

PHYSICAL GROWTH AND MATURATION OF ADOLESCENT ASSAMESE AND BENGALI GIRLS OF GUWAHATI

Dissertation

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RUMI DEY

Department of Anthropology
NORTH EASTERN HILL UNIVERSITY
SHILLONG

1992.





PHONE :
GRAMS : NEHU

North-Eastern Hill University

Mayurbhanj Complex, Nongthymmai, Shillong-793014

Department of

Dr. R. K. Pathak
Reader
Department of Anthropology

CERTIFICATE

and Certified that the subject matter of the dissertation is the record of work done by RUMI DEY, that the contents of her dissertation entitled "PHYSICAL GROWTH AND MATURATION OF ADOLESCENT ASSAMESE AND BENGALI GIRLS OF GUWAHATI" did not form a basis of any previous degree to her or to the best of my knowledge to anybody else, and the dissertation had not been submitted by her for research degree in any other University.

NOVEMBER

SHILLONG

NOVEMBER 9, 1992.

R.K. Pathak

(R. K. Pathak)
Supervisor

DECLARATION

The content embodied in this dissertation is original and has not been submitted in part or full for any other diploma or degree of any University or Institution. The contents of this dissertation are true to the best of my knowledge and belief.

SHILLONG

NOVEMBER 9, 1992

Rumi Dey.
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With deep
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NERU, for his untiring
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Rumi Dey
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CHAPTER I

INTRODUCTION

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Since time immemorial the study and investigation of life has fascinated scholars more than any subject in the field of research. The perpetuation of life in any organism involves the process of growth and development. Growth is manifestation of changes in shape and size i.e., form of an organism over a period of time.

The difference of growth of a body size and shape in adults is due to the different growth pattern in adolescence. Adolescence is a period which takes a girl to womanhood. In this period there is a growth spurt known as the 'adolescent spurt'. Every muscular and skeletal dimension of the body seems to take part in the adolescent spurt, the reproductive organs in particular. The growth of reproductive organs is expressed externally as the appearance of secondary sex characters like development of breast, appearance of pubic hair, axillary hair, and the onset of menarche. It is the general term used to describe the psychological changes occurring in the passage from childhood to adulthood.

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The last great evolutive crisis of growth, lasts from 5 to 6 years and is the most typical and important transitional period. Because of the femine precocity,

adolescence in girls usually starts and ends two years before boys. The norm is from 11/12 to 15/16 years in girls and from 12/13 to 17/18 years in boys. Children mature into adults in sequence of three stages of adolescence: early (10-14), middle (15-16) and late (17-20) years of age (McAnarney, 1985).

The adolescent period may be divided into prepubertal characterised by a last spurt of linear growth, and pubertal, during which the primary and the secondary sexual traits developed. The prepubertal period lasts about two years. During these years, height is acquired predominantly through the lengthening of the legs. Weight increase is retarded with the consequent accentuation of the morphological type of late childhood and a complete lack of harmony in body proportions; arms and legs are extremely long, the trunk short and the thorax narrow, during this prepubertal stage, vital capacity is diminished and attributes this to the increasingly greater weight of arms which also explains the marked downward slope (about 1 cm) of the shoulders in this period. The musculature is strengthening but still does not achieve the development required at a later date by a considerable bone growth.

The pubertal period is characterized by the maturity of genital organs and the appearance of secondary

sex characters and by modifications in body proportions. In girls, it is easy to determine the beginning of the ovarian activity by the first menstruation, which usually occurs around the thirteenth years, although it may be delayed until the fifteenth year (the influence of climate and diet are basic considerations). In the male sex, it is more difficult to determine the precise moment in which the testes have matured. The appearance of pubic and axillary hair and the development of breast in girls, are the most visible secondary sex characters, and in young boys it is the change of voice and a slight indication of a beard.

Linear growth lessens noticeably during the pubescent period concomitantly with continuous growth and the dominance of transverse diameters causing considerable weight increase. The annual mean increase in stature is 7 cm in boys from 14-15 years, but only 3 cm between 16 and 17 years.

