Case Study

Development of Local Percentile Growth Charts of Children between Birth to Ten Years

Vikas Chintaman Kakade[1], Anil Prabhakar Mokashi[2]

[1]Associate Professor, Department of Statistics, Tuljaram Chaturchand College, Baramati-413102, MH, India
[2]Director, Institute of Rural Pediatrics, Bal Kalyan kendra, Baramati-413102, MH, India

Corresponding Author: Vikas Chintaman Kakade

ABSTRACT

Growth pattern of human population changes with time and place. Particularly developing countries, country like India, is in a stage of nutritional transition hence it is necessary to update growth references regularly. The present study is carried out on 0-10 years from Baramati from Pune district of Maharashtra. We considered that children from maternity homes, BCG camps, well baby clinics, immunization camps, private clinics, 'Anganwadis and Balwadis', Nurseries' and schools etc. Our study shows that growth performance of Anthropometric indices for Baramati children is much less than National Centre of Health Statistics (NCHS) and slightly less than Indian Council of Medical Research ICMR and Affluent Indians (AI). We have proposed growth charts for Baramati region to monitor growth parameters.

Keywords: Anthropometric Indices, NCHS, ICMR, AI.

1. INTRODUCTION

Normal growth comprises all dynamic, physiologic and psychological changes which take place from conception to maturity [1]. The term 'growth' has commonly been used for those aspects of maturation which can be described by a measurement of size [2]. The factors nutrition, hormones, secular trends, seasonal, socioeconomic status and other environmental factors play a vital role in growth of an individual [3]. The 'Growth' is measured in specific term like Mean, standard deviations, percentile in the cross sectional studies or longitudinal studies [4] [5].

India is a developing country since under the major nutritional transition stage [6]. In 2006, WHO developed the first single uniform global growth standard as prescriptive chart for the children under the age of 5 years with encouragement to all countries for its applicability [7]. Further WHO stated that it would not be possible to have prescriptive growth standards for children between 5-18 years of age. Since hormonal and environmental factors in this age group cannot be controlled. Nutritional, environmental and genetic factors and timing of puberty play a major role on growth of children above the age of 10 years. Country-to-country and region-to-region variation and impact of these factors on growth, reflects in differing growth patterns amongst different population. Hence, it is necessary to have country-specific and also region-specific growth charts to monitor growth of children between 5-18 years [8]. Growth charts are most commonly used tools for assessing the health of human population [9], which gives graphical method of comparison of child's growth with reference population of same age and sex. [10]

The factors nutrition, hormones, secular trends, seasonal, socioeconomic status and other environmental factors play a vital role in growth of an individual. In the present state of developmental flux in rural India, growth standards developed on the observed growth performance may be valid

only for 10 years. The secular trend of gradually increasing height over generations may create the need to re-evaluate growth standards.

Aims and objectives

The present study was planned with following aims and objectives in mind.

1. To collect suitable data for construction of the reference standards of growth and physical development of children below ten years of age in and around BARAMATI.

2. To assess the extent to which growth performance of Baramati children

corresponds to the National Centre of Health Statistics (NCHS) of USA, Indian Council of Medical Research (ICMR) and Affluent Indians (AI) values.

3. To design growth charts for growth monitoring based on Baramati data, improvising upon the available growth charts.

4. To assess the validity of various anthropometric statements used estimation of growth in the field.

2. MATERIALS AND METHODS

PROFORMA USED FOR THE STUDY

Sr. No   :   _____

Name   : _____

Address   : _____

Sex   : Male/Female

Area   : Urban/Rural

Birth date : DD / MM / YY

Date of examination : DD / MM /YY

Age groups:

0 – 1 mth	2 mth	3 mth	4 mth	5 mth	6 mth
7 Mth	8 Mth	9 Mth	10 Mth	11 Mth	1.5 Yrs
2 Yrs	2.5 Yrs	3.5 Yrs	4.5 Yrs	5.5. Yrs	6.5 Yrs
7.5 Yrs	8.5 Yrs	9.5 Yrs	10 Yrs		

Measurements:

1. Head Circumference : _____
2. Chest Circumference : _____
3. Mid-arm circumference : _____
4. Hand Length : _____
5. Span : _____
6. Height : _____
7. Upper segment : _____
8. Lower segment : _____
9. Foot Length : _____
10. Weight : _____

