

A Study of Growth Pattern in Males and Females at Various Age Groups from Satara District of Maharashtra State

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Abstract

The growth of a child is of prime importance to all the parents in the world. Studies on growth and development of children in a community provide important information about the nutritional status of the community. Growth and development are unique in each person with limits of normalcy.

The present study was conducted on early adolescent children of following age groups.

i) 9 to 10 years, ii) 10 to 11 years and iii) 11 to 12 years.

The subjects selected for study were from the schools selected by random sampling from Rural and Urban areas of Satara District of Maharashtra State. The subjects consist of 1800 males and 1800 females of each age group from both H.I.G. and L.I.G; with total number of subjects are 3600.

Ten different anthropometric measurements were studied. Written informed consent from parents of subject and ascent of subject were obtained prior to the study. The present study was undertaken with the aim to comprehend the growth Patterns of early adolescent children of

1. The age group of 9 to 12 years.
2. School children belonging to both the genders.
3. Belonging to two different socio-economic strata.

Present study revealed that there is a difference in growth rate between the different age groups i.e. 9 to 10, 10 to 11, 11 to 12 years in the L.I.G. as well as in H.I.G. and there is a significant difference between Males and Females in these age groups and socio-economic groups. In almost all studies we have observed that H.I.G. values are always greater than L.I.G. values in all the age groups. The growth of L.I.G. can be increased up to the growth of H.I.G. with nutritional supplements. The data may be useful to the applicants to understand the growth pattern in school children of age group of 9 to 12 years as influenced by the socio-economic factors.

Keywords: Growth Pattern; Anthropometric Measurements; Early Adolescent Children.

Introduction

The growth of a child is of prime importance to all

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the parents in the world. Studies on growth and development of children in a community provide important information about the nutritional status of the community.

Growth is an increase in size of body i.e. quantitative growth leading to physical maturation while development is maturation of function or quantitative growth leading to mental maturation [1].

Growth and development are unique in each person with limits of normalcy. The term growth and development used in the studies of physical growth is referred as a process not only intimately linked with time but also affected by following factors [1]:

1. Genetic factors

2. Environmental factors like climate and pollution
3. Demographic factors like ethnic origin and gender
4. Nutritional factors
5. Socio-economic status
6. Biological factors like chemicals, infectious drugs and emotional factors

In general Ontogenic growth implies an increase in size and mass, which results from synthesis of protoplasm an extracellular material which are specific tissue component [2].

Growth refers mainly to changes in magnitude increments in size of organs, increase in thickness of tissues or changes in size of an individual as a whole.

Human seems to be the only species to have a long quiescent interval between the rapid growth that takes place immediately after birth and the adolescent growth spurt [2].

Growth in height continues at a slower rate even after the adolescent growth spurts [3]. However weight gain is more variable.

Adolescence is a period of rapid growth and perhaps the last chance to grow. It is a transitional stage in human life. The exceptional rapid growth in this stage is characterized by a lot of individual variation that possess difficulty in defining normality.

The priorities of society have been based on infant morbidity and mortality rates. Adolescents have been overlooked by health planners, however recently their presence, care and counselling are coming to lime light. There is a high prevalence of malnutrition and anaemia among them.

The three dimensions of growth during adolescent are physical growth, mental or emotional blooming and sexual development. Most of the Indians especially the rural and the urban poor population fail to achieve the full-endowed genetic potential for growth and intelligence. This is due to sub optimum interaction of host factors with nutrition and environment. High prevalence of low birth weight babies and adolescent growth failure are indications of social deprivation.

Growth assessment is an essential component of health surveillance and gold standard for growth assessment in anthropometric measurements.

Adolescent growth reflects the adult size, the productivity of the future nation and even the size and health of future citizens. So it is important to give ample importance to adolescent nutrition and growth momentary.

The adolescent child should take a balanced diet. Nutrition of an adolescent girl should get priority, as she is the prospective mother. Improving the nutrition of the girl child will help to reduce the incidence of low birth weight babies.

The adolescent phase of the growth is equally important as childhood growth. Physiological changes during this period contribute immensely to the growth differences among the boys and girls.

Physical outcome in growth, form and shape manifest differently between both sexes. Therefore there is a need to study the pattern of physical growth in terms of growth dynamics, which work differently in each individual as among the males and females at different age groups.

