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Assessment of Body Composition among the Sabar Preschool Children of Purulia districts, West Bengal, India

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Abstract

There is scanty information on body composition characteristics among preschool children from underprivileged communities of India. Therefore, the present cross-sectional study was designed to assess the body composition characteristics among Sabar preschool children aged 1-5 years. The present study was conducted at six different villages of three blocks under Purulia district, West Bengal, India. The subjects were randomly selected from house-to-house visit from studied villages. Significant age variations were noticed in mean height, weight, and Body mass index (BMI) among both sexes. Boys showed significant age variation in mean triceps skinfold thickness (TRISKF), whereas the girls showed significant age variation in mean Mid-upper arm circumference. Maximum significant age variation was observed in mean height (Boys: F = 52.36, $P < 0.001$; Girls: F = 49.78, $P < 0.001$), and minimum significant age variation was noticed in mean TRISKF among boys (F = 3.78, $P < 0.05$) and in mean BMI (F = 5.13, $P < 0.05$). Age-combined mean values of percent body fat (PBF) and fat mass (FM) were significantly higher among girls (20.39% and 2.36 kg) than boys (16.17% and1.84 kg). The Pearson correlation coefficients (r) showed that body composition measurers were significantly correlated with the majority of variables among these children. In conclusion, the results revealed that PBF, FM, and fat-free mass were good indicators to measure the degree of fat deposition, which could be used as a nutritional indicator in terms of leanness.

Keywords: Fat mass, Fat-free mass, Percent body fat, Preschool children, Sabars, Tribes

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Introduction

During infancy rapid postnatal growth occurs and it changes body composition. The knowledge of these changes in infants are useful to understand the nutritional needs and functional outcome of nutritional management for healthy and sick infants.[1] Body composition is a major factor for metabolic disease. It has been widely considered that inconsistency fat distribution causes certain metabolic disorders, and it introduces the morbidity and mortality.[2] Many skinfold-thickness equations are used to calculate body fat percentage, fat mass (FM), and fat-free mass (FFM) in children. However, most of these estimates were developed using multiple skinfold-thickness measurements.[3] Moreover, nutritional status could be evaluated through the assessment of body composition. Assessment of FFM from the body composition gives an evaluation of nutritional status.[4] Assessment of fat and FFM is a considerable interest in the evaluation of body composition and nutritional status in children. Many researchers have conducted several studies in children to estimate the body composition by measuring percentage of body fat percent body fat (PBF), FFM, and FM.,[5,6] The FFM works as an indicator to build the body composition, especially among preschool children.[7] Understanding the knowledge of the FM and FFM is used during childhood to assess a child's nutritional status.[8] Due to rapid growth, sizeable changes in body-composition occurs during infancy and puberty. Thus, the assessment of body composition among infants is more challenging than among adults. Indirect measurements of body-composition and its consisting assumptions may be introduced error in deferent barring cadaveric studies.[9] The relationship between body mass index (BMI) and PBF among Chinese, Ethiopians, Indonesians, Polynesians, Thais, American blacks, and American whites revealed that people of different ethnic groups had significantly different BMIs at the same levels of BF. BMI and PBF have also difference in populations from Singapore, Japan, and Hong Kong.[10]

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FMI and fat-free mass index (FFMI) provide to discrete the two components which are vary with size.[11] Clinical value of FMI and FFMI can be helpful to measure nutritional status and deficits of foods by which occurs protein energy malnutrition.[12] Anthropometric and body composition characteristics are shown comparatively among preschool children of Coastal, Himalayan and Desert Ecology in India.[13] Body fatness is related with risk factor of cardiovascular disease.[14] Research findings suggest that the body composition is affected by the macronutrient composition of the diet. In particular, it appears that the proportion of fat ingested, compared with carbohydrate and protein, influences the amount of body fat.[15] It is well known that there is a scanty information on body composition characteristics among tribal preschool children in India especially in West Bengal.[16] Keeping in mind, the present study was aimed to assess the body composition characteristics among the Sabars preschool children (aged 1–5 years old) from three blocks of Purulia district, West Bengal, India.