Name of Examiner : _____

The present cross-sectional study was carried out in and around Baramati, District Pune, Maharashtra. Since the objective of the study was to investigate the growth performance of all the children in and around Baramati below 10 years of age, not subject to any growth restraints. Hormonal and environmental factors play their role in post pubertal age. So this study was restricted to children below ten years of age. The data is collected from maternity homes, BCG camps, well baby clinics, immunization camps, private clinics, 'Anganwadis and Balwadis', Nurseries' and

schools. The study team was headed by the research candidate, a pediatrician of 17 years standing and academic credentials. Six part time graduate assistants were employed for period of 2 years. The staff recruited was trained to collect data, record the measurements at Dr. Anil Mokashi Hospital, Baramati and B. J. Medical College, Pune. A statistician was involved from the planning stage of the study and training of the staff. The total number of children investigated in the project was 40200. With such a large coverage in a small community and variety of places of contacts, nearly every eligible child was covered. This totally removed the sampling bias that hampers statistical significance of most of the studies. We measured ten anthropometric indices like the 1)Head Circumference 2)Chest Circumference 3) Mid-arm circumference 4)Hand Length 5)Span 6)Height 7)Upper segment 8)Lower segment 9)Foot Length and 10)Weight for every children.

In this article, we focus only on height and weight of children. The aim of this article is to study of 50th percentile of Baramati. Also, we compare of 50th percentile of Baramati data with ICMR and NCHS data and design a suitable 'Mokashi growth chart' based on Baramati data.

The total number of children covered in the study was 40, 200. Recorded data was classified according to age, sex & locality. The sex ratio in the study was 1.28 male: 1 female. There were twenty two age groups, out of them first twelve for 12 months and next ten 1-1.5 yr, 1.5- 2yr, …,9.5-10 yr.

3. Statistical Methods

We use the linear regression analysis model at 5 percent level of significance to assess the validity of various anthropometric statements which are used to estimation of growth of anthropometric indices. Descriptive statistics is used to find the mean, S.D. for the anthropometric indices. Also, we use percentiles methods for development of growth charts for of

anthropometric indices. Here, we use purposive sampling method to collect the relevant data to achieve the objectives of propose study.

4. RESULTS
50th percentile of anthropometric indices for height and weight

We obtained 50th percentile of anthropometric indices of height and weight for infants below 1 year and children aged 1 through 10 years using SPSS software. These data have been given in Table 1 to Table 2. In presenting the tables the 'number' given is for the age and the next. For example '7' includes all children aged '7' years and above, excluding those who have completed 8 years of age.

Table No. 1: 50th percentile value for Weight in Kg. for infants below 1 year and children aged 1 year through 10 years

Age	Weight in Kg.		Age	Weight in Kg.	
	Boys	Girls		Boys	Girls
1 Month	2.8	2.65	3	11	10.5
2	4.2	3.7	3.5	12.3	11.3
3	5.2	4.3	4	13	12
4	5.6	5	4.5	14	13
5	5.7	5.7	5	14	14
6	6.2	6.3	5.5	15	14
7	7.0	6.5	6	15	15
8	7.5	6.2	6.5	16	15
9	7	7.3	7	17	16
10	7.4	6	7.5	17	17
11	7.7	6.5	8	18	18
1 Year	7.8	7	8.5	19	19
1.5	8.3	8.2	9	20	20
2	9.7	8.5	9.5	20	20
2.5	11	10	10	21	20

Table No. 2: 50th percentile value of Height in cm. for infants below 1 year and children aged 1 year through 10 years

Age	Height in cm.		Age	Height in cm.	
	Boys	Girls		Boys	Girls
1 Month	45	45	3	85	84
2	49	50	3.5	89	88
3	54	51	4	96\3	92
4	57	57	4.5	96	95
5	59	57	5	100	98
6	60	62	5.5	102	101
7	63	63	6	105	103
8	67	62	6.5	107	107
9	65	65	7	111	109
10	68	65	7.5	113	113
11	69	65	8	116	115
1 Year	69	69	8.5	118	117
1.5	73	73	9	120	119
2	77	74	9.5	121	121
2.5	82	81	10	123	123

From Table-1 the observations were made that birth weight boys and girls are 2.8 kg and 2.65 kg (50th percentile) respectively.

Weight gain in 10 years for boys and girls are 18.2 kg and 18.1 kg (50th percentile) respectively. Also, from Table-2 the observations were made that birth height boys and girls are 45 cm (50th percentile). Height gain in 10 years for boys and girls are 78 cm (50th percentile).

