

## AGE VARIATIONS AND SEXUAL DIMORPHISM IN ADIPOSITY AND BODY COMPOSITION AMONG TRIBAL ADOLESCENTS OF KHARAGPUR, WEST BENGAL, INDIA

DOI: <http://doi.org/10.26758/11.1.5>

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### Abstract

**Objectives.** Although tribals constitute around 8.6% of the total population of India, detailed information on their body composition is scanty. Thus, our objective was to evaluate age variations and sexual dimorphism in adiposity and body composition among rural tribal adolescents of Kharagpur, West Bengal, India.

**Material and methods.** This cross-sectional study was conducted among 788 tribal adolescent boys and girls, aged 10-17 years of Kharagpur, West Midnapore, West Bengal, India. Height (kg), weight (cm) and skinfolds were measured following standard method. The Body Mass Index (BMI) was derived. Body composition measures including Percent Body Fat (PBF), Fat Mass (FM), Fat Free Mass (FFM), Fat Mass Index (FMI) and Fat Free mass Index (FFMI) were computed using standard equations.

**Results.** All the variables showed a significant age trend in both sexes. Age-combined significant sex differences existed in mean BMI and all body composition measures. Girls had significantly higher mean values of fat measures (PBF, FM and FMI) whereas boys had significantly higher mean values of non-fat measures (FFM and FFMI). In both sexes, age had significant correlations with BMI and the five body composition measures. Similarly, all body composition indicators were significantly correlated with BMI in both sexes.

**Conclusions.** There were significant age and sex variations in body composition measures. Girls had significantly more fat mass whereas boys had more lean body mass. All body composition measures increased significantly with increasing age as well as BMI. Attainment of puberty could be a mediating factor causing these age variations and sexual dimorphism.

**Keywords:** India, tribal adolescents, age variations, sexual dimorphism, body composition.

### Introduction

The adiposity of an individual can be assessed by body composition. Eveleth and Tanner (1990) commented that, the age, sex, genetic component, environmental conditions affect the differential accumulation of body fat which is considered as a good indicator of the health and nutritional status of a community. Skinfold thickness is an important measure of fatness (Roche, Sievogel, Chumlea, & Webb, 1981). Body mass index (BMI) has been found to be associated with body composition (Garrow & Webster, 1985) and nutritional status. It also has a high correlation with body fatness (Rolland-Cachera, 1993). The influence of body fat distribution on health, first suggested by Vague in 1956, is a topic of current interest. Several criteria are used for selecting

probable measures for nutritional studies. Skinfold thickness measures subcutaneous or “low-risk” fat and is thus better for measuring body composition, while BMI is good for assessing the relationship between internal fat and risk factors (Rolland-Cachera, 1993). Skinfold thickness has been measured to estimate total body fat (TBF) and provide a fair assessment of the fat location. Nearly all of the fat in the body lies beneath the skin, so thickness of subcutaneous fat reflects body fat (Orphanidou, 1994). As the subcutaneous fat serves as a reservoir of energy during nutritional deprivation, lower BF indicates a lower energy intake by children. The role of environment in the development of adiposity is also evidenced in USA (Troiano, Flegal, Kuczmarski, Campbell, & John, 1995) and some developing countries (Martorell, Kettel Khan, Hughes, & Grummer-Strawn, 2000). In very poor countries, such as those in Sub-Saharan Africa and South Asia, obesity among women was greatly concentrated in an urban environment and among better educated women, whereas in more developed regions, obesity levels were more equally distributed in the general population. The distribution of BMI and subcutaneous fat in children of different ethnic origins - African or Indian subcontinent descent living in Trinidad and Tobago, was studied by Gulliford, Mahabir, Roche and Chinn (2001). A study among young people of Romania by Rada (2017) pointed out that although sedentary life was high among girls, boys showed higher rates of overweight and obesity and opined that it may be due to the diet practices among girls.

