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BMI, MUAC, Skin Fold And Body Fat % Of Bengalee And Tribal Boys Of Agartala, Tripura, - An Anthropometric Approach

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ABSTRACT
The present study assessed anthropometric measurements of adolescents in Agartala, Tripura, with the goal of examining the nutritional status of the adolescent Bengalee and tribal male populations. Data for the anticipated research were collected from currently enrolled students. Children who are enrolled in school were separated into age groups starting at 12 and going up to 18. The study includes seven different age groups (age group 12 to 18). In total, 280 individuals were selected (Bengalee 140 & Tribal 140). Data was analyzed using SPSS. According to the study's findings, adolescents in Agartala are significantly less nourished and Bengalee boys are taller and heavier than Tribal boys.
Keywords: Anthropometry Nutritional status, BMI, MUAC, Skin fold, Bengalee, Tripuri

INTRODUCTION
The cornerstone of youth is adolescence. It is the responsibility of our society to guarantee that adolescents are well-fed because when adolescence is healthy and fed, so are the youth and their communities. Teenage years are a time of potential opportunities. The most crucial stage of a person's life is adolescence since it marks the passage from childhood to maturity and is a time of numerous physical, psychological, and emotional changes. This significant alteration necessitates a lot of energy and other nutrients. The significant growth spurt that takes place during adolescence is greatly influenced by the nutrients that are consumed.[1]
Anthropometrics can be a sensitive indicator of a child's or infant's health, growth, and development. In several instances involving nutritional status during adolescence, anthropometry has been used in particular. A serious global issue impacting nearly one-third of the world's population, the prevalence of malnutrition, especially among adolescents, has no immediate solution. This could have long-term effects on both mental and physical development. The prevalence of undernutrition is rising in many emerging nations.[2]
India's problems are also coming to a head at this time. The state of Tripura in the northeast is not an exception to this rule. Between childhood and adulthood, the adolescent stage is a crucial time in a person's life because it is a time of rapid growth and maturation. Because of this rapid growth in stature, muscle mass, and fat mass during the adolescent growth spurt, adolescent nutritional needs are as high as or higher than those of any other age group.[3]The nutritional state of the population is greatly influenced by the nutritional status of teenagers, who will eventually become parents. Additionally, this age group makes up more than a quarter of the global population. This age group makes up 21.4% of the overall population in India.[4]

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

This time serves to provide the groundwork for sound mind and body. Additionally, it is a fundamental turning point in a person's life and is to blame for a lot of the changes that occur in later life. A child's physical, mental, emotional, and social development are all changing during this age, which is why it is seen as a dynamic time for growth and development. More information on the health and nutrition of school-age children is required in order to determine the scope of the issue, according to the United Nations Sub-Committee on Nutrition meeting held in Oslo in 1998. School children are a readily available, capacitive, and responsive demography. Teenagers have been given minimal importance when it comes to nutritional status assessments because they are thought to have the lowest mortality rates among all age groups. Although adolescent health issues including STDs and reproductive health have received adequate attention, little study has been done on their nutritional status, particularly in rural India.[5]

The nutritional condition of children is a good indicator of the health situation of a community since school-age children are the most important population in our society and reflect the overall health of a community and the nation. A trustworthy way to evaluate the children's nutritional status is anthropometry. To evaluate children's nutritional health, the World Health Organization (WHO) has proposed a variety of anthropometric-based indices. Body mass index (BMI) is a low-cost, non-invasive technique that is frequently used to assess adolescent thinness and adult nutritional status. Numerous investigations into the nutritional status and physical development of aboriginal children have been carried out across the nation. The north-eastern region of India has produced relatively few studies on tribal children.[6]

Due to undernourishment, children and adolescents in developing nations continue to be most at risk for illness, early death, and morbidity.[7] The prevalence of undernutrition is a major worry for many of Asia's rising nations. With its sizable population, socioeconomic disparities, high rate of illiteracy, and restricted access to healthcare, India is hardly an exception. Therefore, nutritional status surveys might be very helpful in the creation of this country's development programs.[8] India shows the highest occurrence of childhood undernutrition in the world[9] and it has been estimated that more than half of Indian children are undernourished.[10]

Bengalees, the second-largest ethnic group in the world, are mostly of Indo-Aryan ancestry. The ethnic makeup of the Bengalee people is varied. They are most prevalent in West Bengal and Tripura, respectively. North-eastern between the longitudes of 23º 45' North and 91º 30' East is the sub-Himalayan state of Tripura in India. To the north, west, south, and south-east, it is bounded by the international border of Bangladesh. In northeastern India, several populations show differing degrees of undernutrition.[11]

Since anthropometry is a low-cost, non-invasive method that provides thorough information on a wide range of body structure components, notably the muscular and fatty ones, it has a long history of use in evaluating teenagers' nutritional and physical health.[12] Additionally, biochemical and clinical markers are only helpful for the most severe forms of malnutrition, but anthropometric measures are particularly sensitive to the full spectrum of nutritional status. Body mass index (BMI) and mid-upper-arm circumference (MUAC) are the most significant and trustworthy anthropometric measures.[13]BMI is frequently utilized as a trustworthy indicator for assessing chronic energy deficiency in adolescents, particularly in developing countries. [14] It

