

## A Comparative Study on Anthropometry and Central Body Fat Distribution of Pre-menarcheal and Post-menarcheal Santal Girls of Jharkhand

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**ABSTRACT** The cross sectional study of 103 pre-menarcheal and post-menarcheal Santal girls was carried to investigate difference in General adiposity Body mass index (BMI), anthropometric variables and central body fat distribution (Waist-hip ratio and conicity index). The result showed that menarcheal girls had significantly greater values for mean height, weight, BMI, minimum waist circumference compared with pre-menarcheal girls. However, both groups had similar central body fat distribution, i.e., Waist hip ratio (WHR) and conicity index (CI). Attainment of menarche had significant effect on all anthropometric characteristics except the two central fat distribution (WHR and CI) indices.

### INTRODUCTION

Menarche is the most important biological event occurring in girls during puberty. Anthropometry provides the single most portal, universally applicable, non-invasive and non-inexpensive techniques for assessing the size, proportions and composition of human body. Anthropometry is particularly important during adolescence because it allows the monitoring and evaluation of the hormone-mediated changes in growth and maturation during this period. BMI is the most commonly used measure of overall adiposity while circumference and skinfolds are measures of regional adiposity. Two commonly used indices, Waist-hip ratio (WHR) and conicity index (CI) measure central body fat distribution. In many studies world wide (Weststrate et al., 1989; Gower et al., 1998; Van Lanthe et al., 1998; Durenberg et al., 1990; Chen et al., 1999; Goran et al., 1999; Gower et al., 1999; Gutin et al., 1999) and in India as well (Bhadra et al., 2001) have investigated regional adiposity and body fat distribution among pre-pubertal and pubertal girls. Pubertal girls had significantly different adiposity compared with pre-pubertal girls (Laccia et al., 1999; Bhadra et al., 2001). Studies from India have reported mean ages of menarche and various factors affecting it in different ethnic groups (Rana

et al., 1986; Singh et al., 1992; Sen et al., 1994). Considering the menarcheal age of tribals of eastern India also be the subject matter of different scholars (Tyagi et al., 1983; Sengupta et al., 1996; Das et al., 2005). The present study reports the first available data on regional adiposity and central body fat distribution among pre-menarcheal and post menarcheal Santal Girls and among the tribes also.

### MATERIAL AND METHODS

The investigation was carried out in the Santal girls of Galudih, Jharkhand, India. Apparently subjects were selected randomly. All information given by the participants filled in a pre-tested questionnaire by using status quo method, which included specific questions on age, menarcheal status and age at menarche. All anthropometric measurements were done using standard anthropometric techniques (Lohman et al., 1988) by one of us (SC). Height was measured to the nearest 0.1cm using Martin's anthropometer while, body weights of lightly clothed subjects were recorded nearest to 0.5 kg on a weighing scale. Both for height and weight, participants were requested to remove their shoes prior to taking measurements. Circumference measurements were made to the nearest 0.1cm using a steel tape. BMI was computed using the standard equation (Chumlea et al., 1986). Two central body fat indices Waist hip ratio (WHR) and conicity index (CI) was computed using the standard equation. (Yassin and Terry, 1991; Valdez et al., 1993).

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**RESULTS**

Out of the total 103 samples 79 were pre-menarcheal and the rest were in post-menarcheal status. Mean age of the studied population was 10.01 yrs. while mean age were 9.27 yrs and 1370 yrs for Pre and Post menarche Santal Girls, respectively. The mean age of menarche among Santal girls were found to be 11.47 yrs. The anthropometric characteristics of pre-menarcheal girls and post-menarcheal girls are presented in Table 1. Significant difference ( $P < 0.0001$ ) between the two groups were observed for all anthropometric characteristics, except the two indices of central fat distribution, WHR and CI. Correlation with age (Table 2) shows the impact of attainment of menarche and in the linear regression analysis also revealed that (Table 3)