Many environmental factors can contribute to the differences in growth, besides the genetic factors.

In India, socio-economic differences are highly prevalent and it is expected that such differences in the form of food resources would finally have their influence on growth outcome.

Present study is an attempt to provide anthropometric baseline data of early adolescent age group children amongst two contrasting socio-economic groups in randomly selected rural and urban areas of Satara district from the state of Maharashtra.

Material and Methods

The study was carried on total 3600 subjects inclusive of the both sexes so also Higher and Lower socio-economic groups.

Socio-Economic Groups

Ideally it is necessary to decide the economic status of each subject. However, it is extremely difficult to carry out such a survey because students as subjects for this study were not in a position to give their family income correctly. Thus it was decided to select those schools (Corporation/ Municipal/ Zhillia Parishad schools) in slum areas in and around Satara district, where the students belonged to the Lower socio-economic status/Lower income group (L.I.G.) generally opt to enrol. The English medium schools, specially run by the Christian missionaries, in elite areas in and around Satara district, on the contrary have majority of students (more than 95%) who belongs to the upper and middle class families/ Higher socio-economic status/Higher income group (H.I.G.) where the income is quite high.

The study was carried on total 3600 subjects inclusive of both sexes and both higher socio-economic status / Higher income group (H.I.G.) and lower socio-economic status / Lower income group (L.I.G.).

School registers, which had the record of date of births of subject's were considered as the reliable and feasible reference for the age.

Other Criteria for Selection

1. The Subject should be normal and healthy and

should not have any obvious body deformity.

2. The subject should hail originally from Rural and Urban areas of Satara District in Maharashtra State over three generations.
3. The subjects should be i) 9 to 10 years, ii) 10 to 11 years and iii) 11 to 12 years of age.
4. The subject should not have undergone any physical surgical procedures.
5. The subject should not have any history of trauma.

Table 1: Distribution of sample size

Age (years)	Male		Females	
	H.I.G.	L.I.G.	H.I.G.	L.I.G.
9-10	300	300	300	300
10-11	300	300	300	300
11-12	300	300	300	300
Total	900	900	900	900

Total No. of Subjects = 3600

Males = 1800

Females = 1800

Written informed consent from the parents (as all subjects are minor) and ascend from subjects were obtained prior to the anthropometric measurements.

Following Measurements were Taken on the Subjects for the Study

1. Height vertex (cm)
2. Sitting Height vertex (cm)
3. Head circumference (cm)
4. Chest circumference (cm)
5. Waist circumference (cm)
6. Mid-arm circumference (cm)
7. Mid-thigh circumference (cm)
8. Weight (Kg)
9. Skin fold thickness-mid arm (cm)
10. Skin fold thickness-mid thigh (cm)

All mentioned measurements were taken and recorded by the same person by calibrated anthropometric instruments and standard anthropometric techniques. An average of the three readings was considered for every measurement to minimize the error.

The following Index was also Calculated for Comparison

1. Body Mass Index (BMI)

$$\text{BMI} = \text{Weight (kg)} / \text{Height (mts)}^2$$

The Instruments Used

1. Anthropometric Rod
2. Skinfold Calliper
3. Flexible measuring tape
4. Weighing Balance

Body Mass Index (B.M.I.)

The body mass index is calculated as weight (kg) per height. Height (mt)².

i.e. $\text{B.M.I} = \text{Weight (kg)} / \text{Height (mt)}^2$

As mentioned by K.E.Elizabeth,¹ B.M.I. of 18.5 is considered as normal but in our Adolescent group especially below 13 years, B.M.I. is always less than 18.5. In Indian's the normal value of B.M.I. is 15. If it is less than 15 it indicates chronic energy deficiency or underweight and if it still less than 13 is indicates serves underweight [1].

Observations

Observations of the present study are as follows.

1. In H.I.G. all the ten parameters showed much higher values in all the three age groups, 9 to 10 yrs;10 to 11 yrs. and 11 to 12 yrs. than L.I.G.
2. For Height vertex values, there is an increase in height values in both the boys and girls of H.I.G. There is a similar trend observed in Boys and girls of L.I.G. Baselines of increase in height are

different. Growth spurt of boys is later than that of girls in both H.I.G. & L.I.G. Growth spurt in height of girls is seen at 10 to 11 yrs. in both H.I.G. & L.I.G. Growth spurt in height of boys is seen in 11 to 12 years in both H.I.G. & L.I.G.

