©Genus Homo (ISSN 2457-0028)
Dept of Anthropology
West Bengal State University

Genus *Homo*, Vol. 7, 2023
Maitra et al. pp. 57-78
Accepted on 14th December 2023
Published on 31st December 2023

Original article

ASSOCIATION OF ANTHROPOMETRIC AND PHYSIOLOGICAL VARIABLES WITH BONE MASS AND HEMOGLOBIN LEVELS: A COMPARATIVE STUDY AMONG THE TRIPURI AND CHAKMA POPULATIONS OF TRIPURA AND THE BENGALEE HINDU CASTE POPULATION OF WEST BENGAL, INDIA

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ABSTRACT

Introduction: An ample number of studies related to bone mass and other variables have revealed that bone mass is an extremely important factor that determines several factors of the human body. Peak bone mass attained by early adulthood, is influenced by genetic and lifestyle factors. Hemoglobin (Hb) is the iron-containing oxygen-transport metalloprotein in the red blood cells. Prior studies have also revealed that hematopoietic and osteogenic cells are known to affect each other's functions.

Objective: To unravel the association of several anthropometric and physiological variables with bone mass and hemoglobin levels among Tripuri and Chakma of Tripura and Bengalee Hindu caste population of West Bengal.

Methodology: The present study has been conducted in Chakma (n=68), Tripuri (n=67) populations from Tripura and Bengalee Hindu caste (n=95) population from West Bengal. Anthropometric and Physiological data have been collected and analyzed. p<0.05 was used to determine significance level.

Results: The mean bone mass of the Chakma, Tripuri and Bengalee Hindu caste populations was 7.20±1.68 Kg, 7.27±1.82 Kg and 7.59±2.32 Kg respectively. Concurrently, the mean hemoglobin levels of the aforementioned population were 11.90±1.78 mg/dl, 12.49±1.36 mg/dl and 12.13±1.59 mg/dl respectively. The current study found that bone mass has a substantial negative correlation with PBF (%) in the Chakmas. Hemoglobin levels in the Chakmas, on the other hand, exhibited substantial negative correlations with BMI, PBF, and VF. Whereas in Tripuris, bone mass was positively correlated with height, weight, BMI, VF, FM, FFM, LV, and hemoglobin levels. Additionally, the hemoglobin levels of the Tripuris displayed a substantial positive correlation with weight, BMI, VF, FM, and FFM. Furthermore, bone mass

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showed substantial positive correlations with height, weight, BMI, VF, FM, and FFM in the Bengalee Hindu caste community. Hemoglobin levels, on the contrary, exhibited a substantial negative correlation with PBF in the aforementioned community. Moreover, significant differences have been found only in VF, FFM, LV, and oxygen saturation between the studied populations.
Conclusion: The present study revealed that there was a significant association between bone mass and Hb levels only among the Tripuris. No significant differences in bone mass or Hb levels between the three populations were found. Moreover, weight and bone mass were positively correlated among Tripuri and Bengalee Hindu caste populations. No evidence of anemia was found in any of the groups.

