CHAPTER II

SUBJECTS AND METHODS

Growth is an outstanding characteristic of children and adolescents. It is a gradual increase in size of the body and its organs. A period of rapid growth during early infancy is followed by one of chanalization during pre-school years. Though growth is believed to be stabilised in this period,it is time related and is a complex process.

Malnutrition is one of the important causes of growth retardation resulting in reducing physical activity (Martorell R.*et al.*, 1984; 74-86). As such growth faltering is commonly observed in children from low socio-economic class. Factors responsible are many and it is perhaps difficult to isolate any single one.

Nutritional status is influenced by biological, genetic and environmental factors. Biological factors such as sex, birth order, intrauterine environment etc. are known to be associated with growth. Genetic factors influence the adult size while environmental factors such as nutrition, seasons, climate, socio-economic level and more importantly infections exert their influence on reaching the limits of the genetic potential. It is well known that not all individuals are able

to attain their full growth potential.

Clearly, different individuals interact with environment, resulting into large observed between individual variation in attained growth among individuals, even in the same environment. This will also affect by time related changes within the same individual, thus giving rise to within individual variation. Understanding of the magnitude as also the nature of these variations are essential for better appraisal of growth process in a given community.

Reported studies attempted to investigate relationship of attained growth with major environmental factors such as morbidity or socio-economic factors. However, most of them are cross-sectional studies and analyse the data at group level rather than individual level. Thus prevalence of malnutrition is shown to be significantly higher among rural than urban population (Cameron, 1992: 223-224) or low socio-economic communities than high socio-economic communities (Datta Banik *et al.*,1970: 438-447). Similarly relationship between malnutrition and morbidity has been examined in many communities. Thus the increasing trend in morbidity prevalence or days of illness with decreasing nutritional status are reported by many (Rowland *et al.* 1977: 441-450, El Samani

et al.,1988: 93-105). However, it is not precisely known to what extent morbidity contributes in terms of variations in attained growth or growth faltering in these communities.

One of the major considerations that has escaped the attention of these researchers is the consequent changes in the process of growth, happening at an individual level. Thus within individual variations in growth have not been examined by many.

It is general observation that not all children of same age-sex group, living in similar environmental conditions have similar weights and heights. Some children will have started to accelerate and develop higher velocities while others will have low velocities which precedes acceleration. Therefore, investigating growth process owing to adverse conditions in which poor children live, would need longitudinal data.

Longitudinal studies not only examine the between individual variation but also allow examination of within individual variation by means of various statistical tools, such as growth modelling, analysis of variance, serial correlations etc. It is intended that this will in turn help to understand the underlying mechanism that gives rise to

observed variations in growth of individuals, and thus forms the main aim of the study.

For this purpose a longitudinal study on rural children in the age group (1-5) yrs was planned. Details of the longitudinal data on anthropometry and morbidity collected in this study are discussed here.

2.1 Study Design :

The data for the present study comes from a research project investigating growth and morbidity among rural children. This study had wider objectives from the point of view of assisting policy decisions at the national level. The study population covered all children below 12 years from 8 different villages near Pune, for a period about 3 years viz. March 84 to June 87. In the present study data for pre-school children i.e. 1 to 5 years of age from 4 villages is considered. Relevant details of the data considered for the present study are discussed below.

2.1.1 Study Population :

One of the major considerations given in selecting the villages for the Departmental project was the co-operation of

villagers for measuring their children for weight, height and morbidity. Selected villages viz. Murhevasti (Tahasil-Khed), Kasarsai (Tahasil-Mulshi), Arvi and Rahatwade (Tahasil-Haveli) were about 30-40 km from Pune.

For the present study rural children, between 1 to 5 years age are considered because during infancy, growth is very rapid and is mainly affected by duration of exclusive breast feeding, birth weight, age of starting weaning food etc.(Waterlow J.C., 1988: 1-16). However, alterations in growth thereafter occurs mainly due to poor environmental conditions, giving rise to morbidity among children. Hence the study group was confined to 1-5 yrs age.