3. For sitting height vertex values, there is an increase in sitting vertex values in boys and girls of H.I.G. and L.I.G. from 9 to 12 years. Growth spurt in sitting height is seen at 10 to 11 years in boys and girls in H.I.G. and 11 to 12 years in boys and girls in L.I.G.
4. Head circumference is maximum at 11 to 12 years in boys of H.I.G. and L.I.G. Maximum head circumference is observed at 9 to 10 years in girls of L.I.G. and at 10 to 11 years in girls of H.I.G. Decreasing values are seen in 10 to 11 years of boys and girls of L.I.G. Decreasing values are seen in 11-12 years of girls in H.I.G. The values at 10 to 11 yrs. of girls in H.I.G. have decreased in 11 to 12 years. Decreasing values could be explained on the basis that the studies are cross-sectional. Therefore Head circumference is not a good parameter to be considered in growth studies.
5. Growth in chest circumference is more significant in females than in the males, which is obvious due to Breast development in females. But in the females of H.I.G. group this chest circumference is more than females of L.I.G. group.
6. The females show steady growth in waist circumference irrespective of socio-economic groups. The values are much higher in H.I.G. as compared to L.I.G. This difference could be because of consumption of more fatty food by H.I.G. children; this is evident from the data collected about dietary intake.
7. Growth of mid-arm circumference is maximum at 10 to 11 years in males and females of H.I.G. and at 11 to 12 years in males and females in L.I.G.

Thus for the growth of mid-arm circumference, the High socio-economic groups show the same pattern in both the sexes, while there is a steady growth in mid-arm circumference in males and females Low socio-economic group.

8. The mid-thigh circumference also showed maximum value in H.I.G. at 10 to 11 years in both sexes, while in L.I.G. the values of mid-thigh circumference are steadily increasing from 9 to 12 years.
9. There is a growth spurt in weight at 10 to 11 years in females of H.I.G. This is maintained even up to the next age group of 11 to 12 years in females, where fat deposition is more before the onset of menarche. The growth spurt in weight in females of L.I.G. is observed at 11 to 12 years.
In the males of L.I.G. the more weight gain is seen at 11 to 12 years, while in males of H.I.G. the growth spurt of weight is seen in 10 to 11 years of age.
10. There is a clear difference in values in mid-arm skin - fold thickness in H.I.G. and L.I.G.
In males, the mid-arm skin fold is thicker at 10 to 11 years of age in H.I.G. while at 9 to 10 years of age in L.I.G. In the male L.I.G. group, skin fold thickness is reduced at a later age (11 to 12), may be due to acceleration in height during the same period.
In girls, the mid arm skin fold is thicker at 10 to 11 years of age in H.I.G. at 11 to 12 years of age in females of L.I.G.
11. Thickness of mid-thigh skin fold is maximum at age of 10 to 11 years in both sexes H.I.G. while it is maximum at 11 to 12 years in both sexes of L.I.G.
12. B.M.I. is highest in 11 to 12 years of H.I.G. in both sexes, while highest at 9 to 10 years in Boys of L.I.G. and 11 to 12 years in girls of L.I.G. The differential weight gain as well as growth spurt due to increase in height during the adolescent

Table 2: Showing works of different indian researchers

Sr. No.	Name of Researcher	Title of the Topic	Year and State
1.	M.V. Phadke ¹¹	Growth norms in Indian Children	1967, Maharashtra
2.	K.D. Mohanta ¹²	Anthropometric measurements of children of Western Orissa	1971, Orissa
3.	B. Bhandari et al ¹³	Nutritional anthropometry of rural school children of Udaipur District	1972, Udaipur (Rajasthan)
4.	N.K. Dutta et al ¹⁴	Growth pattern of Indian school children in relation to nutrition and adolescence	1972, Delhi
5.	Vijay Raghavan et al ¹⁵	Height and Weight of well nourished Indian school Children.	1971, Hyderabad (A.P.)
6.	Vijay Raghavan ¹⁶	Arm circumference and fat fold at triceps in well nourished Indian school children	1973, Hyderabad (A.P.)
7.	S.K. Bhasin et al ¹⁸	Skin fold thickness in well nourished school children in Haryana	1990, Haryana
8.	Satipati Chatterjee et al ¹⁹	Physical growth pattern for girls (9-17) from rural West Bengal	1991 West Bengal