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

allows one to evaluate the body's protein and fat reserves because of its significant association with fat and fat-free mass.[15]

In addition to age, another variable that may change the functional importance of BMI at different ages is adolescence's propensity to shed fat-free mass with age and.[16]

Oedema may potentially have an effect on the BMI's applicability. Teenagers who are severely undernourished may develop oedema, which artificially raises weight and gives the appearance of having a higher BMI than is actually the case.[17] Furthermore, different populations are unable to employ the BMI's worldwide cut-off. These flaws thus diminish the efficacy of BMI as a trustworthy screening tool for identifying adult undernutrition.[18]

The MUAC (Mid-Upper Arm Circumference), however, is an additional critical marker for a rapid evaluation of adult nutritional status, particularly in developing countries. The measurement takes little equipment, therefore even the most disabled persons may complete it.[19] It reveals the arm muscle and subcutaneous fat, two body parts that are independent of height and necessary for surviving hunger. Despite being more effective than the BMI category at identifying undernutrition, the MUAC category still has some errors. The relationship between MUAC and undernutrition as well as other functional indicators in adults across a range of racial and demographic groups is poorly understood. The age-related redistribution of subcutaneous fat towards the center of the body may have an effect on adults' usage of MUAC. As a result, age-specific MUAC cut-off points may be necessary.[20]

Aims and Objective

The aim of the present study is to examine and compare the nutritional status of the adolescent Bengalee and Tribal males (Debbarma) populations of Agartala, Tripura.

Study Area

Tripura's capital city of Agartala has been chosen as the site of this study.

Methodology

Everything from methodology to measurements to ethical considerations to data collection and analysis is a part of this study. Since academic pursuits define research in its purest form, it stands to reason that research is also an academic endeavour. Researchers assert that research entails identifying and clarifying issues, developing hypotheses or potential solutions, amassing and analysing data, making conclusions, and testing those conclusions to ascertain whether or not they confirm the produced ideas.

Sampling Method: Students who are currently enrolled in school provide the data for the planned study project. School-going kids were divided into age groups starting at 12 and extending up to 18. A straightforward random sample approach was used to choose people from various age groups. For the purpose of verifying age, a birth certificate or school record was taken into account.

Simple Random Procedure: Every member of the population had an equal probability of being chosen for the sample using this methodology. The lottery approach was used for the current investigation. In the lottery approach, identity information for each person mentioned in the population was written down on small, uniform-sized slips of paper, which are then thoroughly mixed in a container before the required number of slips, were randomly selected.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

Sample size and inclusion & exclusion criteria: There are a total of seven age groups in the study (age group 12 to 18). A total of 280 participants were chosen from each community (Bengalee 140 & Tribal 140).

Only those who reported having no chronic disease in the previous two years and who had not been hospitalised in the two months before the survey were included in the current investigation.

Data analysis:

SPSS 22.0, a statistical software programme, was used to evaluate the study's data for both secondary qualitative and quantitative data, as well as content analysis for quantitative data. The investigation of the data that was thought to be the most significant involved the use of analytical techniques like the t test and percentage approaches.

Results

Descriptive Statistics Frequency and Percentage of Data

The demographics of the respondents revealed the crucial findings that are listed below. The initial round of inquiries focuses on demographics, including gender, occupation, and other details. An in-depth examination of the data collected was carried out with the aid of the graph, the number of participants, the frequency of various measurements, and the percentages in the tables. Using the t test appropriately, statistical analysis was completed.

Table 1.1: Age wise height distribution of participants (Bengalee)

Age	Height (cm) (Bengalee)							Total
	124 to 135	136 to 145	146 to 155	156 to 165	166 to 175	176 to 185	186 to 195	
12.00	4	7	7	2	0	0	0	20
13.00	0	2	10	8	0	0	0	20
14.00	0	2	6	7	4	0	1	20
15.00	0	3	2	7	8	0	0	20
16.00	0	0	0	7	11	2	0	20
17.00	0	0	0	8	8	4	0	20
18.00	0	0	0	2	11	5	2	20
Total	4	14	25	41	42	11	3	140

Graph 1.1: Graphical representation of Age wise height distribution of participants (Bengalee)