Any organic process that retards or accelerates the somatic and sexual growth that normally occurs between the ages of 10 and 14 can, by making an adolescent different from his or her peers, affect the adolescent's ability to accept the physical changes of puberty. The fact that pubertal change might not be occurring for the affected

individual as they are for his or her peers can leave the adolescent feeling isolated.

Identity development in the early stage of adolescence often focuses on the distinctive physical and sexual changes of puberty (Coleman, 1978). Normally early adolescent girls are often concerned about breast symmetry, physiologic vaginal secretions, menstruation, and being too fat or too tall. The early process of identity formation thus focuses on the peer group, the members of which are going through similar physical changes. Because early adolescents often have an intense need to be like their peers in as many respects as possible.

McCandless' (1970) views are not atypical within the study of adolescent development. To an extent remarkably similar to the ideas of McCandless Erik Erikson (1968) also stressed an inevitable and strong link between organismic constitution and behaviour and development. Similarly, both Anna Freud (1969) and Keslenberg (1967) believed that biological changes associated with pubertal maturation inevitably and directly alter psychological and social functioning and development.

Both life-span developmental and ecological developmental psychologists have described several intra-

individual, inter-individual, familial, social network, sociocultural, and historical variables presumed to be involved in the dynamic inter-actional processes described within developmental contextualisms (Baltes, 1987; Bronfenbrenner, 1979). The resulting view of the range of, and complexity of interrelations among, the variables involved in development is – to say the least – formidable.

The adolescent developmental literature contains studies examining the relation, within the person, of menarche and other characteristics of individuality, such as perceptions of self (Tobin Richards, Boxer & Peterson, 1983), Cognition (Hamburg, 1974; Peterson, 1983) or the experience of menstrual discomfort (Brooks-Gunn & Ruble, 1983). In turn, other studies examine how the occurrence of menarche influences a girl's relation with the significant others in her context (Brooks-Gunn & Matthews, 1979; Hill, Hohnbeck, Marlow, Green & Lynch, 1985; Lynch, 1981; Simmons Blyth & McKinney, 1983). Such studies provide data constituting "adolescent effect" on that portion of their social context composed of significant others.

These "adolescent – social context" studies stand in contrast to those that examine how contextual features – such as parental demands regarding desired behaviour in adolescent children (Anthony, 1969) continuities or

discontinuities in school structures (Blyth, Simmons and Bush, 1978), or cultural beliefs regarding menstruation (Brooks-Gunn & Rubble, 1980) influence the adolescent undergoing the biopsychosocial transition of menarche; such studies are social context - adolescent ones, and provide the other direction of effect to complement the adolescent - social context one.

There are four major tasks of adolescence that emerge from the developmental theories of Freud, Piaget and Erikson include, (a) the acceptance of the physical changes of puberty, (b) the attainment of independence, (c) the emergence of a stable identity, (d) the development of adult cognitive patterns (Sahler & McAnarney, 1981). Each of these tasks takes on special characteristics in each stage of adolescence (Kreipe & McAnarney, 1985). Because of the numerous variables that determine overall development, it is impossible to predict how an illness will affect the development of an individual adolescent. However, some illness do have recognised behavioural alterations associated with them that can lead in turn to the problems in development. The literature in adolescent medicine suffers a number of limitations with respect to behavioural and developmental considerations. Few illness occur uniquely in adolescents and medical research

focus specifically on adolescent is only a recent phenomenon (Barnes, 1980).

Human growth is an active dynamic process involving ceaseless changes. Increase in height, weight and size of the body constitute physical or morphological growth which is only one of the many aspects of growth. In anthropology the study of growth is of much importance in elucidating the mechanism of evolution. It occupies an important place in the study of the individual differences in the form and function in man. The rate of growth of an organism and ultimate size and degree of complexity are conditioned by many environmental factors. The growth in length begins a considerable time before birth and the peak velocity of growth in height averages about 10 cm in boys and slightly less in girls (Tanner, 1964).