According to Must and Anderson (2006), although BMI is frequently used to evaluate obesity among children, it has its limitations like, there is no possibility to differentiate obesity due to fat mass (FM) from that due to excess lean body mass. It is important to assess body composition continuously and accurately during infancy which will help to evaluate the weight gained overtime. Furthermore, it also provides useful information on nutritional requirements, the efficacy of diet and medical interventions, and the influence of chronic diseases (Olhager & Forsum, 2003). The global prevalence of overweight and obesity among children increased from 4.2 % in 1990 to 6.7 % in 2010 and is expected to reach 9.1 % by 2020 (de Onis, Blössner, & Borghi, 2010). The major patterns of fat distribution develop in childhood and adolescence in both sexes. Males develop more trunk fat than females, and this development is more clearly established after puberty (Bray & Bouchard, 1988). Children and adolescents with a high BMI also tend to have a high level of body fatness, but because BMI is based only on weight and height, it can be an inaccurate indicator of body fatness, particularly among those who have normal or relatively low levels of body fatness (Bray, DeLany, Volaufova, Harsha, & Champagne, 2002). Many authors pointed out that relation of BMI to body fatness differs based on race-ethnicity groups (Deurenberg, Deurenberg-Yap, Foo, Schmidt, & Wang, 2003; Freedman et al., 2008). Asians generally have more body fat and blacks have less body fat than white Caucasians. Although, Ulijaszek and Kerr (1999) commented about the technical error of measurements related with skinfold thicknesses, these are being widely used among children and adolescents as they provide a more direct and accurate estimate of body fatness than BMI (Laurson, Eisenmann, & Welk, 2011; Leitao, Rodrigues, Neves, & Carvalho, 2011; Going et al., 2011). Furthermore, many authors are of opinion that, there is stronger association of body fatness with skinfold thicknesses than with BMI (Bray et al., 2002; Sardinha, Going, Teixeira, & Lohman, 1999; Steinberger et al., 2005; Freedman et al., 2007). In a study among children and adolescents aged 7 – 15 years from Vojvodina, North Serbia, it was reported that percent of skeletal muscle mass (% SMM) increased with age in both sexes and was significantly influenced by gender, age and physical activity, cumulatively and partially (Pavlica & Rakic, 2019). The role of physical activity in body composition had also been investigated in another study (Nikolova, Mladenova, Boyadzhiev, & Paskaleva, 2019) among 7-17 years aged children and adolescents from Plovdiv, Bulgaria. The authors had observed that the increase in percentage body fat and values of the fat mass index and the decrease in frame index were entirely or partially caused by reduced physical activity. Albu and Rada (2014) had studied in detail the dynamics of anthropological markers among Romanian teenagers between 1978-1999. They had found significant changes in anthropometry and body composition in this time span.

Adolescence is one of the four known sensitive periods in life for the development of obesity, the other three being intrauterine life, infancy and ages 5-7 years (Monyeki, van Lenthe, & Steyn, 1999). It begins with pubescence, the earliest signs of emergence of secondary sexual characters and continues up to the morphological and physiological maturation to the adult status (WHO, 1995). Unique changes that occur in an individual during this period are accompanied by progressive achievement of biological maturity (Tanner, 1962). This period is very crucial since these are the formative years in the life of an individual when major physical, psychological and behavioural changes take place (Patil, Wasnik, & Wadke, 2009).

There are several socially disadvantaged communities in India, among which tribal populations are the most deprived ones. Although, tribals constitute around 8.6% of the total population of India, detailed information on their body composition is scanty (Khadilkar & Khadilkar, 2019). In this context, we have tried to investigate age variations and sexual dimorphism of body composition of the tribals of a particular area of Eastern India.

In this context, our objective was to evaluate age variations and sexual dimorphism in adiposity and body composition among rural tribal adolescents of Kharagpur, West Bengal, India.

## Material and methods

*Area under study.* The present cross-sectional study was conducted in Higher Secondary Schools of 10 villages (Changual, Gangarampur, Benapur, Balarampur, Sankoa, Gopinathpur, Chakmakrampur, Mawa, Amlatoria, Chakturia) of Kharagpur Community Development Block II, West Midnapore, West Bengal, India which are situated around 10 km from Midnapore town, the district head quarter. A total of 25.6% of the total population of the Block is constituted by tribal groups.