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

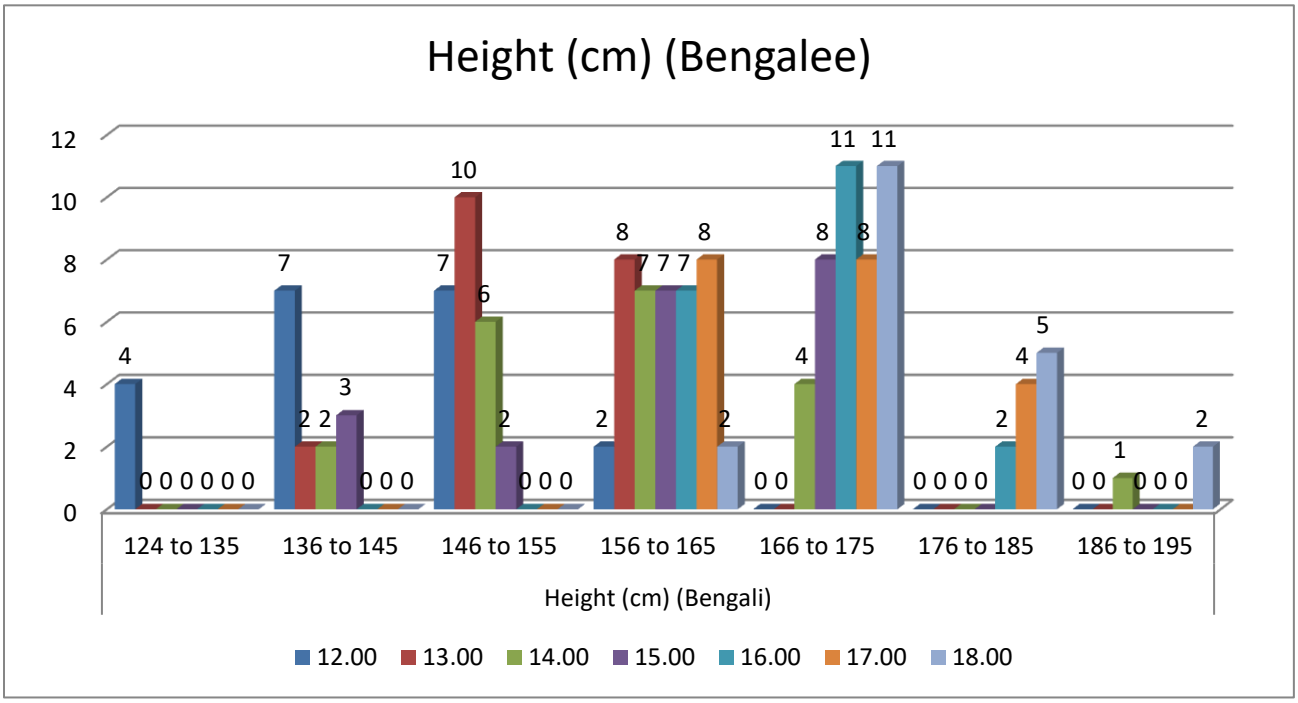

Table 1.2: Age wise height distribution of participants (Tripuri)

Age	Height (cm) (Tripuri)					Total
	124 to 135	136 to 145	146 to 155	156 to 165	166 to 175	
12.00	9	6	5	0	0	20
13.00	2	6	5	7	0	20
14.00	1	2	5	7	5	20
15.00	0	0	3	14	3	20
16.00	0	0	0	10	10	20
17.00	0	0	3	12	5	20
18.00	1	0	2	8	9	20
Total	13	14	23	58	32	140

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

Graph 1.2: Graphical representation of Age wise height distribution of participants (Tripuri)

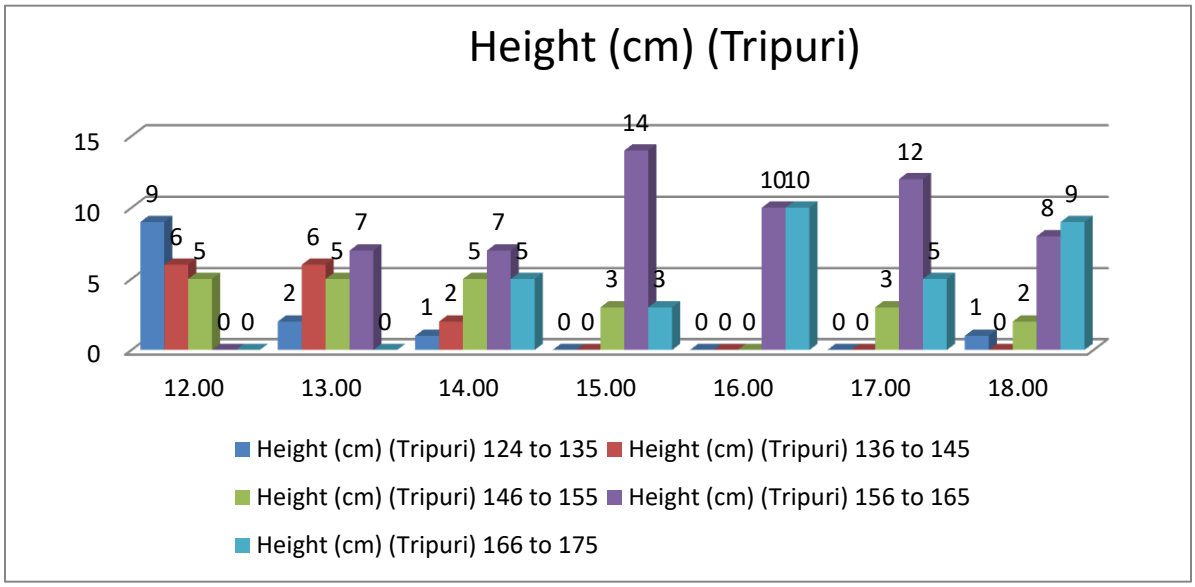

Table 1.3: Age wise weight distribution of participants (Bengalee)