5. DISCUSSION

There is no point in shouting loudly 'we don't have Indian Reference Standards to assess our children's growth'. There is also no point in evaluating how much percentage of NCHS or Boston standard our children compare with. Growth norms are not 'sacred' like national anthem! It is not a matter of national pride! To have growth standards is a scientific need.

Our Job is to see that our children grow well in existing socioeconomic and hereditary scenario. We have to identify and correct the growth derivations as early as possible. We need something to compare with that is 'applicable', 'scientific', 'standardised' and 'handy'.

Under the circumstances we logically pursue the hypothesis that a growth standard in a community should be based on the growth performance of all the 'normal children'. Selecting only affluent children is as good as using NCHS data. It is well established that the most important two growth promoting factors are 1) Growth monitoring 2) Proper nutrition.

All the other factors play a minor role. Growth monitoring and nutrition depend upon Knowledge, attitudes, customs, beliefs and practices. Those who know, about diet and growth monitoring, have well fed well grown children. Those who do not know have smaller size children. Growth is not an Urban/Rural, Rich/Poor, North/South or East/West problem. Growth is a knowledge/Lack of knowledge problem.

1] At the beginning of the study we thought Urban/Rural differences may not be significant. We decided to put forward the hypothesis that "Rural children are not lagging behind the Urban children in growth! "But the study revealed that in fact rural children were really lagging behind. Our presumption proved to be wrong and more emotionally based in favour of 'our rural' and those urban'. So we dropped the hypothesis!

2] In the present state of developmental flux in rural India, growth standards developed on the observed growth performance may be valid only for 10 years. The secular trend of gradually increasing height over generations may create the need to re-evaluate growth standards. Our study shows that growth performance of Baramati children is much less than NCHS and slightly less than ICMR and AI. So there is no case for the NCHS standard to be used as a yardstick to assess Indian children.

3] 50th percentile of Baramati data is presented in tabular format for each measurement viz. Head, Chest, Mid arm circumference, span, hand length, foot length, weight, height and upper segment and lower segment. The 50th percentile figures for boys and girls are depicted separately for each criterion. The 50th percentile figures for Baramati data generally match with ICMR data and are overall slightly on lower side of ICMR. These are ready for use as a cut off line for field conditions.

4] Comparison of Baramati data with other studies:

All the indices in Baramati data were matched with NCHS/ICMR data. The NCHS figures in all measurements were higher than ICMR and Baramati data. Baramati data matched with 30th percentile of NCHS. The ICMR figures were generally above Baramati data; still they were closely matching (insignificant statistical difference) barring a few differences.

a) Growth of Baramati children lagged behind Indian and International levels between 6 months to 1 year of age: Probably because of delayed weaning and lack of growth monitoring.

b) Chest circumference overtakes Head circumference by about two years of age [8]. It is supposed to be an 'Health Indicator'. In case of Baramati children this

occurred at 4 years. Probably indicating 'not so healthy' state of affairs.

5] Mokashi Growth Chart:

The 'road to health chart' gives a wrong impression of minimum and maximum growth. In fact the lower line (50th percentile ICMR) is not a minimum, and upper line (50th percentile NCHS) is not a maximum. It is a drawback of the road to Health Chart.

The rainbow chart has too many lines, curves, figures on it. It is incomprehensible for paramedical workers (who are untrained) and mothers.

