Introduction
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Physical growth and development is an important subject from both clinical as well as anthropological points of view. Various scientists have given different definitions in order to explain the concept of growth. According to Garn (1952) "The term growth and development as used in physical growth studies refers to the processes common to all living organisms, intimately linked with time but partially independent, unquestionably genetically determined, yet uniquely susceptible to environmental modifications". Meredith (1957) writes "Physical growth includes a gamut of changes sometimes subgrouped under such captions as morphologic differentiation, dimensional growth, proportional development and structural maturation". Stuart and Stevenson (1959) state "the term growth and development as used in pediatrics applies to all processes of human organisms from conception to maturity. Falkner (1962) comments that since there is no sharp dividing line between the two terms, growth and development it may be advisable to drop an unnecessary division and to use one of the two good words. Mitchell (1962) describes growth as summation of those co-ordinated biological and chemical processes that are initiated with the fertilization of ovum and terminated with the attainment of body size and conformation of the physiological capabilities, characteristic of the species and the hereditary background of the individual.

Growth also incorporates disciplines of Anatomy, Physiology, Biophysics, Biochemistry, Pediatrics and Child Health. Physical Anthropologists and Human Biologists have taken keen interest in the study
of physical growth and development as a means to investigate the morphological variations in individuals and nature-nurture problems.

A body does not grow symmetrically in all its parts and hence there are changes in body proportions at different ages. The head, for instance, grows more rapidly than other parts during fetal life and infancy, thereafter the extremities grow more rapidly than the trunk and both grow faster than the head. The growth of trunk continues even after the arms and legs have ended their growth (Tanner, 1962).

The phenomenon of growth is expressed in terms of rate of growth, adolescent growth spurt, peak velocity etc. Generally the velocity of growth decreases from birth onwards (Tanner, 1962). This decrease is interrupted certainly once and perhaps twice. Once between 6 and 8 years a period called juvenile or mid-growth spurt (Robertson, 1915, 1923; Meredith, 1935; Grubb, 1942; Tanner, 1947) but information regarding this period is still very meagre. Second time this decrease is entirely reversed between 13-15 years showing marked acceleration of growth known as adolescent growth spurt. The initial growth spurt or the pre-adolescent spurt is fairly uniform in age of occurrence. The secondary or adolescent spurt is a constant phenomenon and occurs in all children though it varies in intensity and duration from one child to another and its distribution is roughly Gaussian (Tanner, 1962). This introduces a host of individual differences. The difference in size between adult men and women is to a large extent the result of the difference in the adolescent spurt, which in girls, takes place two years earlier (10-13 yrs) than in boys (13-15 yrs).
Marked changes are also visible in various other body systems during adolescence e.g. bones, muscles and fat, simultaneously the body becomes mature sexually to take up the final biological responsibility of adulthood. Rapid growth of stature which previously grows at a diminished rate may mark the onset of adolescence, accompanied by development of breast, appearance of axillary and pubic hair and onset of menarche and skeletal maturity (Tanner, 1962).

Menarche, the first menstrual period, is an important indicator of maturity when assessing the developmental status of a pubertal female. It is also a single important index of physiological development and maturity of every girl. It usually occurs between 11-14 years and is influenced by temperature, humidity, socio-economic conditions and other environmental factors such as nutrition, improved hygiene and increased sexual stimulation in childhood (Tanner, 1962).

Most published studies on physical growth and development of Indian Children and adolescents have been confined to a few body measurements and their changing proportions. Very few studies have also included skeletal maturity. It is now increasingly recognised that physical growth and skeletal maturity are closely interlinked and that some of the pubertal changes are better correlated with bone age rather than chronological age, it is therefore desirable to include skeletal maturity along with body measurements to interpret results more meaningfully (Sharma, 1991).

