Factors Affecting Body Composition among Adolescent Boys of Jhargram and Paschim Medinipur districts, West Bengal, India

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Abstract

Introduction: Adolescence period is a very important period in human life cycle, most of the physical and psychological changes occur in this period. During this time body composition changes markedly. In humans body composition varies depending on ethnicity, heredity, age, sex, environment and nutrition. This study focuses on examining the factors influencing nutritional status and body composition. **Methods:** This study was done among 516 boys belonging to the age of 10-17 years, chosen randomly. Data on monthly family income, community, anthropometric and body composition variables were taken using a pretested schedule. Statistical tests like *t*- Test, ANOVA and Regression analysis were performed using SPSS 16.0 v. Significance level was set up at the level $p<0.05$. **Results:** The mean values of every variable discussed, found to be highest in higher income category i.e. >7396.00 Rs. And lowest in lower income category i.e. <4634.99 Rs. PBF, FM and FMI are observed to increase with increasing income category. The mean values of PBF, FM, FMI and FFMI are higher in non-tribal participants, and FFM and BMI are found to have no significant difference between the two groups. There is significant effect of income on PBF, FM, FFM, FMI, FFMI and BMI. There is also significant effect of community on PBF, FFM, FFMI, BMI, except FM and FMI. It is also observed that if income can be controlled for the participants, over that community has impact on the body composition variables except FM and FMI. **Conclusion:** Many factors are influencing body composition with a combined effect. More such studies need to be done to compare the diverse pattern of body composition change among other ethnic populations across world.

Keywords: India, Adolescent, Body Composition, Income, Community

Resumen

Introducción: La adolescencia es un período muy importante en el ciclo de vida humano; la mayoría de los cambios físicos y psicológicos ocurren en este período. Durante este tiempo, la composición corporal cambia notablemente. En los humanos, la composición corporal varía según la etnia, la herencia, la edad, el sexo, el entorno y la nutrición. Este estudio se centra en examinar los factores que influyen en el estado nutricional y la composición corporal. **Métodos:** Este estudio se realizó entre 516 niños de entre 10 y 17 años, elegidos al azar. Los datos sobre los ingresos familiares mensuales, la comunidad, las variables antropométricas y de composición corporal se tomaron utilizando un programa preprobado. Las pruebas estadísticas como la prueba t, ANOVA y el análisis de regresión se realizaron utilizando SPSS 16.0 v. El nivel de significancia se estableció en el nivel p <0,05. **Resultados:** Los valores medios de cada variable discutida fueron más altos en la categoría de ingresos más altos, es decir, >7396,00 Rs. Y más bajos en la categoría de ingresos más bajos, es decir, <4634,99 Rs. Se observa que la composición corporal (PBF), la MG y el IMG aumentan con el aumento de la categoría de ingresos. Los valores medios de PBF, MG, IMG e IMG son mayores en los participantes no tribales, mientras que la MG y el IMC no presentan diferencias significativas entre ambos grupos. Los ingresos tienen un efecto significativo en la PBF, la MG, la MG, el IMG, el IMG y el IMC. También existe un efecto significativo de la comunidad en la PBF, la MG, el IMG y el IMC, excepto en la MG y el IMG. Asimismo, se observa que, si se pueden controlar los ingresos de los participantes, la comunidad influye en las variables de composición corporal, excepto en la MG y el IMG. **Conclusión:** Muchos factores influyen en la composición corporal con un efecto combinado. Es necesario realizar

más estudios de este tipo para comparar los diversos patrones de cambio en la composición corporal entre otras poblaciones étnicas del mundo.

Palabras Clave: India, Adolescente, Composición corporal, Ingresos, Comunidad

Introduction

Adolescence is the most crucial phase of human life where physical and psychological changes take place the most (Hansda et al., 2023). During this time body composition changes markedly (Manna, 2022). This is an intense anabolic and formative period which requires much nutritional attention (Kotecha et al., 2009). Nutritional status and body composition varies depending on many reasons viz. socio-economic condition, nutritional intake, physical activity etc. this also may vary between communities.