Age	Weight (kg) (Bengalee)							Total
	20 to 30	31 to 40	41 to 50	51 to 60	61 to 70	71 to 80	81 to 90	
12.00	9	6	5	0	0	0	0	20
13.00	0	14	2	3	1	0	0	20
14.00	1	9	3	6	0	1	0	20
15.00	0	4	8	4	3	1	0	20
16.00	0	0	7	9	3	1	0	20
17.00	0	1	5	8	2	2	2	20
18.00	0	0	2	6	8	3	1	20
Total	10	34	32	36	17	8	3	140

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

Graph 1.3: Graphical representation of Age wise weight distribution of participants (Bengalee)

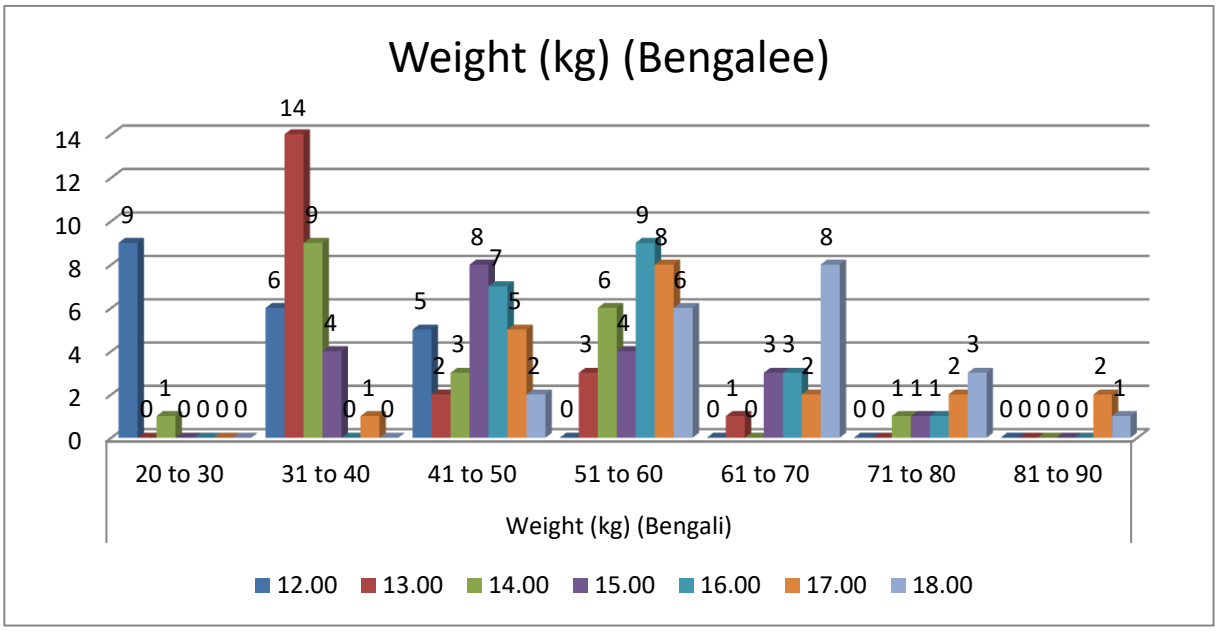

Table 1.4: Age wise weight distribution of participants (Tripuri)

Age	Weight (kg) (Tripuri)						Total
	20 to 30	31 to 40	41 to 50	51 to 60	61 to 70	71 to 80	
12.00	14	5	1	0	0	0	20
13.00	3	13	4	0	0	0	20
14.00	0	8	9	2	1	0	20
15.00	0	0	8	11	1	0	20
16.00	0	1	9	9	0	1	20
17.00	0	0	8	12	0	0	20
18.00	1	0	5	12	2	0	20
Total	18	27	44	46	4	1	140

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

Graph 1.4: Graphical representation of Age wise weight distribution of participants (Tripuri)