Factors influencing growth

Growth and development of an organism, although functions of age, are determined by genetic factors and influenced by environmental factors.
Nutrition is the most important factor affecting growth. It is likely though not certain, that the time of occurrence of the adolescent spurt is a more sensitive indicator of nutritional deficiency than is the growth rate at earlier periods (Tanner, 1966). Malnutrition during childhood delays growth and in the years preceeding adolescence, it delays the appearance of adolescent spurt (Tanner, 1962). Other environmental factors which have been found to influence growth are geography and climate (Holtker, 1949; Wilson et al, 1950a, b; 1953; Roberts, 1953; Whiteacre and Grimes, 1959). These authors have found that growth is faster in warmer than in colder regions. Fitt (1941), Reynolds et al (1944), Bransby (1945 a,b) Bogin (1977, 1978) have demonstrated that there are seasonal variations in velocity of growth. They found that height increases maximally, on the average, during spring and weight during autumn. Growth and maturity are very sensitive to environmental stresses, which means that child’s growth is ecosensitive (Hass, 1983). Body weight is more sensitive to environmental stress than height and other body measurements (Malina, 1985). Laskar (1960) demonstrated convincingly the effects of changes of environment in altering some of the physical dimensions of descendants of immigrants. Greulich (1957) compared the American born and native born Japanese and found that the former were taller, heavier and skeletally more mature than latter. This was however, attributed to differences in nutrition.

Secular trend in rate of growth and time of adolescence

During the last century there has been a tendency of adolescence, as typified by menarche and growth spurt, to occur earlier. The growth data on heights and weights from various studies also shows that the process
of growth has progressively speeded up. Children at all ages, born between 1913 and 1950’s were larger than those born in 1900’s (Gray, 1927; Boas, 1935; Friend, 1935; Weir, 1952; Clement, 1953; Lenz, 1959; Meredith and Meredith, 1944, 1963, 1976).

Secular trend towards early maturity and greater adult size has also been seen by many investigators (Kiil, 1939; Morant, 1950). The magnitude of the secular trend in certain countries such as Sweden and USA is so large that it dwarfs the differences between socio-economic classes and between geographical regions. This secular trend was quite clearly seen during the period 1920-40 and has overridden the social class differences though these still exist in the average body of today, at all ages. It is difficult to know for certain why such secular trends have occurred. Better nutrition, generally improved environmental circumstances such as widely available medical care are usually given the credit with considerable reason. Cane (1961) has presented work on secular acceleration of height and biological maturation of children. Secular changes in sexual maturation have been studied by Taranger (1983).

Review of literature from abroad

G.S. Stanlay-Hall a renowned American psychologist was the first to have aroused interest in this subject as early as 1888. He recognised growth and development of body and mind as first thing in education (Tanner 1959). He initiated Franz Boas, who pioneered the study of growth following individual children through a part or whole of their growing period for almost fifty years (1892-1941). He introduced the concept of physiological or developmental age. Most of the earlier work on human
growth had come from United States of America and England towards the end of 19th century and first half of 20th century. In 1935 several longitudinal studies were undertaken on a semi-permanent basis, majority of our knowledge comes from their results. Bowditch (1877), Baldwin (1921), Scammon (1930a), Davenport (1931), Todd (1937), Krogman (1941), Bayley (1943), Simmons (1944), Tanner (1948), Hammond (1957), Skerlj (1959), Acheson (1960), Tanner (1962), Watson et al (1962), Evelethe et al (1976) and Bailey et al (1984) are some of the well known researchers from developed countries who can claim to be leaders in their own right in the development of application and new approaches in the study of physical growth, body composition and body maturation. In the past years there have been numerous investigations related to human growth, such as by Harriss et al (1930), Boynton (1936), Shuttleworth (1937), D'Arcy W. Thompson (1942), Vickers and Stuart (1943), Brody (1945), Boothby et al (1952), Stuart et al (1959), Stuart (1954), Ashcroft et al (1964, 1966), Fischbein (1978) Lindgren (1976) to mention a few.

Stuart et al (1959) presented results on American and North European children belonging to low and middle socio-economic groups. Johnston et al (1976) conducted a height, weight study on school going children between 6-17 years in Guatemalan city, in upper socio-economic group. These studies showed that Guatemalan children of upper class were taller and heavier than those of lower socio-economic group. Fischbein (1977) conducted a study on school achievements and test results, in relation to the social background of twins and singletons. Lindgren (1976) presented results on height and weight and menarche in Swedish Urban children in
relation to socio-economic and regional factors. Most of the above mentioned studies are crossectional.