Nutritional status and body composition are mostly assessed by using height, weight, skinfold measurements. Body mass index (BMI) and body composition measures like Percent of Body Fat (PBF), Fat Mass (FM), Fat Free Mass (FFM), Fat Mass Index (FMI), Fat Free Mass Index (FFMI) are used as markers to assess fatness or thinness (Pratihar et al., 2016).

The present study focuses on the factors influencing nutritional status and body composition of the study participants who are the school going boys of age 10-17 years of Paschim Medinipur and Jhargram district. This study hypothesizes that family income and community have a relationship with the body composition variables of the studied participants and also differ between tribes and non-tribes.

Materials and Methods

This study is a cross-sectional one where the studied participants are selected out from three higher secondary schools- Gurguripal High School, Siramani Birsha Munda High School of Medinipuir Sadar Block of Paschim Medinipur district and Andharia Rajballav High School of Binpur-I block of Jhargram district. The study was done among 516 boys belonging to the age of 10-17 years, chosen randomly. Among the 516 participants, 166 (32.2%) belonged to tribal communities and the rest 350 (67.8%) represented non-tribal communities.

The present study tries to examine the body composition characteristics and find out the interrelationship between family income, community, chosen playtime activity and body composition. Also, it envisages to find out the differences in the result, if any among tribes and non-tribes.

Data on socio-economic profile, anthropometric and body composition variables were taken using a pretested schedule. Name, age, monthly family income and community were recorded using a pre-tested schedule for socio-economic data. . Monthly family income is further categorized in four groups using quartile method as- "<4634.99 Rs.", "4635.00 Rs.-6260.99 Rs.", "6261.00 Rs.-7395.99 Rs." and ">7396.00 Rs." Height, weight, mid upper-arm circumference (MUAC), skinfold of bicep, triceps, sun-scapular and supra-iliac were measured by trained investigators using standard techniques (Weiner & Lourie, 1969). Finally derived measurements as body mass index (BMI), percent of body fat (PBF), fat mass (FM), fat free mass (FFM), fat mass index (FMI), fat free mass index (FFMI) were computed using standard equations by Slaughter et al. (1988) as mentioned below.

Body Mass Index (BMI)=	**Body weight(kg)/Height(m)²**
Percent Body Fat (PBF)=	If (Triceps + Subscapular) > 35 mm) then,
(For Boys)	**0.783(TSKF + SSKF) + 1.6**
	If (Triceps + Subscapular) < 35 mm) then,
	1.21 (TSKF + SSKF) – 0.008(TSKF + SSKF)² –1.7
Fat Mass (FM)=	**Body Weight (Kg)*(PBF/100)**
Fat Free Mass (FFM)=	**Body Weight (Kg)-FM**
Fat Mass Index (FMI)=	**FM in Kg/ Height in meter²**
Fat Free Mass Index (FFMI)=	**FFM in Kg/ Height in meter²**

Statistical tests like *t*- Test, ANOVA and Regression analysis were performed using SPSS 16.0 v. Significance level was set up at the level $p < 0.05$.

Results

Table 1. Table of ANOVA for Body Composition Values between Participants of Monthly Family Income Groups.

Body Composition Variables	Monthly Family Income Groups				F
	<4634.99 Rs. (n= 127) (Mean ± SD)	4635.00 Rs. - 6260.99 Rs. (n=126) (Mean ± SD)	6261.00 Rs. - 7395.99 Rs. (n=132) (Mean ± SD)	>7396.00 Rs. (n=131) (Mean ± SD)	
PBF	10.70 ± 4.76	12.77 ± 5.41	14.78 ± 5.33	18.95 ± 5.50	**57.80*****
FM	3.65 ± 1.95	4.70 ± 2.62	5.26 ± 2.50	8.96 ± 3.42	**96.26*****
FFM	29.65 ± 5.85	31.57 ± 8.50	30.19 ± 5.97	37.93 ± 7.86	**37.27*****
FMI	1.67 ± 0.79	2.12 ± 1.05	2.39 ± 1.05	3.62 ± 1.26	**81.19*****
FFMI	13.85 ± 1.36	14.36 ± 1.84	13.61 ± 1.61	15.23 ± 1.83	**24.33*****
BMI	15.52 ± 1.43	16.49 ± 2.02	15.99 ± 1.96	18.85 ± 2.36	**73.03*****
***=$p<0.001$					

