Original Article

Pattern of physical growth and pubertal changes in adolescent girls with Systemic Lupus Erythematosus

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Abstract

Aims: To study the pattern of physical growth and pubertal changes in adolescent girls with Systemic Lupus Erythematosus (SLE). **Methods and Material:** Weight, height, BMI, waist and hip circumference among 50 adolescent SLE girls (aged 8–17 years) were cross-sectionally studied using standardized techniques and instruments. Breast development stage, presence or absence of pubic and axillary hair and age of attainment of menarche were also noted. **Results:** With the advancement of age, weight and height of SLE girls increased but they were lighter and shorter compared to normal Indian peers. 18.4% of study girls were short-statured while only one participant was underweight. As per mid-parental height, 34.3% were predicted to have shorter final heights. BMI demonstrated an inconsistent trend with 12.3% and 9.2% being obese and overweight, respectively. Interestingly, 10.7% of SLE girls were at risk of metabolic syndrome (waist circumference >70th centile). About 50% of study girls had attained menarche (mean age: 13.04 ± 1.38 years). Appearance of pubic and axillary hair occurred around 1 year later than attainment of menarche. 33.80% of study subjects were in prepubertal stage of breast development and rest 66.20% were in advanced stages of breast development. SLE girls who had younger age at diagnosis and longer duration of therapy had significant delay in breast development and attainment of menarche. **Conclusions:** SLE girls show delayed growth and pubertal attainments compared to their normal Indian and Western counterparts. The data presented will provide an understanding of the auxological dynamics and pattern of pubertal changes among adolescent girls with SLE living in north-western India.

Keywords: Anthropometry, India, physical growth, puberty, SLE

Introduction

Systemic Lupus Erythematosus (SLE) is a chronic autoimmune disorder affecting multiple systems. Commonly, the disease has its onset in adulthood while 10–20% of the cases are present in childhood.[1] Individuals in whom the onset of the disease is at <18 years of age have been considered as Juvenile Systemic Lupus Erythematosus (jSLE).[2] The incidence of jSLE ranges from 0.36 to 2.5 per 100,000 per year and the prevalence ranges from 1.89 to 25.7 per 100,000.[3] Prevalence of jSLE from the North Indian population has been reported between 14 and 60 per 100,000.[4] The disease tends to affect women more frequently than men for every age and ethnic group.[5] jSLE has a myriad of clinical manifestations with the commonly involved organ systems being the renal system, mucocutaneous, central nervous system and haematological system.[6] Patients with mild SLE can be monitored by a primary care physician, but patients with more severe symptoms and greater disease activity should be managed by rheumatologists.[7]

Growth failure and delayed puberty are unique features of juvenile SLE caused by long-term disease activity, suboptimal

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nutrition, prolonged steroid use, chronic inflammatory process itself and/or co-morbid conditions.[8-10] Growth failure was suggested to be added to the Modified Systemic Lupus International Collaborating Clinics/American College of Rheumatology (SLICC/ACR) SLE Damage Index (M-SDI) as a damage measure for paediatric SLE.[11,12] Despite being a major manifestation, growth and pubertal development in SLE are not well studied[13] and still remain an under-researched area. Only a few attempts made by various researchers in the West have revealed compromised physical growth,[13-18] as well as delayed pubertal attainments[12,16,17,19,20] among children and adolescents with SLE. Predominantly only small population studies estimating the proportion of final adulthood short stature have been conducted, and nearly one-fourth of children with SLE are expected to have shorter adult height.[18] Till date, there is not a single study documenting the auxological pattern among Indian SLE children.

Owing to growth complications associated with SLE and a lack of data describing growth trajectory in Asians, we attempted to study the pattern of physical growth and pubertal changes in adolescent girls with SLE from north-western India.

Subjects and Methods

A total of 65 observations were made on 50 girls, aged 8 to 17 years, diagnosed as cases of SLE according to ACR/SLICC criteria, inhabiting north-west India comprised sample for this study. These children were enrolled from the Pediatric Rheumatology Clinic of Department of Pediatrics, PGIMER. Each child was evaluated for different indicators of physical growth and sexual maturation in the Growth Laboratory/Clinic of Department of Pediatrics, PGIMER from June 2020 to December 2021 following a cross-sectional study design. The study protocol was approved by 'Institutional Ethics Committee'. Written informed consent was obtained from parents in the presence of a witness as well as each patient was enrolled after obtaining the 'assent for participation'. Socioeconomic status of the family was determined as per the modified Kuppuswamy SES scale. In addition, relevant demographic details and clinical history were also recorded.