*The participants.* Measurements as well as other information were collected from 788 tribal adolescents (370 boys; 418 girls), aged 10-17 years. The students who were present in class were randomly selected. Various tribal communities like Santhal, Bhumij, Munda, Mahali, Sabar live in these villages. The living amenities were more or less same for all the groups. Hence, we considered them as a single homogenous population termed 'tribal group'. Age of the participants was calculated from the Date of Birth recorded in the school registration books. Adolescents of non-tribal communities were excluded from this study. Table 1 represents the age and sex wise distribution of the participants.

**Table 1**

*Distribution of the participants by age and sex*

Sex	Age in years							Total	
	10	11	12	13	14	15	16		17
Boys	55	42	54	52	43	39	45	40	370
Girls	40	48	64	58	50	57	52	49	418
Total	95	90	118	110	93	96	97	89	788

*Anthropometric variables.* Height (kg), weight (cm), triceps skinfold (TRSF, mm) and subscapular skinfold (SSSF, mm) were measured following standard methods (Lohman, Roche, & Martorell, 1988) by the second and third (SB and PKR) authors. Skinfold measurements were used to measure BF (%) from which fat mass (FM, kg) and fat-free mass (FFM, kg) were calculated. Triceps (TRSF, mm) and subscapular (SSSF, mm) skinfold thicknesses were measured to the nearest 0.1mm using Holtain skinfold caliper. The following measures were derived: BMI, Percent Body Fat

(PBF), Fat Mass (FM), Fat Free Mass (FFM), Fat Mass Index (FMI) and Fat Free Mass Index (FFMI). The equations used are presented in Table 2.

**Table 2**

*BMI and body composition variables*

Variables	Formulae	Reference
BMI	Weight (kg)/Height (m) <sup>2</sup>	WHO, 1995
PBF (Boys)	1.21 (TRSF+SSSF) -0.008 (TRSF+SSSF) <sup>2</sup> -1.7	Slaughter et al., 1988
PBF (Girls)	1.33 (TRSF+ SSSF) -0.013 (TRSF+SSSF) <sup>2</sup> -2.5	
FM (kg)	Body Weight (kg) x[PBF/ 100]	
FFM (kg)	Weight (kg) – Fat Mass (kg)	Van Itallie, Yang,
FMI (kg / m <sup>2</sup> )	FM (kg) /Height <sup>2</sup> (m <sup>2</sup> )	Heymsfield, Funk, &
FFMI (kg / m <sup>2</sup> )	Fat Free Mass (kg)/ Height <sup>2</sup> (m <sup>2</sup> )	Boileau, 1990

The technical error of measurements (TEM) was calculated for height and weight and they were found to be within reference values as given by Ulijaszek and Kerr (1999). Thus, TEM were not incorporated in any analyses.

*Statistical analyses.* Students't-test and ANOVA were performed to study sexual dimorphism and age variations, respectively. Pearson's correlation coefficient (r) analyses was undertaken to study the association between the continuous variables. All statistical analyses were performed using statistical package for social sciences (SPSS, version 16.0).

*Ethical approval.* Ethical approval was obtained from Department of Anthropology, Vidyasagar University. Permission for conducting this study was also obtained from each school authority. Moreover, informed verbal consent was obtained from each participant.

## Results

In case of PBF, among boys the mean values didn't show gradual increase with age. However, there was the gradual increase among girls and these values were much higher at all ages than in boys (Figure 1). Although the sex differences were significant in most of the cases (except at few ages) for FM, FFM, FMI and FFMI, both sexes showed an increasing trend with age. In case of FM the mean values were higher among girls in all age groups, whereas, FFM displayed a reverse trend (Figure 2). When age combined overall means were taken into account, except height, FFM and FFMI, all other variables showed higher means among girls. All the variables showed significant sexual dimorphism in each of the age groups but it was different in BMI, where it was significant in case of only 14 and 15 years of age.

Figure 1 shows that there was a gradual increase of PBF among girls and these values were much higher at all ages.

