

Research Paper :

Assessment of the growth parameters of adolescent girls in relation to menarche

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ABSTRACT

The present study was conducted on adolescent girls of Varanasi and Sonbhadra districts, to assess their growth parameters in relation to menarche. 656 samples were taken from urban (Varanasi) and tribal (Sonbhadra) areas. The mean age at attainment of menarche (AM) in Varanasi was 12.93 years and in Sonbhadra 13.38 years. Sonbhadra girls who attained menarche (AM) had better mean value of growth parameters than Varanasi girls who attained the menarche.

Key words : Adolescent, Growth parameters, Attainment of menarche (AM)

Growth and development depend on both genetic and hereditary background of the individual and the physical and cultural environment into which the person is born. The maximum growth takes place in the adolescent phase. Adolescent growth spurt is a constant phenomenon. The spurt occurs at different ages among girls in any population, whereas the mean age may vary considerably from one population to another. The adolescent girls spurt takes place two years earlier than in boys (Tanner, 1962; Agarwal, 1974).

Indian Council of Medical Research (1972) reported higher mean value for height and weight observed in urban high socio-economic and higher per capita income group. Gupta *et al.* (1990) observed that the rural girls have a delayed and slower gain in physical growth characteristics than urban well to do girls. Sachar *et al.* (1997) also observed that the growth of Punjab adolescent girls have lower growth performance when compared with their urban counterpart and delayed growth spurt.

Tanner (1962) found that girls at menarche are taller and heavier than those of the same age who have not attained menarche. The correlation between the growth status the age at menarche is so much that Frisch and Revelle (1970) had hypothesized that a critical weight of 47-48 kg. and mean height at menarche was 158 ± 0.50 cm. The mean height increases significantly ($P < 0.97$ cm. to 160.9 ± 1.4 cm.) as the mean age of menarche increased from 11.4 to 11.5 years. But the mean weight at menarche 48 kg. remained constant, a change in metabolic rate may trigger the onset of menarche.

Early matures grow more rapidly in height and weight than late matures during the adolescent spurt. (Shuttleworth, 1937; Simmons and Greulich, 1943). Late

matures also take longer to attain menarche after attainment of maximum rate of growth (Frisch and Revelle, 1969a). Early and late matures are of same height (Frisch and Revelle, 1969b), but the late matures are lighter in weight (Ellison, 1982; Frisch and Revelle 1969, 1971).

At the initiation of the spurt, the unchanging mean weight and at menarche in early and late maturing girls suggests that the attainment of a critical body weight may be essential for each of these events of adolescence. (Frisch *et al.* 1973). A significant relationship was found between the growth curve of height and the time of menarche. Although menarche occurs during the descent of the height velocity curve, some have the menarche soon after the time of peak velocity and still have a relatively great growth potential at the time of menarche. Observations indicate that growth after menarche is affected not only by the age of menarche but the increment of height during the year prior to the menarche. It is reasonable to say that the height at the time of menarche is not the determinant of adult height and girls who attained menarche at an early age are not necessarily short in their adult height even if their height at time of menarche were relatively shorter. (Frisch and Revelle, 1969, Tanner *et al.*, 1966).

METHODOLOGY

The growth parameters of adolescent girls in relation to menarche was assessed in present study. Multy-stage random sampling method was used for selecting the samples from urban and tribal areas. For urban area, Varanasi city and for tribal study, Sonbhadra villages were selected. A total sample of 656 adolescent girls was

randomly selected from Varanasi urban (500) and Sonbhadra tribal (156). The girls belonging to 9 to 16 years of age group were selected because majority of adolescent girl age of menarche belongs to this range.

For collecting uniform and comparable data, schedule was designed and pre-tested. The data were collected by questionnaire-cum-interview method. The

anthropometric measurements of the girls were recorded.