Brody (1945) states, "Growth is biologic synthesis, production of new biochemical units. It is the aspect of development concerned with increase in living substance or protoplasm and includes one or all of these processes: (1) Cell multiplication, (2) Cell enlargement, (3) incorporation of material from the environment". The third process in Brody's definition means the inclusion of non-protoplasmic substances like fat, blood plasma, cartilage, etc. in the body; it is not a 'true' growth but a part

of growth process. Berrill (1955), while discussing about growth, says, "The size that any organism finally attains is the result of growth and the regulation of size is essentially a matter of rate and duration of growth". He continues: "Growth and therefore size regulation is associated with all living things living from sub-microscopical molecular components of a cell to the giant organismal whales and red woods. The basic phenomenon of growing to a limited size is a general characteristic of organisms and their parts". This is determined genetically in the species and in general not subject to experimental modification, other than a degree of stunting through some form of malnutrition.

Weiss (1949) says that 'growth' is not a scientific term 'it has come to connote all or any of these, reproduction, increase in dimension, linear increase, gain in weight in organic mass, cell multiplication, mitosis, cell migration, protein synthesis and perhaps more. According to Garn (1952), "The term 'growth' and 'development' as used in physical growth studies refer to processes common to all living organisms, processes intimately linked in time but partially independent, unquestionably genetically determined, yet uniquely susceptible to environmental modification." Growth refers to the increment in the size

of organs, increases in the thickness of tissues or sizes of individuals as a whole.

Though in recent years more stress is being given to the longitudinal study of growth (measuring the same child repeatedly all through his growing period) the importance of cross sectional study cannot be ignored. In the cross-sectional study a number of children of different ages are measured only once, so that the means of measurement at different age levels may be accepted as representatives for particular population (if homogeneous one).

Tanner (1962) mentions the other advantages of this kind of studies: "They tell us most of what we want to know about the particular distance curve of growth; that is about height attained at a particular age. Clinical standards for height attained by healthy children at various ages can be constructed from purely cross-sectional data". The mean ages of menarche, appearance of secondary sex characters, emergence of teeth both milk and permanent sets, menopause, etc., for a population can be found out more conveniently by cross-sectional studies. Climatic effect of growth and development has been recognised by many workers. Mills (1937) said that the maturity in tropical countries comes two years later than in the temperate regions. Besides this, there are many classical examples

of comparative anthropological studies to determine the differential influence on growth by the city and country. It often proves that habitat of (town or country) is not only conditioning factor in growth, but must be considered in conjunction with the socio-economic among other factor. The family standard of living seems to have a decisive influence on the height of the children. It is observed by many workers that a larger income and a better economic status in general is reflected in children by a mean value of greater height. The periods which follow the wars are of dangerous depression. Until agricultural, industrial and commercial recuperation and re-adaptation are stabilized, child growth is seriously affected as may be observed in Jewish children of Wilna before and after the first world war. The differences are overwhelmingly in favour of the pre-war period, and the examples could be extended to other countries (Rosenstern, 1931). The two main stages in growth and development are pre-natal and post-natal growth. Prenatal growth imitates with the fertilization of ovum by the sperm and continues through embryonic development to the growth of the foetus. The different phase of post-natal growth are infancy, childhood, puberty, adolescence, maturity and senility (Scammon, 1930). In the past the word "adolescence" was used synonymously with "puberty" by many authors. More recently it has become

common practice to use adolescence to physiological changes associated with puberty. The principal manifestations of puberty are as follows:

- (1) The adolescent growth spurt i.e., an acceleration followed by deceleration of growth in most skeletal dimensions and in many internal organs.
- (2) The development of gonads.
- (3) changes in body composition i.e., in the quantity and distribution of fat in association with growth of skeleton and musculature.
- (4) The development of secondary sex characters.
- (5) Development of the circulatory and respiratory systems leading, particularly in boys, to increase in strength and endurance (Marshall and Tanner, 1986).

