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Original Research Article

Growth in children aged 5 to 15 years with special reference to sexual maturity rating: cross-sectional study

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ABSTRACT

Background: Puberty is a critical period for children since hormonal changes impact directly on linear and sexual growth. This study aimed to assess the growth pattern of children aged 5-15 years with special reference to sexual maturity and to find association of sexual maturity rating (SMR) with body mass index (BMI) and socioeconomic scores.
Methods: Cross sectional study was done in Pushpagiri Institute of Medical Sciences a tertiary care hospital. The 910 children in the age group of 5 to 15 years with consent /assent formed the study group via multistage sampling. Study period was for 18 months (March 2016 to September 2017). Physical examination included anthropometry and SMR by Tanner staging. Probit analysis was done to calculate the mean ages of attainment of SMR. Bivariate analysis and Pearson's chi-square test were used to test the possible association between SMR and BMI/ socioeconomic status.
Results:910 children were included in the study (M:F=1.25:1). The mean and 50th percentile values for height and weight were in close agreement in all age groups in both sexes. The maximum increase in height was noted between 11-12 years in girls and 14-15 years in boys. The mean age of onset of Gonadarche and Pubarche in boys was 11.4±0.99 years and 12.4±1.36 years respectively. The mean age of attainment of Thelarche, pubarche, and menarche was 10.4±1.38, 10.9±1.29, and 11.2±1.56 years respectively in girls. The time interval between Thelarche and Menarche was 10 months. The association of thelarche with SES was statistically significant ($p<0.001$). Overweight/obese girls showed 9.6 months earlier onset of thelarche when compared to the normal/thin subjects.
Conclusions: The study yielded normative values for height, weight, and sexual maturation patterns in children of central Kerala. Obese/overweight female subjects tend to attain sexual maturation earlier compared to non-obese subjects

Keywords: Children, Growth, Sexual maturation

INTRODUCTION

Growth is the fundamental physiologic process that characterizes childhood. Growth is the result of the concerted effect of a complex network of regulatory factors with varying interactions.

Adolescents experience different types of maturation, including cognitive, psychosocial, and physical. This complex series of physical transitions is known as puberty. Puberty is a critical period for developing excess body weight since hormonal changes impact directly on weight gain and linear growth. These changes comprise the chemical maturation of body tissues, including the amount and distribution of adipose tissue, and increase in bone mass and fat-free mass. In both sexes, there is a possibility of rapid increments in height and weight.[1]

The American academy of pediatrics reiterated the importance of growth in "Recommendations for

preventive Pediatric Health Care" stating that a child's height and weight should be measured at least at birth, age two to four days, 1, 2, 4, 6, 9, 12, 15, 18 and 24 months, and every year through the age of 21 and the measurements be plotted on a growth chart.[2]

There are regional differences in growth and development. Also, certain temporal differences have been observed in the case of sexual maturity with many children reaching adolescence earlier than normal when compared with historical data.[3,4]

A growth chart committee was formed by the IAP in January 2014 to design new growth charts for Indian children older than 5 years so that they are based on contemporary data that represents the growth of modern-day Indian children. The IAP growth chart committee recommends revised growth charts for height, weight, and BMI for the assessment of growth of 5-18-year-old Indian children.[5]

Recent Indian studies have shown that there is an increase in overweight and obese Indian Children. An association between increasing obesity and early pubertal onset has been reported across different studies. There is a paucity of data on the pattern of growth and impact of increasing obesity on pubertal development and progression in this part of the state of Kerala. We conducted the study with this aim and that underscores the relevance of the study

METHODS

This Hospital based cross-sectional study was done in the pediatric department of Pushpagiri Institute of Medical Sciences a tertiary care teaching hospital in south central Kerala. Children in the age group of 5 to 15 years satisfying the inclusion criteria with informed consent were recruited in the study. They were selected by multistage sampling till the desired sample size was achieved. The study was done in a period of one year and 6 months (March 2016 to September 2017).

