UNIT 1 METHODS OF STUDYING GROWTH

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Learning Objectives

After going through this unit, you should be able to:

➢ have a complete understanding of the concepts of the various methods of studying human growth;
➢ describe cross-sectional, longitudinal and mixed longitudinal methods along with their merits and demerits; and
➢ choose the most appropriate method to be employed while undertaking specific growth studies.

1.1 INTRODUCTION

It is our earnest endeavour to introduce you to various methods of studying human growth in this unit. Is it not interesting to know as how do we grow from a small infant to an adult? What is the process of human growth and development and how do we study this complex phenomenon? The clinical assessment of the growth of an individual involves answering a number of questions, concerning his/her amount of growth and the corresponding growth velocity. Is the growth ‘normal’ for the age, is it proportionate? Thus, the study of human growth is one of the most fascinating areas of biological anthropology which gives us a clear understanding of all these concepts.

Growth data on children play an important role in the assessment and monitoring of child health and nutrition. These data are also used in epidemiological investigations aimed at understanding the determinants of human growth. For healthy normal children, the course and pattern of growth and maturation is determined by their genetic complement, if unconstrained by environmental factors. With infection, inadequate nutrition, hormonal deficiency or other unfavourable environmental factors, growth can be impaired.
In order to gain an understanding of the dynamics of human growth and average growth patterns, it is essential to have an in-depth knowledge about various methods of studying growth. Data gathered through different methods of studying growth are used to establish standards/charts or norms of a population. Growth standards/charts are used as a dynamic usable tool to educate and motivate health workers and parents to take action to improve or maintain the child’s growth and to screen for growth faltering and targeting of appropriate interventions. Therefore, it is extremely important to make you understand the concepts and details of various methods (cross-sectional, longitudinal and mixed longitudinal) used for collecting and analysing growth data along with their merits and demerits. This knowledge has its implications in designing of a well planned growth study. This information will also help you in choosing the most appropriate method to be employed while undertaking specific growth studies. In this Unit, an attempt has been made to explain various methods of studying growth in a very simple way and with the help of suitable examples wherever required, to make you understand the importance of each method in studying human growth.

1.2 METHODS OF STUDYING GROWTH

A well designed growth study is a prerequisite to monitor the health status of a population. Rigorous thought should precede collection of data, regarding method of study, time and cost involved with precise planning of sampling procedures, careful training in anthropometric measurements and statistical methods to be used for data analysis. In order to gain an understanding of the dynamics of human growth and average growth patterns, it is essential that the appropriate methods are selected. Auxologists, anthropologists, nutritionists and health professionals use precise methods of studying human growth while conducting growth surveys of children in different populations. The type of method that should be used depends on the objective of the study. If the aim of the study is to ascertain growth patterns of children of a community, a cross-sectional method would suffice. To investigate variations during the adolescent growth spurt, a longitudinal design over several years would be necessary so that the time of initiation of the growth spurt and of peak of the growth spurt can be identified and the magnitude of the spurt quantified. A mixed longitudinal study also provides information on both growth status and rate of growth. The most commonly employed methods by researchers to obtain age and sex specific growth data are either cross-sectional or longitudinal. Both types of methods are required for a full understanding of the growth processes. Both have their own importance but they do not give the same information and cannot be handled in the same way. In a cross-sectional study, individuals are measured or observed at a given age or at several ages, but each individual is represented only once in the sample. Longitudinal study involves repeated observations on the same individuals at specific intervals over a period of time. A third type of study is a serial study in which a group of children is followed longitudinally, some children leave the study and others join it as new entrants at some age points is termed as mixed-longitudinal study. These methods have been described below.

1.3 CROSS-SECTIONAL METHOD

Human growth most commonly is studied using cross-sectional method, which involves measuring children of different ages only once during the entire span of the study. In this method for example, all the children being measured by an investigator at age 9 are altogether different from those at age 8, which in turn are different from children being measured at 7 years and so on. In other words, the method of study using different children at each age is called cross-sectional. It is basically a cross section of a given age group, sex group or of a given population.
In this method there is no element of periodic assessment. Cross-sectional surveys provide information about the distance curve of growth of any dimension of the body. This type of study is used in analysis of growth and development to provide base line information at one point of time.

### 1.4 MERITS AND DEMERITS OF CROSS-SECTIONAL METHOD

The merits of the cross sectional studies are that they are obviously cheaper, less time consuming, can include much larger number of subjects in a brief duration and provide important information about the distance attainments or gross size attained by children during a span of time. (e.g., on average, a newly born child attains 10 kg of weight and 78 cm of supine length at 1 year of age). Results of cross-sectional studies give information on growth, maturity, performance or physical activity status of a sample of children and the variability within the sample. Such studies thus provide information on body size, stage of maturity or level of performance and especially activity attained at the time of survey. This method is very useful for constructing growth standards for communities. Cross-sectional surveys are valuable in assessing the nutritional status and health related problems of children prevailing in different communities at any given point of time (Malina et al., 2004).