Table 1 presents the descriptive statistics (Mean ± SD) of body composition variables among participants of Monthly Family Income categories. The mean values of every variable discussed, found to be highest in higher income category i.e. >7396.00 Rs. And lowest in lower income category i.e. <4634.99 Rs. PBF, FM and FMI are observed to increase with increasing income category. It was observed by using one way ANOVA and these differences are found to be statistically significant at the level $p<0.01$.
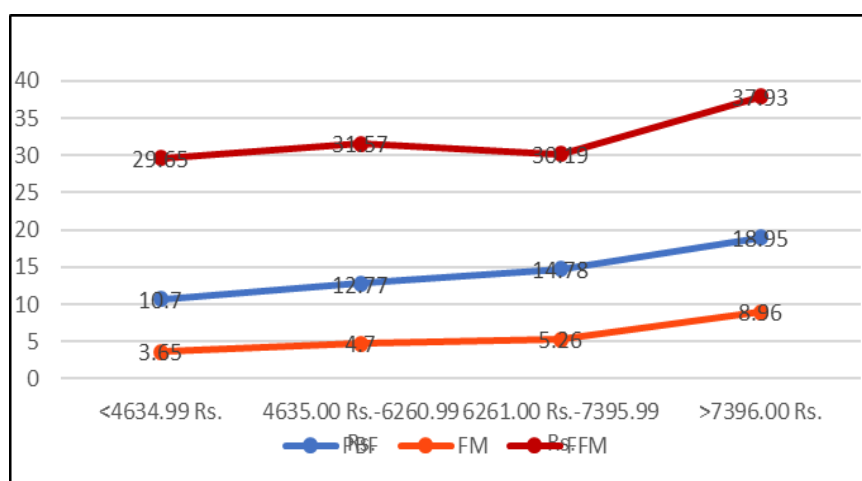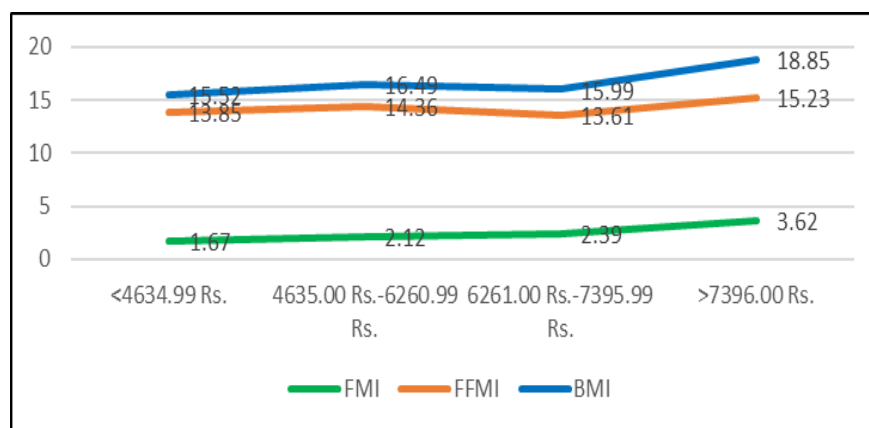

Figure 1. Income Group specific line graph of PBF (%), FM (Kg) and FFM (kg)

Figure 2. Income Group specific line graph of FMI (Kg/m^2) and FFMI (Kg/m^2) and BMI (Kg/m^2)

Figure 1 shows the changes in mean values of PBF, FM and FFM with increasing income category which clearly defines the difference in body composition measures in different income group and Figure 2 shows changing pattern of mean values of FMI, FFMI and BMI with increasing income category.