Children of the age <5 years and >15 years and those with chronic debilitating diseases like cerebral palsy, chronic renal failure, congestive cardiac failure, syndromes affecting growth, children on long-term oral steroids, antiepileptic drugs & immunosuppressant were excluded from the study.

The study was formulated after obtaining approval from the institutional research and ethical committee. Subjects were recruited to the study after obtaining written informed consent from the parents/assent from the subjects. All details including the demographic data were included in a predesigned proforma. Data safety norms were followed to preserve the privacy of the patients. Socioeconomic grading was done by the modified Kuppuswamy scale 2016.[6]

Physical examination was performed which mainly included anthropometry by standard methods and SMR. SMR was done using Tanner staging.[7-8] Measurements were done by a single doctor using standard techniques. Female subjects were assessed in the presence of a female assistant.

Measurements were made following international protocols using previously standardized anthropometric techniques BMI was assessed by the formula of Quetelet.[9] The observed values were compared with IAP growth standards and CDC growth standards and were expressed in percentiles.[8,10]

For ease of assessment and comparison of data, the socioeconomic classes of the modified Kuppuswamy scale 2016 were combined and made into 3 classes. Upper middle and lower middle classes were taken together as middle and upper lower and Lower were taken as lower. Genital development in relation to age and BMI was assessed. The age of attainment of menarche was assessed by the recall method.

Statistical analysis

Data was entered into Epi-Info 7.0, free software developed by CDC, Atlanta, USA, and was analyzed using SPSS 20.0 (IBM). The categorical data were presented as frequency and percentage. Continuous data such as age, weight, and height were presented as mean and standard deviation. Probit analysis was done to calculate the mean ages of various breast development and genitalia stages and the age of menarche. Bivariate analysis and Pearson's Chi-Square test were used to test the possible association between SMR and BMI /Socioeconomic status. P value of less than 0.05 was taken as statistically significant.

RESULTS

A total of 910 subjects formed the study population. Of this, 55.6 % were males (M:F=1.25:1).

Weight

The mean, standard error, and percentile of weight for males and females of the present study are given in Table 1. The mean and 50th centile values of weight for age are in close agreement in both males and females in all age groups. A progressive increase in mean weight of 2-3 kg per year was noted in both males and females till 10 years of age. The average gain in weight from 10 to 15 years in boys was 14.5 kg and 17 kg in girls. Female subjects tend to be heavier than their male counterparts through 10-15 years.

Height

The mean, standard error, and percentile values of stature for males and females in the present study are given in

Table 2. The mean and 50thpercentile values of height for age are similar in males in females. A progressive increase in mean height of 5-6 cm per year was noted in both males and females till 10 years of age. The height increment after that was 6.6 cm, 6 cm, 3.2 cm, and 7 cm per year for boys and 7.2 cm, 3.5 cm, 5.5 cm, and 4.8 cm per year respectively. The maximum increase in height was noted between 14 to 15 years of age in boys and 11 to 12 years in girls.

BMI

The 17.1 % of the total study population was found to be either overweight or obese. Analysis of the data revealed a progressive increase in BMI through all ages in both sexes. At 15 years the mean BMI for boys was 20.4 and 20.6 for girls. The phenomenon of adiposity rebound (AR) was not observed in this age group of children

BMI and socioeconomic status

An increase in the prevalence of overweight and obesity was noted in the upper socioeconomic class (52.3%) compared to the other classes (Table 3). The lowest prevalence was observed in the lower class with only 9.1% of children in the overweight/obese range.

SMR-boys

Of the 506 male subjects studied the mean age for genital stages G2, G3, G4, and G5 were 11.4, 13.2, 13.8, and 14.4 years respectively (Table 4). The mean age of pubic hair appearance was 12.4 years in boys (Table 4). The time for progression from gonadarche to pubarche was 1 year as noted in our study.