**Figure 1**

*Age specific sex variation in PBF*

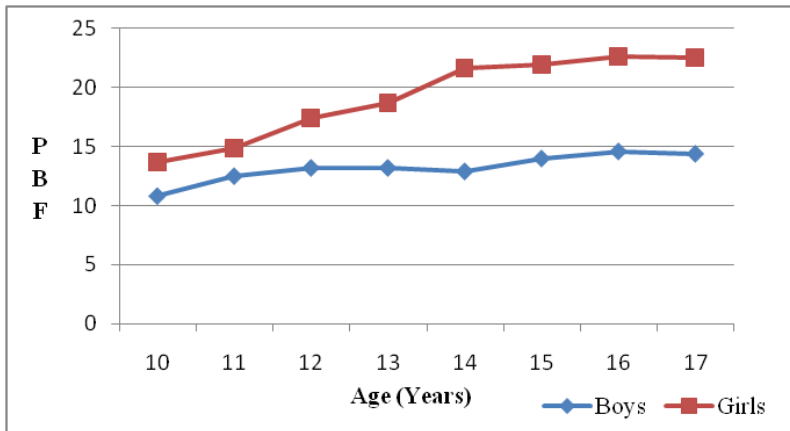


Figure 2 shows a reverse trend compared to the previous figures with boys having higher values from age 13 onwards.

**Figure 2**

*Age specific sex variation in FFM*

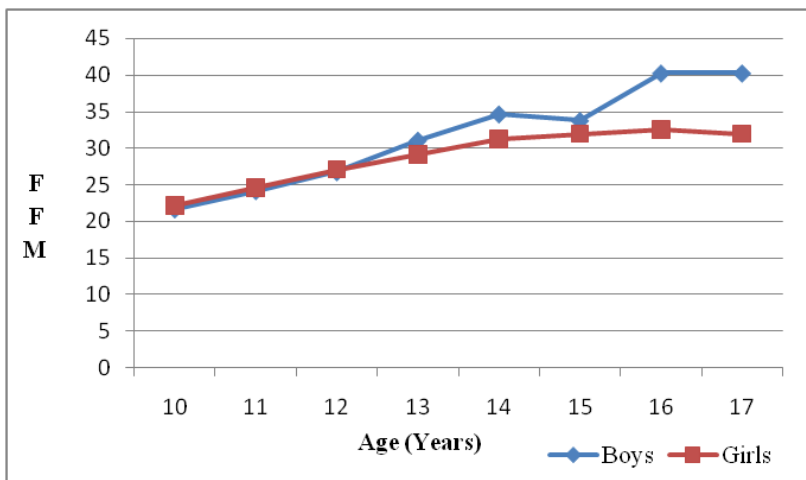


Table 3 presents the age and sex-specific mean height, weight, BMI and the five body composition measures. The mean values of all the variables significantly ( $p < 0.001$ ) increased with age. In case of height and weight, the mean values were lower among boys in earlier ages which were reversed in the later ages. This was indicative of probably an earlier occurrence of adolescent growth spurt among girls.

**Table 3**

*Age and sex-specific mean height, weight, BMI and the five body composition measures*