2.1.2 Study period :

Morbidity data collection was started from March 1984, but anthropometric data was collected from September 1984 in the Departmental project . Therefore, for the present study data for two years from September 84 was considered.

2.1.3 Socio-economic information :

This information was collected by trained Field Enumerators (FE) who were master's degree student. Once the village was

selected FEs visited each and every household and collected information about family size, age-sex distribution of household, their occupation, literacy status etc. by interviewing the head of the household. The households having children below 12 years were included in the study. New births during the study period were also recorded and followed. Thus complete enumeration of the village was done.

All villages in the study were representative of typical Indian villages. In all villages there was lack of safe drinking water. Lack of sanitation facilities and that for waste disposal was seen in every village. In the villages poor environmental conditions were evident. The main occupation was cultivation. 50% families had their own land and 23% were working as agricultural labourers on daily wages. 18 % men were working in neighboring city. 50 % parents were illiterate and especially, 71 % mothers were illiterate. Although 48 % families were of nuclear type, average family size was 7.6. 50 % mothers also worked in their own farm or in the other farms as labourers.

2.1.4 Age Assessment :

Exact birth dates of children were taken from Gram Panchayat records. In cases where birth dates were not available mothers were interviewed. For this purpose specially prepared local calender, giving dates of important events and festivals for last 5 years was used to help recall of the mothers.

2.2 Morbidity :

In order to study the role of morbidity in explaining growth alterations, it was decided to collect continuous morbidity information. Two Community Health Workers (CHWs) from each village were selected for collecting morbidity data and to help FE for field work. These CHWs were resident of the same villages and had education at least upto 7th standard.

'Morbidity' is defined as deviation from normal state. Morbidity can be measured by various methods depending on the objectives of the study. One way is to use hospital data or by interviewing their mothers or by actual examination of those children. For continuous morbidity data actual examination is very difficult, while hospital data has also limitations as public health centers are about 5 to 10 km. from village and

only for severe cases villagers go to hospitals. Therefore, interview method was observed to be suitable for longitudinal survey.

Morbidity was recorded using symptomatic approach. A morbidity proforma containing about 20 symptoms of illness, commonly occurring in children was prepared with the help of a pediatrician (Appendix I). The information was collected by 7 day recall method. The information collected on this proforma contained the date of onset, date of absence of a particular illness and thus duration of illness during last 7 days.

To increase accuracy in data collection, a training programme of 3 days was arranged in the Institute for all CHWs. Interview techniques, identifying illness, recording of data was taught to them. After this programme actual training on the field was also given.

2.2.1 Morbidity Survey :

It was not possible to visit each household on every day to collect information. Therefore whole village population was divided into two blocks, one for each CHW. Then each block was subdivided into 6 parts, each part allocated to each day of the work. Each CHW visited every day those children assigned to

him/her for that particular day and collected the morbidity information for last 7 days for children in these houses. CHWs worked for 6 days in a week. Thus on each day he/she covered 1/6th of his/her population. The two CHWs thus covered entire population in a week's period. This procedure was repeated for next week and a system of continuous morbidity follow-up was developed. Morbidity proforma was printed on 3 different colored sheets viz. white, pink and green forms.

White Forms : This white form was developed exclusively for collection of morbidity information by recall. Thus when CHW visited households, assigned to him/her on each day, he/she filled this form by asking mother of that child, whether the child was ill in last 7 days and filled the information about onset of particular illness and duration of that illness. In case sick child was met pink form was filled by CHW. The pink forms on a given day indicated number of sick children.

Pink Forms: This form was mainly used for follow-up information of sick child. Thus a sick child was visited every day and his morbidity status was recorded on pink proforma, till his cure i.e. till the absence of the particular observed symptom. This was useful to get exact duration of particular illness. Thus white form gave exclusively recalled

information, the pink one gave follow-up information. However, there was a possibility that CHW could miss child who becomes sick on a day other than scheduled visit for that child. Yet this information was caught up in white form. Therefore, morbidity data from white as well as pink forms was used for analysis.