SMR-girls

Of the total 404 female subjects the mean age for breast stages B2, B3, B4, and B5 were 10.4, 11.2, 13.1, and 13.8 respectively (Table 5). The mean age of pubarche was 10.9 years in girls (Table 5). The interval between the onset of thelarche and onset of pubarche was 6 months as observed in our study.

Menarche

The mean age of attainment of menarche was 11.2±1.56 years in the present study. The earliest age of attainment of menarche noted was 9.8 years. The time interval between thelarche and menarche was 10 months. The mean age of menarche was 11.2±1.56 years which chronologically occurred between breast stages 2 and 3.

Peak height velocity

The maximum increase in height was observed in both sexes between Tanner stage 2 and 3 and the increase being 7 cm in boys and 7.5 cm in girls (Tables 6 and 7).

Socio-economic status

The 12.2% of the total study group belonged to the upper class, 49.1% to the middle class, and 38.8% to the lower class.

Sexual development in relation to socio-economic status

The mean age of onset of gonadarche in boys of upper, middle, and lower socio-economic classes were 12.486, 12.162, and 12.880 years respectively. Pearson Chi-square test did not reveal any statistical significance in gonadarche and socio-economic class. Breast development appeared first at 10.278 years in the upper socio-economic class. Thelarche appeared a year later in the middle class and at 12.016 years in the lower class. These differences in attainment of thelarche among various socio-economic classes were found statistically significant. ($p<0.001$). The mean age of menarche was 12.493, 12.731, and 12.397 years in upper, middle, and lower SES respectively. There was no statistical significance found in menarchal age and socio-economic class. Pubarche in relation to socio-economic class was analyzed in both sexes which did not show any statistically significant association

Sexual maturation versus BMI-boys

On analyzing the association of gonadarche with BMI, no statistically significant association was found in the onset of gonadarche between normal and overweight/obese subjects (Table 8).

Sexual maturation versus BMI girls

A statistically significant association was found in analysing the association between thelarche in normal and obese females (Table 9). Overweight/obese girls showed 9.6 months earlier onset of thelarche when compared to normal/thin subjects.

Table 1: Weight (kg) mean, standard error and percentiles for boys and girls.

Age (years)	Gender	N	Mean (kg)	SE	Percentiles							
					3rd	5th	10th	25th	50th	75th	90th	97th
5-6	Boy	77	17.6	0.386	13.17	13.5	14	15	17	19	23	25
	Girl	35	17.8	0.713	11.1	11.4	12.3	16.0	17.0	20.0	23.4	25.4
6-7	Boy	76	20.1	0.386	14	14.2	16	18	20	22	25	26
	Girl	50	19.6	0.465	15.0	15.9	16.0	17.0	19.0	22.0	25.0	26.4

Continued.

Age (years)	Gender	N	Mean (kg)	SE	Percentiles							
					3rd	5th	10th	25th	50th	75th	90th	97th
7-8	Boy	52	23.0	0.58	16	16.3	17.9	21	22	24	28	31.5
	Girl	29	21.8	0.556	15.5	16.5	17.5	20.0	22.0	23.0	26.0	27.8
8-9	Boy	29	26.8	1.036	20	20.5	21.6	22	24.4	25	30	35
	Girl	15	26.1	1.394	20.0	20.9	21.6	26.5	28.0	29.2	30.0	31.5
9-10	Boy	50	28.1	0.679	20.5	21	21.5	24.8	28.5	30.6	33.9	36.5
	Girl	35	28.4	0.712	20.3	21.2	22.6	26.0	28.5	31.5	34.1	35.9
10-11	Boy	47	32.0	0.474	25.4	26.8	28	30	31.6	33	36	40
	Girl	79	31.6	0.483	22.4	23.0	26.0	30.0	32.0	34.0	36.5	41.5
11-12	Boy	43	36.8	0.403	27.3	28.1	30.8	31.5	36.5	37	38.5	45.5
	Girl	29	36.4	0.933	26.7	27.3	28.4	33.8	36.5	38.7	44.2	45.6
12-13	Boy	51	41.3	0.491	36.2	36.6	37.5	38.9	41	43	45.8	50.7
	Girl	56	42.2	0886	30.4	31.8	34.8	39.8	41.2	44.5	48.7	61.5
13-14	Boy	50	42.9	0.35	37	37.2	41.2	42.3	43.1	44	46.5	53.3
	Girl	38	46.3	1.357	32.6	35.8	39.2	40.9	44.9	49.4	55.8	65.8
14-15	Boy	31	46.6	0.644	41.6	43.1	44.3	45	46.5	47.6	48.7	54.0
	Girl	36	48.3	1.259	36.6	40.5	42.5	43.7	46.8	50.3	61.8	69.7