All study subjects were assessed for various body parameters using standardized anthropometric techniques and instruments.[21,22] Body weight (kg) was measured with the help of an electronic weighing scale with platform wearing minimum clothing, maintaining the privacy (Make: Avery, Capacity: 150 kg, least count: ±50 grams). Height (cm) was measured using a 'Stadiometer' (Make: Holtain limited, Crymych, Dyfed, UK, least count: ±1 mm). A non-stretchable measuring tape was used to measure waist and hip circumference. Waist circumference was measured at midpoint between the lowermost margin of last palpable rib and topmost point of the iliac crest. Hip circumference was measured at level of maximum protuberance of the buttocks. Body Mass Index (kg/m^2) was calculated by dividing the weight in kilograms by the square of height in meters. Waist-Hip Ratio was calculated as the ratio of waist circumference upon hip circumference. Sexual maturity of each patient was assessed as per Tanner's Sexual Maturation Scale[23] in a separate room of the Growth Laboratory, in the presence of either parent or guardian along with another female staff posted in the Unit. Information concerning breast development stage, presence or absence of pubic and axillary hair was noted. Information with respect to age of attainment of menarche was also recorded. Parent's height (mother's height and father's height) was measured for each subject once during the study period. Mid-parental height (MPH) was calculated as:

$$\frac{(\text{Height of father in centimetres} + \text{height of mother in centimetres}) \pm 6.5}{2}$$

Target height range was obtained by adding (+) and subtracting (-) 8.0 cm to the MPH.

Statistical analysis

The Shapiro–Wilk and Kolmogorov–Smirnov tests of normalcy were used to assess the distribution of the quantitative variables. Continuous data was presented as its median and inter-quartile range when it was skewed and as its mean and SD when it was normally distributed. The study participants' mean weight, height, BMI and waist circumference were compared with the mean of a normal reference population[24,25] using a one sample *t*-test. To determine the relationship between various quantitative data sets, the Spearman correlation coefficient was computed. Depending on their suitability, Fisher's exact test or the Chi-square test were used to compare categorical data. *P* value less than 0.05 was regarded as significant. Version 22.0 of IBM SPSS Statistics was used for the analysis.

Results

Our study girls were predominantly Hindus (76%) and hailed from the region of Punjab (30%) followed by those who represented the state of Haryana (32%). The remaining 38% were from Chandigarh, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh, Delhi, Rajasthan, Uttarakhand and Maharashtra. Mean age at diagnosis was 10.3 ± 2.7 years (median: 11.0 years). Majority of girls were diagnosed between 8 and 11 years of age (38.5%). The mean duration of therapy was 3.2 ± 2.5 years (median: 3.0 years). Only 13 girls (20%) had received treatment for more than 5 years, 17 (26.2%) for less than 1 year while, in majority (53.8%) of the study girls the duration of treatment was between 1 and 5 years. Majority of study girls belonged to Lower Middle Class (34%), followed by Upper Middle (32%), Upper (30%) and Upper Lower (4%) classes. The cohort however had no representation from the Lower class.

Physical growth attainment

Mean height among SLE girls depicted a regular increase from 8 to 17 years of age [Table 1]. The study girls were shorter as compared to their normal IAP counterparts,[24] indicating

Table 1: Mean, SD of different anthropometric parameters among SLE girls

Age (years)	*n*	Height (cm)		Weight (kg)		BMI (kg/m²)		Waist circumference (cm)		Hip Circumference (cm)		Waist-Hip Ratio	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
8	4	124.77	11.30	23.57	3.98	15.41	3.78	53.60	6.91	63.37	4.86	0.84	0.06
9	3	124.90	7.91	25.85	0.21	16.66	1.97	58.25	0.35	68.93	4.10	0.82	0.08
10	3	126.33	5.21	27.50	7.37	17.14	3.79	61.05	4.59	64.63	7.35	0.92	0.09
11	12	139.85	8.47	37.13	12.29	18.73	4.92	70.06	15.93	75.98	13.62	0.91	0.06
12	5	140.38	8.54	37.50	6.48	18.92	1.52	72.13	10.36	75.36	7.29	0.92	0.03
13	7	145.91	8.83	40.54	7.45	19.10	2.41	72.04	9.53	83.70	6.47	0.86	0.08
14	7	148.72	6.48	40.94*	6.22	18.44	3.29	62.94*	5.76	79.65	10.10	0.79	0.07
15	5	151.30**	1.32	49.88	8.54	21.80	3.81	68.68*	6.34	89.13	6.76	0.79	0.05
16	7	153.74	8.97	49.47	7.10	21.03	3.56	65.35	11.38	89.23	8.25	0.77	0.05
17	12	154.00	7.26	48.33	6.19	20.61	4.15	80.45	7.06	91.30	7.53	0.84	0.02

