

Menarcheal Status and Physical Structure of Punjabi Girls

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ABSTRACT The present study has been conducted on 301 Punjabi adolescent girls with a view to exploring the relationship between sexual maturity and physical structure. Data in respect of anthropometric measurements and menarcheal status were collected from Ropar District of Punjab during April 1990. Anthropometric measurements have been taken following the standard techniques given by IBP/HA sub-committee (Tanner et al., 1969). Status quo information regarding menarcheal status was collected from the girls. Amount of body fat was derived from the equations of Slaughter et al. (1988) and log transformations were applied to the skinfolds before applying any statistics. The data were split up into two groups, viz., early and late maturers on the basis of menarcheal status. Age based comparisons indicate that the early maturing girls have larger body dimensions than the late maturing ones. The menstruating girls are fatter than the non menstruating ones at 13 and 14 years. The menstruating girls have broader physical frame, are more massive and possess a greater sturdiness of their musculo-skeletal structures. The early maturity is linked to greater physical performance whereas the late maturity brings in other problems related to social adjustments.

INTRODUCTION

The onset of menarche is a useful indicator of maturity in girls and is associated deeply with physical growth and development. The menarcheal age in females can rightly be considered as a measure of adolescent development which marks the definite and probably mature state of uterine development in majority of the cases. It generally occurs about a year after the apex of the height spurt. Harmonious growth is reflected through a well co-ordinated development of different measures of maturity.

Can it be argued that the early maturing girls are also ahead in physical measurements? An earlier study conducted by Singh and Malhotra (1990) indicated that the boys who were early maturers in terms of sexual characteristics

were taller, heavier and bigger in various body measurements than their late maturing counterparts. Tanner (1978) has also emphasised that the early maturing boys, on the average, are always ahead of the late maturing ones after birth just as the average girl is developmentally ahead of the average boy.

Maturity status affects the growth and physical performance among adolescents. According to Beunen (1989), the early maturing boys and girls are advanced in their physical growth at various ages. The earlier the maturity, the larger the amount of lean body mass, fat mass and heart volume among the growing children. A compilation of various studies done by Beunen et al. (1989) reflects that the skeletally advanced girls had larger body dimensions than the skeletally retarded ones. Because of the role of differential maturity on physical structure and consequently the physical performance, the biological age has been recommended as the most appropriate classification for adolescent sports competitions. According to a study conducted by Singh et al. (1992, 1996) the sports boys who were actively competing in sports had significantly larger body dimensions than those who never participated in sports. Biological age has been recommended by Beunen et al. (1981) as the most appropriate classification for the adolescent sports competitions. Clearly the maturity and physical structure are inter-linked. This emphasizes and highlights the need to explore maturity linked differences in body structure.

The present study has been planned on Punjabi adolescent girls on these lines to evaluate the effect of maturity status on physical measurements. The menarcheal status has been chosen as the criterion for the maturity status.

MATERIALS AND METHODS

The sample of the present study includes

301 Punjabi girls ranging in age from 12 to 15 years. The data were collected during April, 1990 from Ropar District of Punjab. The anthropometric measurements taken included height, weight, linear measurements, circumferences, diameters and skinfolds. The information about the menarcheal status was also noted. The girls were taken into confidence and were asked to report about their menarcheal status, which was recorded as year or no. The lady teachers of the schools from where the data were collected provided the maximum co-operation in obtaining the information from the girls regarding their menarcheal status.

The date of birth of the girls were recorded from the school registers which maintain fairly accurate records. The ages were calculated upto three decimal places with the help of decimal age calendar. The data were arranged in yearly age groups so as the age of the mean group comes around a whole year figure.

The body measurements were taken following the IBP/HA techniques given by Tanner et al. (1969). The data of each year were further split up in two groups, viz., the early and the late maturers. The menarcheal status (whether experienced or not) has been taken as the criterion of maturity.

Standard statistical techniques were applied to calculate the descriptive statistics. Skinfolds were converted into their logarithmic values by using the formula of Edwards et al. (1955)

which is as follows:

$$Z = 100 \log_{10} (X \text{ in } 1/10\text{mm} - 18)$$

where X is the actual measurement.