Table 2: Height (cm) means, standard error and percentiles for boys and girls.

Age (years)	Gender	N	Mean (cm)	SE	Percentiles							
					3rd	5th	10th	25th	50th	75th	90th	97th
5-6	Boy	77	110.8	0.545	101.3	102	105.4	107.5	110.0	113.5	119	119
	Girl	35	109.8	2.941	108.0	18.4	100.6	106	109	113	116.4	119.7
6-7	Boy	76	116.4	0.450	108.3	109	111	113	116	118	120.1	125
	Girl	50	115.5	0.666	109	109.5	110	112	115	119	123.1	127.6
7-8	Boy	52	122.0	0.384	115.7	117.0	118.6	120.0	122.5	123.5	125.5	127.6
	Girl	29	122.0	0.733	115.5	116.2	117	119.5	122	124.5	126	130.2
8-9	Boy	29	128.5	4.145	10.00	66.25	123.0	126.0	128.0	131.0	134.5	137.6
	Girl	15	130.2	0.799	125	125	126.2	127.5	129	134	134.5	135.5
9-10	Boy	50	135.4	4.319	124.0	124.8	126.0	129.0	135.2	136.1	139.0	140.4
	Girl	35	134.3	0.750	120.1	121.6	122.9	128.5	135.5	136.5	138.9	140.9
10-11	Boy	47	142.0	0.441	133.7	134.0	135.3	138.0	139.5	142.0	144.5	145.5
	Girl	79	139.0	0.325	134	135	135.6	138	139.5	142	143	145.0
11-12	Boy	43	148.7	0.396	133.9	138.0	138.7	139.8	146.0	148.6	149.4	150.6
	Girl	29	146.2	0.574	139	139.6	140.7	142.3	145.2	145.6	148.9	152.8
12-13	Boy	51	151.9	0.387	142.6	144.3	144.7	146.6	150.7	151.0	152.0	154.4
	Girl	56	149.5	1.771	141.0	145.9	146.5	147.6	149.8	152.3	154.6	158.2
13-14	Boy	50	153.1	0.294	146.9	148.9	150.0	152.2	153.5	154.5	155.5	156.4
	Girl	38	155.0	0.608	147.7	148.6	149.8	152.3	154.5	157.8	159.0	164.9
14-15	Boy	31	160.1	0.512	153.4	153.7	154.6	157.8	158.7	161.2	162.8	164.5
	Girl	36	159.8	0.762	148.1	148.9	150.1	154.4	158.7	159.4	162.7	166.9

Table 3: Distribution pattern of BMI in different socioeconomic classes.

SES	BMI	N	Percentage (%)
Upper	Normal/ thin	53	47.7
	Overweight/ obese	58	52.3
	Total	111	100.0
Middle	Normal/ thin	380	85.2
	Overweight/ obese	66	14.8
	Total	446	100.0
Lower	Normal/ thin	321	90.9
	Overweight/ obese	32	9.1
	Total	353	100.0

Table 4: Mean age of onset of boys' genitalia (G) and pubic hair (PH).