Key words: Bone mass, BMD, Hemoglobin, Anemia, Correlation

INTRODUCTION

Bone mass is a fundamental driver of bone strength and is determined by bone size and volumetric bone mineral density (BMD) (Leonard & Bachrach, 2012). Peak bone mass is reached in early adulthood and is determined by the amount of bone mass gained throughout skeletal growth and development. Greater peak bone mass compensates for the unavoidable bone loss that occurs in adulthood as a result of ageing, menopause, and a variety of chronic conditions. As a result, accretion of bone mass during infancy and adolescence has significant consequences for lifetime bone health. To address skeletal health evaluation in children and adolescents, the International Society of Clinical Densitometry held a Pediatric Position Development Conference in 2007 (Baim et al., 2008; Bishop et al., 2008; Gordon et al., 2008; Rauch et al., 2008; Zemel et al., 2008). Although heritability estimates for bone mass, shape, and density range from 45 to 85%, currently discovered bone genetic markers explain just a small proportion of the diversity in individual bone mass (Arden et al., 1996; Arden & Spector, 1997; Koay et al., 2007; Paternoster et al., 2010). Many other variables impact bone acquisition during infancy and childhood, including sex, the timing of puberty, calcium and vitamin D intake, physical activity, and obesity. Large-cohort epidemiology studies have shed light on the factors that influence bone mass throughout childhood. Recent research has underlined the impact of the intrauterine environment and maternal variables such as maternal smoking, physical activity, and diet (particularly calcium and vitamin D) on fetal bone acquisition and long-term bone health (Cooper et al., 2006; Macdonald-Wallis et al., 2011). The link between bone mass, bone strength, and fat deposition is gaining popularity. Marrow adipose tissue, a well-known component of the marrow environment, differs metabolically from peripheral fat depositions, but its functional importance remains unknown (Fazeli et al., 2013). Prior research has looked at the fact that bone involvement is a common clinical symptom of sickle cell disease (Baldanzi et al., 2011). Physical activity has a significant influence on bone mass in children with T1DM and osteopenia (Maggio et al., 2012). According to Fung et al. (2011), up to 70% of people with thalassemia major have poor bone mineral density. Diabetes and osteoporosis are both prevalent conditions with high morbidity and death. Diabetes patients are at a higher risk of bone fractures. The risk is raised sixfold in T1DM due to decreased bone mass. Despite increasing bone mineral density, people with T2DM are at a higher risk than the general population due to inadequate bone quality (Jackuliak & Payer, 2014). Chronic inflammation predisposes to bone health problems. Women with PCOS have androgen excess, ovulatory problems, insulin resistance, abdominal obesity, and chronic inflammation (Kalyan et al., 2017). In PCOS, the detrimental effect of oestrogen shortage on bones is not offset by androgen overproduction. Women with PCOS exhibited considerably lower lumbar spine BMD than controls. Insulin appears to be one of the most significant stimulators of favourable bone development (Katulski et al., 2014). Several PCOS-related conditions can have an impact on bone metabolism, either favourably or adversely. Even though insulin, androgens, oestrogens, and obesity have some favourable effects on bone, insulin resistance, oestrogen insufficiency, low-grade chronic inflammation, and gut microbiome dysbiosis may have a deleterious effect on bone metabolism in PCOS women (Noroozzadeh et al., 2022). In a study from the Indian context, which was based on the Rohtak, Hariyana participants, 70% of the men (> 50 years) and 48% of the post-menopausal women had osteopenia while 18% of the men and 25% of the women had osteoporosis (Aggarwal et al., 2021).

Hemoglobin (Hb) is a protein found in red blood cells that is crucial for oxygen transport to tissues. A sufficient hemoglobin level must be maintained to ensure proper tissue oxygenation (Billett, 1990). Age, gender, lifestyle, race, and socioeconomic status all influence the normal distribution of hemoglobin (Hb) levels (McLean et al., 2009). The Hb level is a significant indication of anemia, a global public health concern that affects both developing and wealthy nations, with serious ramifications for human health as well as social and economic development (Nah et al., 2020). Anemia is linked to higher morbidity, mortality, and hospitalization rates (Culleton et al., 2006). Furthermore, iron deficiency anemia has been shown to have a severe impact not only on children's cognitive and psychomotor abilities but also on adults' physical performance (WHO, 2007). Because anemia is linked to poor health outcomes, its prevalence is an important public health indicator. The World Health Organization (WHO) has classified the level of public health concern linked with anemia prevalence (WHO, 2007).