The growth chart was designed with above problems in mind. The Baramati data of 40200 children was subjected to analysis for percentiles. The curves for 3rd, 50th, and 97th percentile were plotted. The age groups 0-1 years and 1-10 years are depicted on separate charts. Presence of 3(two prominent and one dotted) curves removes the minimum-maximum concept and avoids the confusion of many curves. The message that a given child should follow his own path is enough and easily understood. The chart is presented as follows:
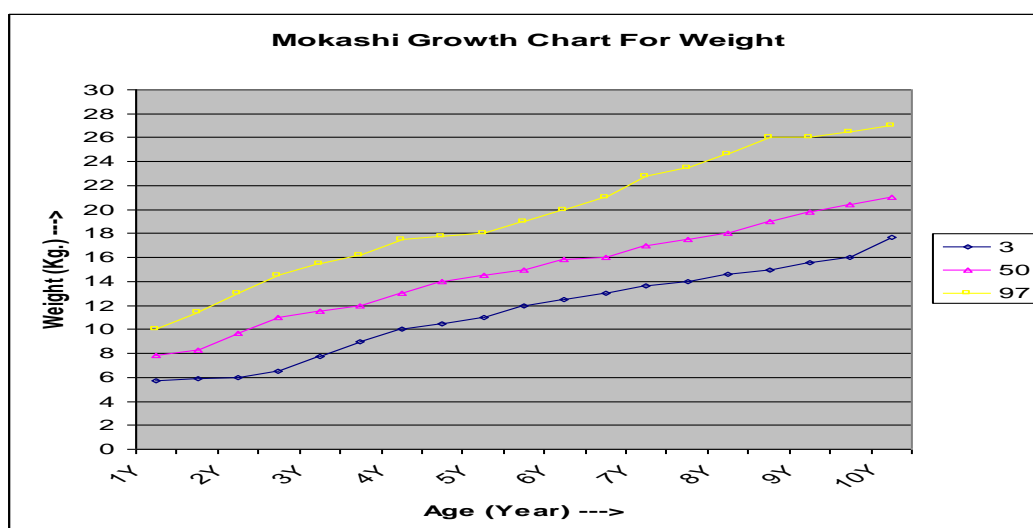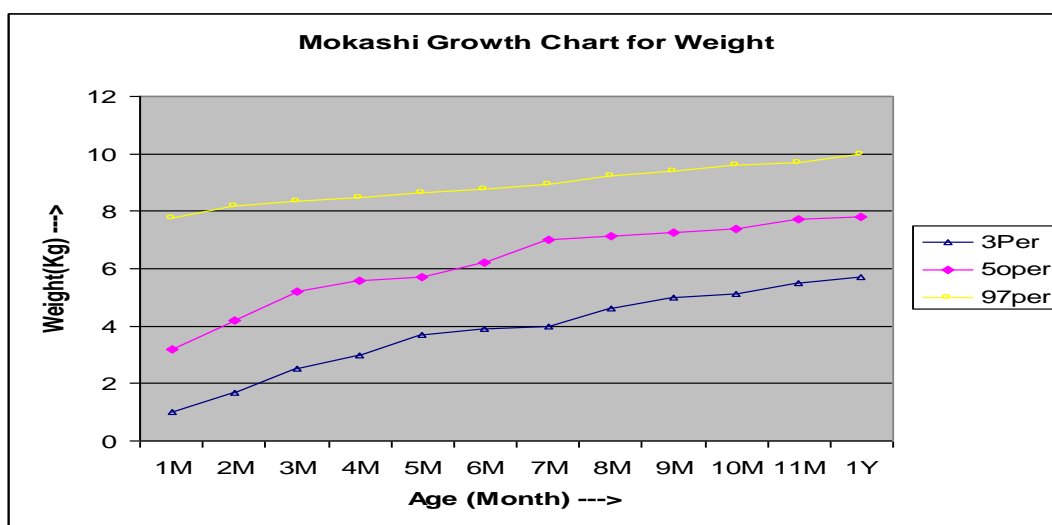
Infant growth:

The growth of an infant since birth shows a regular increase in all the anthropometric measurements. In this study, this was indicated by the increase in both percentile values of the measurements. The girls were shorter and lighter than the boys. Boy had a broader chest and larger head circumference.

The standard deviations appeared to increase with age and these were lower in infants than in children aged 1 to 10 years for all measurements except head circumference and upper segment. The measurements appeared to be more compact in later months of infancy than in earlier months as compared by the co-efficient of variation.

It was interesting to note that, on an average, the growth of infants during the first 6 months after birth was more rapid as compared with their growth in the later months.

The statement made for longitudinal growth estimation was not included as this study was a cross-sectional one.

No	STATEMENT	TRUE / FALSE
1	Weight in kg after 1 yr = (Age in Yrs+3) x 2	FALSE
2	Height in inches = Age in Years x 2.5+30	FALSE
3	Weight in kg up 1Yr= (Age in months/2) +3.5	TRUE
4	Weight in kg between 1 to 5 Yrs = (Age in Yrs+3)x2 (Based on the study)	TRUE
5	Weight in kg between 5 to 10 Yrs = (Age in Yrs+2)x2 (Based on the study)	TRUE
6	At birth head is larger than chest by 3 cm	TRUE
7	At birth span is less than length by 1-2 cms.	TRUE

6. CONCLUSIONS

Our study proposes the new anthropometric statements for estimation of growth in the weight of children for Baramati rural area. Also, the innovative outcome of this study is the common mother can assess the growth of her children using Mokashi Growth chart.

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