The consistency/reliability of the investigator regarding the measurements can be checked in table 1. It is based on the measurements taken on two consecutive days on 10 subjects.

The difference on two occasions in different body measurements are very small. Only the skinfolds show a difference of 2.57% when taken on two different occasions. The correlation coefficients between different body measurements taken as two occasions are very high, all correlation greater than 0.92.

RESULTS

Comparisons between the early and late maturing Punjabi girls for body weight, stature, humerus bicondylar and femur bicondylar diameter have been made in table 2. The menstruating girls who have been termed as early maturers are significantly heavier in body mass from 12 to 15 years than their late maturing counterparts. The early maturers also possess significantly greater values of height, humerus and femur bicondylar diameter than the late maturers at most of the ages.

Table 3 and 4 indicate comparisons for the skin and subcutaneous tissue fold thicknesses between menstruating and non-menstruating

Table 1 : Reliability for taking measurements

S. No.	Measure	Mean difference	%age difference	Coefficient of correlation	Standard error of coefficient of correlation
1.	Weight (kg)	0	0	1.00	0
2.	Height (cm)	0.39	0.25	0.98	0.090
3.	Upper arm circumference (N) (cm)	0.01	0.81	0.99	0.005
4.	Upper arm circumference (F) (cm)	0.10	0.38	0.99	0.002
5.	Calf circumference (cm)	0.05	0.15	0.99	0.010
6.	Biacromial diameter (cm)	0.04	0.11	0.99	0.016
7.	Bicristal diameter (cm)	0.01	0.04	0.99	0.019
8.	Humerus bicondylar (cm)	0.00	0.00	1.00	0.000
9.	Femur bicondylar (cm)	0.11	0.30	0.99	0.002
10.	Triceps (mm)	0.35	1.48	0.95	0.060
11.	Subscapular (mm)	0.82	4.89	0.93	0.070
12.	Suprailiac (mm)	0.25	1.52	0.92	0.100
13.	Calf skinfold (mm)	0.29	1.09	0.94	0.060

girls. Generally, the menstruating girls possess significantly thicker fat folds at triceps, subscapular, suprailiac and calf than the non-menstruating girls between 12 and 15 years of age.

The percentage of body fat as calculated with the help of equations given by Slaughter et al. (1988) in menstruating and non-menstruating girls has been given in table 3. It emerges from the table that the menstruating girls possess significantly greater percentage of body fat than the late maturing girls only at 13 and 14 years.

The biacromial and bicristal diameters are significantly larger in early maturing girls as compared to their late maturing counterparts almost at all ages (Table 5).

Generally, the early maturing girls possess significantly greater values of upper arm and calf circumferences.

It may be generalised from the forgoing results that the early maturing girls described in terms of menarcheal status have significantly larger body dimensions than the late maturing

girls. It is indicative of their broader physical frame, sturdiness and massivity.

DISCUSSION

From the present study it has emerged beyond doubt that the maturity status is linked to the physical structure among the adolescent girls of Punjab. The early maturers defined in terms of menarcheal status are not only heavier in body mass, taller in stature, bigger in other linear dimensions but are also more fatty than their late maturing counterparts.

Generally, the different measures of maturity are interlinked (Tanner, 1962). Maturity in one indicator is related to the maturity in the other. On the basis of this, it is expected that the girls who are ahead in sexual maturity should also be ahead in the physical maturity.

