craniotabes - in this condition on pressing occipital or posterior part of parietal bone, a sensation like pressing a ping-pong ball can be felt.

Bossing of skull.

Sternum pushed forward.

Pigeon's chest (Harrison's sulcus) deformity of thorax.

Bow legs.

Knock knee.

All deformity of bones result in rachitis dwarfism.

Iron deficiency

Pale conjunctivae.

Koilenychia.

Atrophic lingual papillae.

Folic acid or Vitamin B12 deficiency.

This condition is usually accompanied by pale conjunctivae due to anemia.

Iodine deficiency.

A deficiency of Iodine produces enlargement of Thyroid gland size, and is assessed by the techniques of Perez Scrimshaw Munoz (1960).

Excess of fluorine (Fluorosis)

Mottling of teeth.

Calcification of ligaments and tendons.

Weakness (anemia)

Loss of weight & brittle bones.