FINDINGS AND DISCUSSION

It is evident from the Table 1 that out of 387 Varanasi urban girls who had attained menarche, 31.53 per cent belonged to 12 year of age followed by 27.91 per cent for 13 year and 22.48 per cent for 11 year. Similarly, 37.5

Table 1 : Age and district wise distribution of girls according to recent attainment of menarche

Age in year	Varanasi				Sonbhadra			
	AM		NAM		AM		NAM	
	No.	%	No.	%	No.	%	No.	%
9	3	0.77	13	11.51	-	-	06	13.64
10	7	1.80	28	24.78	-	-	12	27.27
11	87	22.48	40	35.39	18	16.07	06	13.64
12	122	31.53	18	15.93	42	37.5	10	22.73
13	108	27.91	12	10.62	20	17.86	06	13.64
14	27	6.98	02	1.77	14	12.5	04	9.08
15	19	4.91	-	-	06	5.36	-	-
16	14	3.62	-	-	12	10.71	-	-
Total	387	100	113	100	112	100	44	100
Mean \pm SD.	12.93 \pm 1.33		11.45 \pm 1.20		13.38 \pm 1.52		11.73 \pm 1.54	
	Varanasi		Sonbhadra		Total			
					AM		NAM	
t value	11.25		6.08		2.83		1.08 NS	
df	498		154		497		155	
P	<0.001		<0.011		<0.001		>0.05	

Table 2 : Mean and S.D. of growth parameters of girls who attained menarche (AM) and girls who had not attained menarche (NAM) at each age point (Varanasi)

Anthropometric parameters	Attain of Menarche	9 (16)	10 (35)	11 (127)	12 (140)	13 (120)	14 (29)	15 (19)	16 (14)
Weight (kg)	AM	24.66 \pm 1 (3)	29.00 \pm 2.13 (7)	34.17 \pm 2.1 (87)	36.64 \pm 2.85 (122)	39.75 \pm 2.7 (108)	41.31 \pm 3.53 (27)	40.12 \pm 2.38 (19)	42.64 \pm 3.24 (14)
	NAM	23.23 \pm 1.87 (13)	25.71 \pm 3.02 (28)	30.28 \pm 2.35 (40)	30.94 \pm 2.93 (18)	34.33 \pm 4.08 (12)	33.00 \pm 0.00 (2)	-	-
Height (cm)	AM	133.67 \pm 3.3 (3)	141.71 \pm 7.48 (7)	146.93 \pm 5.09 (87)	148.95 \pm 4.39 (122)	152.39 \pm 4.62 (108)	154.55 \pm 4.62 (27)	152.95 \pm 5.83 (19)	156.83 \pm 4.65 (14)
	NAM	129.3 \pm 4.59 (13)	139.42 \pm 6.86 (28)	143.12 \pm 6.52 (40)	143.43 \pm 6.48 (18)	146.33 \pm 5.12 (12)	147.5 \pm 5.5 (2)	-	-
Head Circumference (cm)	AM	51.00 \pm 3.55 (3)	52.86 \pm 2.03 (7)	53.49 \pm 1.99 (87)	54.08 \pm 2.37 (122)	53.92 \pm 1.56 (108)	54.72 \pm 1.08 (27)	54.37 \pm 1.22 (19)	54.86 \pm 1.36 (14)
	NAM	49.23 \pm 2.12 (13)	51.64 \pm 2.07 (28)	52.17 \pm 1.55 (40)	52.22 \pm 2.04 (18)	52.45 \pm 1.49 (12)	52.5 \pm 0.50 (2)	-	-
Chest Circumference (cm)	AM	62.33 \pm 3.09 (3)	66.85 \pm 2.69 (7)	69.06 \pm 3.17 (87)	73.00 \pm 4.96 (122)	77.96 \pm 6.09 (108)	81.92 \pm 4.57 (27)	79.32 \pm 5.07 (19)	82.14 \pm 5.82 (14)
	NAM	59.92 \pm 2.69 (13)	64.75 \pm 3.87 (28)	66.95 \pm 3.09 (40)	66.67 \pm 5.9 (18)	70.08 \pm 6.57 (12)	66.5 \pm 1.5 (2)	-	-
MUAC (cm)	AM	20.67 \pm 2.05 (3)	20.00 \pm 1.61 (7)	20.43 \pm 2.08 (87)	20.48 \pm 1.47 (122)	21.71 \pm 1.80 (108)	22.85 \pm 2.15 (27)	22.89 \pm 1.86 (19)	23.64 \pm 1.39 (14)
	NAM	18.59 \pm 1.51 (13)	18.66 \pm 1.73 (28)	18.72 \pm 1.19 (40)	18.64 \pm 0.92 (18)	19.25 \pm 1.83 (12)	19.0 \pm 1.20 (2)	-	-

Numbers in parenthesis indicate the sample size

per cent girls of Sonbhadra who had attained menarche belonged to 12 year of age followed by 17.86 per cent for 13 year and 16.07 per cent for 11 year. Majority of Varanasi girls who had not attained menarche belonged to 11 years of age, while in Sonbhadra the majority of girls who had not attained menarche belonged to 10 year of age (27.27 per cent). The mean age at menarche in Varanasi girl was 12.93 ± 1.33 and in Sonbhadra girls 13.38 ± 1.52 .