The major drawback in cross-sectional studies is that they can never reveal individual differences in rate of growth (i.e. growth velocity) of different body dimensions of children, since in this method we measure each child only once without any periodic follow up. In fact, it is these individual differences which reflect the cumulative effect of various genetic, environmental, hormonal, nutritional, psychological, and socio-cultural factors on human growth. Moreover, cross-sectional data do not provide precise information about timings of particular phases of growth like onset of “Juvenile growth spurt”, attainment of “Peak height velocity”, “Peak weight velocity” etc. Though they give us an average of the mean rate of growth of a population (by subtracting the mean height at 8.0 e.g., from that at 9) they tell us nothing about variability around that mean. Therefore, as a caution, we should not compute “growth velocity” of any body parameter based on cross-sectional data.

### 1.5 LONGITUDINAL METHOD

The method of study using the same child at each age is called longitudinal method. In this method of studying human growth every child enrolled in the study is periodically measured for one or many body measurements at fixed intervals of time throughout the period of study. In other words, a longitudinal study involves repeated observations on the same individuals at specific intervals over a period of time. All children say measured at age 5.0 years will remain the same as those who were examined at 4.0 years. Constancy of sample size and strict adherence to stipulated periodicity at which children are to be followed up remain the most important prerequisite of this method. A growth study may be longitudinal over any number of years. To obtain the simplest type of velocity standards, individuals have only to be measured twice i.e. once in a year. There are short term longitudinal studies extending from age 3 to 6 for instance and full birth to maturity longitudinal studies in which children may be examined once, twice, quarterly or even more times every year from birth until 20 years or more depending upon the objective of the study. Generally, longitudinal studies are more useful during infancy and early childhood and again in adolescence. These are the two periods of life characterised by very rapid growth and change.

The main drawback of a comprehensive longitudinal study is that it takes a long time to complete and relatively small number of subjects can be followed. To
overcome these problems. ‘Linked longitudinal studies’ are undertaken i.e., studies covering the ages 0 to 6, 5 to 11, 10 to 15, 14 to 20 years. Through this design within a period of six years, whole age range of growing phase of human life is spanned. However, efficient sampling of the population is crucial to obtain smooth joins of the data collected during short intervals. For an intensive investigation of the relation between continuously unfolding events in individuals and very often for clinical investigations of growth disorders, long term longitudinal studies even from birth to maturity are necessary. We need to use appropriate statistical methods while working out the results of each type of study.

### 1.6 Merits and Demerits of Longitudinal Method

The merits of the Longitudinal studies are that besides providing information about the distance (gross size) growth attainments, they also provide growth velocity related data i.e., about individual rate of growth measured by increment between two successive periods (e.g., kg/year or cm/year). Such studies also tell us about the timing of particular phases like ‘onset of juvenile growth spurt’ or ‘adolescent growth spurt’ of individuals. As the growth velocity denotes innate capacity of a child to grow and develop, so these studies help to understand the influence of genetic and environmental factors on the growth dynamics of children.

During childhood we often have illnesses which are short-termed. Longitudinal studies provide opportunity to have information about the duration of any disease or nutritional stress with which any child might have remained afflicted with for a longer period. Similarly, effect of intervention (medical/nutritional etc.) may also be assessed with the help of these studies as children included in such surveys are often monitored periodically.

The demerits of the Longitudinal studies are:

- **Longitudinal studies are very expensive and require great skills to organize.** A true longitudinal study from birth to young adulthood would take approximately 18 to 20 years. Such studies are expensive and require a well-organized logistical team.

- **Studies are very laborious and time consuming.** These studies require patience, perseverance and motivation on the part of both subjects as well as researchers who undertake it. The researchers have to stick to the already planned periodic schedule during the entire duration of the study, which at times becomes difficult to adhere to because of certain compelling circumstances.

- **The number of subjects who complete a longitudinal study tends to be small.** It is not always possible to maintain consistency of sample size throughout the entire span of the study. Many subjects leave the study as they move to new places because of social as well as occupational reasons.

- **Hawthorne Effect:** This is a unique but not commonly known phenomenon in the context of human growth. The principal drawbacks of longitudinal studies are the time these take to complete and the small number of subjects that can usually be followed-up. One of the ways to maintain adequate sample size in such studies is to generate a high level of involvement amongst children and their parents in the study. Unfortunately, greater the involvement the more likely it is to affect the growth of children participating in the study. The phenomenon of greater involvement of parents in a longitudinal series yields to Hawthorne Effect (Blalock, 1970), which results from subjects knowing that they are a part of study. According to Johnston (1980), continuous and persistent health care advice to the parents (whose children are part of a longitudinal study) may
become aware of relationship between growth and need for proper environment. As a result they may change their children's diet etc. which may lead to improved general growth status of the children included in the longitudinal study.