Materials and Methods

The Setting

This cross-sectional study was carried out on the Sabar tribe during June 2019 to December 2019 at three community development blocks namely Barabazar, Bandwan and Manbazar-II of Purulia district, West Bengal, India. These blocks are highly Sabar's concentrated area in the Purulia district and border area between Jharkhand and West Bengal. All three block are situated between 225 and 255 km away from Kolkata, the capital city of West Bengal.

Samples

A total of six villages (Latpada, Dumurdih, Herbona from Barabazar block, Haludboni, Chhoto Parashya from Bandwan block and Boro, Tamakhun, Olgara from Manbazar block) were selected from the three block of the Purulia district, West Bengal. These villages are dominated by Sabars. Ethical approval was also obtained from SKB University to conduct this study. A total of 333 Sabars household were surveyed during this period. And all preschool Sabar preschool children were randomly selected from these villages from above mentioned surveyed households. The minimum estimated sample size (n = 87) was calculated based on standard formula with 95% confidence interval, 80% power, margin of error 3%, and assuming standard deviation of height 10 cm. A total of 115 preschool children (55 boys and 60 girls) aged 1–5 years included in the present analyses. Age of the children were ascertained from the immunization card, birth certificate and Aadhar card and it was cross checked with the help of senior member of the family.

Anthropometric Measurement

All anthropometric measurements were measured by first author (LLM) on each subject following the standard techniques.[17] Height was taken using Martins anthropometric rod to the nearest 0.1 cm. Weight was taken using spring balance weighing machine to the nearest 0.5 kg. Mid-upper arm circumference (MUAC) was measured using nonstretchable plastic measuring tape to the nearest 1 mm accuracy. Skinfold measurements such as Triceps (TRISKF), Biceps (BISKF) and Subscapular skinfold (SUBSSKF) thickness were measured to the nearest 0.2 mm using Holtain skinfold caliper.

Assessment of Body Composition

PBF was calculated with two skinfold thickness and one circumference measurement, that is, triceps skinfold (TRISKF), sub-scapular skinfold (SUBSSKF), and MUAC. Sex specific PBF derive using standard formulae developed by Shaikh and Mahalanabis.[18] These equations were:

Boys: $PBF = 5.304+0.269\times T+0.50\times S+0.685\times M-0.063\times A$

Girls: $PBF = 7.017- 0.053\times T+0.201\times S+0.765\times M+0.052\times A$

Where, T = triceps skinfold thickness in mm, S = subscapular skinfold thickness in mm, M = mid upper arm circumference in cm, and A = age in months.

The FM was calculated following the standard equation:

$FM = (PBF/100) \times \text{body weight (kg)}$.[12]

$FFM = \text{Body weight (kg)} - FM \text{ (kg)}$.[12]

The FM and FFM were then divided by height-squared in meter to determine the FMI and FFMI, respectively.

Statistical Analysis

Sex differences (age-specific) were determined using Independent sample t-test. One-way ANOVA (Scheffe's procedure) was performed to see the significant age variations in anthropometric variables. Pearson's correlation coefficients were used to find out the relationship between anthropometric characteristics and body composition variables. All statistical analyses were carried out using the Statistical Package for Social Sciences (IBM SPSS, version-25).

