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Research Article

Effect of time elapsed after the onset of menarche on physique and body composition of 11 to 15 years girls

■ NAVDEEP KAUR

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Author for Correspondence :

NAVDEEP KAUR
Akal college of Physical Education, Punjabi University, Mastuana Sahib SANGRUR (PUNJAB) INDIA
Email: nav_dream@rediffmail.com, navdeepkaur33@yahoo.com

■ **ABSTRACT**

The current study have been done to see the effect of duration passed after the onset of menarche on physique and body composition girls. Total 327 school going girls ranging in age from 11 to 15 were taken from Patiala and its surrounding area. The conformation of age was taken from the school attendance register by class in charge. The skinfolds measurements (biceps, triceps, subscapular, suprailiac and calf) were taken by standard technique. Their age at menarche and duration of menarche from the onset was recorded by retrospective method and divided into five groups on the interval of 6 months *viz.,* 0.000-0.500, 0.501-1.000 to $\geq$2.00 according to their time elapsed after the onset of menarche. Total body fat percentage was calculated by using the equation of Slaughter *et al.* (1988). The formula was used to calculate the three components of physique (endomorphy, ectomorphy and mesomorphy). The above data were compiled by "t" test and ANOVA. It was observed that all the measurements and fatness increased with the increasing the duration after the onset of menarche. The endomorphic component showed increase while the ectomorphic component decrease as the duration elapsed after the onset of menarche. ANOVA revealed significant differences ($p<0.05$) between all the age groups for all the measurements.

■ ***Key Words*** **:** Menarche, Physique, Body composition, BMI, LBM, Somatotypes

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The term 'menarche' was first introduced by Stratz in 1908, denoting the occurrence of the first menstruation. The onset of menstruation is the most applied criterion for an estimation of female sexual maturity in the adolescent period. Adolescence is the period of changes in the reproductive organs and the secondary sex characters, in body size and shape, in the relative proportions of muscle, fat and bone and in a variety of physiological functions (Tanner, 1978). Adolescence holds us spellbound more than any other age, simply because of the sheer magnitude of changes unfolding in this phase. The adolescent growth period is the phase of one's life which reflects overall and cumulative growth. There is intense physical, physiological, psychological and emotional development during this period. Though menarche marks a definitive and probably mature stage of uterine development, it does not signify the attainment of full reproductive function. The age of menarche is associated with the biological and socio-cultural environment of maturing girls as well as with the genetically constitution (Marshal, 1978). In pubertal females while assessing the developmental status the age at menarche is an important maturity indicator. In other words mean or median age at menarche for group of girls is an important indicator of population health, well-being and socio-economic stratification which progressively declines when subjected to improving environmental conditions (Eveleth and Tanner, 1976). It is closely related to the height spurt e.g. during the downwards part of the height velocity curve, indeed on average, menarche occurs at the time of maximum declaration of height growth, the moment when the velocity is dropping fastest (Tanner, 1978).

■ METHODOLOGY

The present cross sectional study was conducted on adolescent girls. Total data of 327 were taken from different schools of Patiala (Punjab) and its surrounding area. The girls who have already experienced menarche comprised into five groups on the interval of 6 months identified and examined for the effects of duration gap on the height, weight and their physique. Nutritionally they were almost the same but their socio-economic background was different from each other. The measurements of height, weight and skinfold (biceps, triceps, subscapular, suprailiac and calf) were taken according to Lohman *et al.* (1988) standard technique. Their age at menarche and duration of menarche from the onset of menarche was recorded by retrospective method and divided into five group *viz.,* 0.000-0.500. 0.501-1.000 to $\geq$ 2.00 according to their time elapsed after the onset of menarche. The percentage of body fat was calculated by using the equation of Slaughter *et al.* (1988) as follows :

Per cent fat = 1.33 (triceps + subscapular) - 0.013 (triceps + subscapular)^2-2.5

The following equation was used for those who exceeded from 35mm of the sum of triceps and subscapular skinolds :

Per cent fat = 0.546 (triceps + subscapular) + 9.7 For calculating the total body fat, the total body weight was multiplied by the decimal fraction of percentage of body fat of the subject is :

Total body fat (kg) = Decimal fraction of per cent body fat X body weight (kg)

The lean body mass (LBM) was calculated by subtracting the total body fat weight (kg) from total body weight (kg). The equation used:

Lean body mass = Body weight (kg) - Body fat (kg)

The percentage of lean body mass was calculated by subtracting the lean body mass (kg) from the body weight (kg) and multiplied by 100.