From a methodological point of view, Hawthorne Effect appears to be an inbuilt and inevitable feature of longitudinal design of studying human growth. At one end it leads to the improvement of general growth status of children included in the longitudinal study solely because of the basic nature of the design. Whereas, on the other hand, it looks like harsh indictment of the longitudinal method, as infants with improved growth status stop representing the population from which they were originally drawn as sample. Above comments are not intended to convey that longitudinal design is not basic to the study of growth, rather, it is to emphasise that a longitudinal study should be initiated only after a careful consideration of all aspects of design, of which Hawthorne Effect could be an important one (Bhalla and Kumar, 1986).

1.7 MIXED-LONGITUDINAL METHOD

A serial study in which a group of children is followed such that some children leave the study and others join it as new entrants at different ages, giving various degrees of longitudinally is termed as mixed longitudinal study. Thus, such a study combines data for individuals who were measured on all occasions and data for individuals who were measured on only several occasions. There are many factors which affect the constancy of a sample in longitudinal studies. The most important factor relates to population mobility i.e. a subject's family may move out of the area so he has to leave the study. Similarly, sometimes subjects may simply get tired of participating (normal attrition). Some children may not report on certain occasions because of ill health, family circumstances or due to mortality. Whatever may be the reason for leaving the study it affects the sample size at different age groups. Thus, on one end such a study results in accumulation of data with missing values, on the other hand this design provides an opportunity to make up for the simple loss by enrolling new subjects at any requisite age points.

1.8 MERITS AND DEMERITS OF MIXED LONGITUDINAL METHOD

The merit of the mixed longitudinal studies are that they are relatively cheaper to conduct and also less time and effort consuming as compared to pure longitudinal studies. These studies also provide us with both distance and velocity curves, i.e. these include information on both growth status and rate of growth.

The demerit of the mixed longitudinal studies concerns the estimation of growth velocity of different body parameters from mixed longitudinal data involving missing values is a tedious task and special statistical methods are required to get relevant information out of such data. In some circumstances the manipulation of increments derived from each individual measured twice or more is reasonably efficient and simpler. The means of such increments may be used to calculate more efficient measurement-at-given age or distance means at successive ages.

1.9 SUMMARY

It is impossible to undertake any growth study without having knowledge about its methodology. For a successful planning of a growth study, we should be very clear about the method of data collection, sample size, sampling techniques, relevant anthropometric measurements to be included, training of the research staff, funding
provisions and statistical methods to be employed for data analyses. In this unit an effort has been made to explain different methods of studying human growth along with their merits and demerits. After going through this unit you are able to understand various methods of studying human growth, the basic differences between cross-sectional, longitudinal and mixed longitudinal methods. This information will help you in choosing the most appropriate method to be employed for a specific study. The most common method of growth study is the cross-sectional method. This collects data on children over a range of ages, each child contributing a measurement at a single moment in time. Cross-sectional surveys provide information about the distance curve of growth of any dimension of the body. These types of studies are used in analysis of growth and development to provide information at one point of time. Cross-sectional studies can estimate, say, the mean annual growth trends through the difference in size of successive year groups, but they provide no information about the variability of growth. Although cross-sectional studies are seemingly simpler to undertake than longitudinal studies, they require considerable care in sampling so that the subjects selected represent a true cross-section of the population being studied. Longitudinal studies are a repeated-measures design and provide serial data that are dependent and correlated. A longitudinal study involves repeated observations on the same individual at specific intervals over a period of time. Such studies are costly, laborious and time consuming. Both subjects and staff must be motivated to continue in the study for which lot of patience and perseverance is required on the part of those who participate and those who conduct the study. Longitudinal studies provide information not only on mean growth but also, and more important, on the variability of growth. It is not always possible to measure exactly the same number of children every year for a prolonged period; inevitably some children leave the study and others, if desired join it. A study in which this happens is called a mixed longitudinal study. Special statistical techniques are needed to get the maximum information out of this data. The main difference between a longitudinal and a mixed longitudinal study is the time period over which growth is assessed. Longitudinal methods cover longer periods. If annual velocities are the only concern then two successive surveys one year apart, with say 50% of subjects measured on both occasions, constitutes a mixed longitudinal study that provides all the required growth velocity information. Data gathered through different methods of research is used to construct growth standards or norms of a population.

1.10 REFERENCES


Suggested Reading


Sample Questions

1) Describe various methods of studying human growth, giving their merits and demerits.

2) Differentiate between longitudinal and cross-sectional methods of studying growth.

3) What do you understand by mixed longitudinal method? How is it different from longitudinal method?

4) What do you understand by Hawthorne Effect? Discuss its role in longitudinal studies.