Thus, puberty is the time of greatest sexual differentiation since early intra-uterine life. It refers to series of morphological and physiological changes that occur in the growing boy or girl. These changes involve development of secondary reproductive organs and secondary sex characters besides changes in bodily measurements. Puberty is not complete until the individual has the physical capacity to conceive and successfully rear children.

Girls normally experience a sequence of changes that include widening of hips, budding and development of breasts, accelerated growth and later, the onset of menstruation at the time of adolescence. Menarche is an important episode in a girl's life. It is, however, only a single event in the combination of physical changes which constitute puberty. Menarche – the first menstrual cycle, usually occurs late in puberty. In girls the adolescent spurt shows relationship with menarche. Generally, all the girls begin to menstruate after reaching the peak height velocity (PHV), i.e., during the downward part of the height velocity curve (Tanner, 1978). Menarche occurs on an average about 1.3 yrs after PHV with a range of 0-2.5 years. Only about one per cent girls have menarche before PHV (Falkner and Tanner, 1986).

The first indication of puberty, immediately before the morphological changes is an increased secretion of two gonado-trophic hormones of the pituitary gland, follicle stimulating hormone (FSH) and luteinizing or leydig-cell-stimulating hormone (LH). Both are secreted at a low level during childhood and increase sharply at puberty. Luteinizing hormone in females is secreted in a cyclic manner and interacts with FSH to control the menstrual cycle. The egg grows under the influence of follicle stimu-

lating hormone and is shed; the eggs immediately surrounding it remains behind the uterus forming a body called corpus luteum. LH stimulates this body to produce the hormone progesterone. Progesterone maintains the uterus in a state receptive to implantation and growth of the ovum should it be fertilized. If no fertilization occurs, the level of LH falls, the uterus sheds its lining in menstruation, and the cycle begins again. Hypothalamic luteinizing-hormone-releasing hormone (LHRH) regulates the release of both FSH and LH from pituitary, which also stimulates their synthesis and storage. The feedback which shuts off LHRH is through oestradiol in the females (Tanner, 1978).

The age at menarche has been extensively studied world wide. It has been seen to vary from one population to another as well as between different ethnic groups with the same geographic region. The reason attributed for this may be interaction between genetic component and environment. Many hypotheses have been put forward and tested to explain the variation in age at menarche. The genetic factors, seems to exert a more direct influence on the age at menarche which may be accounted significantly for the variation among female adolescents.

It is well established fact that nutritional intake

during and preceding growth period influences various biological phenomena. The age at menarche is highly sensitive to nutritional deficiencies and especially to protein-calorie malnutrition. The effect of appropriate diet, absence of certain diseases, genetic factors, etc., would satisfy the criterion of a good hypothesis. The hypothesis, that a good diet during childhood and the pre-menarcheal period causes early menarche emerges as a very important one (Kumar, 1975).

As regards the influence of temperature and humidity on the onset of menstruation, traditional view that menarche has its earliest onset in temperate countries and the latest in cold countries around Antic Circle, has been rejected by many studies (Tanner, 1962; Zacharian and Wurtman, 1969).

The girls belonging to the lower socio-economic strata generally attain menarche significantly later than those in higher strata (Eveleth and Tanner, 1976). Socio-economic status indirectly affects the nutritional intake. The nutritional contents in a diet of a well off family is richer than those of the lower status. Of all the factors affecting the rate of maturation, the socio-occupational factor exerts by far the strongest influence.



The biological changes in human populations are very sensitive bio-indicators of social stresses, socio-economic changes, as well as of pollution and transformation of the natural environment. Since, these changes may occur as an effect of the factors influencing man during ontogenic development, and at the same time they may be part of micro-evolutionary (i.e., phylogenetic) changes, studies of the kind now represents an important methodological and methodical research forefront in human biology (Wolanski, 1985). Due to secular trend towards early maturity among girls as well as boys the adolescence period now starts relatively earlier.