Table 2 and 3 show the mean and SD of growth parameters in relation to menarche at each age point of girls in Varanasi and Sonbhadra. The girls who attained menarche at each age point had greater mean values of growth parameters than girls who not attained menarche

of both Varanasi and Sonbhadra districts.

Table 4 shows the mean value of growth parameters of 9-16 years of girls of Varanasi and Sonbhadra. The girls of Sonbhadra who attained menarche had better mean values of growth parameters than Varanasi girls who attained menarche.

Conclusion :

The mean age of menarche was early in Varanasi girls (12.9 years) in comparison to Sonbhadra girls (13.3 years). The girls who attained menarche at each age point had greater mean values of growth parameters than girls who not attained menarche of both Varanasi and Sonbhadra district. Tribal (Sonbhadra) girls had better

Table 3 : Mean and SD of growth parameters of girls who attained menarche (AM) and girls who had not attained menarche (NAM) at each age point (Sonbhadra)

Anthropometric parameters	Attain of Menarche	9 (6)	10 (12)	11 (24)	12 (52)	13 (26)	14 (18)	15 (6)	16 (12)
Weight (kg)	AM	-	-	35.47 ± 1.33 (18)	36.59 ± 2.96 (42)	43.95 ± 0.61 (20)	41.50 ± 2.14 (14)	41.25 ± 0.85 (6)	41.92 ± 1.99 (12)
	NAM	23.33 ± 0.79 (6)	28.21 ± 2.09 (12)	29.33 ± 1.09 (6)	30.55 ± 0.94 (10)	32.42 ± 0.67 (6)	32.50 ± 1.12 (4)	-	-
Height (cm)	AM	-	-	149.05 ± 1.60 (18)	148.88 ± 4.19 (42)	152.50 ± 2.87 (20)	152.86 ± 7.07 (14)	154.17 ± 1.0 (7)	152.50 ± 3.8 (6)
	NAM	124.25 ± 0.8 5 (6)	136.49 ± 3.8 6 (12)	144.50 ± 1.71 (6)	142.02 ± 1.16 (10)	143.34 ± 3.02 (6)	144.5 ± 1.12 (4)	-	-
Head circumference (cm)	AM	-	-	52.99 ± 1.53 (18)	53.78 ± 1.32 (42)	53.90 ± 1.30 (20)	54.21 ± 1.32 (14)	54.67 ± 1.11 (6)	54.34 ± 0.97 (12)
	NAM	46.00 ± 0.82 (6)	50.58 ± 1.19 (12)	51.83 ± 0.69 (6)	52.39 ± 0.84 (10)	54.16 ± 1.06 (6)	52.30 ± 1.12 (4)	-	-
Chest circumference (cm)	AM	-	-	73.22 ± 3.52 (18)	73.47 ± 4.38 (42)	83.60 ± 1.85 (20)	82.86 ± 2.85 (14)	79.83 ± 2.67 (6)	78.83 ± 3.18 (12)
	NAM	55.33 ± 0.47 (6)	64.91 ± 1.80 (12)	64.17 ± 1.07 (6)	65.80 ± 1.47 (10)	68.17 ± 1.03 (6)	67.75 ± 0.83 (4)	-	-
MUAC (cm)	AM	-	-	23.44 ± 0.55 (18)	23.15 ± 1.38 (42)	25.80 ± 1.31 (20)	25.43 ± 0.90 (14)	25.25 ± 0.69 (6)	24.00 ± 0.82 (12)
	NAM	18.67 ± 0.47 (6)	19.96 ± 1.19 (12)	20.75 ± 0.56 (6)	21.65 ± 0.59 (10)	24.50 ± 0.41 (6)	23.38 ± 0.41 (4)	-	-

Numbers in parenthesis indicate the sample size

Table 4 : Mean and S.D. of age dependent anthropometric parameters of girls who attained menarche and not attained menarche