Tanner stage		Mean age of onset (years)	SD
2	G	11.4	0.99
	PH	12.4	1.36
3	G	13.2	0.88
	PH	13.7	0.69
4	G	13.8	0.68
	PH	14.1	0.63
5	G	14.4	0.64
	PH	14.9	0.58

Table 5: Mean age of onset of breast development and pubic hair in girls.

Tanner stage breast (B), pubic hair (PH)		Mean age of onset(years)	SD
2	B	10.4	1.38
	PH	10.9	1.29
3	B	11.2	1.31
	PH	12.5	1.17
4	B	13.1	1.33
	PH	14.1	0.75
5	B	13.8	0.95
	PH	14.4	0.39

Table 6: Mean weight and height in each stage of sexual development-boys genitalia.

Boy's genitalia (G) stage	Parameters	N	Minimum	Maximum	Mean	SD
2	Weight (kg)	56	25	50	36.92	6.478
	Height (cm)	56	138	163	145.24	5.752
3	Weight (kg)	47	29	47	41.87	3.704
	Height (cm)	47	141	161	152.05	4.870
4	Weight (kg)	33	37	52	44.85	2.959
	Height (cm)	33	149	166	155.46	3.939
5	Weight (kg)	5	42	64	52.48	9.830
	Height (cm)	5	155	162	159.06	3.255

Table 7: Mean weight and height in each stage of sexual development-girls breast development.

Breast development (B) stages	Parameters	N	Minimum	Maximum	Mean	SD
2	Weight (kg)	81	26	48	35.73	5.390
	Height (cm)	81	135	159	140.10	6.252
3	Weight (kg)	75	25	64	40.26	6.916
	Height (cm)	75	137	163	148.44	6.982
4	Weight (kg)	40	35	75	46.16	7.060
	Height (cm)	40	141	163	152.40	5.739
5	Weight (kg)	15	41	80	54.51	7.366
	Height (cm)	15	145	167	156.84	6.217

Table 8: Age of gonadarche in relation to BMI.

BMI	Boy's genitalia (G)		Minimum age (Years)	Maximum age (Years)	Mean	SD	Pearson chi-square
Normal	1	Tanner	5.0	14.2	8.053	2.2822	0.310
	2	Tanner	11.0	14.6	12.403	0.9814	
	3	Tanner	12.4	14.8	13.193	0.8811	
	4	Tanner	13.0	14.9	13.933	0.6311	
	5	Tanner	13.6	14.9	14.472	0.7698	

Continued.

BMI	Boy's genitalia (G)		Minimum age (Years)	Maximum age (Years)	Mean	SD	Pearson chi-square
Over-weight/ Obese	1	Tanner	5.0	12.6	7.397	1.7762	0.310
	2	Tanner	12.3	12.3	12.333	0.8976	
	3	Tanner	12.5	14.9	13.093	0.9063	
	4	Tanner	12.6	12.7	13.625	0.0589	
	5	Tanner	13.8	14.8	14.292	0.6482	

Table 9: Age of thelarche in relation to BMI.

Breast development (B) Tanner stage	BMI	Minimum age (Years)	Maximum (Years)	Mean	SD	Pearson chi-square
2	Normal	10.0	15.0	11.733	1.3874	<0.001
	Obese	10.0	11.8	10.917	1.2964	
3	Normal	10.3	15.0	12.195	1.2996	
	Obese	10.1	14.3	12.483	1.5177	
4	Normal	11.0	15.0	13.325	1.3224	
	Obese	10.2	14.3	12.458	1.1898	
5	Normal	12.2	14.9	14.048	0.9681	
	Obese	11.8	14.9	13.625	0.9512	

DISCUSSION

Weight of boys and girls in the present study, when compared to data from Agarwal et al showed an increase in mean weight in all age groups while recent Indian studies by Khadilkar et al, Khadgawat et al and Surana et al revealed a similar distribution of weight as the present study.[5,11,13] The mean weight of Indian children lags much behind the 50th percentile of CDC standards as well as in the study done by Dahinten et al from Argentina.[10,14] The difference in mean weight between CDC and the present study in both sexes is minimum in younger age groups and continues to increase with age.