Variables	Sex	Age in years								Total	F	
		10	11	12	13	14	15	16	17			
Height (cm)	Boys	131.0 (7.5)	135.6 (6.01)	140.5 (8.4)	147.7 (7.6)	152.9 (10.7)	152.9 (9.3)	160.3 (6.6)	160.4 (7.6)	146.8 (13.1)	87.9***	
	Girls	133.7 (8.3)	139.1 (6.6)	144.2 (7.2)	145.9 (6.5)	148.7 (5.7)	149.9 (4.6)	150.4 (5.3)	150.9 (5.2)	145.7 (8.2)		43.9***
	t	-1.7	-2.6*	-2.6*	1.3	2.4*	2.2*	8.2***	7.1***	1.5		
Weight (kg)	Boys	24.4 (4.3)	27.8 (5.2)	31.1 (6.5)	36.0 (6.2)	40.0 (7.0)	39.4 (8.1)	47.4 (8.0)	47.2 (7.0)	36.1 (10.3)	78.5***	
	Girls	25.8 (5.3)	29.1 (5.7)	32.9 (6.0)	36.0 (6.0)	40.2 (6.5)	41.1 (4.1)	42.4 (6.2)	41.4 (5.1)	36.4 (7.9)		57.9***
	t	-1.40	-1.16	-1.56	-0.02	-0.2	-1.4	3.5**	4.5***	-0.5		
BMI	Boys	14.1 (1.4)	15.0 (1.9)	15.6 (2.0)	16.4 (2.1)	17.1 (2.4)	16.8 (2.6)	18.4 (2.2)	18.3 (2.0)	16.3 (2.5)	24.4***	
	Girls	14.3 (1.9)	14.9 (2.2)	15.7 (1.9)	16.8 (2.1)	18.1 (2.4)	18.3 (1.9)	18.7 (2.2)	18.2 (2.0)	16.9 (2.6)		32.5***
	t	-0.54	0.17	-0.29	-1.0	-2.1*	-3.4**	-0.7	0.21	-3.3**		
PBF	Boys	10.8 (2.6)	12.5 (4.6)	13.2 (4.5)	13.2 (4.3)	12.9 (3.3)	14.0 (4.0)	14.6 (4.1)	14.4 (3.9)	13.1 (4.1)	4.7***	
	Girls	13.7 (3.9)	14.9 (3.8)	17.4 (3.9)	18.7 (4.4)	21.6 (4.7)	21.9 (3.6)	22.6 (4.0)	22.5 (3.8)	19.3 (5.1)		37.6***
	t	4.5***	2.7**	-5.0**	-6.6***	-10.3***	-10.1***	-9.7***	-10.0***	-18.5***		
FM	Boys	2.7 (1.0)	3.6 (2.3)	4.3 (2.5)	4.9 (2.4)	5.2 (1.9)	5.6 (2.6)	7.1 (3.03)	6.9 (2.9)	4.9 (2.7)	19.6***	
	Girls	3.7 (1.8)	4.5 (2.0)	5.8 (2.3)	6.9 (2.5)	8.9 (3.2)	9.1 (2.2)	9.7 (2.9)	9.4 (2.4)	7.3 (3.2)		45.0***
	t	-3.4**	-1.93	-3.4***	-4.3***	-6.5***	-7.2***	-4.3***	-4.5***	-11.1***		
FFM	Boys	21.7 (3.5)	24.2 (3.7)	26.8 (4.6)	31.1 (4.8)	34.7 (5.6)	33.8 (6.4)	40.3 (5.8)	40.3 (5.1)	31.1 (8.2)	92.7***	
	Girls	22.1 (3.8)	24.6 (4.1)	27.1 (4.1)	29.1 (3.9)	31.3 (3.8)	32.0 (2.7)	32.6 (3.8)	32.0 (3.4)	29.1 (5.0)		51.2***
	t	-0.502	-0.57	-0.39	2.4*	3.5**	1.9	7.9***	9.2	4.3***		
FMI	Boys	1.5 (0.5)	1.9 (1.1)	2.1 (1.1)	2.2 (1.1)	2.2 (0.7)	2.4 (1.0)	2.7 (1.1)	2.7 (1.0)	2.2 (1.0)	7.5***	
	Girls	2.0 (0.9)	2.3 (0.9)	2.7 (0.9)	3.2 (1.1)	4.0 (1.4)	4.1 (1.0)	4.3 (1.2)	4.1 (1.0)	3.4 (1.3)		34.8***
	t	-3.3**	-1.61	-3.3**	-4.5***	-7.6***	-8.0***	-6.7***	-6.8***	-13.6***		
FFMI	Boys	12.6 (1.0)	13.1 (1.2)	13.5 (1.2)	14.2 (1.3)	14.9 (1.9)	14.4 (2.0)	15.6 (1.5)	15.6 (1.3)	14.2 (1.8)	29.2***	
	Girls	12.3 (1.2)	12.7 (1.4)	13.0 (1.2)	13.6 (1.1)	14.1 (1.3)	14.3 (1.1)	14.4 (1.3)	14.1 (1.3)	13.6 (1.4)		20.0***
	t	1.3	1.56	2.2*	2.5*	2.2*	0.43	4.4***	5.6***	5.0***		

\* = p < 0.05; \*\* = p < 0.01; \*\*\* = p < 0.001

Sex specific correlations of age with BMI and the body composition measures are presented in Table 4. All the variables showed highly significant (p < 0.01) positive correlations with age. All the fat measures (PBF, FM and FMI) displayed stronger correlations among girls. However in case of all the non-fat measures (FFM and FFMI) the trend was reverse, i.e. much higher correlations were noticed among boys. The sexual dimorphism was most marked in case of PBF followed by FMI. A noteworthy finding was that the BMI showed similar correlations in both sexes.

