

Somatotype Variation in Relation to Sexual Maturation of Adolescent Girls of Sirmaur District, Himachal Pradesh

Taranpreet Kaur* and R. K. Pathak**

Department of Anthropology, Panjab University, Chandigarh, India

*E-mail: *<preettaran@yahoo.com>, **<rajrkpathak@hotmail.com>*

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ABSTRACT Adolescence marks a period of swift growth that is manifested in body size, shape and composition. This phenomenon occurs in all children though it varies in intensity and duration from one child to another. The adolescent spurt in skeletal and muscular dimensions is closely related to rapid development of the reproductive system which takes place at this time. In the present study the relation between somatotype and maturation of adolescent girls of Sirmaur district, Himachal Pradesh, is investigated. Age at menarche is used as indicator of female sexual maturity. The results revealed that the girls, who are early maturing, are endomorph – ectomorph, whereas the girls, who are late maturing, are balanced- ectomorph.

INTRODUCTION

Physique has been useful to assess the outcome of underlying growth and maturation and it also provides an insight to the biological variations among human beings. Somatotyping is extensively used in research for describing and understanding variations in human physique and quantification of the present shape and composition of human body in terms of endomorphy-relative fatness, mesomorphy-relative muscularity or robustness, and ectomorphy- relative linearity (Carter and Heath 1990). Buffa et al. (2003) found that the body dimensions of the adolescent girls mainly increase in concomitance with sexual maturation. Age at menarche is a biological milestone in maturation of adolescent girls and provides a good indicator of sexual maturity. There are studies (Frisancho and Flegel 1982; Sharma et al. 1988; Singal et al. 1990; Talwar and Bhavjit 1994; Pathak 1995; Talwar and Kaur 1997; Kaul et al. 1997; Chang et al. 2000) which reveal that experiencing menarche influences the relative measurements like height, weight, skinfold measurements and overall physique of the girls. But according to Gerber and Stern (1999), body size and body mass measured in various studies as height, weight and skinfold thickness influence the sexual maturation. Again Buffa et al. (2003) remarked that the age at menarche influences the fat mass but not the distribution of visceral and subcutaneous fat. But Classens et al. (2003) contradicts above in his study on world top junior rowing athletes as he found no significant relationship between the age at menarche

and physical and body composition characteristics.

Objective

In the present study, the researchers intend to examine the relationship between somatotype (physique) and sexual maturation (menarche) among adolescent girls of Himachal Pradesh to seek generalisations concerning the somatotype variations during adolescence.

AREA AND PEOPLE

Nahan area under district Sirmaur of Himachal Pradesh is situated over an isolated ridge in the Sivaliks at an altitude of about 932 meters. The area has several famous temples and tanks which add considerably to its attractions, with an ancient palace. Among them, 'Renukaji' is most famous and is visited by lot of tourists every year. It is a lake that resembles a human figure. It is believed that Lord Parshu Rama's mother consecrated into water out of which this lake was formed and there is temple of goddess Renuka along the lake which is of great religious importance among the localities. Climate is pleasant here throughout the year. The main dialect of the area is 'Pahari Sirmauri' followed by Hindi. Mainly people here are Hindus but a small fraction of population belong to Sikh, Muslim, Jain and Buddhist communities. The majority of the Hindus are Rajputs, followed by Brahmins and Kolis. Other caste groups found in the area are Baniyas, Domes and Chimbhas. The majority of population earns their livelihood from petty

jobs. Some are employed in government jobs mostly class IV employees. A few of them are working as teachers or supervisors or clerks in different government institutions. So, mostly the population belongs to the low income group barring few who are from middle income group. Owing to the geographical conditions, life here is really hard.