A low hemoglobin level is linked to poor overall health and poor results in a variety of disorders (Patel, 2008). Anemia is a widespread and complex illness that affects 5.6% of the US population (Le, 2016). Anemia affects one in every four people aged 10 to 24 years (430 million), with low- and middle-income nations having the highest frequency (Azzopardi et al., 2019). India has 253 million adolescents aged 10 to 19, making it one of the world's biggest cohorts (Scott et al., 2022). From 2005-2006 to 2019-2021, NFHS data show a small rise in anemia prevalence among Indian adolescents aged 1519 years (girls: 55.8% to 59.1%, boys: 30.2% to 31.1%) (International Institute for Population Sciences, 2022). Bharati et al. (2009) reported that Jharkhand in eastern India has the highest frequency of anemia (99.9%) in a countrywide investigation. Hypoxia caused by anemia has been linked to bone mass loss (Fujimoto et al., 1999). Anemia was found to be an independent risk factor for poor BMD in a study of older postmenopausal women (Korkmaz et al., 2012). Anemia was also found to be a strong independent predictor of reduced BMD in individuals with chronic obstructive pulmonary illness (Chuang et al., 2019).

Low levels of Hb are recognized as risk factors for osteoporosis, falls, fractures, and physical deterioration in the elderly (Bani Hassan et al., 2020; Hirani et al., 2016). Zhou et al. (2021) conducted a study on 1238 volunteers from Anhui, China, and discovered a U-shaped curve for the correlation between BMD and Hb in healthy men. In contrast, there was a positive correlation between Hb levels and BMD in individuals with chronic obstructive pulmonary disease, chronic kidney disease, sickle cell anemia, and inflammatory bowel illness (Miller et al., 2006; Sarrai et al., 2007; Shirazi et al., 2012; Aggarwal et al., 2013; Rutten et al., 2013). Furthermore, Zarei et al. (2016) measured BMD and bone mineral content in the lumbar spine and femoral neck of 21 patients over 10 years of age with hemoglobin H disease and concluded that the prevalence of BMD in the lumbar spine and femoral neck region in patients with hemoglobin H disease was significantly lower than the expected age range compared to healthy individuals. Cui et al. found that anemia was related to osteoporosis in individuals with type 2 diabetes mellitus, regardless of sex (Cui et al., 2019). The selection of study populations and sample sizes has limited research on the association between Hb and BMD, and the findings are contradictory. Furthermore, only a few studies have looked into the relationship between Hb and BMD in depth (Liu et al., 2022).

The literature review revealed a few works on bone mass and hemoglobin levels have been conducted outside India. In this context, the objective of the present study is to discern the association of anthropometric and physiological variables with bone mass and hemoglobin levels among the Tripuri and Chakma populations from Tripura and the Bengalee Hindu caste population from West Bengal, India. Micro-level comparative research on community health of the populations of the Eastern and Northeast parts of India has been under-represented in prior anthropological studies. To the best of our knowledge, the present discourse is the maiden comparative attempt to understand the variation from Eastern and North Eastern parts of India among the aforementioned three populations.

MATERIALS AND METHODS

To achieve the purpose, participants from two Tibeto-Burman speaker endogamous ethnic populations (Chakmas- the migrant group and Tripuris- the aboriginal group) of North East India (Tripura) and the Indo-Aryan speaker Bengalee Hindu caste population of West Bengal, from Eastern India, have been undertaken. The present study consisted of 68 adult participants from the Chakma group and 67 adults from the Tripuri group of Tripura along with 95 adult participants from the Bengalee Hindu caste population from West Bengal. Participants below 18 years of age were excluded from the study. Extensive fieldwork was carried out in native Tripuri settlements in Amtali town (23.7730° N, 91.2674° E), West Tripura district, to collect data on the Tripuri people. Likewise, another fieldwork was conducted in the Chakma settlements of Manu village (23.9973° N, 91.9906° E), which is located in the Longtarai valley in Dhalai district, Tripura, to collect data on the Chakma people. Furthermore, data on the Bengalee Hindu caste population was collected from the Bally region (22.6497° N, 88.3386° E) of the Howrah district, West Bengal.

Purposive sampling was used for data collection. Verbal and/or Written consent was obtained from each participant before the collection of data. Anthropometric measurements were taken following standard techniques (Weiner & Lourie, 1981). Assessment of bone mass was done using bioelectrical impedance analysis using a body scanner (Rossmax Glass body fat monitor with scale model WF260 and OMRON Body Composition Scanner Monitor with scale model H6F362). Assessment of physiological variables was done by using Hudson-Spyrometer (for Lung Volume), HemoCue 201 (for Hb level), and RAMPASS Pulse Oximeter (for Oxygen saturation). Obtained data were analyzed for descriptive and inferential statistics in appropriate places by SPSS (version 20.0). $p<0.05$ was used to determine statistical significance level.