attainment of menarche has a significant ( $P < 0.001$ ) effect on all anthropometric characteristics except the two indices of central fat distribution (WHR and CI). Test of significant (t-test) demonstrated that attainment of menarche had a significant effect on height, weight, BMI, MWC, MHC, sitting height, sub-ischial height except two central body fat distribution indices, i.e. WHR and CI. Considering the correlation matrix (Table 4 and 5) all variables have a higher correlation with age in pre-menarcheal girls than the post-menarcheal girls apart from the central body fat distribution WHR and CI. WHR and CI have a higher correlation with age in post-menarcheal girls than pre-menarcheal girls. This study provided evidence that with the onset of menarche, a concomitant significant increase in anthropometric variables among Santal girls.

**Table 1: Anthropometric characteristics of pre-menarcheal and post-menarcheal girls**

	Premenarche		Post menarche	
	Mean	SD	Mean	SD
Height	119.75	14.42	150.37	7.96
Weight	19.15	5.61	40.89	7.03
BMI	13.21	1.41	18.08	2.16
WC	52.48	4.71	65.03	4.89
HC	57.28	1.5	76.27	7.4
Sit. Ht	60.65	6.89	74.96	5.01
Sub Is. Ht	59.21	9.38	75.41	7.02
WHR	0.92	0.08	0.84	0.08
CI	1.21	0.08	1.14	0.07

**Table 2: Correlation of variables with age**

	Pre Menarche	Post menarche
Height	0.4626	0.0686
Weight	0.6021	0.2247
BMI	0.5917	0.2846
WC	0.4729	0.4830
HC	0.3105	-0.0824
Sit. Ht	0.4013	0.1038
Sub Is. Ht	0.3352	-0.0193
WHR	-0.1788	0.1041
CI	-0.0932	0.2936

**Table 3: Regression analysis of anthropometric variables with age**

	Slope (B)	Intercept	R <sup>2</sup> (Adj.)
Height	0.0347	6.130	0.2140
Weight	0.0932	8.454	0.3625
BMI	0.3748	5.671	0.3503
WC	0.0891	5.907	0.2237
HC	0.0891	5.802	0.0964
Sit. Ht	0.0950	7.436	0.1610
Sub Is. Ht	0.0493	7.599	0.1124
WHR	-2.0707	12.448	0.0319
CI	-0.07610	11.535	0.0086

  

	Slope (B)	Intercept	R <sup>2</sup> (Adj.)
Height	0.0128	13.887	0.0047
Weight	0.0481	13.849	0.0504
BMI	0.2014	12.161	0.0810
WC	0.1528	5.914	0.2333
HC	-0.0280	17.333	0.0067
Sit. Ht	0.0352	13.177	0.0107
Sub Is. Ht	-0.0044	16.162	0.0003
WHR	1.8956	14.226	0.0108
CI	6.4126	8.516	0.0862

**Table 4: Correlation matrix of pre menarcheal girls**

	Age	Height	Weight	Sit.ht	WC	Hp.c	W/H.R	BMI	Sub ht	CI
Age	1.000	.712**	.712**	.543**	.559**	.655**	-.402**	.273*	.684**	-.140
Height	.712**	1.000	.902**	.825**	.657**	.889**	-.669**	.274*	.895**	-.186
Weight	.712**	.902**	1.000	.807**	.760**	.879**	-.558**	.617**	.773**	-.268*
Sit.ht	.543**	.825**	.807**	1.000	.578**	.752**	-.585**	.308**	.525**	-.144
WC	.553**	.657**	.760**	.578**	1.000	.789**	-.128	.583**	.571**	.336**
Hp.c	.655**	.868**	.879**	.752**	.769**	1.000	-.723**	.415**	.753**	-.054
W/H.R	-.402**	-.869**	-.558	-.585**	-.128	-.723**	1.000	-.099	-.582**	.458**
BMI	.273*	.274*	.617**	.308**	.503**	.415**	-.099	1.000	.177	-.296**
Sub ht	.684**	.895**	.773**	.525**	.571**	.753**	-.582**	.177	1.000	-.183
CI	-.149	-.186	-.268*	-.144	.336**	-.054	.458**	-.296**	-.183	1.000