MATERIAL AND METHODS

Present study is conducted on 286 school going girls ranging between 11-16 years of age, belonging to Nahan area of District Sirmaur. Only those subjects, who were apparently physically and mentally normal and did not suffer from any deformity, were included in the sample. Each subject was measured for ten measurements viz; height, weight, triceps skinfold, subscapular skinfold, suprailiac skinfold, medial calf skinfold, biceps girth, calf girth, humerus bicondylar diameter and femur bicondylar diameter following Carter and Heath (1990). The subjects were somatotyped using 'Heath and Carter Anthropometric Somatotype Method'. Equations used for a decimalized anthropometric somatotype are:

- i) Endomorphy (Endo) = $-0.7182 + 0.1451(X) - 0.00068(X^2) + 0.0000014(X^3)$.

Where, 'X' is the sum of triceps, subscapular and supraspinale skinfolds. The sum of the three skinfolds was adjusted for body size by multiplying it by 170.18/stature (cm).

- ii) Mesomorphy (Meso) = $[(0.858 \times \text{humerus breadth}) + (0.0601 \times \text{femur breadth}) + (0.188 \times \text{corrected biceps girth}) + (0.161 \times \text{corrected calf girth})] - (\text{height} \times 0.131) + 4.50$

- iii) Ectomorphy (Ecto) = $\text{HWR} \times 0.732 - 28.58$

Where HWR (Height-Weight Ratio) = $\frac{\text{Height}}{\sqrt[3]{\text{Weight}}}$.

If HWR < 40.75 but > 38.25 then Ectomorphy =

$\text{HWR} \times 0.463 - 17.63$, and if, $\text{HWR} \geq 38.25$, then a rating of 0.1 is assigned for Ectomorphy.

The individual somatotypes thus obtained, were plotted on the somotocharts, for describing the pattern of component dominance, with the help of super imposed grid system using X and Y coordinates. The X and Y co-ordinates were calculated using the following formulae: $X = \text{III} - \text{I}$; $Y = 2 \text{ II} - [\text{I} + \text{III}]$. Where, I is first component or endomorphy, II is second component or mesomorphy, III is third component or ectomorphy.

Information on menarcheal status was sought following "status quo" method and median age of menarche is calculated using probit analysis. Arithmetic mean, standard deviation and Student's t-test have been employed to interpret the data in numerical terms.

RESULTS AND DISCUSSION

The number and percentage of girls, according to their menarcheal status, are presented in Table 1. The percentage of girls reporting menarche to have occurred, at the time of investi-

Table 1: Menarcheal status according to age

Age group (Years)	N	Menarche			
		Not occurred		Occured	
		Num- ber	Perce- ntage	Num- ber	Perce- ntage
11	48	47	97.92%	1	2.08%
12	55	45	81.82%	10	18.18%
13	52	43	82.69%	9	17.31%
14	39	18	46.15%	21	53.85%
15	43	11	25.58%	32	74.42%
16	49	6	12.25%	43	87.76%

N=Total number of subjects

Table 2: Age changes in mean somatotypes and X and Y coordinates in adolescent girls of Nahan area

Age group (years)	N	Mean somatotype (Endo-Meso-Ecto)	Co-ordinates	
			X	Y
11	48	2.76 - 2.86 - 4.45 (0.83 - 0.72 - 1.20)*	1.68 (1.75)	-1.50 (2.15)
12	55	3.11 - 2.91 - 4.20 (0.98 - 0.78 - 1.20)	1.10 (1.96)	-1.46 (2.24)
13	52	2.76 - 2.41 - 4.55 (0.94 - 0.87 - 1.31)	1.75 (2.00)	-2.37 (2.65)
14	39	3.57 - 2.62 - 3.89 (0.94 - 0.96 - 1.39)	0.32 (2.11)	-2.23 (2.65)
15	43	3.49 - 2.09 - 4.32 (1.21 - 0.90 - 1.28)	0.82 (2.27)	-3.63 (2.32)
16	49	3.99 - 2.47 - 3.89 (1.07 - 0.92 - 0.99)	-0.11 (1.75)	-2.94 (-2.37)