Percentage of LBM = Body weight (kg) - Lean body mass (kg) x 100

Body mass index (BMI) was calculated by :

$$\text{BMI} = \frac{\text{Bodyweight(kg)}}{\text{Height(meter)}^2}$$

The formula was used to calculate the three components of physique *i.e.* endomorphy, mesomorphy and ectomorphy and were plotted with the help of triangle standard chart.

The first component of physique endomorphy was calculated by using the equation as:

Endomorphy = -0.7182 + 0.1451 (X) - 0.00068 (X)^2 + 0.0000014 (X)^3

where, x = Corrected sum of skinfolds

Corrected sum of skinfolds = (triceps + subscapular + suprailia

The second component of physique *i.e.* mesomorphy was calculated by using the equation given by Carter (1980).

Mesomorphy = (0.858 humerus width + 0.601 femur width + 0.188 corrected arm girth + 0.161 corrected calf girth) - (height x 0.131) + 4.50

Corrected arm girth = Upper arm circumference – triceps skinfold

Corrected calf girth = Calf circumference – Calf skinfold

The third component of physique ectomorphy was calculated by following equation:

Ectomorphy = height / cube root of weight ratio (HWR)

The ectomorphy rating was calculated directly by height-weight ratios by using equation is:

Ectomorphy = HWR x 0.732 - 28.58

If HWR < 40.75 but > 38.25 then the following equation was used:

Ectomorphy = HWR x 0.463 - 17.63

If HWR was $\leq$ 38.25 then a rating of 0.1 was assigned.

The x and y values were calculated from the endomorphy, mesomorphy and ectomorphy using the following formula.

X = Ectomorphy - Endomorphy

Y = 2 Mesomorphy - (Endomorphy + Ectomorphy)

■ OBSERVATIONS AND DISCUSSION

The data comprised of 327 school going girls ranging in the age from 11 to 15 years, studying in 4th to 10th classes in different schools of Patiala and its surrounding areas. The results of this study are presented with the help of suitable figures and somatochart. The 1 year duration group showed significant differences for all the skinfolds (biceps, triceps, subscapular, suprailiac and calf) with $\geq$ 2 years duration group. Most of the differences for years were also depicted as significant whereas non-significant for 1$^{1/2}$ years duration group. Again 1$^{1/2}$ years duration group reflected significant differences with $\geq$ 2 years duration group and non-significant differences with 2years duration group. Comparison between 2 and $\geq$2 years duration groups demonstrated non-significant differences among each other (Table 1and 3.).

Table 2 and 3 illustrat an increase in the mean values of percentage of fat, BMI, absolute fat, absolute LBM, endomorphy and mesomorphy from 6 months onwards up to $\geq$ 2 years duration of menarche and a decrease in the percentage of LBM and ectomorphy. Highly significant differences were noticed for physique and body composition variables between 6 months duration group and that of duration of 2 and $\geq$2 years. Similarly body composition parameters were found to be significantly lesser in 6 months duration group as compared to 1 year group, whereas physique variables exhibited non-significant differences. One year group reflected significant differences for all the variables with $\geq$ 2 years group, whereas an opposite trend was seen from 1$^{1/2}$ duration group. Differences for all the

Table 1 : Skinfolds in 0.000 days to 2.000 years elapsed after the onset of menarche