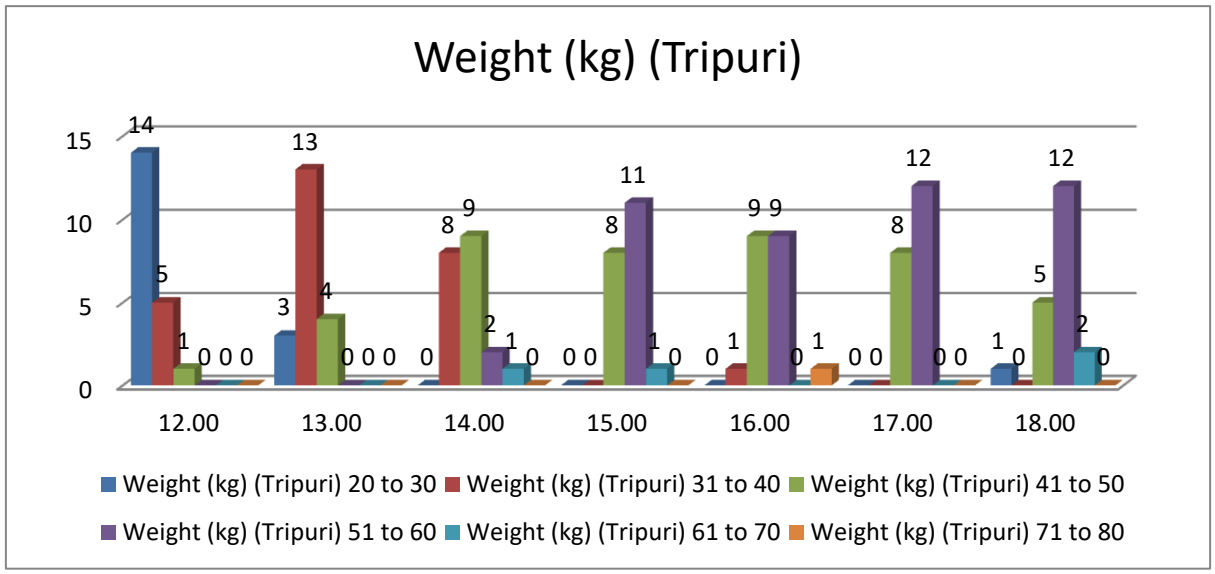

Table 1.5: Age wise BMI distribution of participants (Bengalee)

Age	BMI (Bengalee)				Total
	10.5 to 15	15.1 to 20	20.1 to 25	25.1 to 30	
12.00	9	9	2	0	20
13.00	4	12	3	1	20
14.00	1	9	10	0	20
15.00	0	15	4	1	20
16.00	0	11	8	1	20
17.00	0	11	5	4	20
18.00	2	5	9	4	20
Total	16	72	41	11	140

The above table shows age wise BMI distribution of participants (Bengalee). In age 12, 9 participants in 10.5 to 15, 9 in 15.1 to 20, 2 in 20.1 to 25. In age 13, 4 participants in 10.5 to 15, 12 in 15.1 to 20, 3 in 20.1 to 25 and 1 in 25.1 to 30. In age 14, 1 participants in 10.5 to 15, 12 in 15.1 to 20, 10 in 20.1 to 25. In age 15, 15 in 15.1 to 20, 4 in 20.1 to 25 and 1 in 25.1 to 30. In age 16, 11 in 15.1 to 20, 8 in 20.1 to 25 and 1 in 25 to 30. In age 17, 11 in 15.1 to 20, 5 in 20.1 to 25 and 4 in 25 to 30. In age 18,2 participants in 10.5 to 15, 2 in 15.1 to 20, 9 in 20.1 to 25 and 4 in 25.1 to 30.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

Graph 1.5: Graphical representation of Age wise BMI distribution of participants (Bengalee)

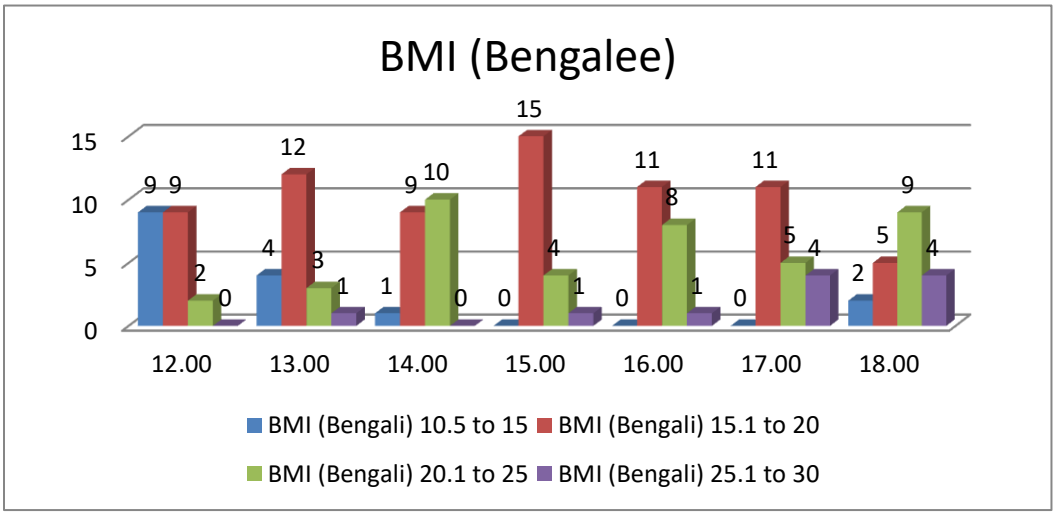

Table 1.6: Age wise BMI distribution of participants (Tripuri)

Age	BMI (Tripuri)				Total
	10.5 to 15	15.1 to 20	20.1 to 25	25.1 to 30	
12.00	11	9	0	0	20
13.00	4	16	0	0	20
14.00	0	16	3	1	20
15.00	0	13	7	0	20
16.00	1	14	4	1	20
17.00	0	14	6	0	20
18.00	1	17	2	0	20
Total	17	99	22	2	140