RESULTS

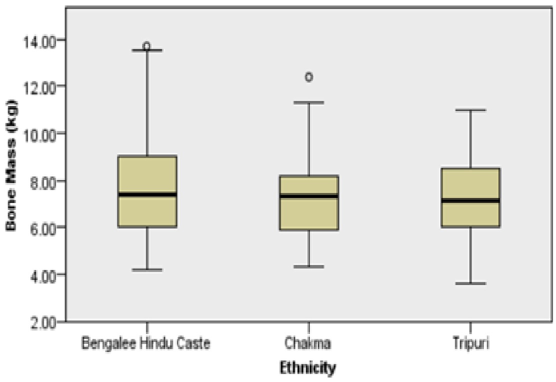
Table-1 bespeaks the descriptive statistics of the studied populations. Normality test analysis (Kolmogorov-Smirnov test and Shapiro-Wilk test) was conducted to comprehend the distribution of the dataset. Test results revealed that for the Chakma population, data of Body Mass Index (BMI), Fat Mass (FM), Fat-Free Mass (FFM), Percent Body Fat (PBF), Hemoglobin (Hb) and Bone Mass were normally distributed whereas Visceral Fat (VF), Lung Volume (LV) and Oxygen Saturation (OS) data were not normally distributed. For the Tripuri, data of FM, PBF, Hb and bone mass was normally distributed and BMI, VF, FFM, Lung volume and oxygen saturation data were not normally distributed. Concurrently, for the Bengalee Hindu caste population, data of BMI, FM, FFM, PBF and Hb was normally distributed but VF, Lung Volume, Oxygen Saturation and bone mass were not normally distributed. Population wise distribution of Hb levels and bone mass are given in Figure-1.

Analyses revealed that there are significant differences between male and female Chakma populations in Height, Weight, VF, FFM, PBF, LV and bone mass (Table-2). Similarly, between Tripuri males and Tripuri females, significant differences were found in height, weight, FFM, PBF, Hb and bone mass (Table-3). On the other hand, between the Bengalee Hindu caste males and Bengalee Hindu caste females, significant differences were found in Height, Weight, FM, FFM, PBF, LV, Hb and bone mass (Table-4).

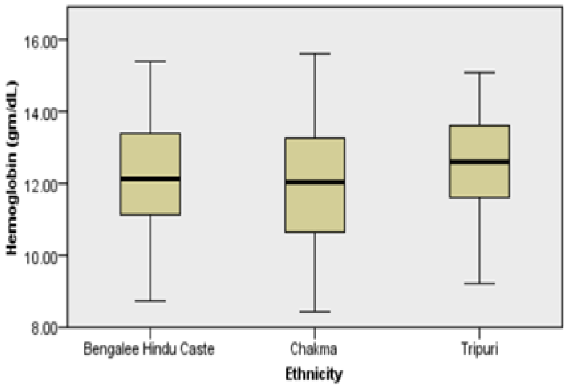
Table-1: Descriptive statistics of the studied population