Skinfolds (mm)	0.000 – 0.500		0.501 – 1.000		1.001 – 1.500		1.501 – 2.000		≥ 2.000	
	X ± SD	SEM	X ± SD	SEM	X ± SD	SEM	X ± SD	SEM	X ± SD	SEM
Biceps	5.44 ±2.97	0.28	6.53±3.42	0.45	6.00 ± 3.59	0.41	6.43±4.01	0.76	8.79 ± 5.08	0.73
Triceps	9.33 ± 4.15	0.39	10.67±3.42	0.45	10.27±4.79	0.54	11.25±5.11	0.97	14.35±5.88	0.85
Subscapular	12.10±4.29	0.40	12.67±3.39	0.45	13.33±5.07	0.57	14.79±5.14	0.97	17.12±5.72	0.82
Suprailiac	9.21 ± 3.20	0.30	9.57 ± 2.44	0.32	10.00±3.52	0.40	11.14±4.62	0.87	12.77±4.72	0.68
Calf	12.74±4.70	0.44	13.09±3.24	0.43	12.86±4.11	0.46	14.79±4.41	0.83	16.58±6.09	0.88

Table 2 : Component of physique and body composition in 0.000 to 2.000 years groups elapsed after the onset of menarche

Measurements	0.000 – 0.500		0.501 – 1.000		1.001 – 1.500		1.501 – 2.000		≥ 2.000	
	X ± SD	SEM	X ± SD	SEM	X ± SD	SEM	X ± SD	SEM	X ± SD	SEM
Per cent fat	19.35±4.98	0.46	20.93±4.35	0.57	20.66 ±5.07	0.57	22.31±5.25	0.99	25.32±5.21	0.75
BMI	17.41±2.24	0.21	18.27±2.21	0.29	18.37 ±2.67	0.30	19.79±3.11	0.59	19.93±3.00	0.43
Per cent LBM	80.64±4.98	0.46	79.07±4.35	0.57	79.34 ±5.07	0.57	77.69±5.25	0.99	74.68±5.21	0.75
Endomorphy	3.08 ±0.99	0.09	3.34±0.81	0.11	3.37 ± 1.13	0.13	3.73 ± 1.23	0.23	4.41 ± 1.25	0.18
Mesomorphy	1.52 ±1.05	0.10	1.79 ± 0.93	0.12	1.80 ± 1.21	0.14	2.40 ± 1.41	0.24	2.31 ± 1.33	0.19
Ectomorphy	3.88 ±1.42	0.13	3.49 ± 1.24	0.16	3.55 ± 1.38	0.16	2.93 ± 1.58	0.30	2.81 ± 1.57	0.23

Table 3 : 't' values of all anthropometric measurements, components of physique and body composition, physical fitness parameters test and derived variables

Measurements	Group I t-values				Group II t-values			Group III t-values		Group IV t-values
	I vs II	I vs III	I vs IV	I vs V	II vs III	II vs IV	II vs V	III vs IV	III vs V	IV vs V
Biceps (mm)	2.16*	1.17	1.46	5.24***	0.88	0.13	2.72**	0.53	3.61***	2.11*
Triceps (mm)	1.88	1.45	2.10*	6.20***	0.48	0.50	3.50***	0.91	4.26***	2.33*
Subscapular (mm)	0.88	1.81	2.85**	6.15***	0.86	2.28*	4.97***	1.30	3.88***	1.78
Suprailiac (mm)	0.75	1.62	2.61**	5.91***	0.86	2.07*	4.49***	1.35	3.76***	1.46
Calf (mm)	0.51	0.18	2.09*	4.35***	0.35	2.02*	3.78***	2.09*	4.10***	1.37
Percent fat	2.04*	1.77	2.78**	6.88***	0.33	1.29	4.73***	1.47	4.96***	2.42*
BMI	2.39*	2.69**	4.63***	5.88***	0.22	2.60*	3.27**	2.31*	3.03**	0.19
Percent LBM	2.04*	1.77	2.78**	6.88***	0.33	1.29	4.73***	1.47	4.96***	2.42*
Endomorphy	1.71	1.90	2.97**	7.20***	0.19	1.76	5.28***	1.40	4.78***	2.29*
Mesomorphy	1.64	1.68	3.68***	4.03***	0.04	2.39*	2.37*	2.17*	2.24*	0.27
Ectomorphy	1.76	1.59	3.12**	4.24***	0.26	1.81	2.49*	1.98	2.77*	0.30