*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$ (*indicate significant inter-group differences)

a compromised height gain. The magnitude of inter-group differences was however statistically significant only at 15 years of age ($P \leq 0.001$; CI -6.45, -3.15). 18.40% (n = 12) of our study subjects were short-statured (height for age <3rd centile). As per MPH (available for 38 patients), 13 (34.30%) were stunted.

With an increase in age, weight and BMI of SLE girls increased from 8 to 15 years whereafter, a slight decrease in mean values was recorded [Table 1]. Mean weight attainment of SLE girls was comparable to mean weights of normal population and inter-group differences remained statistically non-significant, except at 14 years ($P = 0.04$, CI -11.61, -0.09). Interestingly, in the entire cohort there was only one subject who was underweight (weight for age <3rd centile). BMI of the study group was higher compared to their normal counterparts, except having similar values at 17 years. The patients were classified into four BMI categories according to IAP (2015) references.[24] Patients with BMI < 3rd centile were classified as thin, between ≥3rd and < 23rd centile as normal, ≥23rd and <27th centile as overweight and ≥ 27th centile as obese. 75.38% (n = 49) of SLE patients had a normal BMI, 12.30% (n = 8) were obese**,** 9.20% (n = 6) were overweight. Only 3.07% (n = 2) were noted to fall in the thinness category.

The mean waist circumference of SLE girls showed a continuous increase, but it was lower than that of healthy children. The magnitude of inter-group differences was statistically significant at 9 ($P = 0.02$, CI -10.23, -3.87), 14 ($P = 0.003$, CI – 23.22, -8.90) and 15 years ($P = 0.03$, CI -21.53, -1.32) of age. It was interesting to note that 89.2% (n = 58) of our study subjects had normal waist circumference for age and 10.7% (n = 7) were at risk of metabolic syndrome (waist circumference for age ≥70th centile).[25]

Throughout the study period, mean hip circumference of SLE girls showed an inconsistent trend. It is not possible to attempt inter-population comparison for hip circumference because there are no standard references available. An additional indicator of body fat distribution is the Waist-Hip Ratio (WHR), with a WHR <0.85 in females regarded as normal. The WHR showed a mean value greater than 0.85 among our SLE girls between the ages of 10 and 13.

Pattern of pubertal changes

Mean age of attainment of menarche of our SLE girls was 13.045 ± 1.38 years, and 50.7% (n = 33) had attained menarche. The minimum and maximum age at which menarche was attained by our study subjects was 11 and 15 years, respectively. However, the appearance of pubic hair (14.58 ± 2.88 years) and axillary hair (15.00 ± 2.73 years) was noted to have occurred around 1 year later than attainment of menarche [Table 2]. Pubic hair was noted to be absent in 19 girls (29.20%); likewise, axillary hair was absent in 24 girls (36.90%) with SLE. Around 33.80% of our study subjects were still in prepubertal stage of breast development, i.e. stage B1 and the rest 66.20% were in advanced stage of breast development with 7 (10.8%) in B2, 5 (7.7%) in B3, 3 (4.6%) in B4 and 28 (43.1%) in B5 stage. The mean age of entering into puberty, i.e. stage B2 of breast development was 11.429 ± 1.618 years among our study girls [Table 2].

Sequence of occurrence/attainments of various components of SMR in our study children is as depicted below:

Breast stage →Menarche→ Pubic hair →Axillary Hair

Pearson Chi-square and Fischer's exact test were applied to look for association between age at diagnosis and duration of therapy with various anthropometric and pubertal parameters [Tables 3 and 4]. None of the anthropometric parameters were found to be significantly correlated to the duration of therapy; however, a younger age at diagnosis was found to be significantly ($P \leq 0.05$) related to a higher waist circumference and hence a greater risk of developing of metabolic syndrome. An additional comparison showed that patients with a longer therapy duration and a younger age at diagnosis had a significant delay in the onset of axillary hair and breast development ($P \leq 0.001$, $P < 0.05$, respectively). It was observed that a delay in menarche ($P \leq 0.001$) and the appearance of pubic hair ($P < 0.05$) was significantly correlated with a younger age at diagnosis.