**Table 5: Correlation matrix of post menarcheal girls**

	Age	Height	Weight	Sit.ht	WC	Hp.c	W/H.R	BMI	Sub ht	CI
Age	1.000	.944	.256	.923	.378	.263	.175	.342	.038	.112
Height	.944	1.000	.753**	.586**	.315	.195	-.117	.140	.726**	-.258
Weight	-.823	.753**	1.000	.652**	.582**	.422*	.145	.605**	.456*	-.392
Sit.ht	.378	.586**	.852**	1.000	.440*	.125	.102	.317	-.075	-.146
WC	.380	.315	.582**	.446*	1.000	.529**	.183	.448*	.112	.481*
Hp.c	.263	.105	.422*	.125	.529**	1.000	.245	.317	.100	.094
W/H.R	.175	-.117	.145	.102	.183	.245	1.000	.353	-.210	-.035
BMI	.342	.140	.605**	.317	.443*	.371	.353	1.000	-.073	-.257
Sub ht	.038	.726**	.456*	-.075	.112	.100	-.210	-.073	1.000	-.191
CI	.112	-.258	-.392	-.146	.481	.094	-.035	-.257	-.191	1.000

## DISCUSSION

The onset of menarche is the most acceptable indicator of sexual maturation in girls. This paper reports, for the first time, data on the effect of menarche on different anthropometric variables and central body fat distribution. It has been reported that a positive relationship between age at menarche and central body fat distribution (Garn et al., 1960; Rona et al., 1974; Bhadra et al., 2001).

The present study also corroborate the finding of (Weststrate et al., 1989; Gower et al., 1998; Van Lanthe et al., 1998; Durenberg et al., 1990; Chen et al., 1999; Goran et al., 1999; Gower et al., 1999; Gutin et al., 1999) and in India from the Caste Hindu population as well (Bhadra et al., 2001).

Since hormonal (particularly sex hormones) and metabolic changes are associated with the onset of menarche. The results of this study show a significant change in adiposity accruing concomitant with the onset of menarche acquiring.

Cross sectional comparative studies could highlight the difference between pre-menarcheal girls and menarcheal girls. Longitudinal studies while carried out to investigate the dynamics of changes in anthropometric, hormonal and metabolic variables (Weststrate et al., 1989; Gower et al., 1998; Van Lanthe et al., 1998; Durenberg et al., 1990; Chen et al., 1999; Goran et al., 1999; Gower et al., 1999; Gutin et al., 1999) which occur during the attainment of menarche the tribal population of India. Since growth may be sensitive to nutritional deficit, adolescent anthropometry provides indicators of nutritional status and health risk and may be diagnostic of obesity. Studies might provide insight for ethnic differences.

Menarche varies from population to population, and is influenced by a wide variety of factors including geographical connotations (Chompoota-

weep et al., 1997). Therefore, comparative studies should also be carried out on migrant Indians and on native populations in any countries might reveal information or the genetic and environmental factors with regard to menarche. Such studies could provide valuable information on the 'gene environment' interaction involved in the process of attainment of menarche.