* p< 0.05, ** p< 0.01, *** p<0.001

variables mostly showed non-significant between 1 year and $1^{1/2}$ years group. When a comparison was made between $1^{1/2}$ group with 2 years and ≥ 2 year groups for all variables, differences were found to be significant for the later and mostly non-significant for the former. Duration of 2 years and ≥ 2 years did not reveal any significant differences in values from each other for all the variables. The analysis of variance indicated the significant differences ($p<0.05$) between all the groups for all the variables (Table 3).

It exhibited an increase in all the anthropometric measurements as the months passed after the onset of menarche. The endomorphy and fatness resulted in increase, while the ectomorphy and percentage of LBM decreases as the duration increases after the onset of menarche (Fig. 1).

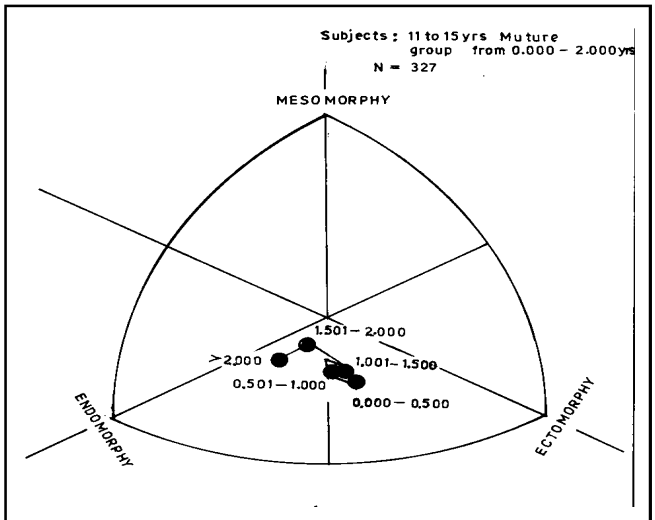

Fig. 1 : Component of physique and body composition

It has been observed that as the gap increased after the onset of menarche, weight, heights, skinfold thicknesses, percentage of fat, total body fat, total body LBM, BMI and endomorphy increased. The percentage of LBM and ectomorphy decreased with the increase in duration elapsed after the onset of menarche. Lots of studies have been conducted on the menarcheal status of the girls in relation to pre-menarcheal and post-menarcheal as well as early and late maturer. It has been noticed that the girls who have experienced menarche were taller, heavier and have more fatness as compared to those who have yet not experienced menarche. Very few studies showed the effect of months elapsed after the onset of menarche on physique, body composition and physical fitness. Cronk *et al.* (1996) found the median 1.5cm growth rate for stature, 1.1 cm for sitting height, 2.7 mm for knee height per year in the first full year after the menarche. The continued increase in height, sitting height and knee height has been observed from 1 year to 5 years elapsed after the onset of menarche. In the modern years girls enters in puberty at younger ages than that of past (Garn, 1992 and Wattigncey *et al.,* 1999). The reduction across the time in the age of onset of puberty historically was attributed to greater access of food and improvement in environment conditions resulting in better health (Wyshak, 1982). A recent large scale studies among American girls suggested the downward trend in the timing of the onset of puberty. Various authors have studied the secular trend of shift towards earlier menarche. They have observed a decrease of about 3-4 months per decade over the past century. Around 1840 in occidental counties the age of menarche was observed at 15.3 years. But in the early 1980s, the average age of 12.8 years was found (Ducros and Pasquet, 1978).