The indicators of physical maturity include the timing of the adolescent spurt and the percentage of given measurement to its mature value. The girls who would enter the adoles-

Table 2 : Mean, S.D. and t-value of menstruating and non-menstruating girls for body weight, stature, humerus bicondylar and femur bicondylar diameters

Age group	Menstruating			Non-menstruating			t-value
	N	Mean	S.D.	N	Mean	S.D.	
<i>Body weight (kg)</i>							
12±	18	37.22	6.43	55	29.69	5.37	4.40*
13±	39	39.25	6.52	39	32.56	6.86	4.14*
14±	53	41.26	6.30	23	32.95	5.74	5.65*
15±	58	39.37	6.95	16	34.93	6.45	2.41*
<i>Stature (cm)</i>							
12±	18	147.45	4.60	55	140.72	6.94	4.70*
13±	39	149.70	5.43	39	145.33	6.59	3.27*
14±	53	151.49	6.01	23	146.89	6.00	3.08*
15±	58	151.44	4.85	16	148.93	5.13	1.76
<i>Humerus bicondylar (cm)</i>							
12±	18	5.60	0.27	55	5.53	0.38	1.00
13±	39	5.61	0.25	39	5.43	0.24	3.60*
14±	53	5.61	0.36	23	5.46	0.39	1.68
15±	58	5.60	0.26	16	5.48	0.26	1.09
<i>Femur bicondylar (cm)</i>							
12±	18	8.01	0.32	55	7.72	0.38	3.60*
13±	39	7.99	0.36	39	7.82	0.46	2.12*
14±	53	8.22	1.14	23	7.43	1.38	2.54*
15±	58	7.90	0.35	16	7.82	0.35	1.00

* P < 0.05

Table 3 : Mean, S.D. and t-value of menstruating and non-menstruating girls for triceps skinfold, triceps skinfold after log, calf skinfold, calf skinfold after log and percentage body fat

Age group	Menstruating			Non-menstruating			t-value
	N	Mean	S.D.	N	Mean	S.D.	
<i>Triceps skinfold (mm)</i>							
12±	18	17.94	4.31	55	13.78	3.18	3.63*
13±	39	18.28	3.47	39	15.58	3.64	3.41*
14±	53	18.59	3.90	23	16.08	2.93	3.13*
15±	58	18.17	3.96	16	16.25	3.47	1.93
<i>Triceps skinfold after log</i>							
12±	18	219.05	13.55	55	207.50	12.58	3.33*
13±	39	218.12	17.34	39	212.43	12.14	1.68
14±	53	221.37	10.69	23	213.91	9.36	3.06*
15±	58	220.22	10.97	16	214.50	11.93	1.73
<i>Calf skinfold (mm)</i>							
12±	18	19.55	4.15	55	15.53	4.01	3.65*
13±	39	19.00	3.21	39	16.91	3.94	2.58*
14±	53	19.15	3.85	23	16.39	3.31	3.20*
15±	58	17.84	4.06	16	18.37	2.84	0.45
<i>Calf skinfold after log</i>							
12±	18	223.66	10.15	55	212.90	11.80	3.74*
13±	39	222.82	9.20	39	216.58	11.57	2.64*
14±	53	223.00	9.50	23	215.39	10.27	3.04*
15±	58	219.24	10.81	16	221.37	7.64	0.89
<i>Percentage body fat</i>							
12±	18	24.68	4.56	55	20.26	3.37	0.99
13±	39	25.42	3.67	39	21.60	3.46	4.83*
14±	53	25.85	3.89	23	22.30	3.65	3.85*
15±	58	25.80	4.19	16	23.84	4.11	1.70

* P < 0.05

Table 4 : Mean, S.D. and t-value of menstruating and non-menstruating girls for subscapular, subscapular after log, supra iliac and supra iliac after log

Age group	Menstruating			Non-menstruating			t-value
	N	Mean	S.D.	N	Mean	S.D.	
<i>Subscapular (mm)</i>							
12±	18	10.75	3.21	55	8.11	2.11	3.64*
13±	39	11.51	3.07	39	8.34	2.13	5.37*
14±	53	11.91	3.15	23	8.82	2.37	4.82*
15±	58	12.35	3.90	16	11.34	3.59	0.99
<i>Subscapular after log</i>							
12±	18	189.55	18.90	55	177.98	13.85	2.40*
13±	39	196.61	13.60	39	179.61	13.09	5.64*
14±	53	198.58	12.66	23	182.60	12.90	5.00*
15±	58	199.75	15.32	16	194.93	16.26	1.06
<i>Supra iliac (mm)</i>							
12±	18	11.02	3.38	55	7.43	2.38	4.69*
13±	39	10.87	3.01	39	8.23	2.57	4.19*
14±	53	10.95	2.76	23	8.06	2.35	4.73*
15±	58	11.11	3.16	16	10.06	2.27	1.54
<i>Supra iliac after log</i>							
12±	18	191.05	15.15	55	171.54	16.50	4.64*
13±	39	193.25	15.10	39	177.82	15.81	4.42*
14±	53	194.26	13.43	23	156.82	15.86	9.90*
15±	58	194.62	14.93	16	184.90	22.21	1.66