Table 3: Height Vertex (cm): Comparison of height vertex with other similar studies

Groups (years)	Present Study		(2015)		M.V. Phadake ¹¹ (1967)		B. Bhandari ¹³ (1971)		N. Datta et al ¹⁴ (1972)		S. Chatterjee ⁸ (1991)							
	H.I.G.	F	L.I.G.	M	H.I.G.	F	L.I.G.	M	H.I.G.	F	M	F	H.I.G.	M	F	L.I.G.	M	F
	133.47	129.10	116.21	116.64	-	-	-	-	118.4 ± 20.1	133.84	132.05	127.05	126.04	-	-	126.49 ± 5.05	-	-
	136.37	140.04	121.29	122.11	128.9	129.7	127.2	124.1 ± 23	138.58	134.09	131.80	130.62	130.62	-	-	131.66 ± 5.56	-	-
	141.70	143.82	132.75	126.52	-	-	-	130.2 ± 15	143.06	143.94	136.73	136.25	136.25	-	-	137.29 ± 6.21	-	-

Table 4: Sitting Height Vertex: (cm), Comparison of sitting height vertex with other similar studies:

Age Group (yrs.)	Present Study (2015)		B. Bhandari ¹³ (1971)		S. Chatterjee ⁸ (1991)					
	H.I.G.	F	L.I.G.	M	H.I.G.	F	L.I.G.	M	F	
9-10	63.60	62.57	57.18	57.45	59.9±9.6	-	-	-	-	67.00±2.68
10-11	70.57	66.46	59.31	60.58	62.50±8.8	-	-	-	-	68.55±2.84
11-12	74.00	70.05	63.03	64.57	64.5±8.2	-	-	-	-	71.01±3.31

Table 5: Head Circumference: (cm), Comparison of head circumference with other similar studies:

Age Group (yrs.)	Present Study		(2015)		B. Bhandari ¹³ (1971)				
	H.I.G.	F	L.I.G.	M	H.I.G.	F	L.I.G.	M	F
9-10	51.80	51.14	50.68	50.82	48.4±5.2	-	-	-	-
10-11	52.62	52.67	50.12	49.46	48.9±5.4	-	-	-	-
11-12	52.64	50.37	51.10	50.76	49.0±4.4	-	-	-	-

Table 6: Chest Circumference: (cm), Comparison of chest circumference with other similar studies:

Age Group (yrs.)	Present Study (2015)		B. Bhandari ¹³ (1971)						
	H.I.G.	F	L.I.G.	M	H.I.G.	F	L.I.G.	M	F
9-10	57.90	58.99	55.19	54.67	56.1±8.4	-	-	-	-
10-11	60.89	61.81	58.31	58.56	55.4±10	-	-	-	-
11-12	62.92	63.67	58.44	60.48	54.2±11	-	-	-	-

Table 7: Mid- Arm Circumference: (cm)
Comparison of Mid-Arm Circumference with other similar studies

Age Groups (years)	Present Study (2015)		Vijay Raghvan ¹⁵ (1971)		B. Bhandari ¹³ (1971)		N. Datta ¹⁴ (1972)			
	H.I.G. M	L.I.G. F	H.I.G. M	F	H.I.G. M	F	H.I.G. M	F		
9 to 10	18.62	18.03	18.55± 1.28	18.75± 2.29	16.20± 2	15.97± 1.26	18.61	18.47	16.30	15.94
10 to 11	20.65	21.06	18.98 ± 2.41	19.28± 2.26	16.00 ± 4	16.50 ± 1.16	20.00	19.61	17.90	17.86
11 to 12	19.82	20.88	19.58 ± 1.28	19.78 ± 2.31	17.2 ± 2	16.86 ± 1.25	20.43	20.86	18.45	18.40

Table 8: Mid-arm Skin fold thickness: (cm)
Comparison of Mid- arm Skin- fold thickness with other similar studies:

Age Group (yrs.)	Present Study (2015)		Vijay Raghavan ¹⁶ (1973)		S.K. Bhasin ¹⁷ (1990)			
	H.I.G. M	L.I.G. F	H.I.G. M	F	H.I.G. M	L.I.G. F		
9-10	0.62	0.80	0.54	0.49	0.922	1.1	0.588	0.726
10-11	1.11	1.15	0.43	0.50	0.95	1.11	0.591	0.709
11-12	1.04	1.10	0.48	0.56	0.95	1.11	0.579	0.741