Tanner (1951a, 1952a, 1953a, 1953c, 1958a,b, 1959 and 1962) has contributed to the subject most. He and his associates have published a lot of data on human growth, physical maturation, behaviour at adolescence and measurement of body fat in man. Tanner, Whitehouse and Takashai (1966) published standards from birth to maturity for height, weight, height velocity and weight velocity based on British children.

Few mixed longitudinal studies have been carried out by Van Venrooij et al (1978) on Dutch children, Little et al (1987) on Nomadic Turkana Pastoralists and Santos et al (1991) on Brazilian (Amazonian) children, but these studies have been analysed crossectionally. Low (1970), Israelsohn (1960) also conducted studies on growth following similar method which have been analysed mixed longitudinally.

**Growth and nutrition studies in India**

Studies on growth and nutrition in India are comparatively of recent origin, although few studies can be traced back to thirties and forties; among these include those by Aykroyd et al (1936), (1937 a,b), (1938), Singh (1939), Shorie (1939), Bhave (1941), Ghosh et al (1944), Mitra (1940, 1941, 1942, 1947). Indian Council of Medical Research (ICMR, 1951 - 1965) made the first systematic attempt of studying the nutrition, physical growth and development of children from various parts of India with a view of providing growth norms for Indian children on regional basis in different socio-economic groups. Although these data are now more than 40 years old these still remain the only large scale reference data for any
comparison The results of which are presented in various ICMR publications.

Growth studies have also been undertaken by staff and research students of Anthropology department, Panjab University, Chandigarh since 1960 (Sharma, 1963; Khajuria, 1968; Sidhu, 1969; Singh, 1970; Kaul, 1975; Ghai, 1979; Chopra, 1982). Nutritional surveys in the context of physical growth were also conducted by National Institute of Nutrition (NIN) in different parts of the country and in different socio-economic groups. One such study on well nourished Indian school children (Vijayraghvan, 1971) revealed that children from low socio-economic group not only showed nutritional deficiency signs but they were also shorter and lighter than those from the upper socio-economic group. Most of the studies carried out by NIN strongly suggest that environmental influences, especially nutrition, are more important than the genetic background in childrens' growth and development.

Thereafter, the Indian children fell far short of the American children. Bajpai (1975) reported on growth of Rajasthani girls; Malhotra (1975) studied physical growth of Kinauri children; Ghai (1979) studied growth of Rajput girls of Himachal Pradesh; Sharma (1982) conducted a study on undernourished and malnourished tribal children of Orissa and Madhya Pradesh.


Sharma (1983) presented work on physical growth and sexual maturity of twins to demonstrate that both genetic and environmental factors work in the overall development.

Studies regarding nutritional status/disorder/deficiencies and relationship with growth were given by Khanduja (1967), Rao et al (1970), Chaudhary et al (1972). Almost all the studies mentioned above are based on crosssectional data.
Those which have followed \textit{longitudinal} method are by ICMR (1961), Swaminathan et al (1964) and Bhalla (1984). Studies which followed \textit{mixed longitudinal} method of data collection but were analysed crosssectionally are by Datta Banik (1970, 1980), on Delhi children. Growth studies which followed \textit{mixed longitudinal approach of analysis} are by Kaul (1975) on Kashmiri boys, Hauspie et al (1980) on Bengali Children and Qamra (1990) on erstwhile panjab girls of upper socio-economic group.

Since growth studies on adolescents involve psychological and sociological problems, it is not very easy to have repeated measurements and observations on Indian children, especially girls, for reasons of orthodoxy. This may account for paucity of data on Indian adolescents especially with regard to secondary sexual characters.

It can be seen from the above review that though numerous studies have been conducted on Indian children, only few have considered nutritional factors and still fewer have included the sexual maturity. The present mixed longitudinal study is one such effort to produce reliable data on physical growth, sexual maturity of punjabi adolescent girls with special reference to their nutritional and socio-economic status.