Populations	Variables	Minimum	Maximum	Mean	Std. Deviation
Chakma (N=68)	***Height (cm)***	139.60	174.60	155.68	±7.64
	Weight (Kg)	33.90	75.30	57.20	±9.32
	BMI (Kg/m²)	16.28	30.05	23.55	±3.11
	VF	1.00	15.00	7.15	±3.31
	FM (Kg)	5.17	30.50	16.32	±4.96
	FFM (Kg)	3.20	52.90	28.80	±10.77
	PBF (%)	10.30	41.00	28.39	±6.66
	LV (ml)	119.00	1200.00	642.93	±308.73
	OS (%)	87.00	99.00	97.12	±2.06
	HB (mg/dl)	8.40	15.60	11.90	±1.78
	BM (Kg)	4.30	12.40	7.20	±1.68
Tripuri (N=67)	***Height (cm)***	141.90	178.80	156.26	±8.52
	Weight (Kg)	36.30	103.40	57.68	±13.36
	BMI (Kg/m²)	17.24	44.99	23.46	±4.21
	VF	1.00	30.00	6.16	±4.29
	FM (Kg)	5.71	39.60	15.87	±5.56
	FFM (Kg)	28.26	75.08	41.81	±9.73
	PBF (%)	11.00	42.40	27.31	±6.057
	LV (ml)	200.00	1200.00	722.39	±333.86
	OS (%)	49.00	99.00	97.13	±6.39
	HB (mg/dl)	9.20	15.10	12.49	±1.36
	BM (Kg)	3.60	11.00	7.27	±1.82
Bengalee Hindu Caste (N=95)	***Height (cm)***	139.40	176.10	156.21	±9.05
	Weight (Kg)	34.50	77.50	56.42	±10.51
	BMI (Kg/m²)	16.19	32.52	23.10	±3.80
	VF	2.00	20.00	8.12	±3.96
	FM (Kg)	6.59	30.67	16.42	±5.53
	FFM (Kg)	-4.70	54.30	27.40	±12.66
	PBF (%)	11.60	45.90	29.02	±7.70
	LV (ml)	100.00	1200.00	446.32	±243.99
	OS (%)	91.00	99.00	97.47	±1.66
	HB (mg/dl)	8.70	15.40	12.13	±1.59
	BM (Kg)	4.20	13.70	7.59	±2.32

Figure-1: Distribution of Bone mass (1A) and Hemoglobin levels (1B) among studied populations.



(1A)



(1B)

Table-2: Sex-wise distribution of variables in the Chakma population

Variables	Sex		*t* value
	Male N= 20	**Female N=48**	
Height (cm)	164.35±0.51	152.06±0.52	**8.9****
Weight (Kg)	63.8±8.7	54.42±8.16	**4.26****
BMI (Kg/m^2)	23.67±3.32	23.49±3.05	0.21
VF	8.9±3.9	6.41±2.75	**2.98***
FM (Kg)	15.10±5.86	16.82±4.5	1.31
FFM (Kg)	40.83±6.45	23.79±7.83	**8.58****
PBF (%)	23.03±7.1	30.63±5.04	**5.002****
Lung Volume (ml)	790±271.25	581.65±305.11	**2.647***
O_2 ***saturation (%)***	97.4±1.18	97±2.32	0.729
Hemoglobin (mg/dl)	13.23±1.35	11.36±1.65	**4.494****
Bone Mass (Kg)	8.11±2.00	6.83±1.39	**3.03****

(* p<0.05; ** p<0.01)

Table-3: Sex wise distribution of variables in Tripuri population

Variables	Sex		*t* value
	Male N=30	Female N=37	
Height (cm)	161.97±7.44	151.63±6.27	**6.168****
Weight (Kg)	64.56±14.62	52.103±9.15	**4.26****
BMI (Kg/m²)	24.53±5.1	22.59±3.14	1.907
VF	8.03±5.01	4.65±2.87	3.47
FM (Kg)	16.56±6.56	15.31±4.6	0.917
FFM (Kg)	47.99±9.64	36.79±6.39	**5.69****
PBF (%)	25.12±5.66	29.08±5.84	**2.8****
Lung Volume (ml)	793.33±342.34	664.86±319.91	1.58
O_2 saturation (%)	96.57±9.04	97.59±2.92	0.652
Hemoglobin (mg/dL)	13.19±0.98	11.91±1.36	**4.306****
Bone Mass (Kg)	7.98±1.74	6.69±1.69	**3.06****

(***** $p<0.05$; ****** $p<0.01$)

Table-4: Sex-wise distribution of variables in the Bengalee Hindu Caste population