* SD in parenthesis

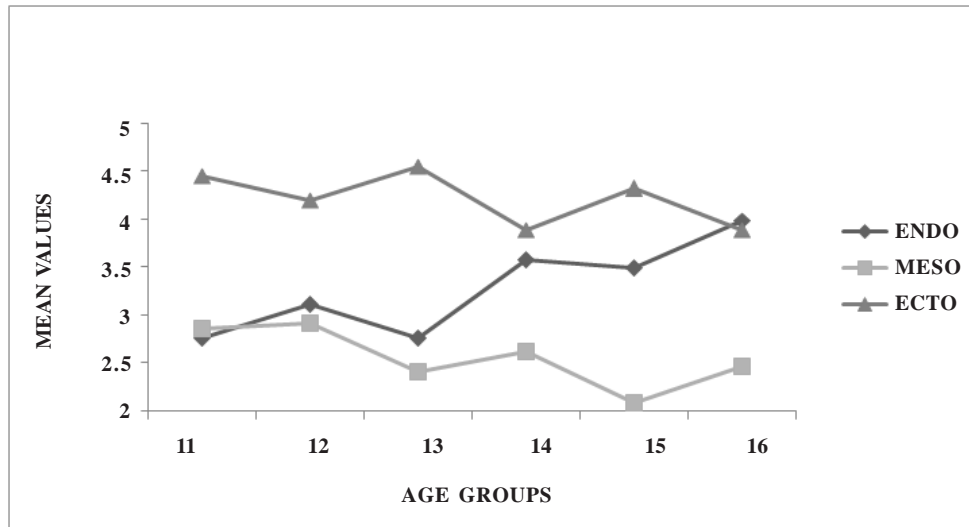


Fig. 1. Distance curve for various components of somatotype (endomorphism, mesomorphism and ectomorphism)