The above table shows age wise BMI distribution of participants (Tripuri). In age group 12, 11 participants in 10.5 to 15, 9 in 15.1 to 20. In age 13, 4 participants in 10.5 to 15, 16 in 15.1 to 20. In age 14, 16 in 15.1 to 20, 3 in 20.1 to 25 and 1 in 25.1 to 30. In age 15, 13 in 15.1 to 20, 7 in 20.1 to 25. In age 16, 1 in 10.5 to 15, 14 in 15.1 to 20, 4 in 20.1 to 25 and 1 in 25 to 30. In age 17, 14 in 15.1 to 20, 6 in 20.1 to 25. In age 18,1 participants in 10.5 to 15, 17 in 15.1 to 20, 2 in 20.1 to 25.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

Graph 1.6: Graphical representation of Age wise BMI distribution of participants (Tripuri)

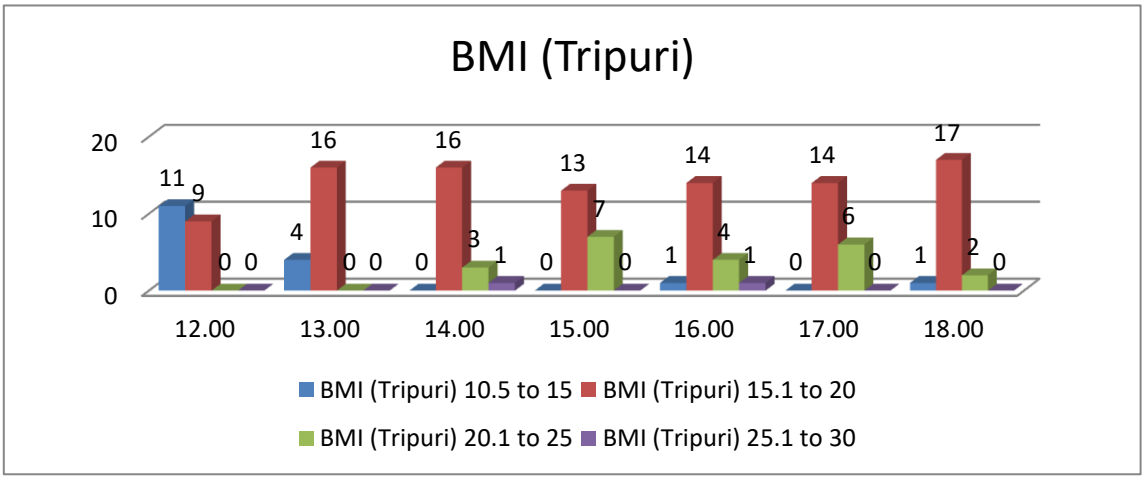

Table 1.7: Correlation of SES with BMI, MUAC and Body fat %

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SES	2.9750	280	.46692	.02790
	BMI	18.8879	280	3.76140	.22479
Pair 2	SES	2.9750	280	.46692	.02790
	MUAC (cm)	23.4871	280	3.52774	.21082
Pair 3	SES	2.9750	280	.46692	.02790
	Body fat %	8.6543	280	5.56914	.33282

Paired Samples Test							
		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	SES - BMI	-15.91286	3.81645	.22808	-69.770	279	.000
Pair 2	SES - MUAC (cm)	-20.51214	3.60303	.21532	-95.262	279	.000
Pair	SES -	-5.67929	5.67146	.33893	-16.756	279	.000

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

3	Body fat %						

The above table shows correlation of SES with BMI, MUAC and Body fat % in which all variables are statistically correlated.

Table 1.7: Comparison of anthropometric measurements

Group Statistics					
	Test variable	N	Mean	Std. Deviation	Std. Error Mean
BMI	Bengalee	140	18.7064	3.79149	.32044
	Tripuri	140	17.9307	2.45098	.20715
MUAC (cm)	Bengalee	140	23.3271	3.73573	.31573
	Tripuri	140	22.3021	3.03380	.25640
Triceps Skin fold (mm)	Bengalee	140	11.3243	5.58971	.47242
	Tripuri	140	6.7743	2.97997	.25185
Suprailliac Skin fold (mm)	Bengalee	140	9.7193	5.65260	.47773
	Tripuri	140	6.2736	3.66672	.30989
Abdominal Skin fold (mm)	Bengalee	140	17.0064	9.82188	.83010
	Tripuri	140	10.4743	6.75459	.57087
Thigh Skin fold (mm)	Bengalee	139	18.4655	6.42216	.54472
	Tripuri	140	11.2814	4.71513	.39850
Body fat %	Bengalee	140	11.2463	5.66373	.47867
	Tripuri	140	6.0623	4.07954	.34478

Independent Samples Test						
		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
BMI	Equal variances assumed	2.033	278	.043	.77571	.38156
	Equal variances not assumed	2.033	237.902	.043	.77571	.38156
MUAC (cm)	Equal variances assumed	2.520	278	.012	1.02500	.40673
	Equal variances	2.520	266.770	.012	1.02500	.40673