Variables	Sex		*t* value
	Male N=37	Female N=58	
Height (cm)	164.17±7.01	151.12±6.04	**9.64****
Weight (Kg)	61.22±10.35	53.35±9.48	**3.8****
BMI (Kg/m2)	22.66±3.21	23.39±4.14	0.916
VF	8.88±3.19	7.64±4.34	1.48
FM (Kg)	14.42±3.73	17.69±6.11	**2.92****
FFM (Kg)	37.67±11.38	20.84±8.38	**8.28****
PBF (%)	23.55±4.75	32.5±7.2	**6.68****
Lung Volume (ml)	597.3±240.93	350.0±193.08	**5.52****
O_2 saturation (%)	97.43±1.32	97.5±1.85	0.19
Hemoglobin (mg/dl)	12.98±1.19	11.58±1.57	**4.64****
Bone Mass (Kg)	8.55±2.44	6.98±2.02	**3.38****

(***** $p<0.05$; ****** $p<0.01$)

Spearman's rank correlation analysis among the Chakma population **(Table-5**) demonstrated significant ($p<0.05$) negative correlation between bone mass and PBF. Similarly, significant ($p<0.01$) negative correlations were found between Hb-PBF ($p<0.01$) and Hb-FM ($p<0.05$). Also, a significant ($p<0.01$) positive correlation was found between Hb and FFM. Among the Tripuri population **(Table-6)**, bone mass demonstrated significant ($p<0.01$) positive correlations with height, weight, BMI, FFM, LV and VF, Hb (both $p<0.05$). Also, significant ($p<0.01$) positive correlations were found between Hb and Weight, BMI, FM and FFM ($p<0.05$). In the case of the Bengalee Hindu caste population **(Table-7)**, significant ($p<0.01$) positive correlations were found between bone mass and height, weight, BMI, VF, FM, FFM and LV ($p<0.05$). Similarly, significant ($p<0.01$) positive correlations were found between Hb and height, FFM, and LV. However, a significant ($p<0.01$) negative correlation was found between Hb and PBF.

Table-5: Correlation matrix of Chakma population

Variables	*Height*	*Weight*	*BMI*	*VF*	*FM*	*FFM*	*PBF*	*Lung Volume*	*O_2 saturation*	*Hb*	*Bone mass*
Height	1										
Weight	**0.568****	1									
BMI	0.026	**0.808****	1								
VF	**0.324****	**0.775****	**0.723****	1							
FM	0.014	**0.647****	**0.784****	**0.604****	1						
FFM	**0.801****	**0.763****	**0.386****	**0.526****	0.066	1					
PBF	**-0.44****	0.118	**0.454****	0.212	**0.798****	**-0.492****	1				
Lung Volume	**0.342****	0.235	-0.053	0.244*	-0.158	**0.395****	**-0.360****	1			
O_2 Saturation	0.002	-0.077	-0.124	-0.054	-0.128	-0.016	-0.119	0.160	1		
Hb	0.332	0.069	-0.121	-0.152	**-0.291***	**0.396****	**-0.403****	0.207	0.027	1	
Bone mass	0.155	0.002	-0.085	-0.065	-0.224	0.177	**-0.299***	0.209	0.081	0.126	1

(***** $p<0.05$; ****** $p<0.01$)

Table 6: Correlation matrix of Tripuri population

Variables	Height	Weight	BMI	VF	FM	FFM	PBF	Lung Volume	O_2 Saturation	Hb	Bone mass
Height	1										
Weight	**0.641****	1									
BMI	0.208	**0.851****	1								
VF	**0.243***	**0.741****	**0.813****	1							
FM	0.129	**0.748****	**0.910****	**0.715****	1						
FFM	**0.857****	**0.867****	**0.549****	**0.524****	**0.367****	1					
PBF	**-0.448****	0.164	**0.504****	**0.333****	**0.726****	**-0.277***	1				
Lung Volume	**0.343****	**0.333****	0.236	0.214	0.135	**0.372****	-0.103	1			
O_2 saturation	0.11	-0.003	-0.025	-0.125	0.028	0.010	-0.019	-0.174	1		
Hb	0.135	**0.395****	**0.408****	**0.460****	**0.331****	**0.312***	0.167	0.099	-0.075	1	
Bone Mass	**0.503****	**0.562****	**0.408****	**0.272***	**0.278***	**0.627****	-0.124	**0.458****	-0.074	**0.269***	1

