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Relation of Obesity and Hypertension Among Elderly Karbis of Karbi Anglong, Assam

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ABSTRACT Worldwide there is increasing incidence of obesity. Obesity and hypertension are interrelated and result from changes in body composition and lifestyle factors concomitant to age. The present study examines the prevalence and relation of obesity and hypertension among elderly Karbis following a traditional way of life in the hill district of Karbi Anglong, Assam.The sample of the study consists of 335 male and female elderly (60 years and above) Karbis. Whole body obesity and abdominal obesity are assessed from anthropometric variables, indices and fat percentage. Hypertension is categorised according to the WHO classification of systolic and diastolic blood pressure used in estimating risk for metabolic syndrome.Prevalence of obesity by fat percentage is higher. Abdominal obesity and hypertension prevalence is higher in elderly female in comparison to elderly male. Hypertension prevalence is influenced significantly by fat percentage in both male and female elderly and by Waist Circumference in male elderly.

INTRODUCTION

Obesity is recognised as a major public health problem in both developed and developing countries. Obesity is often defined as a condition of abnormal or excessive fat accumulation in adipose tissue, to the event that health may be impaired (WHO 2000). Obese individuals differ not only in the amount of excess fat they store, but also in the regional distribution of fat within the body. Fat accumulation is also affected by age as body composition undergoes change and fat gets redistributed and accumulates around the abdominal region. Fat accumulation in the abdominal region puts people at risk for various metabolic disorders. Obesity prevalence among the elderly population from marginalised tribal communities has not been studied in the northeast Indian context. Studies on nutritional status among tribal elderly people from the region have reported higher prevalence of under nutrition and some proportion of over nutrition (Das and Sarmah 2015; Sarmah 2019). Elderly people can face the dual burden of under nutrition and over nutrition as found in the studied societies.

Obesity predisposes an individual to a number of cardiovascular risk factors including hypertension, raised cholesterol and impaired glucose tolerance. It is also one of the criteria for identifying metabolic syndrome. Excess body fat in addition to being a significant contributor to disease risk also varies between individuals by age, sex, region, socio-economic condition and ethnicity. Among elderly population excess body fat, age and other environmental factors may be significant in increasing disease risks.

One of the conditions, which arise out of obesity, is hypertension. Hypertension results from changes in the cardiovascular system with age. Structural changes taking place in the cardiovascular system brings about a decline in the functional capacity of the circulatory system resulting in higher blood pressure levels with age. This dynamic physiological measure is influenced by both biological and socio-cultural factors. It is influenced by various factors like climate, degree of urbanisation, work schedule, activity pattern and dietary habits (Bassey 1992). Blood pressure shows greater relation with age among people living in modern urbanised economies than people living in cultures following traditional beliefs and values (Waldron et al. 1982).

In developing countries hypertension is found to exist in a background of under nutrition (Tesfaye et al. 2007). Moreover, Body Mass Index (BMI) is significantly and positively correlated with both SBP and DBP in some populations. Studies have shown that higher BMI is associated with hypertension (Dua et al. 2014; Wang et al. 2014; Babu et al. 2018; Hossain et al. 2019). Similar association is not understood to the desired extent among elderly in rural or tribal context in northeast India. Very few studies on relationship between obesity and blood pressure have been done in the region. Hypertension prevalence among different communities of the region has been reported by few studies (Hazarika et al. 2003; Hazarika et al. 2004; Mungreiphy et al. 2011; Borah and Sarmah 2012; Das and Sarmah 2017). Hypertension among adults in these studies ranges between fifteen to thirty-five percent and among the elderly population it is reported to be much higher (63.3%) (Hazarika et al. 2003). Prevalence of hypertension has also been found to be higher among overweight individuals. Significant positive correlation between BMI, age, Systolic Blood Pressure and Diastolic Blood Pressure was found among adults (age 20-70 years) of Tangkhul Nagas of Manipur (Mungreiphy et al. 2011). Relationship between BMI and hypertension is yet to be understood among different communities who are following a traditional way of life in the northeastern region of India.