The growth of children is a sensitive indicator of public health and well-being of populations. Methods of assessing growth have developed over many years and involve gathering information from 'normal' population. The difference observed in the growth rate of children from various populations depend on both their genetic potential and environmental conditions. In European populations, for example, living under fair biographic conditions (and probably with a similar genetic potential), the difference in growth of children are due to socio-economic and cultural conditions (Szemith, 1985). Effects of the environmental factors on body form are well documented

(Bailey et al., 1978; Eveleth and Tanner, 1976; Strauss, 1976). The influence of nutrition, socio-economic factors and family structure has been studied on body size (Howells, 1949; Chamla et al., 1959; Bench et al., 1990; Oliver, 1974; Sussane, 1980; Bielicki et al., 1981). The role of environmental factor may change with the changing living condition and the body form may be represented by a set of different body measurement (Chopra, 1985).

Body measurements can give valuable information concerning the nutritional profile of a community (Hautvast, 1971). Body weight divided by a power of height is said to be independent of stature in adults (Keys et al., 1972). In case of infants and children average Body Mass Index (BMI) values change with age (Roll and Cachera et al., 1982). Individuals with high indices are classified as overweight, even obese, and those with sub-normal indices are undernourished. Thus, the BMI has found usefulness in evaluating groups of individuals - Moreover, it appears that early adolescence may be a time of diminished positive interactions between children and parents; compared with their actions in other development periods, parents and young teenagers are less apt to do pleasant things together, less apt to say positive things to each other and less apt to feel close to each other (Montemayor, 1986).

Accordingly, empiricists have argued that the notion of family strain and stress is mythical, and that psychoanalytic theory simply is off the mark on this subject (Petersen, 1988). There are a variety of explanations for discrepancies between the views of parents and clinicians on the other.

It seems reasonable to conclude that biological maturation accelerates the process through which youngsters become autonomous from their parents. Though endocrinologists have contributed much to the understanding of the mechanism of 'growing' they are not able to explain the difference existing in this phenomenon from one population to another. This perhaps takes us back to the importance of environment in influencing growth and development. Growth studies in western countries have been conducted and are being conducted at many places, on many communities. But there are very few studies on the Asiatic and African populations. The consolidated report on the All India study on growth and development on children (ICMR, 1971-72) serves for the All India norms of growth based on adequate cross-sectional data collected by an uniform method from a large part of the country excepting some states of Eastern India. It has, however, a limited application in view of the large environmental and genetic

variation in Indian populations. The ICMR report may serve as a reference norm for further regional studies, on growth which are much needed. The broad interstate and inter-regional variation referred to in the report does not clearly demonstrate the ethnogenetic and local variation in growth pattern.

A review of literature would reveal that numerous studies have been conducted on growth and maturation of girls of different populations of the world in the last many decades. Both WHO and International Biological Programme (Baker and Weiner, 1969) have stressed the importance of gathering growth data on the population across the world. The ICMR data on growth and physical development of Indian children did not include the various populations of North-East India. Some of the better known anthropometric and menarcheal studies on various populations of North-East India include those by Rakshit (1960), Das and Das (1967), Srivastava and Goswami (1968), Das and Das (1969-71), Deka (1976), Das (1977), Das and Choudhury (1982), Das et al. (1985a, 1985b, 1986a, 1986b, 1988), Das (1986), Das and Choudhury (1992), and Choudhury, Begum and Baruah (1992). Moreover, there are some unpublished dissertation researches conducted on this subject of North Eastern Indian populations by the Departments of Anthropo-

logy at Guwahati University, Dibrugarh University, North Eastern Hill University and Manipur University. The present comparative study has been undertaken to visualize growth and maturation of 10-16 year old Assamese and Bengali girls of Guwahati, Assam, North East India. The objectives of the present study are:

- (i) to evaluate the body size of adolescent girls,
 - (ii) to ascertain their age at menarche,
 - (iii) to examine changes in body dimension in relation to age,
 - (iv) to observe the influence of environmental conditions on body size and menarche, and,
 - (v) to compare the results of the present study with those reported in the literature.
-