(* $p<0.05$; ** $p<0.01$)

Table-7: Correlation matrix of Bengalee Hindu Caste population

Variables	Height	Weight	BMI	VF	FM	FFM	PBF	Lung Volume	O_2 saturation	Hb	Bone mass
Height	1										
Weight	**0.465****	1									
BMI	-0.112	**0.807****	1								
VF	0.161	**0.576****	**0.564****	1							
FM	**-0.227***	**0.612****	**0.849****	**0.429****	1						
FFM	**0.8****	**0.771****	**0.334****	**0.381****	-0.005	1					
PBF	**-0.653****	0.055	**0.487****	0.123	**0.806****	**-0.57****	1				
Lung Volume	**0.476****	**0.307****	0.019	0.120	**-0.208***	**0.525****	**-0.476****	1			
O_2 saturation	0.068	-0.021	-0.078	-0.126	0.002	-0.022	0.003	0.104	1		
Hb	**0.338****	0.184	-0.024	0.090	-0.131	**0.314****	**-0.295****	**0.326****	-0.091	1	
Bone Mass	**0.291****	**0.634****	**0.506****	**0.401****	**0.413****	**0.479****	0.051	**0.233***	-0.086	0.131	1

(* $p<0.05$; ** $p<0.01$)

The Kruskal-Wallis H test was performed to determine if there are statistically significant differences between the three populations. Significance values have been adjusted by the Bonferroni correction for multiple tests. However, no significant differences in bone mass or Hb levels were found between the populations **(Table-8)**. Moreover, the result revealed significant differences ($p<0.01$) in only VF, FFM, LV and OS between the populations. Pair-wise analysis indicated that, between the Tripuri and Bengalee Hindu caste populations, there were significant differences in all four aforementioned variables. Whereas, between the Chakma and Tripuri, there were significant differences in fat-free mass and oxygen saturation. However, between the Chakma and Bengalee Hindu caste populations, there was a significant difference only in lung volume **(Table-9)**.

Table-8: One-way ANOVA on ranks between the populations

Variables	Chakma		Tripuri		Bengalee Hindu Caste		p value
	Mean	SD	Mean	SD	Mean	SD	
Height (cm)	155.68	±7.64	156.26	±8.52	156.2	±9.04	$p>0.05$
Weight (Kg)	57.3	±9.32	57.68	±13.36	56.41	±10.51	$p>0.05$
BMI (Kg/m²)	23.55	±3.11	23.46	±4.21	23.11	±3.8	$p>0.05$
VF	7.14	±3.3	6.16	±4.29	8.12	±3.96	**$P<0.01$**
FM (Kg)	16.31	±4.96	15.87	±5.56	16.42	±5.52	$p>0.05$
FFM (Kg)	28.8	±10.77	41.8	±9.73	27.4	±12.66	**$p<0.01$**
PBF (%)	28.39	±6.66	27.3	±6.04	29.01	±7.7	$p>0.05$
Lung Volume (ml)	642.92	±308.73	722.38	±333.85	446.32	±243.99	**$P<0.01$**
O_2 saturation (%)	97.12	±2.05	97.13	±6.39	97.47	±1.66	**$P<0.05$**
Hemoglobin (mg/dl)	11.90	±1.77	12.49	±1.36	12.13	±1.58	$p>0.05$
Bone Mass (Kg)	7.2	±1.68	7.27	±1.81	7.58	±2.31	$p>0.05$

Table-9: Pair-wise comparisons of the studied populations.