The height of boys and girls in the present study when compared to a study done by Agarwal et al showed an increase in mean height in all age groups.[11] Recent Indian studies by Khadilkar et al, Khadgawat et al and Surana et al revealed a pattern similar to the present study.[5,12,13] The mean height of Indian children and the 50th percentile of CDC standards shows a marked difference.[10] The present study observed that the mean heights were comparable with that done by Dahinten et al.[14] The present data on Indian children (Mean Height) from 5 to 15 years are lower at all age points compared to CDC 2000 the mean difference is 2 cm at the age of 5 years in both sexes and 5 cm at the age of 12 years in girls and 6 cm at the age of 15 years in boys.[10]

The overall prevalence of obesity was 17.1% in the present study. Similar observations were done by Khadilkar et al and Khadgawat et al.[12,15] A study done among American-Indian children reported a prevalence of 18.5%.[16] The current Indian data as per studies done by Khadilkar et al, Khadgawat et al and Surana et al showed a trend similar to the present study.[12,13] Compared with the CDC[10]standards there is no significant difference found in the mean BMI in various age groups. Observation done by Dahinten et al showed a higher BMI at earlier age groups, but after the onset of sexual maturation, it is comparable with the data in the present study of 5 to 15 years at all ages in both sexes.[14]

Sexual maturation boys

In the present study the mean age for G2, G3, G4, and G5 were 11.4, 13.2, 13.8, and 14.4 years respectively and the study done by Agarwal et al 2.5 decades back observed the same to be at 11.9, 13.3, 14.6 and 15.9 years respectively.[11] In a similar study done by Surana et al the ages of onset of successive genital stages were 10.41, 13.06, and 14.59 years.[13] In studies from Thailand, Poland and China the mean age of gonadarche was 10.6, 11.9, and 11.4 years respectively.[17-19] The pubertal onset in our cohort revealed 6 months difference as compared to an earlier Indian study done by Agarwal et al which reported pubertal onset at 11.9 years by Tanner's method.[11] Similar secular trends were observed in Copenhagen puberty study where puberty evaluated in a combined cross-sectional and longitudinal study in 2006-2008 occurred earlier at 11.66 years in boys as compared to 11.92 years in the 1991-1993 cohort.[20]

The mean age of onset and progression of pubic hair stages in boys in the present study were 12.4, 13.7.14.1, and 14.9 years respectively for PH2, PH3, PH4, and PH5. Compared to an Indian study done by Surana et al which observed the mean age of pubic hair stages at 13.6, 14.27, 14.65, and 14.96 years.[13] Pubarche in the study on Thailand boys by Jaruratanasirikul et al was 12 years.[17]

An important issue in determining pubertal onset in boys is the lack of a single parameter, unlike thelarche which defines pubertal onset in girls and hence is difficult to study. The majority of the studies have defined pubertal onset based on gonadarche instead of pubarche and have

reported a time lag between the onset of both. Our study observed a difference of 1 year similar to earlier reports on Indian boys. This time difference varied from 9 to 15 months in studies from the United States and Europe.[19.21] In a study on Hungarian boys, pubarche occurred 2 months earlier than gonadarche.[22]