To study the strength and direction of association between anthropometric parameters with variables of sexual maturation, non-parametric spearman's correlation coefficient was applied; mean weight, height, BMI and hip circumference among our

study subjects had a significant positive correlation ($P \leq 0.001$) with the various stages of breast development and age of attainment of menarche. However, no correlation of waist circumference with age of attainment of menarche could be observed; there was a significant correlation with the breast stage ($P < 0.05$).

Additionally, an attempt was made to investigate the relationship between components of sexual maturity and study children who were determined to be underweight (weight <3rd centile), short-statured (height <3rd centile), thin (BMI <3rd centile), overweight and obese.[24] Compared to 33.3% of SLE girls who were short in stature, 45.3% of SLE girls with normal height were found to be in breast stage B-5. Nonetheless, the outcomes lacked statistical significance. In accordance with this, it was recorded that menarche, presence or absence of pubic and axillary hair among the study girls were not found to be significantly associated with the shortness in height. Similar findings were noted for SLE girls whose weight and BMI fell below the third percentile.

Table 2: Mean age of attainment of pubic hair, axillary hair and breast development stage in SLE girls

	n	Mean±SD	Percentiles		
			25th	50th	75th
Pubic Hair					
Present	46	14.58±2.88	13.00	15.00	17.25
Absent	19	10.68±1.64	10.00	11.00	11.50
Axillary Hair					
Present	41	15.00±2.73	13.00	15.00	18.00
Absent	24	10.79±1.64	10.00	11.00	11.87
Breast Development Stage					
B1	22 (33.80%)	10.54±1.74	8.87	11.00	11.62
B2	7 (10.80%)	11.42±1.61	11.00	11.00	13.00
B3	5 (7.70%)	12.20±0.83	11.50	12.00	13.00
B4	3 (4.60%)	13.83±0.76	13.00	14.00	14.50
B5	28 (43.10%)	16.41±1.69	15.00	17.00	18.00

Discussion

Growth failure and pubertal delay are often overlooked complications in paediatric patients with SLE. The present study analyses the auxological and pubertal status of girls with SLE, from a tertiary care centre catering to the north-western India. Around 72% of our study children were diagnosed with SLE after 8 years of chronological age and only 20% had received treatment for more than 5 years. None of the subject's parents had history or features of SLE.

The mean weight and height attainments among our SLE girls showed a regular increase; however, their auxological status was compromised as compared to their normal Indian[24] and American[26] counterparts. In the present study, percentage of SLE girls with growth failure (height <3rd centile) was 18.3%, which falls in tandem with the observations made by Bandeira *et al.*,[11] and Gutiérrez-Suárez *et al.*[12], wherein 15.3% and 15.8% of the study population demonstrated poor growth attainments. These results also corroborate with the findings of Heshin-Bekenstein *et al.*[15] and Ponin *et al.*,[20] who also reported growth failure in 14.7% and 17.2% of SLE-afflicted females from Italy and Thailand, respectively. This proportion was remarkably lower than that reported by Lacks and White,[13] wherein growth failure was recorded among 38% of SLE patients from Washington, DC. The variations in the percentage may be explained by differences in the demographic profiles and may

Table 3: Association of duration of therapy with anthropometric and sexual maturity parameters in SLE girls