**Table 4**

*Sex specific correlation of age with BMI and body composition measures*

Variables	<i>r</i>	
	Boys	Girls
BMI	0.553**	0.561**
PBF	0.260**	0.600**
FM	0.515**	0.632**
FFM	0.787**	0.642**
FMI	0.340**	0.582**
FFMI	0.582**	0.464**

\*\* = p < 0.01

Table 5 presents the sex specific correlations of BMI with the indicators of body composition. In both sexes, all the measures showed significant positive correlations (p< 0.01) with BMI. It was observed that all the fat measures (PBF, FM and FMI) displayed much stronger associations with BMI in girls. The most noticeable sexual dimorphism was found in PBF.

**Table 5**

*Sex specific correlation of BMI with the body composition measures*

Variables	<i>r</i>	
	Boys	Girls
PBF	0.646**	0.821**
FM	0.833**	0.901**
FFM	0.779**	0.839**
FMI	0.810**	0.923**
FFMI	0.939**	0.933**

\*\* = p < 0.01

**Discussions**

Adolescence is a decisive period of rapid physical growth attainment and development or maturity with multiple physiological changes occurring between the childhood and adulthood. It also includes body composition transforming with differential changes taking place between sexes (WHO, 1995; Wells, 2007).

Mean height and BMI of the present adolescents were much higher than the Santhal adolescent boys (134.8 cm) and (girls-142.8cm) respectively from Purulia, West Bengal (Das & Bose, 2011). However, mean weight among boys and girls were similar (Das & Bose, 2011). Mean height (134.2 cm) and weight (29.9 kg) among adolescent boys of Kolam tribe of Telengana (Karri, Ghritlahre, Das, & Bose, 2017) state were much lower than our participants. A study among rural male adolescents from Naxalbari, Darjeeling District, West Bengal (Dey et al., 2011) found that the height (154.4 cm) and weight (42.0 kg) among boys were much higher than the participants of the present study. However, in comparison of the rural adolescent boys of West Bengal studied by Pal, Pari, Sinha and Dhara (2017), the mean values of the present adolescent boys were slightly lower for height and weight but these were slightly higher among the girls of the present study. Mean BMI among the boys was slightly higher than adolescent boys (15.6 kg/m<sup>2</sup>) and slightly lower than found

among girl ( $17.4 \text{ kg/m}^2$ ) Santhal adolescents from Purulia, West Bengal (Das & Bose, 2011). Adolescent boys from Naxalbari, Darjeeling showed higher mean BMI ( $17.7 \text{ kg/m}^2$ ) than boys of the present study (Dey et al., 2011). Among the Rajbanshi adolescent girls from North Bengal, the three anthropometric variables had similar (to our study) mean values (Roy, Barman, Mondal, & Sen, 2016).

The present study revealed that girls had higher mean PBF, FM and FMI than boys at all ages. A reverse sex trend was observed in case of FFM and FFMI. This indicated that the level of adiposity was significantly higher among girls. A similar trend has been reported in other studies from India as well as other countries also (Dutta Chowdhury, Chakraborti, & Ghosh, 2007; Rakic & Pavlica, 2014; Mandal & Bose, 2017; Mehdad et al., 2012; Rajkumari, Akoijam, Akoijam, & Longjam, 2012; Freedman, Horlick, & Berenson, 2013; Nwizu, Njokanma, Okoromah, & David, 2014; Sharma & Mondal, 2018). Mean PBF among boys and girls of the present study were 2.8% and 3.9% lower respectively, than those found among the adolescents from Imphal, Manipur, India (Rajkumari et al., 2012). In the same study, it was observed that FM was 3.8 kg higher among both the boys and girls than the participants of our study. A similar trend was also found among Moroccan adolescents aged 11-17 years, where, PBF among boys was 15.9% higher and among girls it was 11.2% higher than our study (Mehdad et al., 2012). Similar results were observed in case of FM of the participants of the same study and school children from Washington, USA (Freedman et al., 2013). However, these were lower among Nigerian adolescents aged 10 – 18 years (Nwizu et al., 2014) and among school going children and adolescents from Phanshidewa Block, Darjeeling District, WB, India (Debnath, Mondal, & Sen, 2018). Our study provided preliminary evidence of a significant spurt growth in PBF and FM. This indicated the approaching of peak velocities in height and weight (Bell, 1993). It is noteworthy to mention here that the role of height is more important than adiposity in predicting lean body mass (LBM or FFM) (Malina, Bouchard, & Beunen, 1988).