Results and Discussion

Anthropometric characteristics of the studied preschool children are depicted in Table 1. Significant age variations were noticed in mean height, weight and BMI among the both sexes. Boys showed significant age variation in mean triceps skinfold thickness (TRISKF), whereas the girls showed significant age variation in mean MUAC. Maximum significant age variations were observed in mean height (Boys: F= 52.36, $P < 0.00$; Girls: F = 49.78, $P < 0.001$). Minimum significant age variation were noticed in mean TRISKF among boys (F = 3.78, $P < 0.05$) and in mean BMI (F = 5.13, $P < 0.05$). Body composition characteristics of the sample are presented in Table 2 and Figure 1. It was found that age-combined mean values of among the girls PBF, FM and FMI were significantly higher among the girls in compare to their counterpart. It was also noticed that boys had higher mean value of FFMI in compare to girls. However, boys and girls showed more or less similar mean values of FFM. Significant age variations were observed in all body composition characteristics irrespective of sex except FMI among girls. Age specific sex differences were observed in mean PBF among the studied children except at the age of 1 year and girls showed higher mean values than boys. Girls of all ages showed significantly higher mean values of FM and FMI in all ages than boys except at age of 1 year. In case of FFMI, boys showed higher mean values at of 3 year and onward.

The Figures 1a-e also depict the body composition characteristics of the studied preschool children, Figures 1a and b showed that there were increasing trends of sex differences in account of PBF and FM. It revealed that deposition of fat significantly higher among girls during the age of 2 years and onward. Interestingly, it was also noticed that there were no sex differences in FFM [Figure 1c] irrespective of age (except at the significant age of 3 year), and it also implied that boys had greater muscle mass compare to girls. As per characteristics of PBF, FM and FFM similar characteristics also showed in FMI [Figure 1d] and FFMI [Figure 1e].

In Table 3, sex-wise Pearson's correlation coefficients have been shown between anthropometric measurements and body composition (aged 1–5 years). FM, FFM were with weight and height in both sexes. In girls, PBF has also positively correlated with weight and MUAC. Among boys, BMI was significantly positively correlated with PBF and FMI, but among girls there was no relation between BMI and PBF. There were no relationships of BMI with FM and FFM among the studied preschool children.

Anthropometric measurement is simple, inexpensive to assess the body composition but less accurate than Laboratory techniques. Assessment of body composition is essential for

Table 1: Anthropometric characteristics of the studied preschool children

Age in years	Boys	Height (cm)	Weight (kg)	BMI (kg/m2)	MUAC (cm)	TRISKF (mm)	SUBSSKF (mm)	Girls	Height (cm)	Weight (kg)t	BMI (kg/m2)	MUAC (cm)	TRISKF (mm)	SUBSSKF (mm)
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
1	8	75.30 (2.86)	8.50 (0.46)	14.94 (1.04)	13.26 (1.09)	7.40 (1.90)	5.04 (0.64)	9	74.56 (6.37)	7.94 (1.51)	14.18 (1.98)	12.32 (0.96)	6.36 (0.37)	4.56 (0.71)
2	10	85.02 (3.49)	9.88 (0.75)	13.71 (1.26)	13.45 (1.03)	6.97 (1.12)	4.71 (0.49)	10	79.88 (5.30)	9.52 (1.54)	14.86 (1.75)	13.20 (1.21)	7.10 (1.56)	4.84 (1.07)
3	10	87.81 (2.94)	10.72 (0.58)	13.91 (0.53)	13.93 (0.63)	7.54 (0.77)	4.92 (1.05)	10	88.89 (2.97)	10.17 (1.36)	12.79 (0.93)	13.22 (1.19)	7.74 (1.74)	5.04 (1.29)
4	10	94.83 (6.40)	12.13 (2.02)	13.41 (1.36)	13.98 (0.57)	8.38 (1.78)	5.22 (2.28)	16	98.62 (6.28)	13.03 (1.82)	13.35 (1.18)	14.26 (0.98)	6.64 (1.64)	4.74 (1.52)
5	17	102.82 (5.96)	13.77 (1.94)	12.95 (0.86)	14.00 (0.92)	6.15 (1.64)	3.98 (1.00)	15	103.54 (6.98)	13.67 (2.70)	12.65 (1.07)	14.62 (1.35)	6.96 (2.00)	4.53 (0.88)
Age-combined	55	91.40 (10.65)	11.44 (2.37)	13.64 (1.19)	13.78 (0.89)	7.14 (1.66)	4.66 (1.30)	60	91.50 (12.29)	11.37 (2.87)	13.46 (1.55)	13.71 (1.38)	6.94 (1.63)	4.73 (1.14)
F value		52.36***	22.90***	5.42*	1.54	3.78*	2.04		49.78***	18.31***	5.13*	7.46*	1.05	0.36