In conducting a field study in inaccessible terrain, anthropometry can be a helpful and sometimes only usable tool for assessing nutritional status other than diet surveys. Anthropometry has also been recognised as one of the simplest non-invasive methods of estimating obesity in epidemiological studies.Obesity can be classified based on anthropometric data, which alternates for other direct estimates of body composition (Anjos et al. 2013). Body Mass Index, in spite of its limitations, is one of the most commonly used variables for diagnosing obesity at population level due to its simplicity and association with disease. A BMI >25 is associated with increased morbidity, primarily from diabetes and cardiovascular disease (Gluszek et al. 2020). Studies have demonstrated that various anthropometric characteristics like BMI (Mooney et al. 2013), WHtR (Hsieh and Muto 2006) are useful tools for estimating obesity.

Elderly population living in a remote tribal context are expected to be unaware about the risk factors associated with obesity or hypertension. The conditions of obesity and hypertension may be the outcome of some of their lifestyle factors or common cultural practices, which are now understood to have adverse effect on health conditions. The Karbis follow a traditional way of life practicing *jhum* cultivation in the hills of the district. The elderly individuals continue to be active workers in the field as long as their physical conditions allow them to. As such their physical activity level remains high from their continued involvement in cultivation as well as mobility in the hills.However, among the elderly Karbis, habits of regular drinking of their traditional rice beer '*hor*' and smoking are two significant lifestyle factors, which may affect the prevalence of obesity and hypertension. Preventive health measures among the elderly Karbis in the form of avoidance, screening or management are negligible. Multiple factors are responsible for the absence of practice of preventive health care among which socio-economic condition may be dominant.

Considering the above background the present paper attempts to assess the prevalence of obesity and hypertension among the elderly Karbis of Karbi Anglong District of Assam.

Objectives of the Study

The objectives of the study are to:

1. Assess the prevalence of obesity among elderly Karbis from their Body Mass Index, Fat Mass Index and Fat Percentage.
2. Evaluate the prevalence of abdominal obesity from Waist Circumference, Waist to Hip Ratio and Waist to Height Ratio.
3. Assess the prevalence of hypertension from systolic and diastolic blood pressure measures.
4. Understand the relationship between obesity and hypertension among the elderly Karbis.

MATERIAL AND METHODS

Data were collected from 32 villages in Karbi Anglong district of Assam. Elderly people who have attained sixty years or above were included in the study. The number of elderly meeting the 60 years age criteria in a single village ranged from one elderly to twenty-eight elderly individuals. Houses were situated very far apart from each other on the hill slopes. The sample of the study comprises of 335 (145 male and 190 female) elderly Karbis. The villages were approached through the village headman and data could be collected after his permission was attained to conduct the study. The objective of the study was explained to each participant to obtain a verbal consent.

Only those who consented to be part of the study were included.

Demographic variables of age and sex were collected. Anthropometric variables of height, weight, waist circumference and hip circumference were measured using standard protocol (Lohman et al. 1988) with the individual in Frankfort Horizontal Plane. Height was measured with an anthropometer, and weight with a balance with minimum clothing. Waist and hip circumference were measured with a non-elastic measuring tape. Waist circumference was measured at the midpoint between the lower border of the lowest rib and upper point of the iliac crest. Hip circumference was taken at the maximum circumference of the buttock.