Green Forms : This form was introduced to check the working of CHW's by Field Enumerators. Two Field Enumerators used to visit each village once on a random day in a week. In their weekly visit FEs used to fill this green form by collecting morbidity information of those children assigned for that day to CHWs. Thus 1/6th of the study population was actually examined for morbidity status by FE every week, for the sake of quality control.

2.2.2 Grouping of Symptoms :

Although there were 20 symptoms in the proforma, group of symptoms together were considered to reflect illness of a system. Thus Gastro-intestinal (GI) system consisted of symptoms like diarrhoea, dysentery, vomiting and stomach pain. Respiratory Track Infection (RTI) consisted of symptoms like cough, breathlessness, running nose etc. Fever (FEV) included

all types of fever and fever with chill. These three main systems that affects growth of children are considered mainly in the analysis. All other infections such as skin infection, ear discharge, etching and so on are considered as other infections. Morbidity prevalence andduration of illness were computed for such system.

2.3 Anthropometry :

Anthropometry is the technique of expressing quantitatively the form of the body. Weight, height, arm circumference, chest circumference, head circumference, skin fold thickness at triceps are important measurements used to assess the nutritional status of children. Measurements like arm circumference, head circumference, chest circumference, skin fold thickness vary among individuals, but with very narrow range, while the measurement errors associated with these measurements especially in younger age are high. This reduces the accuracy of measurements. Therefore, only weight and height were measured in our study.

Anthropometric data can be collected cross-sectionally or longitudinally depending on the objective of the study. As longitudinal studies facilitate examination of between as well

as within individual variations, this approach was adopted in the present study.

In our study weights and heights were therefore, recorded periodically after every three months (+ 7 days) for each child over a period of two years.

Weight : Weight is the key anthropometric measurement most in use. The prevalence of protein-calorie malnutrition is best revealed by weight deficiency in all age groups. Weight is more sensitive to current nutritiona status.

Weight was recorded with the help of lever balance (manufactured by Avery, Pune) with least division of 50 gm. Balance was checked on the day of measurements using known weights. For very young children (mostly infants) weights were taken by subtraction method i.e. weight of (mother + child) - weight of mother.

Height : Height is another important measurement. Unlike weight, height is considered to reflect long term nutritional status. Height in pre-school age is most important as adult height can be predicted from height in pre-school age (Tanner,1956: 372-381). Secondly, it is shown that deficit in height in pre-school age delayed the adolescent growth spurt

(Kanade A.N. 1993).

Height was measured accurately upto 0.1 cm. by vertical detachable measuring rods fitted to a wooden platform (Apparatus manufactured by UNO & Co. India). Supine lengths were measured for children below 2 years with the help of infantometer.

Necessary care was taken in standardizing methods for achieving accuracy in these measurements. The same pair of Field Enumerator measured the children all through the study period, thus reducing personal error.

2.4 Assessment of Nutritional Status :

Nutritional status of children can be assessed by several methods such as clinical examination, biochemical tests, dietary intakes, nutritional anthropometry etc. Often clinical and biochemical approach in field studies are difficult to adopt. Dietary intake assessments of children are equally difficult in rural areas. Therefore, nutritional anthropometry was used for assessment of nutritional status.

Anthropometric measurements such as weight and height are not only useful for assessment of the nutritional status of

children but are also helpful to investigate its association with morbidity. Further, such measurements are also useful to observe the critical age of malnutrition in a given community.

Six indicators based on these two measurements were considered. Standards developed by National Center for Health Statistics, NCHS (WHO, 1983 : 63-101) are used for comparison.

(I) Weight for age (W/A)

It is calculated as

$$\frac{\text{Observed weight of child in a given age-sex group}}{\text{expected weight for that age-sex group}} \times 100$$

Although this indicator is easy to compute one of the limitations of this indicator is that it is based on age which is often difficult to assess accurately in rural areas. Nevertheless this indicator is used by Gomez et al (1956: 77-83) to classify children into different grades of malnutrition, which is widely used in field study.

According to Gomez classification children are classified into 4 groups as

i) Normal - children with W/A >= 90 are classified as normal.

ii) Mild malnutrition - children with W/A between 75 & 90 are called mildly malnourished.

iii) Moderate malnutrition - children whose weight for age are between 60 to 75 are classified in this category.

iv) Severe malnutrition - children with W/A < 60 are classified as severely malnourished.