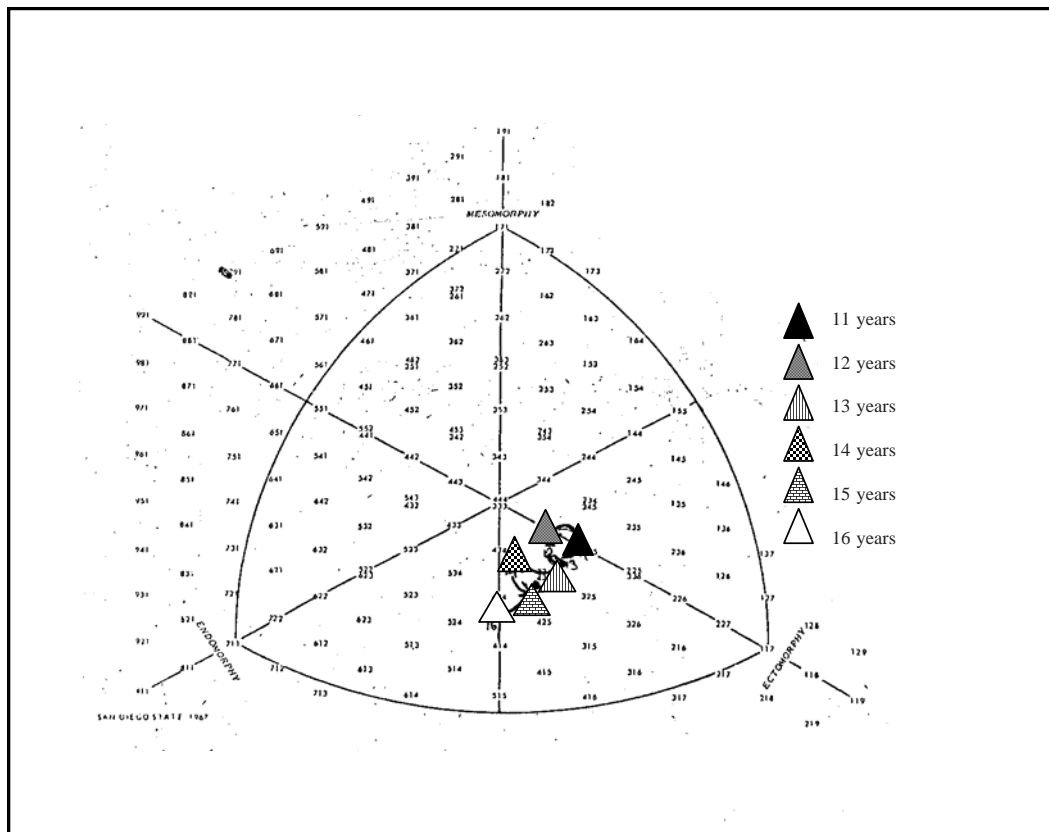


Fig. 2. Somatochart showing age changes wise mean somatotype of the sample

Table 3: Relationship between menarche and somatotype

Age group (years)	N	Menarche occurred			N	Menarche not occurred			t- values Endo-Meso-Ecto
		Mean (SD) Endo-Meso-Ecto				Mean (SD) Endo-Meso-Ecto			
12	10	3.6754	- 3.1553	- 3.4947	45	2.9803	- 2.8816	- 4.3543	2.0435*-1.0922-1.8972
		(0.93)	(0.65)	(1.26)		(0.95)	(0.81)	(1.13)	
13	9	3.7499	- 2.6435	- 3.7989	43	2.5475	- 2.3502	- 4.7038	
		(1.22)	(1.07)	(1.11)		(0.73)	(0.85)	(1.31)	2.7090**-0.7303-2.0465*
14	21	3.9969	- 2.7318	- 3.4780	18	3.0726	- 2.4807	- 4.3656	3.4351**-0.8151-2.0204*
		(0.88)	(1.10)	(1.30)		(0.74)	(0.73)	(1.34)	3.4351**-0.8151-2.0204*
15	32	3.7441	- 2.0952	- 4.1912	11	2.7816	- 2.0810	- 4.6941	3.0241**-0.4499-1.2573
		(1.24)	(0.89)	(1.34)		(0.73)	(0.91)	(1.01)	3.0241**-0.4499-1.2573
16	43	4.0952	- 2.5026	- 3.8324	6	3.2648	- 2.2594	- 4.2893	1.9275-0.7656-0.9632
		(1.06)	(0.95)	(0.99)		(0.89)	(0.63)	(1.00)	1.9275-0.7656-0.9632

** Significant at 1% level

* Significant at 5% level

gation, increased with increasing age. Converting the percentage of girls, in whom menarche had occurred, into probit values and using graphical method, the median age (\pm S.D.) at menarche for adolescent girls of present sample is found to be 13.90 ± 0.85 years.

Mean (\pm S.D.) somatotypes (Table 2) were studied along with X and Y co-ordinates for different age groups and same had been plotted in a somatochart (Fig. 2) in order to evaluate the age changes and variation in mean somatotypes. It is clear from Figure 2 that the mean somatotype of adolescent girls of present study changes from balanced ectomorph (at 11, 12, 13 years) to endomorph-ectomorph (at 14 years) to endomorph-ectomorph (at 15 years) and again to endomorph-ectomorph (at 16 years). Further, the somatotype values of the subjects are compared according to their maturation status (Table 3) and here, the age group 11 is being ignored since there is only one girl in the group who has experienced menarche. The comparison reveals that the girls who had experienced menarche show higher values for endomorphy and mesomorphy but lower values for ectomorphy in comparison to the girls in whom menarche had not occurred. The girls who had experienced menarche show significantly higher values for endomorphy in all age groups, except for age 16 (where it is approaching significance level, that is, $t = 1.9275$) than the girls who had not been menstruating. Similarly, the ectomorphy values for all age groups are higher for the menstruating girls than the non-menstruating girls, though

significant differences are observed only for 13 and 14 year age groups. Whereas, in case of mesomorphy, again the values are higher in girls who have experienced menarche, but the differences are not statistically significant.

The results thus reveal that menarche (sexual maturation) has definite impact on the somatotype (physique) of the adolescent girls, with both endomorphy and ectomorphy values undergoing a greater change as compared to the mesomorphy values (as depicted in Fig. 1). This is further supported by the mean somatotypes, as girls who are early maturing are endomorphic ectomorph, while the girls who are late maturing remain balanced ectomorph for all age groups.

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