Anthropometric indices for assessing obesity included the Body Mass Index, Fat Mass Index and Fat percentage. Abdominal obesity was assessed from Waist Circumference, Waist to Hip Ratio and Waist to Height Ratio. Body Mass Index was calculated from stature and weight using the formula weight (kg) divided by height^2 (metres). Obesity was determined using the WHO cut off (> 25) for obesity for the Asian population (2000). Fat percent was obtained from Bioelectric Impedance Analysis. The Fat Mass was obtained from the percentage converted to kilograms of fat mass from the weight of individuals. Obesity from fat percentage was identified following the Neiman (1990) (male >25 and female > 32). The Fat Mass Index was calculated according to the formula of VanItallie et al. (1990), which is Fat Mass (kg) divided by height^2 (metres). Fat Mass Index > 9 for male and >13 for female was assessed as obese as per Kelly et al.'s (2009) recommendation.

Abdominal obesity from waist circumference was identified from the WHO recommendation for the Asian population (male > 85cm; female > 80cm). Waist to Hip Ratio measures of >0.90 cm for male and $\geq$ 0.85 cm for female were used for assessment of abdominal obesity. Waist to Height Ratio of e" 0.50 was taken for estimating abdominal obesity for both male and female.

Blood pressure was assessed using a digital blood pressure monitor. Three measurements were taken on an individual after a gap of five minutes each, after the individual had rested for a period of ten minutes before the commencement of the procedure. The average of the three measurements was used for the purpose of analysis. The WHO classification of hypertension used for identification of metabolic syndrome was followed for identifying hypertensive individuals. Systolic blood pressure > 130mm/hg and diastolic blood pressure > 85mm/hg were taken as hypertensive.

Appropriate statistical analysis was done to understand the prevalence of obesity and blood pressure and the relationship between the two and with age and sex. Descriptive statistics of mean, median and percentage have been used. Pearsonian correlation coefficient, t statistics and chi square have been used to understand the relation between variables. Logistic regression has been performed for assessing the relation between hypertension and the obesity indicators and age for both the sexes.

RESULTS

Anthropometric Variables, Indices and Blood Pressure by Age and Sex

The mean age of the elderly Karbis males of the study (67.37 ± 7.2) and the elderly Karbi females (66.2 ± 8.1), though show some amount of difference, it is statistically not significant. The mean of the anthropometric variables of height, weight, waist circumference and hip circumference are similar among the male and female elderly Karbis (Table 1). The observed gender difference in the mean of these variables is statistically insignificant, which means that they are similar with regard to these variables. The findings regarding their body composition as indicated from their mean Fat Percent, Fat Mass and Fat Mass Index are similar among the male and female elderly Karbis. Whole body nutritional status and abdominal obesity indicators also show similar means for the male and female elderly Karbis. It can be therefore said that the elderly Karbis do not show significant difference in the means of the variables used in the study. Both male and female elderly Karbis have similar anthropometric dimensions and indices. This is also true for the physiological measure of blood pressure. The male and female elderly Karbis have similar mean systolic and diastolic pressure. From the findings it can be said that the elderly Karbi male and female show insignificant difference in their lin-

Table 1: Descriptive statistics according to sex and their correlation with age

Variable	Male			Female			Gender difference (t value)
	Mean± SD	Median	Age (r value)	Mean± SD	Median	Age (r value)	
Age	67.37 ± 7.2	65	-	66.2 ± 8.1	63.5	-	-0.223
Height	156.70 ± 6.19	156.2	-.034	147.88 ± 5.6	147.75	-.034	-0.139
Weight	51.05 ± 8.85	50	-.267*	46.41 ± 10.48	45	-.267*	-0.202
WC	76.78 ± 9.5	78	.001	77.34 ± 11.19	76	-.001	- 0.192
HC	84.91 ± 6.4	84.5	-.031	85.41 ± 9.2	84	-.031	-0.198
BMI	20.75 ± 3.84	19.99	-.290*	21.15 ± 4.27	20.69	-.290*	-0.203
Fat %	26.03 ± 5.81	25.35	.020	28.55 ± 7.9	27.75	-.020	-0.161
Fat Mass	13.59 ± 4.92	12.81	-.124	13.95 ± 6.74	12.49	-.124	-0.129
FMI	5.56 ± 2.08	5.21	-.094	6.33 ± 2.95	5.84	-.094	-0.122
WHR	0.84 ± .24	0.91	-.035	0.79 ± .31	0.90	-.035	-0.148
WHtR	0.45 ± .14	0.48	-.006	0.45 ± 0.19	0.49	-.006	-0.142
SBP	139.28 ± 25.17	139	-.043	143..35 ± 23.99	140	-.043	-0.253
DBP	85.27 ± 15.08	84	-.134	85.44 ± 15.97	84.33	-.134	-0.239