(II) Z score for Weight for age :

Z-scores are nothing but the distance in Standard Deviation (S.D.) units from the median of the standards. Thus it is calculated as

$$\frac{\text{Observed wt of a child in a given age-sex group} - \text{expected wt for that age-sex group}}{\text{Standard deviation of expected weight for that age-sex group}}$$

Child whose Z score weight for age is less than -2 is considered as underweight.

(III) Height for age (H/A) :

Unlike weight, extent of height deficit in relation to age indicates past and chronic malnutrition.

Height for age is calculated as

$$\frac{\text{Observed height of child in a given age-sex group}}{\text{expected height for that age-sex group}} \times 100$$

This indicator can be used to classify children into four different groups (Chen et al, 1980: 1836-1845) as

i) Normal - Children whose height for age is greater than or equal to 95 are categorized as Normal.

ii) Mild malnutrition or Ist degree of stunting - children whose H/A is between 90 to 95 are classified as mildly malnourished.

iii) Moderate malnutrition or IInd degree of stunting - Children with H/A is between 85 to 90 are moderately malnourished.

iv) Severe malnutrition/stunted - Finally, children whose height for age is below 85 are classified as severely stunted.

IV Z score for height for age :

This indicator is computed as

$$\frac{\text{Observed ht of a child in a given age-sex group} - \text{expected ht for that age-sex group}}{\text{Standard deviation of expected height for that age-sex group}}$$

Child whose Z score height for age is below -2 is considered as stunted.

V) **Weight for height (W/H) :**

Indicator based on weight alone or height alone is of less use as weights and heights are highly correlated. Therefore, indicator based on weight and height is most important. It is calculated as

$$\frac{\text{Observed weight of child in a given age-sex group}}{\text{expected weight for observed height of that child}} \times 100$$

Another advantage of this indicator is that it is independent of age. Many times, particularly in rural areas when exact birth dates of children are not available, this indicator is more useful to assess the nutritional status of children. This indicator is considered to reflect current nutritional status.

By using weight for height values children are classified into 4 grades of wasting.

i) Normal - Children with W/H >=90 are classified as Normal.

ii) Ist degree wasting - Children with 80=< W/H < 90.

iii) IInd degree wasting - Children with 70=< W/H < 80.

iv) IIIrd degree wasting - Children whose weight for height is below 70.

VI) **Waterlow Classification :**

Based on two indicators viz. height for age and weight for height, Waterlow (1972: 566-569) has suggested a classification in which current nutritional status and past nutritional history can be jointly studied.

The children can thus be cross-classified as

	Degree of wasting			
Degree of stunting	Normal	I	II	III
Normal I	Normal		Wasted but not Stunted	
II III	Stunted but not Wasted		Wasted and Stunted	

For practical purposes this is divided into 4 categories as follows :

i) Normal - Children whose weight for ht. is greater than or equal to 80 and height for age is greater than or equal to 90 are Normal.

ii) Stunted (but not wasted) - Children whose W/H >= 80 and H/A <90 are classified as stunted.

iii) Wasted (but not stunted) - Children whose W/H < 80 and H/A >= 90 are wasted children

iv) Stunted and Wasted - Children whose W/H < 80 and H/A < 90 are called stunted as well as wasted.

All these classifications were used to investigate the critical ages for different types of malnutrition prevalent in rural children.

Data collected on total of 376 children who were initially enrolled in 4 villages was considered for analysis. Age-sex distribution of study population is given below.

Age(yr)	Boys	Girls	Total
1 - 2	51	42	93
2 - 3	50	49	99
3 - 4	47	47	94
4 - 5	55	35	90
Total	203	173	376

During follow-up visits there was some dropout. Thus in longitudinal data only a cohort of 277 children who had continuous data on eight consecutive 3 monthly periods (i.e. 2 yr.) was available for analysis.

The detailed analysis highlighting various aspects of variability in growth among rural pre-school children is presented in following chapters.