Anthropometric Variables	Duration of therapy				Fischer's Exact test/ Pearson Chi-Square	*P*
	Centile cut-off	Upto 1 year	1–5 year	>5 year		
Height	≥3rd centile (*n*=53)	14 (82.40%)	31 (88.60%)	8 (61.50%)	4.61	0.10
	<3rd centile (*n*=12)	3 (17.60%)	4 (11.40%)	5 (38.50%)		
Weight	≥3rd centile (*n*=64)	17 (100%)	34 (97.10%)	13 (100%)	0.87	0.64
	<3rd centile (*n*=1)	0	1 (2.90%)	0		
BMI	<3rd (*n*=2)	0	1 (2.90%)	1 (7.70%)	3.50	0.74
	≥3rd- <23rd (*n*=49)	13 (76.50%)	28 (80.00%)	8 (61.50%)		
	≥23rd - <27th (*n*=6)	1 (5.90%)	3 (8.60%)	2 (15.40%)		
	≥27th (*n*=8)	3 (17.60%)	3 (8.60%)	2 (15.40%)		
Waist Circumference	<70th centile (*n*=58)	15 (88.20%)	32 (91.40%)	11 (84.60%)	0.48	0.78
	≥70th centile (*n*=7)	2 (11.80%)	3 (8.60%)	2 (15.40%)		
Sexual Maturity Parameters						
Menarche attained	*n*=33	8 (24.2%)	13 (39.4%)	12 (36.4%)	18.83	0.000**
Pubic hair present	*n*=46	10 (21.70%)	23 (50.00%)	13 (28.30%)	6.97	0.31
Axillary hair present	*n*=41	9 (21.95%)	19 (46.34%)	13 (31.71%)	9.52	0.009*
Breast stage	B1 (*n*=22)	6 (35.30%)	16 (45.70%)	0	20.00	0.01*
	B2 (*n*=7)	4 (23.50%)	3 (8.60%)	0		
	B3 (*n*=5)	1 (5.90%)	3 (8.60%)	1 (7.70%)		
	B4 (*n*=3)	1 (5.90%)	2 (5.70%)	0		
	B5 (*n*=28)	5 (29.40%)	11 (31.40%)	12 (92.30%)		

*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$

Table 4: Association of age at diagnosis with anthropometric and sexual maturity parameters in SLE girls

Anthropometric Variables	Age at Diagnosis				Fischer's Exact test/ Pearson Chi-Square	*P*
	Centile cut-off	<8 years	8–11 years	>11 years		
Height	≥3rd centile (*n*=53)	14 (26.40%)	20 (37.80%)	19 (35.80%)	0.54	0.76
	<3rd centile (*n*=12)	4 (33.30%)	5 (41.70%)	3 (25.00%)		
Weight	≥3rd centile (*n*=64)	18 (28.10%)	24 (37.50%)	22 (34.40%)	1.62	0.44
	<3rd centile (*n*=1)	0	1 (100.00%)	0		
BMI	<3rd (*n*=2)	2 (100%)	0	0	11.21	0.80
	≥3rd- <23rd (*n*=49)	12 (24.50%)	18 (36.70%)	19 (38.80%)		
	≥23rd - <27th (*n*=6)	0	4 (66.70%)	2 (33.30%)		
	≥27th (*n*=8)	4 (50.00%)	3 (37.50%)	1 (12.50%)		
Waist Circumference	<70th centile (*n*=58)	18 (31.00%)	19 (32.80%)	21 (36.20%)	7.61	0.02*
	≥70th centile (*n*=7)	0	6 (85.70%)	1 (14.30%)		
Sexual Maturity Parameters						
Menarche attained	*n*=33	2 (6.07%)	10 (30.30)	21 (63.63)	30.06	0.000**
Pubic hair present	*n*=46	9 (19.60%)	16 (34.80%)	21 (45.60%)	10.78	0.005*
Axillary hair present	*n*=41	6 (14.60%)	15 (36.60%)	20 (48.80%)	14.25	0.001**
Breast stage	B1 (*n*=22)	12 (54.55%)	9 (40.90%)	1 (4.55%)	28.68	0.000**
	B2 (*n*=7)	2 (28.60%)	3 (42.80%)	2 (28.60%)		
	B3 (*n*=5)	2 (40.0%)	3 (60.0%)	0		
	B4 (*n*=3)	0	0	3 (100%)		
	B5 (*n*=28)	2 (7.15%)	10 (35.70%)	16 (57.15%)		

*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$

be attributed to advancement of medicine over the course of 30 years. As per mid-parental height which was available for 38 of our study patients, 34.3% were short-statured. Similar observations of a shorter-than-expected final adult height in US-based cohort with SLE were reported, and the authors concluded that onset of SLE in the pubertal period may have a major impact on final adult height.[15] A significant loss of growth potential among SLE patients has also been reported.[18,27] In a previous study, the prevalence of growth failure in SLE females with disease onset before the age of 12 was 22% compared to a prevalence of 3.3% in females with disease onset after 12 years of age.[17] These authors observed that children under the age of 12 had no catch-up growth and higher negative z-scores. On the contrary, no significant association between age at diagnosis and height attainments of SLE girls representing the present study could be observed. A higher risk of growth failure among SLE children who were short-statured at diagnosis has been reported;[18] however, due to non-availability of data related to recorded height at diagnosis for our SLE girls, we cannot conclude the same from our study.