Variables	Pair-wise Comparisons	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
Visceral Fat (VF)	Tripuri-Chakma	24.005	11.409	2.104	0.035	0.106
	Tripuri-Bengalee Hindu caste	38.112	10.574	3.605	**0.000**	**0.001**
	Chakma-Bengalee Hindu caste	14.117	10.528	1.341	0.180	0.540
Fat Free Mass (FFM)	**Tripuri-Chakma**	-69.344	11.454	-6.054	**0.000**	**0.000**
	Tripuri-Bengalee Hindu caste	-74.742	10.615	-7.041	**0.000**	**0.000**
	Chakma-Bengalee Hindu caste	-5.398	10.569	-0.511	0.610	1.000
O_2 saturation (OS)	**Tripuri-Chakma**	-42.254	11.039	-3.828	**0.000**	**0.000**
	Tripuri-Bengalee Hindu caste	-28.475	10.230	-2.783	**0.005**	**0.016**
	Chakma-Bengalee Hindu caste	13.779	10.186	1.353	0.176	0.528
Lung Volume (LV)	Tripuri-Chakma	-12.900	11.211	-1.151	0.250	0.750
	Tripuri-Bengalee Hindu caste	-55.376	10.391	-5.329	**0.000**	**0.000**
	Chakma-Bengalee Hindu caste	-42.476	10.346	-4.106	**0.000**	**0.000**

(Significance level is 0.05)

DISCUSSION

Weight has a substantial positive correlation with bone mass among the Tripuri and Bengalee Hindu caste populations, according to the findings. Extensive epidemiological statistics demonstrate that having a high body weight or body mass index (BMI) is connected with having a high bone mass and being less likely to fracture (Margolis et al., 2000; Brainbridge et al., 2004; Shatrugna et al., 2005). Several explanations for this association have been presented. Body weight is hypothesized to influence bone mass by mechanically loading the bones and generating stress via muscular pull (Beck et al., 2001; Vicente-Rodriguez et al., 2005). A lot of Indian research has found that those with low incomes had reduced bone mass and earlier development of osteoporosis and fractures. These investigations have revealed that body weight is a major driver of bone density and may protect against fractures. At the same time, as a result of the dietary change, obesity and its related metabolic implications are a fast-expanding concern, particularly in the high-income group (Misra et al., 2001; Bhardwaj et al., 2008). Furthermore, at a given BMI, Indians and other Asian people have a larger proportion of body fat than other ethnic groups (Deurenberg-Yap et al., 2000). Because overweight and obesity may have opposing effects on the risk of metabolic syndrome and osteoporosis, researchers must look into the body composition factors that modulate the effect of body weight on bone mass.

The current investigation found no evidence of anaemia in any of the populations studied. In previous investigations, a significant incidence of anaemia (74.79%) was identified in non-pregnant women in the study group (Sinha & Halder, 2015). This is higher than recent studies from different states in India, which report a prevalence of anaemia of 55.3% in Rajasthan and 63.2% in West Bengal (IIPS 2007), but lower than a hospital-based study conducted by Gupta et al. (2014) among rural females in Madhya Pradesh, India (82%). According to Chandyo et al. (2007), the prevalence of anaemia among nonpregnant women in Nepal is just 12.0%, but Gebremedhin and Enquselassie (2011) observed 27.4% among Ethiopian women of reproductive age.

Nevertheless, the study was aimed to provide data for future research and public health benefits. Although the current study revealed no significant positive link between bone mass and Hb in the Chakma and Bengalee Hindu caste populations, it did identify a substantial positive correlation in the Tripuri group. More anthropological study is required to provide further insight into this subject matter.

CONCLUSION

The present study, conducted in the eastern and north-eastern parts of India, revealed that there was a significant link between hemoglobin levels and bone mass, but only among the Tripuri populations. However, no significant differences in bone mass or Hb levels were found between the three populations. Only visceral fat, fat-free mass, lung volume, and oxygen saturation are significantly different between the studied populations. Moreover, weight and bone mass are positively correlated among the Tripuri and Bengalee Hindu caste populations. Furthermore, there was no indication of anemia in any of the groups evaluated in the current study.

CONFLICT OF INTEREST

Authors declare no conflict of interest while conducting the study or preparing of the manuscript.

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