* P < 0.05

Table 5 : Mean, S.D. and t-value of menstruating and non-menstruating girls for upper arm circumference (Normal), upper arm circumference (flexed), calf circumference, biacromial diameter and bicristal diameter

Age group	Menstruating			Non-menstruating			t-value
	N	Mean	S.D.	N	Mean	S.D.	
<i>Upper arm circumference (N) (cm)</i>							
12±	18	20.21	2.07	55	18.11	1.76	3.96*
13±	39	20.71	2.12	39	18.63	1.73	4.07*
14±	53	21.50	2.14	23	18.58	1.60	6.70*
15±	58	21.10	1.98	16	20.00	1.96	0.55
<i>Upper arm circumference (F) (cm)</i>							
12±	18	20.24	5.42	55	19.31	1.81	0.72
13±	39	21.92	2.17	39	19.37	1.70	3.94*
14±	53	22.81	2.39	23	19.76	1.64	1.82
15±	58	22.41	2.06	16	21.71	2.83	0.94
<i>Calf circumference (cm)</i>							
12±	18	27.45	2.35	55	25.44	2.08	3.29*
13±	39	27.68	2.17	39	26.04	2.42	2.09*
14±	53	28.46	2.04	23	25.52	2.21	5.65*
15±	58	28.12	1.98	16	26.66	2.33	2.35*
<i>Biacromial diameter (cm)</i>							
12±	18	31.24	1.40	55	29.90	2.29	3.11*
13±	39	31.40	1.90	39	30.32	2.00	2.51*
14±	53	31.85	2.62	23	30.00	2.73	2.84*
15±	58	32.00	2.03	16	31.15	1.61	1.84*
<i>Bicristal diameter (cm)</i>							
12±	18	21.78	1.43	55	20.54	1.71	3.17*
13±	39	21.71	2.02	39	20.53	1.97	2.68*
14±	53	22.40	1.87	23	21.03	2.02	2.85*
15±	58	22.49	1.57	16	21.64	1.57	1.97*

* P < 0.05

cence earlier are likely to be nearer their adult values for a given variable. The early maturing girls of the present study thus may be closer to their final adult values than their late maturing counterparts. Studies conducted by Beunen (1989) Beunen et al. (1978, 1982, 1989) is also conform to the present findings. According to Beunen et al. (1976) the early maturing girls (skeletal maturity) had significantly larger body measurements than those of the late maturing girls. Around 15 and 16 years of age the differences in physical measurements except for body weight and body girths disappear between the two groups. Singh et al. (1992) have pointed out that perhaps it indicates that the skeletal maturity status after 15 years of age is not of much consequence in girls for determining the motor performance tests, and in physical dimensions. The findings reported by Malina (1977) on female adolescent athletes have indicated that the girls who excel in sports are generally the late maturing ones. In

majority of the sports except for the swimming and gymnastics the girls who establish themselves have delayed menarche (Malina 1983). Studies conducted by Sidhu and Grewal (1980) and Mokha and Sidhu (1989), indicate a positive relationship between the athletic performance and the age at menarche. The maturity status of children is of a major social consequence.

Since the maturity status of the children is genetically determined hence, it cannot be altered (the late maturers can not be made early maturers). The emotional, psychological, educational and social problems faced by the early maturers are different from those of the late maturers. There is a need of proper management and counselling of different groups of girls so as they may be brought out of these years of turmoil smoothly.

REFERENCES

Beunen, G. : Biological age in pediatric exercise research.