Anthropometric parameters	Varanasi			Sonbhadra		
	AM (387)	NAM (113)	Total (500)	AM (112)	NAM (44)	Total (150)
Weight (kg)	37.52 ± 3.38	30.27 ± 3.63	35.87 ± 4.88	38.09 ± 5.85	30.45 ± 4.36	35.93 ± 6.4
Standing height (cm)	150.11 ± 5.78	140.59 ± 7.75	147.96 ± 7.4	151.19 ± 4.46	139.97 ± 8.30	147.97 ± 7.7
Head circumference (cm)	54.03 ± 1.81	51.76 ± 2.06	53.52 ± 2.10	53.83 ± 1.39	51.54 ± 2.65	53.19 ± 2.11
Chest circum (cm)	74.57 ± 6.67	65.82 ± 5.02	72.59 ± 7.31	77.30 ± 5.66	64.05 ± 4.09	73.56 ± 7.95
MUAC (cm)	23.11 ± 2.02	20.32 ± 1.64	22.47 ± 2.22	24.12 ± 1.56	20.55 ± 1.93	23.12 ± 2.32

Numbers in parenthesis indicate the sample size

mean values of growth parameters than urban (Varanasi) girls who attained menarche

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REFERENCES

- Agarawal, K.N.** and Sen, S. (1974). Physical growth characteristics in relation to sexual growth. *Indian Pediatr.*, **11**:99-105.
- Ellison, P.T.** (1982). Skeletal growth fatness and menarcheal age, A comparison of two hypothesis. *Human Biol.*, **54** : 269-281.
- Frisch, R.E.** and Revelle, R. (1969 a) . Variation in body weight and the age of the adolescent growth spurt among Latin American and Asian populations in relation to caloric supplies. *Human Biol.*, **41** : 185-212.
- Frisch, R.E.** and Revelle, R.(1969). Height and weight of adolescent boys and girls at the time of peak velocity of growth the height and weight longitudinal data. *Human Biol.*, **41** : 536-559.
- Frisch, R.E.** and Revelle, R. (1970). Height and weight at menarche and a hypothesis of critical body weight and adolescents events. *Sci.*, **169** : 397-399.
- Frisch, R.E.** and Revelle, R.(1971). The height and weight of boys and girls at the time of initiation of adolescent growth spurt in height and weight and relationship to menarche. *Human Biol.*, **43** : 140-159.
- Frisch, R.E.**, Revelle, R., and Cooks (1973). Components of the critical weight at menarche and the initiation of adolescent spurt. Estimated total water, lean body and fat. *Human Biol.*, **45** : 469-483.
- Gupta, V.**, Agarwal, K.N. and Agarwal, D.K. (1990). Physical growth characteristics in rural adolescent girls of Varanasi. *Indian Pediatr.*, **27** : 1269-1274.
- Indian Council of Medical Research** (1972). Growth and physical development of Indian infants and children. Tech. Rep. Ser. No. 18.
- Sachar, R.K.**, Singh, H., Soni, R.K., Singh, W.P., Bhatia, R.C., Raizada, N. and Singh, B.A.(1997). Cross-sectional study of growth parameters of rural adolescent girls of Punjab. *Indian J. Maternal & Child Health*, **8**(1) : 21-25.
- Shutteworth, F.K.** (1937). Sexual maturation and the physical growth of girls age six to nineteen manogr. *Soc. Res. Child Develop.*, **3**:5.
- Simmons, K.** and Greulich, W.W. (1943). Menarcheal age and height, weight and sketetal age of girls age 7-17 years. *J. Pedatr.*, **22** : 518-548.
- Tanner, J.M.** (1962). *Growth at adolescence*. 2nd Ed., Oxford, Blackball Scientific publications, pp. 35-50.
- Tanner, J.M.** and O' Keeffe, B.(1962). Age at menarche in Nigerian School girls, with a note on their height and weight from age 12 to 19. *Hum. Biol.*, **34**: 187-196.
- Tanner J.M.**, (1962). *Growth of adolescent*, Blackwell Scientific Publications, pp. **328**.
- Tanner, J.M.**, Whitehouse, R.M. and Takaishi, M. (1966). Standards from birth to maturity for weight, height velocity and weight velocity: British children 1965. *Arch Dis. Child Health* **41**: 613 – 635.