Table 9: Weight: (Kg)

Age Groups (years)	Present Study (2015)		M.V. Phadake ¹¹ (1967)		B. Bhandari ¹³ (1971)		N. Datta ¹⁴ (1972)		S. Chatterjee ¹⁸ (1991)		
	H.I.G. M	L.I.G. F	H.I.G. M	F	H.I.G. M	F	H.I.G. M	F	H.I.G. M	L.I.G. F	
9 to 10	27.69	28.17	20.58	-	23.30	-	28.85	27.82	25.27	24.68	21.72 ± 2.8
10 to 11	33.97	34.09	22.48	23.3	20.20	-	31.55	30.37	27.43	27.02	24.47 ± 2.62
11 to 12	34.11	35.64	28.23	-	25.00	-	34.06	34.48	29.06	28.27	27.47 ± 3.88

period may be the reason for such variations.

Discussion

History of study of growth patterns in growing children dates back to 1502 done by Gabreilade Zerbis [3]. He published Anatomic differences between a child and an Adult.

The credit for advocating the term, 'Anthropometry' goes to the Belgian astronomer statistician Lambert Aldolphe Jacques Queelet (1796-1874) [4]. His study was the first complete study of physical growth of children. He had extensive study of heights and weights of male and female subjects of all ages.

Growth studies in Adolescents was done in detail by Vierordt (1818-1884) [5] of Tubingen, along with Bowditch [6] recognized the adolescent spurt and also that the girls entered this period sooner than boys. Tanner [7,8] has made particularly large contributions on the subject of the adolescent.

Anthropometric studies are now being carried out in India on large scale. Other anthropometric reports from ancient India is from 'Archeological

Survey of India', stated by Penniman T.K. (1965) [9].

Indian Council of Medical Research (I.C.M.R.-1960) [10] published the report on the growth and development of Indian infants and children.

The purpose of present study is aimed at throwing light on growth patterns in early adolescent children in and around Satara District of both H.I.G. and L.I.G. socio-economic status.

Future of India is dependant on the physical and mental growth of the children. India being a developing country shows a great diversity in its socio-economic status, which would further reflect on the growth pattern of the children. Knowledge of growth pattern of the children is therefore imperative. Healthy children apart from developing into healthy adults and parents can also play a key role in social and health education of their younger sibling and uneducated parents. Studies of growth and development of children in a community provide important information about the nutritional status of the community.

Adolescence is a period of rapid growth. It is a transitional stage in human life. Hence this age group should be well attended and looked after. The accurate assessment of physical growth and development of children has recently created interest in the paediatricians and public health officers. In the developed countries, infectious diseases are well controlled. Their attention has now diverted to correction of disorders of growth as a primary symptom or associated with some metabolic defect. In the developing countries children's growth is now widely recognized as a sensitive index of health and nutrition of the population. Therefore W.H.O is stressing upon the health programs of pre-pubertal and adolescent boys as well as girls. This data will assist in preparing various health programs.

Children of low socio-economic group income group lag very much behind the High socio-economic group. These underprivileged children are constantly exposed to severe nutritional, social and environmental strains as revealed in the present study and the studies done earlier.

Nutritional Anthropometry is concerned with measurement of variations in the physical dimensions and the gross composition of the human body at different ages. It is one of the most important tools in assessing the nutritional status of a community or a nation, which is of great value in guiding public programs.

For establishing growth pattern, standard parameters like Height, Weight, Mid-arm skin fold, Head circumference, Chest circumference, Waist

circumference are studied.

In the present study in addition to the above parameters skin fold thickness of mid-thigh is measured. Skin fold thickness is a good indicator of the nutrition of a person and its measurement by a standard method provides a reliable index of the amount of body fat. This method can be easily applied in field for the study of large population samples for prevalence of obesity as well as to provide an additional parameter of under nutrition. Their measurement forms an essential part of assessment of physique. So far, Western standards have been used for comparison purposes. From the physiologic viewpoint, normal growth in its inception, maintenance and termination depends upon an orderly sequence of genetic, constitutional, environmental, nutritional and endocrine influences. In this context, using Western standards may have the inherent drawback as children are living under different environment and belonging to a different racial stock. Therefore in the present study, the data is compared with Indian researchers who have done their research on Indian population.