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

	not assumed					
Triceps Skin fold (mm)	Equal variances assumed	8.499	278	.000	4.55000	.53536
	Equal variances not assumed	8.499	212.106	.000	4.55000	.53536
Suprailliac Skin fold (mm)	Equal variances assumed	6.051	278	.000	3.44571	.56944
	Equal variances not assumed	6.051	238.381	.000	3.44571	.56944
Abdominal Skin fold (mm)	Equal variances assumed	6.484	278	.000	6.53214	1.00745
	Equal variances not assumed	6.484	246.445	.000	6.53214	1.00745
Thigh Skin fold (mm)	Equal variances assumed	10.656	277	.000	7.18404	.67420
	Equal variances not assumed	10.644	253.230	.000	7.18404	.67493
Body fat %	Equal variances assumed	8.788	278	.000	5.18395	.58992
	Equal variances not assumed	8.788	252.642	.000	5.18395	.58992

The above table discusses comparison of anthropometric measurements in Bengalee and Tripuri boys in which all the variables are statistically significant.

Discussion

The present study aims to compare the adolescent Bengalee and tribal males of Agartala, Tripura from nutritional point of view and socioeconomic status for which we did age wise height, weight and BMI distribution of participants of Bengalee and Tripuri boys. It was found that in Bengalee having 11 participant of height in group 176 to 185 cm. and 3 of height in group 186 to 195 cm. while in Tripuri none participants having height in group 176 to 185 and 186 to 195. In case of weight Bengalee having 3 participants in group 81 to 90 kg. (2 of age 17 and 1 of age 18)

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

while in Tripuri, none participants found in group 81 to 90 kg. In case of BMI, in Bengalee, 11 participants found in group 25.1 to 30 (1 of age 13, 1 of age 15, 1 of age 16, 4 of age 17 and 4 of age 18) which is considered overweight according to national cut offs value while in Tripuri participants only 2 participants found in group 25.1 to 30 (1 of age 14 and 1 of age 16) which is considered overweight according to national cut offs value of BMI. Study also founds significant correlation of SES with BMI, body fat% and MUAC. In our study for comparision of anthropometric measurements (BMI, MUAC, Body fat%, Triceps Skin fold, Suprailliac Skin fold, Abdominal Skin fold and Thigh Skin fold) of adolescents we use t test in which we have found significant difference between both community. Mean ± SD of Bengalee and Tripuri boys found 18.7064 ± 3.79149, 17.9307 ± 2.45098.

Mean MUAC found in our study in Bengalee is 23.3271 cm. and in Tripuri is 22.3021 while in other study done by Olabinri et., 2009, [21] observes mean MUAC of 17.03 cm in males and 17.0 cm in females, respectively.

According to Oliveira, 2017,[22] there was an association between the SGA and body mass index/age (p=0.022), height/age (p<0.001) and arm muscle circumference (p=0.014). According to Debbarma et.al., 2018,[23] weight and height of the children were measured and height-for-age (stunting), weight-for-height (wasting) and weight-for-age (underweight) were calculated. Out of 155 numbers of school children, wasting was found in 53.83% boys and 72.71% girls out of which 16.12% children showed severe degree of wasting. While in our study, correlation between age, height, weight, BMI and chest Circumference are significant.

According to (Roy et.al., 2020),[24] age specific mean values in height, weight and BMI gradually increased. In our study, mean value of age, height, weight and BMI (Bengalee and Tribal) was found to be 15.2750, 15.0750, 161.5250, 155.7800, 50.8500, 43.9250, 19.1700 and 17.8800.

According to Jethwani, 2016,[25] Body mass index (BMI) was analyzed and it was found that 74.4% of students were underweight, 24.3% were in the normal category and 3.57% students were overweight. According to (Sil et.al., 2017)[6], Prevalence of stunting, thinness and overweight among urban tribal boys were 7.67%, 17.81% and 6.03% respectively. According to Patel and Singh, 2019,[26] among the scheduled casts children of Lucknow, 67% were stunted, 74.8% were underweight, 48% were underfed and 57.3% children were malnourished. In the present study of adolescent Bengalee and Tribal boys, it was found that 80.1% are underweight, 14% are normal and 2.5% are overweight.

Conclusion and recommendation

A huge number of adolescent Bengalee and Tribal boys of Agartala, Tripura, is suffering from malnutrition. According to the study's findings, Bengalee boys are taller and heavier than Tripuri boys, and there is a significant difference in their nutritional status. It is therefore advised that a thorough plan be implemented in the state's poor communities to prevent adolescent undernutrition in light of the study's findings.