Table 2. Table of t-Test for Body Composition Values between Participants of Two Communities

Body Composition Variables	Community		t
	Non-tribe (N= 350) (Mean ± SD)	**Tribe** (N= 166) (Mean ± SD)	
PBF	15.79 ± 5.95	11.30 ± 5.13	**8.353*****
FM	6.33 ± 3.51	4.26 ± 2.42	**6.886*****
FFM	32.34 ± 8.08	32.39 ± 7.38	-0.068
FMI	2.72 ± 1.29	1.92 ± 1.05	**6.920*****
FFMI	14.08 ± 1.82	14.67 ± 1.63	**3.549*****
BMI	16.79 ± 2.47	16.59 ± 2.08	0.926
***=*p*<0.001**			

Table 2 presents the descriptive statistics (Mean ± SD) of body composition variables among participants. The mean values of PBF, FM, FMI and FFMI are higher in non-tribal participants, and FFM and BMI are found to have no significant difference between the two groups. It was observed by using independent sample t-test these differences are found to be statistically significant at the level p<0.01
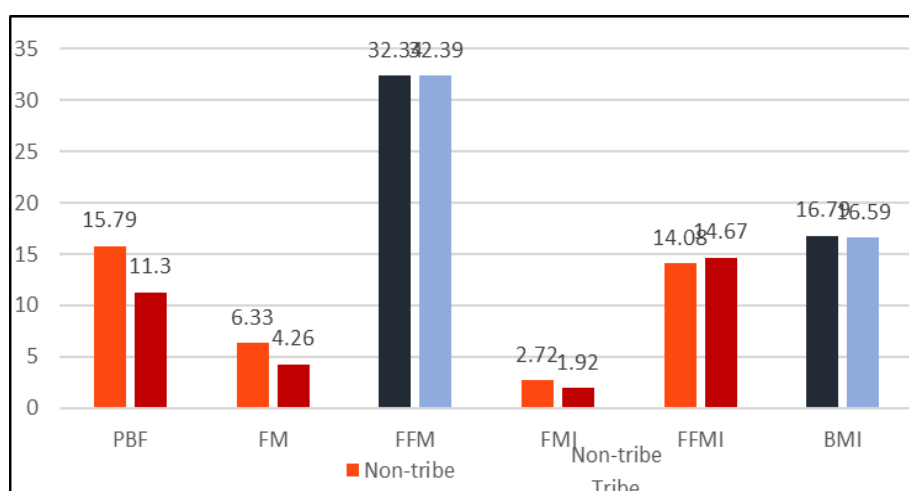

Figure 3. Community specific Bar Diagram of Body Composition variables

Figure 3 shows the mean values of the body composition measures differentiated by shades for non-tribe and tribe category. Among them the two measures with distinct shade combination are FFM and BMI found to have no significant difference between the participants of the two communities

Table 3 shows the effect of income and community on body composition variables. There is significant effect of income on PBF (Adj. R^2 =0.257; t=9.847) FM (Adj. R^2 =0.339; t=14.141) FFM (Adj. R^2 =0.175; t=10.553) FMI (Adj. R^2 =0.303; t=12.772) FFMI (Adj. R^2 =0.159; t=9.196) BMI (Adj. R^2 =0.286; t=14.376). These all are significant at the level p<0.01. This table also shows significant effect of community PBF (Adj. R^2 =0.257; t=3.041) FFM (Adj. R^2 =0.175; t=-5.283) FFMI (Adj. R^2 =0.159; t=-7.873) BMI (Adj. R^2 =0.286; t=-6.156). These all the above mentioned are significant at the level p<0.01 except FM (Adj. R^2 =0.339; t=0.058) FMI (Adj. R^2 =0.303; t=0.584) which are found to be not significant. All the dependent variables i.e. PBF, FM, FFM, FMI, FFMI and BMI can be explained by independent variable- Income and Community.