The following discussion is based on comparison, with other studies available in India.

India has diverse population of having racial, dietic and economic differences.

Various researchers of different communities have done the studies using different parameters as follows.

The study also provides a comparative picture with those similar studies undertaken from 1967 to 1991. It is now well established that all populations in the world are undergoing temporal changes with reference to body measurements mainly caused by the life style changes and better nutritional food intake.

In the Higher income group children in the urban area, it has seen that lots of efforts are taken in terms of exercises and food regulation for maintenance of specific desired body dimensions.

The values for the above measurements are compared in both genders of H.I.G. and L.I.G. in three age groups.

There is a wide heterogeneity observed amongst the Indian population across the expanse of the country, as well as between rural urban divide.

The present data also shows such a variation because the comparative data comes from heterogeneous parts. However, the overall temporal changes are clearly observable from these tables.

A few discrepancies are observed in

measurements. This is because the selection of the school children is based on only one criterion that is economic status. However within the same age group cohorts there can be children belonging to different caste or religious groups, who may have different body dimensions. The fluctuations that we observe here in different age groups could be due to samplings error.

Because of the optimum sample size the values of different anthropometric parameters derived at various age groups of both the sexes in both H.I.G. and L.I.G. socio-economic status in and around Satara District, Maharashtra State, may serve as useful reference by applicants.

Manufacturers of daily objects and wear, forensic experts and concern authorities in the field of anthropometry of 21st century are the important beneficiaries of these findings.

Summary and Conclusion

From 'Birth' to 'Death', there exists a period of growth and development. In children growth, development and nutrition are intricately inter-linked. One aspect tends to influence the other significantly. Malnutrition is a 'man-made disease', which often starts in the 'Womb' and ends in the 'Tomb'. Malnutrition and the associated retarding influences cause a lot of morbidity, growth faltering, developmental retardation and significant mortality. The ultimate expression of endowed potential for growth and intelligence is the net effect of interplay of genetic factors, nutrition and environment.

Globalization has made the people of world come closer. India is progressing with great leaps and bounds in all fields. With the progress of the country, level of the economic disparity among the people could be hopefully levelled.

Healthy children will develop into healthy adults and thus play a key role in development of our country, India. Hence the adolescent child health is a very important and prime concern of the nation. The Adolescent girl should get priority, as she is the prospective mother and thus can produce the next generation of healthy babies. This will also result in reducing the low birth weight babies by improving the nutrition of the girl child.

Studies on Adolescent growth are few. The present study attempts to understand the growth variations between genders, belonging to two different socio-economic groups.

In all 3600 school children belonging to 9 to 12 age

groups were subjected to ten Anthropometric measurements and three indices. Schools were selected by random sampling according to socio-economic status however schools of elite areas of Satara district were selected by random sampling for High socio-economic group (H.I.G.), for both sexes and Municipal Corporation/ Zilla Parishad schools in slum and Rural, below poverty line areas of Satara district were selected for Low Socio-economic group for both sexes. L.I.G. and H.I.G. were studied through anthropometrical parameters and the results clearly divide these two groups.

Thus to conclude,

The present study was undertaken with the aim to comprehend the growth Pattern of -

1. School children in the age group of 9 to 12 years.
2. School children belonging to both sexes.
3. Belonging to two different socio-economic strata.

Present study shows...

1. There is a difference in growth rate between the different age groups i.e. 9 to 10, 10 to 11, 11 to 12 years in the L.I.G. as well as in H.I.G.
2. There is a significant difference between Males and Females in these age groups and socio-economic groups.
3. Girls of both H.I.G. and L.I.G. show growth spurt in Height earlier than boys of H.I.G. and L.I.G.
4. Growth in Chest is more in females than males in both socio-economic groups.
5. Growth spurt in mid-arm circumference, mid-thigh circumference, mid-arm skin fold thickness, mid-thigh skin fold thickness is earlier at 10-11 years in both male and female, which shows decrease thereafter in the above values in 11 to 12 years groups. While steady increase in the growth is observed in the mid-arm and mid-thigh circumference in Males and Females of L.I.G. Therefore a pattern of growth of mid-arm circumference and mid-thigh circumference is similar in H.I.G. and L.I.G.
6. B.M.I. is highest in 11 to 12 years in both sexes of Higher socio-economic group (H.I.G.). It is always more than 15 kg/m² which are normal value of B.M.I. for Indians.
7. The B.M.I. observed in both sexes of L.I.G. in age group of 10 to 11 years has decreased which shows underweight (less than 15 kg/m²) but it is above 13 kg/m² (a value for severe

underweight), which can be corrected by nutritional supplements.