Table 4 : Analysis of variance (ANOVA)

Skinfold measurements(mm)	Between group Df 4		Within group Df 322		F-ratio	P
	SS	MS	SS	MS		
Biceps	392.36	98.091	4862	15.100	7.32	0.000
Triceps	879.62	219.906	4318	13.409	9.50	0.000
Subscapular	942.52	235.631	7450	23.136	10.88	0.000
Supra-iliac	480.53	120.134	6977	21.667	9.48	0.000
Calf skinfold	609.63	152.407	4081	12.674	7.34	0.000
Percent fat	1262.67	315.668	1077549	3346.426	12.85	0.000
BMI (kg/m^2)	278.82	69.706	7910	24.564	10.76	0.000
Percent LBM	1262.67	315.668	2086	6.480	12.85	0.000
Endomorphy	63.09	15.773	362	1.126	14.0	0.000
Mesomorphy	31.32	7.830	425	1.320	5.93	0.000
Ectomorphy	48.59	12.148	646	2.007	6.05	0.000

Bold values $p < 0.05$

Various investigators reported menarcheal age of 13.75 years in US girls (Chumlea *et al.,* 2003). The 13 years of mean age at menarche was found in 17 to 19 years adolescent Indian girls by Shekhar (2005), 11.5 years in white girls and 11.4 years in black girls has been observed (Wattigney *et al.,* 1999). Many studies predicted that early maturation seems to increase overall fatness which persists throughout the reproductive years and beyond (Sherman *et al.,* 1981; Garn *et al.,* 1986; Ness, 1991; Kirchengast, 1993 and Brown *et al.,* 1996). The excess fat also effects on menstrual function, however, very obese females are amenorrhic or have irregular cycle. Abnormal sexual development of function therefore is associated with deviations of too much and too little fat (Boyar *et al.,* 1974; Frisch and McArthur, 1974).

But this hypothesis has been keenly contested by various authors (Johnston *et al.,* 1975; Billewicz *et al.,* 1976; Cameron, 1976; Trusell, 1978, 1980; Ellison, 1981; Scott and Johnston, 1982 and Ellison, 2005). According to them the critical weight of 47 to 48 kg cannot be applied meaningfully to individuals because between several samples of normal white girls the mean menarcheal weights differ significantly. There is some evidence that girls who reach menarche at younger age are heavier than those who begin to menstruate at older age when stature was held constant. Similarly after the onset of menarche the body fatness has been found to increase in the present sample. It may be because of the hormonal changes after the puberty. Because menarcheal girls have higher concentration of estrogen and leptin. The estrogen level accounts for the greater degree of body fatness in the menarcheal girls as well as the storage of fat in more peripheral versus central adipose tissue depots. Secondly, the serum leptin level is strongly associated with the body fat and index of body fatness as well as with the change in body fat over time. The leptin acts as a hormone and provides a direct stimulus to gonads by triggering a reproductive cycle in human females. The better performance may be with the occurrence of peak velocity in the fitness components and less cardiovascular strength can be the region for being greater fatness and heavy build after the onset of menarche.

■ REFERENCES

Boyar, R.M., Katz, J., Kapen, S., Finkelstein, J.W., Weiner, E.D., Weitzman and Hellman, L. (1974). Anrexia nervosa, immaturity of the 24-hour luteinizing hormone secretory pattern. *N. Engl. J. Med.,* **291**: 861-865.

Brown, D.E., Koenig Tvan, Demorales, A.M., McGuire, K. and Mersai, C.T. (1996). Menarche age, fatness and fat distribution in Hawaiian adolescents. *Am. J. Phys. Anthropol.,* **99**: 239-247.

Camerion, N. (1976). Weight and skinfold variation at menarche and the critical body weight hypothesis. *Ann. Hum. Biol.,* **3**: 279-282.

Chumlea, W.C., Schubert, C.M., Roche, A.F., Kulin, H.E., Lee, P.A., Himes, J.H. and Sun, S.S. (2003). Age at menarche and racial comparisons in US girls. *Pediatrics,* **111** : 110-113.

Cronk, C.E., Schall, J.I. Hediger, M.L. and Scholl, T.O. (1996). Growth of postmenarcheal girls from three ethnic groups. *Am. J. Hum. Biol.,* **8** (1) : 31-42.