***P<0.001; **P<0.01; *P<0.05, SD: Standard deviation, BMI: Body mass index, MUAC: Mid-upper arm circumference

Table 2: Age and sex specific body composition characteristics among the Sabar preschool children

Age in years	PBF (%)		t-value	FM (kg)		t-value	FFM (kg)		t-value	FMI (kg/m²)		t-value	FFMI (kg/m²)		t-value
	Boys	Girls		Boys	Girls		Boys	Girls		Boys	Girls		Boys	Girls	
1	17.86 (1.36)	17.89 (0.86)	−0.05	1.52 (0.16)	1.43 (0.31)	0.74	6.98 (0.38)	6.51 (1.20)	1.05	2.68 (0.37)	2.54 (0.42)	0.69	9.25 (0.41)	8.68 (1.30)	1.17
2	16.88 (0.86)	19.10 (1.02)	−5.25***	1.67 (0.18)	1.83 (0.38)	−1.19	8.21 (0.59)	7.69 (1.17)	1.25	2.31 (0.23)	2.84 (0.41)	−3.52***	9.66 (0.66)	9.59 (1.11)	0.17
3	16.75 (0.74)	19.92 (1.08)	−7.66***	1.80 (0.14)	2.04 (0.40)	−1.82	8.92 (0.47)	8.13 (0.97)	2.33*	2.33 (0.13)	2.55 (0.32)	−2.06*	10.16 (0.33)	9.12 (0.78)	3.88***
4	16.45 (1.51)	21.32 (0.87)	−10.48***	2.01 (0.44)	2.79 (0.46)	−4.31***	10.12 (1.64)	10.24 (1.38)	0.20	2.22 (0.39)	2.85 (0.33)	−4.42***	10.62 (1.20)	10.35 (0.95)	0.64
5	14.44 (1.14)	22.06 (1.20)	−18.38***	2.00 (0.44)	3.04 (0.80)	4.64***	11.77 (1.53)	10.62 (1.91)	1.88	1.88 (0.25)	2.80 (0.36)	−8.40***	11.40 (0.91)	10.21 (1.16)	3.25***
	16.17 (1.66)	20.39 (1.79)	−11.22***	1.84 (0.37)	2.36 (0.79)	−4.45***	9.61 (2.06)	9.00 (2.09)	1.73	2.22 (0.38)	2.74 (0.38)	−7.33***	10.40 (1.11)	9.73 (1.21)	−3.10**
Age-combined	15.68***	31.38***		4.24***	19.14***		29.82***	17.75***		12.15***	1.94		13.13***	5.15***	

***P<0.001; **P<0.01; *P<0.05, FFM: Fat-free mass, FFMI: Fat-free mass index, FMI: Free mass index, PBF: Percent body fat

Table 3: Sex specific Pearson's correlation coefficients between anthropometric variables and body composition variables

Sex	PBF (kg)	FM (kg)	FFM (kg)	FMI (kg/m²)	FFMI (kg/m²)
Boys					
Weight	−0.38**	0.86***	1.0***	−0.32**	0.95***
Height	−0.58***	0.68***	0.95***	−0.61***	0.79***
BMI	0.63***	0.13	−0.24	0.88***	0.08
MUAC	0.30*	0.68***	0.45***	0.22	0.45***
TRISKF	0.63***	0.37**	−0.06	0.59***	0.05
SUBSSKF	0.65***	0.32**	−0.12	0.59***	−0.03
Girls					
Weight	0.91***	1.0***	1.0***	0.62***	88***
Height	0.88***	0.90***	0.91***	0.28*	0.62***
BMI	−0.07	0.02	0.06	0.76***	0.51***
MUAC	0.92***	0.88***	0.83***	0.73***	0.78***
TRISKF	0.22	0.16	0.14	0.31*	0.22
SUBSSKF	0.29*	0.20	0.16	0.45***	0.27*