Mean FFM of the adolescents of the present study increased gradually with age in both sexes. Sexual dimorphism became more pronounced at higher ages. The same trend had also been earlier reported among Nigerian adolescents. They showed more or less 30.0% higher mean values among boys and girls (Nwizu et al., 2014). However, another recent study found that there were no significant sex differences among Santhal children (FFM: boys-22.2 kg; girls-21.2 kg) of Purulia, West Bengal, and their mean values were lower than the present study (Dutta Chowdhury et al., 2007).

The BMI was highly correlated with body composition parameters in both sexes and the magnitude was greater among girls (except in FFMI). Similar results had been earlier reported from Santhals of Purulia (Dutta Chowdhury et al., 2007), Moroccan adolescents (Mehdad et al., 2012), adolescents from Imphal, Manipur (Rajkumari et al., 2012), rural adolescent girls from Kabri Anglong, Assam (Sharma & Mondal, 2018) and Chakmas of Tripura (Saha & Sil, 2019). Maynard et al. (2001) in their analysis of the data from the Fels Longitudinal Study had also showed a significantly high correlation between BMI and body composition variables. Similar results had been reported from black Jamaican children (Gaskin & Walker, 2003).

In the present study, the body composition measures that were significantly higher in girls indicated that they tend to accumulate more fat than boys. In our study, we derived body composition measures based on subscapular and triceps measurements. It has been earlier shown that girls possess higher adiposity in their subscapula and triceps regions (Zimmermann, Gübeli, Püntener, & Molinari, 2004). The use of BMI to identify children with excess adiposity during the pubertal development has an important limitation; it has been shown that BMI increases in adolescents from both sexes are primarily determined by increases in FFM (or lean body mass, LBM) rather than in body fat compartment (Yoo, Lee, Kim, & Sung, 2006). Pubertal ages are important for changing body composition and it is more marked earlier among girls between pre and menarche individuals (Prado Martinez, Marrodan Serrano, Acevedo Cantero, & Carmenate Moreno, 2017).



Besides demonstrating distinct age variations in both sexes, our study provided unequivocal evidence that there existed significant sexual dimorphism in body composition measures. We also found that, in girls, fat measures were more strongly associated with both age as well as BMI which is a measure of generalized obesity. The inverse was observed in boys, i.e. non-fat (or lean) body composition measures had a stronger relationship with age. Taken together, these results clearly indicated that with increasing age, there significantly more fat deposition among girls. Moreover, increase in BMI in girls is concomitant with increasing fat deposition. This implied that there was a distinct dimorphism in the increase between fat and non-fat (or lean) components with increasing BMI. These morphological changes could be mediated by the attainment of puberty. More detailed longitudinal studies are needed to fully comprehend the mechanism involved this significant sexual dimorphism in fat deposition. Unfortunately, the present investigation was cross sectional in nature which is major limitation of our study.

### **Conclusions**

There were significant age and sex variations in body composition measures. Girls had significantly more fat mass whereas boys had more lean body mass. All body composition measures increased significantly with increasing age as well as BMI. Attainment of puberty, which involves hormonal changes, could be a mediating factor causing these age variations and sexual dimorphism. Further longitudinal studies are required to understand the mechanisms linked with these changes. The uniqueness of our study is that it deals with age variations and sexual dimorphism in body composition among tribals (indigenous people). Hitherto, to the best of our knowledge, such investigations are scanty from India.

**Conflict of interest:** None

### **Acknowledgements**

All subjects who participated in the study are gratefully acknowledged. Special thanks are due to the parents and the School authorities for their kind cooperation and help.

### **Funding**

The authors received no financial support for the research, authorship, and/or publication of this article.

### **Abbreviations used**

SSSF – Sub scapular skinfold

TRSF – Triceps skinfold

BMI – Body mass index

FM -Fat Mass

FFM – Fat free mass (also known as Lean Body Mass, LBM)

FMI – Fat mass index

FFMI – Fat free mass index

PBF – Percent body fat

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