Ducros, A. and Pasquet, P. (1978). Evolution de age dapparion des Premieres regles (menarche) en France. *Biometrie Humaine,* **13**: 35-43.

Ellison, P.T. (1981). Predication of age at menarche from annual height increment. *Am. J. Phys. Anthropol.,* **56** (1): 71-75.

Ellison, P.T. (2005). Evolutionary perspectives on the fetal origins hypothesis. *Am. J. Hum. Biol.,* **17**: 113-118.

Eveleth, P.B. and Tanner, J.M. (1976). Worldwide variation in human growth. Cambridge University Press,CAMBRIDGE .

Frisch, R.E. and McArthur, J. (1974). Menstrual cycle: fatness as a determinant of minimum weight for height necessary for their maintenance or onset. *Science,* **185** (4155): 949-951.

Garn, S. (1992). Physical growth and development In: Friedman, S., Fisher, M., Schonberg, S. (Ed.) *Comprehensive adolescent health care.* St Louis, MO Quality Medical Publishing Inc. pp.18-23.

Garn, S.M., LaVelle, M., Rosenberg, K.R. and Hawthorne, V.M. (1986). Maturational timing as a factor in female fatness and obesity. *Am. J. Clin. Nutr.,* **43** : 879-883.

Johnston, F.E., Dechow, P.C. and MacVean, R.B. (1975). Age changes in skinfold thickness among upper class school children of differing ethnic backgrounds residing in Guatemala. *Hum. Biol.,* **17** (2): 251-262.

Kirchengast, S. (1993). Anthropometric hormonal correlation patterns in fertile and postmenopausal women from Austria. *Ann. Hum. Bio,* **20** (1): 47-65.

Lohman, T.G., Roche, A.F. and Martorell, R. (1988). Anthropometric standardization reference manual. Human Kinetic Books, CHICAGO.

Marshal, W.A. (1978). Puberty in human growth. In: Falker F., Tanner J.M. (Ed.) *Postnatal growth*, pp. 141-181. Plenum, NEW YORK.

Ness, R. (1991). Adiposity and age of menarche in Hispanic women. *Am. J. Hum. Biol.*, **3** : 41-47.

Scott, E.C. and Johnston, F.E. (1982). Critical fat, menarche, and the maintenance of menstrual cycles: a critical review. *Adolesc. Health Care,* **2** : 249-260.

Shekhar, A. (2005). Iron status of adolescent girls and its effect on physical fitness. *Indian. J. Nutr. Diet.,* **42**: 451-456.

Sherman, B., Wallace, R., Bean, J. and Schlabaugh, L.(1981). Relationship of body weight to menarcheal and menopausal age: implications for breast cancer risk. *Clin. Endocrinol. Metab.,* **52** : 488-493.

Slaughter, M.H., Lohman, T.G., Boilean, R.A., Horswill, C.A, Stillman, R.J. VanLoan, M.D. and Bemben, D.A. (1988). Skinfold equations for estimation of body fatness in children and youth. *Human Biology,* **60** : 709-723.

Stratz, C.H. (1908). Menarche and tokarche. *Verhandlungen der deutschen Gesellchaft fur Gynakologie,* **12**: 777-780.

Tanner, J.M. (1978). *Foetus into man physical growth from conception to maturity.* Harvard University Press, Cambridge, Massachusetts, CAMBRIDGE.

Trussell, J. (1978). Menarche and fatness: Re-examination of the critical body composition hypothesis. *Science,* **200**: 1506-1509.

Trussell, J. (1980). Statistical flaws in evidence for the Frisch hypothesis that fatness triggers menarche. *Hum. Biol.,* **52**: 711-720.

Wattigney, W., Srinivasan, S. and Chen, W. (1999). Secular trend of earlier onset of menarche with increasing obesity of black and white girls: the bogales heart study. *Ethnic. Dis.,* **9** (2): 181-189.

Wyshak, G. (1983). Secular changes in age at menarche in a sample of US women. *Ann. Hum. Biol.,* **10**: 75-77.

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