***P<0.001; **P<0.01; *P<0.05, FFM: Fat-free mass, FFMI: Fat-free mass index, FMI: Free mass index, PBF: Percent body fat, BMI: Body mass index, MUAC: Mid-upper arm circumference

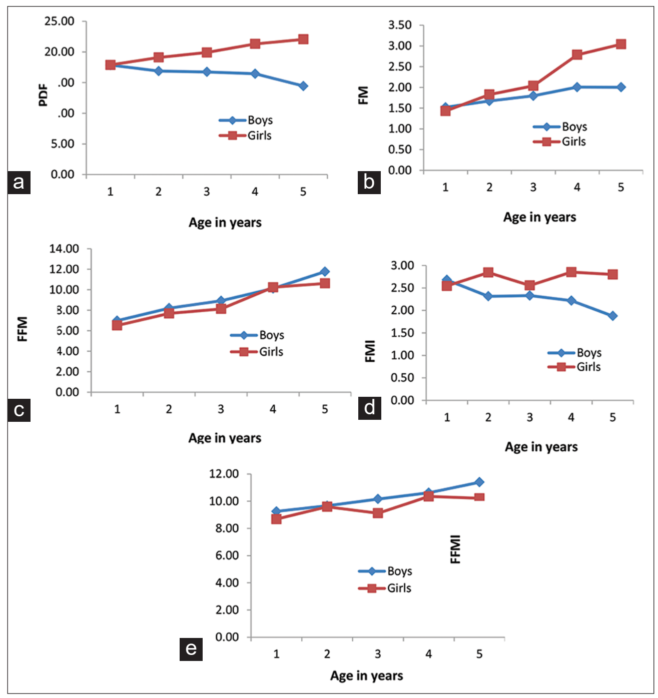

Figure 1: Sex specific age trends of body composition characteristics among the Sabar preschool children

monitoring early childhood disease in the Sabars community as well as nation. Recently, laboratory methods are used to assess absolute body composition, for example, air displacement plethysmography; under-water weighing; dual energy X-ray absorptiometry (DXA); bio-impedance analysis, magnetic resonance imaging, and computerized tomography. Many scholars suggest the use of skinfold method for measuring the subcutaneous fat, and now which is most widely adopted field method to assess body fat in children.[7,19]

FFM is more successful in predicting muscularity than the other quick and simple alternative, UAMA (Upper Arm Muscle Area).[3] Decreasing FFM or loss of FFM is related to mortality in patients with chronic diseases, cancer (including obesity cancer patients), sarcopenia and cachexia. In the case of severe neurologic disability, overweight, and obesity, FFM plays an important role.

From FFM could be calculated for energy requirement and hence nutritional intakes are allowed according to nutritional needs.[4] The sum of triceps and sub-scapular skinfolds were considered to be a good indicator of overall fatness.[9] Future exploration about body composition measurements will help to explain the relationship between the magnitude of FMI (respectively FFMI), potential risk factors and subsequent mortality.[20]

The FFMI is an index of muscle mass related to height of the subject, and FMI has been taken into account the amount of FM related to height of the subject. In this present study, it was found that both these indices showed an age and sex related variation among the studied children. The low FMI and FFMI among the preschool children in comparison to other children again suggested the poor nutritional status of surveyed children.[16] Ethnic variation or spatial variation might be a cause for this differentiation.[16] In conclusion, the present study revealed that PBF, FM and FFM were good indicators for measuring the degree of fat deposition, which could be used as a nutritional indicator in terms of leanness.