Table 3. Regression analysis of Impact of family income and community on body composition

Dependent Variable		B	SE B	β	Adjusted R Square	t	95% confidence interval for B	
							Lower Bound	Upper Bound
PBF	Income	0.002	0.000	0.430	0.257	**9.847****	0.001	0.002
	Community	1.725	0.567	0.133		**3.041****	0.611	2.840
FM	Income	0.001	0.000	0.583	0.339	**14.141*****	0.001	0.001
	Community	0.017	0.295	0.002		0.058	-0.562	0.596
FFM	Income	0.002	0.000	0.486	0.175	**10.553*****	0.002	0.003
	Community	-4.085	0.773	-0.243		**-5.283*****	-5.604	-2.566
FMI	Income	0.000	0.000	0.540	0.303	**12.772*****	0.000	0.000
	Community	0.067	0.115	0.025		0.584	-0.159	0.294
FFMI	Income	0.000	0.000	0.428	0.159	**9.196*****	0.000	0.001
	Community	-1.395	0.177	-0.366		**-7.873*****	-1.743	-1.047
BMI	Income	0.001	0.000	0.616	0.286	**14.376*****	0.001	0.001
	Community	-1.328	0.216	-0.264		**-6.156*****	-1.752	-0.904

***=$p<0.001$: **=$p<0.01$

Table 4. Regression analysis of Impact of community on body composition with family income controlled

Dependent Variable	B	SE B	β	R Square Change	F Change	t	95% confidence interval for B	
							Lower Bound	Upper Bound
PBF	1.725	0.567	0.133	0.013	**9.248****	**3.041****	0.611	2.840
FM	0.017	0.295	0.002	0.000	0.003	0.058	-0.562	0.596
FFM	-4.085	0.773	-0.243	0.045	**27.909*****	**-5.283*****	-5.604	-2.566
FMI	0.067	0.115	0.025	0.000	0.341	0.584	-0.159	0.294
FFMI	-1.395	0.177	-0.366	0.101	**61.980*****	**-7.873*****	-1.743	-1.047
BMI	-1.328	.0216	-0.264	0.053	**37.892*****	**-6.156*****	-1.752	-0.904

***=$p<0.001$; **=$p<0.01$

Table 4 shows the impact of community on body composition variables over controlled income, which means if income can be controlled for the participants, over that community has impact on the body composition variables except Fat Mass (FM) and Fat Mass Index (FMI). The other variables- PBF, FFM, FFMI and BMI can be explained by community and it is significant at P<0.01.

Discussion

There are extensive studies on association between body composition and socio-economic factors (Kumar et al. 2019; Baran et al. 2022). Though in this study not all socio-economic factors have been taken into consideration, but only monthly family income has been studied for association. It has become evident from this study that there is significant relationship between monthly family income and body composition. However, the

underlying mechanism of potential mediators of this relationship remains unclear. The differences are probably for genetic factors or due to poor intake of food and physical activity (Sarkar & Paul 2015).

Relationship between community and body composition has also become evident from this study as the two groups- non-tribe and tribe show different trends in body composition variables except FFM and BMI which found to be not significant. The other measure i.e. PBF, FM, FMI, FFMI have significant difference between non-tribe and tribes. Some other studies from near past have discussed about similar trends as reported by Adhikary (2019) where different ethnic groups from Dooars in West Bengal were studied and results show significant diversity in body composition trends among the groups. Another similar study shows similar results were significantly higher BMI and PBF were observed among the non-tribal participants compared to the tribal counterpart (Manna, 2022). Another study is found (Saha & Sil, 2019) where results indicated ethnic differences in body composition measures- PBF, FM, FMI, FFMI between Chakma tribal and Bengali non-tribal girls of Tripura.

Conclusion

India is the land with vast heterogeneity in ethnicity, food pattern and life style. All these have effects on body composition jointly. Not one single factor can be identified for influencing body composition but all these factors have a combined effect as a whole. Body composition also may vary during growing age and pattern can be different between sexes. More such studies need to be done to compare the diverse pattern among other ethnic populations across India and outside. Such studies will generate intricate and valuable theory for the interest of humankind.

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Conflicts of Interest

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Informed Consent Statement

All the participants included in the study provided written informed consent.

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