- Advance in Pediatric Sport Science*, 3 : Biological issue (1989).
- Beunen, G., Beul, G.de, Ostyn, M., Renson, R., Simons, J. and Van Geuvan, D. : Age of menarche and motor performance in girls aged 11 through 18. *Medicine Sports*, 11 : 18 (1978).
- Beunen, G., Ostyn, M., Renson, R., Simons, J. and Van Geuvan, D. : Skeletal maturation and physical fitness of girls aged 12 through 16. *Hermes (Leuven)*, X : 445-457 (1976).
- Beunen, G., Ostyn, M., Simons, J., Renson, R., and Van Geuvan, D. : Chronological and biological ages as related to physical fitness in boys 12 to 19 years. *Ann. Hum. Biol.*, 8 : 321 (1981).
- Beunen, G., Simons, J., Ostyn, M., Renson, R. and Van Gerven, D. : Physical fitness as related to biological maturity. *Anthrop. Kozl.*, 26 : 149 (1982).
- Edwards, D.A.W., Hammond, W.H., Healy, M.J.R., Tanner, J.M. and Whitehouse, R.H. : Design and accuracy of callipers for measuring subcutaneous tissue thickness. *Brit. J. Nutr.*, 9, 133-143 (1955).
- Lindgren, G. : Height, weight and menarche in Swedish urban school children in relation to Socio-economic and regional factors. *Ann. Biol.*, 3 : 501-528 (1976).
- Low, W.D., Ng, C.K. and Fung, S.H. : Relationship between the age at menarche and the growth in biacromial and bi-iliac diameters. *Z. Morph. Anthropol.*, 69 : 308-315 (1978).
- Malina, R.M. : Physical growth and maturity characteristics of young athletes. In : *Children and Youth in Sport*. R.A. Magill, M.J. Ash and F.L. Smkoel (Eds.). *A Contemporary Anthropology*. Human Kinetic Publishers. Champaign, Illinois (1977).
- Malina, R.M. : Human growth, maturation and regular physical activity. *Acta Medic. Auxo.*, 15 : 5-27 (1983).
- Mokha, R. and Sidhu, L.S. : Age of menarche in Indian female basketball and volleyball players at different competitive levels. *Br. J. Sp. Med.*, 23 : 237 (1989).
- Shuttleworth, F.K. : The physical and mental growth of girls and boys age six to nineteen in relation to age at maximum growth. *Mongov. Soc. Res. Child Development*, 4 : 3 (1939).
- Sidhu, L.S. and Grewal, R. : Age of menarche in various categories of Indian sports women. *Br. J. Sports Med.*, 14 : 199 (1980).
- Slaughter, M.H., Lohman, T.G., Boilean, R.A., Horswill, C.A., Stillman, R.J., Vanloan, M.D. and Bembien, D.A. : Skinfold equations for estimation of body fatness in children and youth. *Hum. Biol.*, 60 : 709-723 (1988).
- Singh, S.P. and Malhotra, P. : Physical growth of early and late maturing Gaddi Boys of the Western Himalaya. *J. Ind. Anth. Soc.*, 25 : 141-146 (1990).
- Singh, S.P., Sidhu, L.S. and Singh, J. : Skeletal maturity of sports and non sports boys. In : *Human Biology-Global Developments*, L.S. Sidhu and S.P. Singh. (Eds.). USG Publishers & Distributors, Ludhiana (1996).
- Singh, S.P., Sidhu, L.S. and Singh, J. : Skeletal maturity In : *Growth Development and Physical Performance*. Human Biology Publication Society, Patiala (1992).
- Tanner, J.M. : *Growth at Adolescence*. Blackwell Scientific Publications, Oxford (1962).
- Tanner, J.M. : *Foetus into Man*. Cambridge University Press, Cambridge (1978).
- Tanner, J.M., Hiernaux, J. and Jarman, S. : Growth and physique studies. In : *Human Biology, A Guide to Field Methods*, J.S. Weiner and J.A. Lourie (Eds.) Blackwell Scientific Publications, Oxford (1969).