It is widely documented that, dysregulated inflammation plays a role in obesity, metabolic syndrome and increased mean weights for age. Around 21.5% of our study children had obesity (12.3%) and were found to be overweight (9.2%). These observations corroborate with the findings of Manaboriboon *et al.*,[28] who too reported overweight (20%) and obesity (10.4%) among 11–18 year adolescents with SLE from Canada. In another study, the excess weight (BMI >25 kg/m^2) in Mexican SLE patients was attributed to increased clinical activity and to the presence of deficiencies of some essential nutrients.[29] Corticosteroids are widely known to cause increased weight gain and this may be the reason for comparable weights and higher BMI observed among our patients with SLE than the normal population. These observations reinforce the role of therapy-related morbidity and development of appropriate steroid-sparing strategies and its monitoring in SLE patients. Waist circumference, generally used as a marker of obesity and for assessing those at risk of developing metabolic syndrome later, was also measured among our study children. The proportion of subjects at risk for metabolic syndrome in our study was 10.7%. This observation brings into question if obesity phenotype induced by steroids in the paediatric age group is different from that of adults, which warrants further studies.

We also assessed sexual maturation rating (SMR) among our study subjects. Majority of SLE girls (43.10%) were in adult stage, i.e., B5 of breast development, 50.7% had attained menarche and the mean age of presence of pubic and axillary hair was ~15 years. However, our study girls were late in achieving breast stage-B2 (11.4 years) compared to the same stage recorded in well-off Chandigarh[30] and affluent Indian[31] girls at ~10.2 years. Similarly, there was a delay in attainment of menarche among SLE girls representing present study in comparison with their normal peers. It was also recorded that SLE girls who had a younger age at diagnosis and a longer duration of therapy were found to have a significant delay in breast development and were significantly correlated to a delay in menarche. This is in tandem with observations made among Canadian SLE patients[16] who had a younger age at onset and also had a significant delay in breast development and age at menarche ($P < 0.05$). These cumulative findings suggest a strong correlation that disease activity directly affects the pubertal status in SLE patients.

The girls with SLE displayed delayed growth and pubertal attainments in comparison with their healthy counterparts. This could be because physical growth of SLE patients is impacted by the disease activity. It can be deduced that a complex interaction

between the activity of the disease, appetite suppression due to chronically upregulated inflammation, and side effects from long-term steroid therapy can result in isolated reductions in height and variations in BMI depending on the severity of the inflammation or steroid use. In addition to cumulative steroid therapy, nutritional and socioeconomic factors may also play a role. Thus, emphasis on serial growth monitoring along with steroid-sparing strategies is required in children with SLE for timely institution of need-based therapeutic, nutritional and other interventions to improve their growth and pubertal status. The data presented will provide understanding of the physical and pubertal growth dynamics as well as basis for inter-population comparison of patients living with SLE. However, due to travel restrictions and closure of physical OPD in our institute during COVID-19 pandemic, this study is based on a small sample size which is a limitation of this study. Further well-planned longitudinal growth studies need to be conducted on a representative sample of children with SLE to elucidate and understand the varied auxological and pubertal aspects of these children.

Ethical policy and Institutional Review board statement

The study protocol was approved by 'Intuitional Ethics Committee' of the Institute as well as 'Departmental Review Board'.

Patient declaration of consent statement

Written informed consent was obtained from parents in the presence of a witness as well as each patient was enrolled after obtaining the 'assent for participation'.

List of Abbreviations

Abbreviation	Definition
SLE	Systemic Lupus Erythematosus
jSLE	Juvenile Systemic Lupus Erythematosus
SLICC/ACR	Systemic Lupus International Collaborating Clinics/ American College of Rheumatology
SES	Socioeconomic Status
BMI	Body Mass Index
MPH	Mid-parental height
SD	Standard Deviation
WHR	Waist-Hip Ratio
SMR	Sexual Maturation Rating

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Conflicts of interest

There are no conflicts of interest.

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