REFERENCES

1. Odedra AD, Sodha DSR. Assessment of Anthropometric measurements of the Adolescents studying in MadhyamikShala of Khadia, Junagadh. *Int J Creat Res Thoughts*. 2018;6(2):853-861.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

2. Mukhopadhyay A, Bhadra M, Bose K. Anthropometric Assessment of Nutritional Status of Adolescents of Kolkata, West Bengal. *J Hum Ecol*. Published online 2005. doi:10.1080/09709274.2005.11905832
3. Dey I, Biswas R, Ray K, Bhattacherjee S, Chakraborty M, Pal P. Nutritional status of school going adolescents in a rural block of Darjeeling , West Bengal , India. *Health (Irvine Calif)*. Published online 2011.
4. Choudhary S, Mishra CP, Shukla KP. Energy balance of adolescent girls in rural area of Varanasi. *Indian J Public Health*. Published online 2003.
5. Gaiki V, Wagh V. Nutritional status of adolescentgirls from selected rural areas of a district from Cen-tral India. *Innov J Med Heal*. 2014;4(2):90-92.
6. Sil SK, Saha S, Roy S, Sarkar SR. Nutritional status of urban Tripuri tribal boys of Agartala, Tripura. *Anthropologist*. Published online 2012. doi:10.1080/09720073.2012.11891234
7. Nandy S, Irving M, Gordon D, Subramanian S V., Smith GD. Poverty, child undernutrition and morbidity: New evidence from India. *Bull World Health Organ*. Published online 2005. doi:/S0042-96862005000300014
8. Mondal N, Sen J. Prevalence of stunting and thinness among rural adolescents of Darjeeling district, West Bengal, India. *Ital J Public Health*. Published online 2010.
9. Bamji MS. Early nutrition and health - Indian perspective. *Curr Sci*. Published online 2003.
10. Measham AR, Chatterjee M. *Wasting Away: The Crisis of Malnutrition in India*.; 1999.
11. Singh J, Sengupta S. Nutritional Status of Sonowal Kachari Children of Dibrugarh District, Assam. *Anthropol*. Published online 2007. doi:10.1080/09720073.2007.11891005
12. Bharati S, Pal M, Bhattacharya BN, Bharati P. Prevalence and causes of chronic energy deficiency and obesity in Indian women. *Hum Biol*. Published online 2007.
13. Misra A, Pandey RM, Rama Devi J, Sharma R, Vikram NK, Khanna N. High prevalence of diabetes, obesity and dyslipidaemia in urban slum population in northern India. *Int J Obes*. Published online 2001. doi:10.1038/sj.ijo.0801748
14. Khongsdier R. Body mass index and morbidity in adult males of the War Khasi in Northeast India. *Eur J Clin Nutr*. Published online 2002. doi:10.1038/sj.ejcn.1601281
15. Shetty PS, James WP. Body mass index. A measure of chronic energy deficiency in adults. *FAO Food Nutr Pap*. Published online 1994.
16. Norgan NG. Population differences in body composition in relation to the body mass index. In: *European Journal of Clinical Nutrition*. ; 1994.
17. Woodruff BA, Duffield A. Anthropometric assessment of nutritional status in adolescent populations in humanitarian emergencies. *Eur J Clin Nutr*. Published online 2002. doi:10.1038/sj.ejcn.1601456
18. Barba C, Cavalli-Sforza T, Cutter J, et al. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. Published online 2004.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, Dec 2022

19. James WPT, Mascie-Taylor GCN, Norgan NG, Bistrian BR, Shetty PS, Ferro-Luzzi A. The value of arm circumference measurements in assessing chronic energy deficiency in Third World adults. *Eur J Clin Nutr*. Published online 1994.
20. Groot L de, Sette S, Zajkás G, Carbajal A, Amorim J. Nutritional status: anthropometry. Euronut SENECA investigators. *Eur J Clin Nutr*. 1991;45:31-42.
21. Olabinri B., Olawoye T., Olaleye M., Ajani R., Olorunnisola O. The relationships between percent body fat and other anthropometric nutritional predictors among male and female children in Nigeria. *African J Biomed Res*. Published online 2009. doi:10.4314/ajbr.v9i1.48772
22. De Oliveira TC, De Albuquerque IZ, Stringhini MLF, Mortoza AS, De Morais BA. The nutritional status of hospitalized children and adolescents: A comparison between two nutritional assessment tools with anthropometric parameters. *Rev Paul Pediatr*. Published online 2017. doi:10.1590/1984.0462/;2017;35;3;00006
23. Debbarma M, Debbarma LL, Nath D. Nutritional Health Status of Rural Tribal Children in Khowai District of Tripura, India. *Int J Curr Microbiol Appl Sci*. Published online 2018. doi:10.20546/ijcmas.2018.709.395
24. Roy S, Fatima A, Saha S. A Comparative Study on Physical Growth and Nutritional Status between Chakma and Riang Adolescent Boys of Tripura, Northeast India | Original Article. *J Adv Sch Res Allied Educ*. Published online 2020. doi:10.29070/JASRAE
25. Jethwani P. IMPACT OF SOCIOECONOMIC FACTORS ON ADOLESCENT HEALTH – A CASE STUDY IN UTTARAKHAND. *Indian J Soc Res*. Published online 2016.
26. Patel R, Singh P. Anthropometric Assessment of Nutritional Status among Scheduled Caste Children (6-12 years) in Lucknow. *Hum Biol Rev*. Published online 2019.