Sexual maturation girls

The mean age for B2, B3, B4, and B5 were 10.4, 11.2, 13.1, and 13.8 years respectively in the present study and the data shows a secular trend in thelarche as compared to the observations in the study done by Agarwal et al.[11] The study done 25 years back noted pubarche at 10.9 years and the successive stages at 12.8, 13.9, and 14.8 years respectively. A similar pattern of change in the timing of breast stages was observed in the study done by Khadgawat et al and the age of onset of B2, B3, and B4/B5 was 10.8, 12.6, and 13.25 years respectively.[12] Among published data in the last 10 years, the earliest pubertal onset was among Chinese girls (9.2 years).[23] There was a 6-month earlier initiation in the mean age of onset of thelarche in the present study when compared to a similar Indian study, showing a secular trend.[11] In a recent study from Turkey, the observations suggested an end of the secular trend in the onset of puberty in a transitional society.[24]

The mean age of onset and progression of pubic hair stages in girls in the present study were 10.9, 12.5,14.1, and 14.4 years respectively for PH2, PH3, PH4, and PH5. Compared to Indian study done by Khadgawat et al observed the mean age of pubic hair stages at 10.9, 12.5, and 13.1 years respectively.[12] Thelarche was first observed 6 months earlier than pubarche in the present study. Similar observations were done by Khadgawat et al and Ma et al but in contrast, the study done by Anyanwu et al among Nigerian girls noted an earlier pubarche.[12,23,25] This may be contributed by adrenal hormones initiating pubic hair development.

The mean age of menarche in the present study was 11.2±1.56 years which is in close agreement with studies from China, Brazil, Nigeria, and India [12].[12,23,25,26] Among the studies compared the earliest menarche was at 11.52 years as noted by Barcellos Gemelli et al which is at par with the present study.[26] This study on 404 girls demonstrates a trend over time of decreasing age at menarche from 12.6 to 11.2 years in the last 25 years when compared with an earlier study by Agarwal et al.[11] Meng et al observed a decline of 0.51 years per decade in the age of menarche and Chen et a observed it as 4.2 months per decade.[27,28]

The duration of progression from thelarche to menarche in our study was 9.6 months in contrast to 2.4 to 3 years as observed in other studies.[23,29] A secular trend of decline in the average age of menarche which was reported earlier has gradually slowed down as evidenced by the present study

In the present study from south central Kerala, we observed earlier onset of puberty among overweight/ obese girls, and was statistically significant. This pattern was observed by Khadgawat et al from India, Anyanwu et al from Nigeria, and Rosenfield et al from the United States.[12,25,30] Khadgawat et al observed that it would be appropriate to combine clinical examination along with gonadotropin levels for prediction of stage B2 especially in overweight and obese girls where clinical examination alone may mislead thelarche.[1]

In our study, we did not find any significant impact of overweight/obesity on the onset of puberty in boys which is in agreement with the observation done by Surana et al from India and Rosenfield et al from the United States.[25,30] The association of obesity and pubertal timing in boys may be non-linear with conflicting data at present. A few other studies reported delayed onset of puberty in overweight and obese boys the normal BMI population.[31]

In an attempt to study the association of SES and pubertal onset we observed a statistically significant difference in the attainment of thelarche in higher socio-economic classes, but the same pattern was not observed in the attainment of menarche. Qamra et al from India and Ayanwu et al from Nigeria found a similar observation in the attainment of thelarche and menarche.[32,25] No statistically significant relationship was found in boys among various socio-economic classes and the age of pubertal onset

Comparing data from the present study with the available similar immediate and past studies an effort was made to look for secular trends in the timing of pubertal events and growth parameters. When our results were compared with the earliest Indian study available done by Agarwal et al on children, the present study revealed earlier age of onset in various parameters of sexual maturation.[11] These observations may be postulated due to better living and economic conditions in India which is a fast-progressing economy.

Limitations of our study were, we had a less sample size compared with other studies and the mean intervals given in our study reflect the maturation status in the study moment and are not identical to the mean ages at which each of the stages was reached.

CONCLUSION

From our study, we concluded that the earlier age of onset of pubertal maturation needs a gonadotropin level correlation. In the background of the present observations of the secular trend of sexual maturation, there is a need to provide relevant information to parents to reduce the anxiety related to pubertal events.

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