## REFERENCES

- Bhadra, M., A. Mukhopadhyay and K. S. Bose. 2001. "Body mass index, regional adiposity and central body fat distribution among Bengalee Hindu Girls: A comparative study of pre-menarcheal and menarcheal subjects." *Acta Medica Auxologica*, 33 (1): 39-45.
- Chompootaweep, S., M. Tankeyoon, P. Poomsuwan, K. Yamarat and N. Dusitsin. 1997. "Age at menarche in Thai girls". *Annals of Human Biology* 24: 427-33.
- Chumlea, W.C., A.F. Roche and D. Mukherjee .1986. "Some anthropometric norms of body composition for elderly adults." *Journal of Gerontology* 41: 36-39.
- Das, M., A.R. Bandyopadhyay. 2005. "A study on age at menarche and Body mass Index in Munda tribal population of West Bengal, India." (Press)
- Deurenberg, P., J.J.L. Pieters and G.A.J. Hautvast. 1990. "The assessment of the body fat percentage by skin fold thickness measurements in childhood and young adolescence." *British Journal of Nutrition*, 63: 293-303.
- Garn, S.M. and J.A. Haskell .1960. "Fat thickness and developmental status in child hood and adolescence." *J. Dis. Child.*, 99: 746-51.
- Gower, B.A., T.R. Nagy, C.A. Trowbridge, C .Dezenberg and M.L. Goran. 1998. "Fat distribution and insulin response in pre-pubertal African American and White children." *American Journal of Clinical Nutrition*, 67: 821-7.
- Goran, M.L. 1999. "Visceral fat in pre-pubertal children: influence of obesity, anthropometry, ethnicity, gender, diet and growth". *American Journal of Human Biology*,11: 201-7.
- Goran, M.L., and R.M. Malina. 1999. "Fat distribution during childhood and adolescence, implications for

- later health outcomes." *American Journal of Human Biology* 11: 187-8.
- Gutin B and Owens S .1999. "Role of exercise intervention in improving body fat distribution and risk profile in children." *American Journal of Human Biology* 11: 237-47.
- Leccia, G., T. Marotta and M.R. Masella. 1999. "Sex related influence of body size and sexual maturation on blood pressure in adolescents." *European Journal of Clinical Nutrition*, 53: 333-7.
- Lohman, T.G., A.F.Roche, and R. Martorell. 1988. *Anthropometric Standardization Reference Manual*. Chicago: Human kinetics Books.
- Rana, T., L .Raman and K.V. Rau. 1986. "Association of growth status and age at menarche in urban middle income group girls of Hyderabad". *Indian Journal of Medical Research*, 84: 522-30.
- Rona, R., and G. Pereira. 1974. "Factors that influence age of menarche in girls in Santiago, Chile." *Human Biology*, 46: 33-42.
- Sen, T., .1994. "A historical study of ages at menarche, marriage, menopause and family size in high- caste Bengalis of Calcutta." *Man in India*, 74: 241-50.
- Sengupta, S., G .Gogoi and H.B. Chetty. 1996. "Variation in menarcheal age of Assamese girls." *Journal of Indian Medical Association*, 4 (3): 88-90.
- Singh, U.P., and B.R.K. Shukla. 1992. "Trend of menarche in five endogamous groups of Tharu tribal females of Uttarpradesh". *Man in India*, 72: 343-52.
- Tyagi, D., G .Pal and P.K. Tewari. 1983. "Menarcheal age among Oraon and Munda girls of Ranchi". *Journal of India Medical Association*, 80 (9-10): 133-4.
- Ulijaszek, S.J., and J.A. Lourie. 1994. Errors of measurements in Anthropometry, the individual and population. Sj. Ulijaszek and C. G. N. Mascie- Taylor CGN (Eds.). Cambridge: Cambridge: University Press.
- Valdez, R., J.C. Seidell, Y.I. Ahy and K.M .Weiss.1993. "A new index of abdominal adiposity as an indicator of risk for cardiovascular disease. A cross population study." *International Journal of Obesity*, 17: 77-82.
- Van Lenthe F.J., W. VanMechelen, H. C. G. Kemper and J. W. R. Twisk. 1998. "Association of a central pattern of body fat with blood pressure and lipoproteins from adolescence into adulthood." *American Journal of Epidemiology*, 147: 686-93.
- Weststrate, J. A. and P. Deurenberg. 1989. "Body composition in children: proposal for a method for calculating body fat percentage from total body density or skin fold thickness measurements." *American Journal of Clinical Nutrition*, 50: 1104-15.
- Yassin Z. and R. Terry. 1991. "Anthropometric characteristics of rural elderly females in Malaysia. *Ecology, Food and Nutrition*, 26: 109-117.