Until now mid-arm circumference and mid arm skin fold thickness were the parameters taken by different researchers. After studying mid thigh circumference and mid thigh skin fold thickness as different parameters it is seen that their values go parallel with that of mid-arm circumference and mid-arm skin fold thickness in both L.I.G. and H.I.G. groups. So these two new parameters i.e. mid thigh circumference and mid thigh skin fold thickness can be added in further studies.

In almost all studies we have observed that H.I.G. values are always greater than L.I.G. values in all the age groups. The growth of L.I.G. can be increased up

to the growth of H.I.G. with nutritional supplements.

The data may be useful to the applicants to understand the growth pattern in school children of age group of 9 to 12 years as influenced by the socio-economic factors.

Acknowledgement

Authors thankfully acknowledge the help and support rendered by Mrs. Manisha Sonavane, Ms. Veena Ashok Kasabe, Smt. Hira Ganpat Sonavane, all subjects and their parents so also the Principals of all the schools in and around Satara district, who permitted us to conduct the study.

ANNEXURE - I

Proforma for Collection of Anthropometric Data

Case No.: Date of Anthropometric Measurements: / /

Name of the Subject:

Name of the School:

Gender: Male / Female

Date of Birth://, Age:years.

Age Group: 9 to10 years / 10 to11 years / 11 to 12 years.

Area: Rural/Urban

Socio-economic Status: L.I.G. / H.I.G.

No. of generations in the Satara District (Maharashtra State):

Measurements:

1. Height vertex =cms
2. Sitting Height vertex =cms
3. Head circumference =cms
4. Chest circumference =cms
5. Waist circumference =cms
6. Mid-arm circumference =cms
7. Mid-thigh circumference=cms
8. Weight =..... kgs.
9. Skin fold thickness-mid arm = cms
10. Skin fold thickness-mid thigh =cms
11. B.M.I.=

**ANNEXURE - II
CONSENT FORM**

(Parent /s /Guardian should fill the consent form as all subjects are minor)

I / We and
 Age: years and years. (Name of child:
 Age: years)

Address:

Hereby state that, I / We have been fully explained about the procedure of external anthropometric measurements of my / our child.

I / We give my / our full consent for the same.

I / We also allow him to take my / our child's photographs of body measurements as a part of documentation for scientific research.

I / We also give my / our full consent to use my / our child's photographs of body measurements for research purpose, scientific publications and presentations in scientific forums.

Name /s and Signature /s of the Consultands:

1. Name: Signature:
 2. Name: Signature:

Witness to Consent:

Name: Signature:

Place:

Date: / /

**ANNEXURE - III
SUBJECT/VOLUNTEER'S ASSENT FORM**

(Assent will be taken of 7 to 15 years of age)

I Age: Years. Freely willing to be as a participant in the present study entitled "*A Study of Growth Pattern In Males and Females at Various Age Groups From Satara District of Maharashtra State*"

(Name of child:)

Address:

Gender: Male / Female

Date of Birth: / /

Age: years

Name of school:

1. I have understood the information sheet dated for above study: **YES/NO**
2. I understood that my participation in the study is voluntary: **YES/NO**
3. I understood that my identity will not be revealed: **YES/NO**
4. I allow to take my body measurements: **YES/NO**

Name of Assenter: Signature:

Name of Parent: Mr./ Mrs. Signature:

Name of Witness: Signature:

Name of Investigator: Signature:

Place:

Date: ... / ... /

ANNEXURE - IV

Abbreviations:

1. H.I.G.: - High Income Group L.I.G.: - Low Income Group
2. i.e. - That is
3. Lt. - Left
4. Rt. - Right
5. Min. - Minimum
6. Max. - Maximum
7. Avg. - Average
8. mm - Millimeters
9. Cm - Centimeters
10. Ht. - Height
11. B.M.I. - Body Mass Index
12. No. /s - Number/Numbers

Conflicts of Interest

All authors have none to declare.

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