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References

1. Koo WW. Body composition measurements during infancy. Ann NY Acad Sci 2000;904:383-39.
2. Kissebah AH, Vydelingum N, Murray R, Evans DJ, Hartz AJ, Kalkhoff RK, *et al*. Relation of body fat distribution to metabolic complications of obesity. J Clin Endocrinol Metab 1982;54:254-60.
3. Boye KR, Dimitriou T, Manz F, Schoenau E, Neu C, Wudy S, *et al*. Anthropometric assessment of muscularity during growth: Estimating fat-free mass with 2 skinfold-thickness measurements is superior to measuring mid upper arm muscle area in healthy prepubertal children. Am J Clin Nutr 2002;76:628-32.
4. Thibault R, Pichard C. The evaluation of body composition: A useful tool for clinical practice. Ann Nutr Metab 2012;60:6-16.
5. Mesa MS, Sanchiez-Andres A, Marrodan MD, Martin J, Fuster V. Body composition of rural and urban children from the central region of Spain. Ann Hum Biol 1996;23:203-12.
6. Musaiger AO, Gregory WB. Profile of body composition of school children (6-18 y) in Baharin. Int J Obes 2000;24:1093-6.
7. Giri SP, Biswas S, Bose K. Body composition among rural Bengalee preschool children of integrated child development service (ICDS) Scheme of Sagar Island, South 24 Parganas, West Bengal, India. J Life Sci 2017;9:111-7.
8. Gerver WJ, Bruin RD. Body composition in children based on anthropometric data. Eur J Pediatr 1996;155:870-6.
9. Sen B, Bose K, Shaikh S, Mahalanabis D. Prediction equations for body-fat percentage in Indian infants and young children using skinfold thickness and mid-arm circumference. J Health Popul Nutr 2010;28:221-9.
10. Eckhardt CL, Adair LS, Caballero B, Avila J, Kon IY, Wang J, *et al*. Estimating body fat from anthropometry and isotopic dilution: A four-country comparison. Obes Res 2003;11:1553-62.
11. Wells JC. Sexual dimorphism of body composition. Best Pract Res Clin Endocrinol Metab 2007;21:415-30.
12. Vanltallie TB, Yang MU, Heymsfield SB, Funk RC, Boileau RA. Height normalized indices of the body's fat-free mass and fat mass: Potentially useful indicators of nutritional status. Am J Clin Nutr 1990;52:953-9.
13. Ghosh A, Kshatriya GK. Anthropometric and body composition characteristics among preschool children of coastal, Himalayan and Desert Ecology in India. Anthropol Anz 2009;67:229-36.
14. Freedman DS, Horlick M, Berenson GS. A comparison of the slaughter skinfold-thickness equations and BMI in predicting body fatness and cardiovascular disease risk factor levels in children. Am J Clin Nutr 2013;98:1417-24.
15. Atkin LM, Davies PS. Diet composition and body composition in preschool children. Am J Clin Nutr 2000;72:15-21.
16. Biswas S, Bose K. Body composition characteristics among rural Bengalee children of integrated child development service scheme from eastern India. Int J Body Compos Res 2011;9:95-9.
17. Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Chicago: Human Kinetics Books; 1988.
18. Shaikh S, Mahalanbis D. Empirically derived new equations for calculating body fat percentage based on skinfold thickness and mid arm circumference in preschool Indian children. Am J Hum Biol 2004;16:278-88.
19. Das S, Bose K. Comparison of body composition among rural preschool children of Purulia, West Bengal, using two different equations. Hum Biol Rev 2012;1:222-34.
20. Schutz Y, Kyle UU, Pichard C. Fat-free mass index and fat mass index percentiles in Caucasians aged 18-98 y. Int J Obes Relat Metab Disord 2002;26:953-60.