*Significant $p< 0.05$ *Source:* Field Study

ear and circumferential measurements, their indices indicative of whole body nutritional status, abdominal obesity and body composition.

Increase in age is generally associated with decline in measures of anthropometric variables. In the study, all anthropometric variables, indices and blood pressure measures with exception to Fat Percent show a negative correlation with age. It indicates that with increase in age the different anthropometric dimensions tend to decline. With regard to weight and Body Mass Index the decline is statistically significant at $p< 0.05$for both the sexes.

Prevalence of Obesity and Hypertension

Obesity prevalence has been examined from the general obesity and abdominal obesity. BMI as a measure of obesity has its limitations, as it unable to take into account the fat percentage in the body. To overcome this limitation Fat Mass Index (FMI) and Fat percentage are taken into account. Individuals showing obesity by BMI and FMI are less (Table 2). But by fat percentage according to the Neiman's scale (1990) obesity is relatively high (43.96%). Obesity on the basis of BMI is among16.21 percent elderly Karbis with

Table 2: Prevalence of obesity and hypertension by sex

Indices	Male			Female			Total (%)	Chi value (Sex² difference)
	Non obese No. & (%)	Obese No. & (%)	Total	Non obese No. & (%)	Obese No. & (%)	Total		
BMI	111 (88.1)	15 (11.9)	126	132 (80.5)	32 (19.5)	164	47(16.21)	2.5022, p>.05
FMI	125 (92.6)	10 (7.4)	135	154 (97.5)	4 (2.5)	158	14(4.78)	2.8076, p>.05
Fat %	62 (45.6)	74 (54.4)	136	105 (64.8)	57 (35.2)	162	131(43.96)	**10.3272, p<.05**
WC	110 (81.5)	25 (18.5)	135	104 (62.7)	62 (37.3)	166	87(28.90)	**11.9474, p<.05**
WHR	52 (39.4)	80 (60.6)	132	33 (20.2)	130 (79.8)	163	210(71.19)	**12.1213, p<.05**
WHtR	70 (52.2)	64 (47.8)	134	72 (43.9)	92 (56.1)	164	156(52.35)	1.7339, p>.05
SBP	<130	≥130		<130	≥130			
	48 (33.1)	97 (66.9)	145	54 (28.4)	136 (71.6)	190	233(69.55)	.06447, p>.05
DBP	<85	>85		<85	>85			
	80 (55.2)	65 (44.8)	145	97 (51.3)	92 (48.7)	189	157(47.01)	0.3458, p>.05

*Significant $p< 0.05$

prevalence being higher among females (19.5%) than males (11.9%). According to FMI, 4.78 percent elderly are obese with prevalence being more in males (7.4%). Abdominal obesity is the outcome of the body composition changes that take place with ageing. Fat proportions are redistributed and tend to be accumulated around the middle from around the fifth decade of life. Prevalence of abdominal obesity is highest from WHR (71.18%) followed by WC (45.60%) and WHtR (40.27%). Abdominal obesity from all the three measures in terms of percentage is prevalent more among female elderly but the gender difference is statistically significant for WHtR alone.

Prevalence of obesity by the sexes shows that there is significant difference with regard to Fat Percentage, Waist Circumference and Waist to Hip Ratio. Abdominal obesity by these two measures is significantly higher among female elderly, and obesity on the basis of Fat Percentage is significantly higher among male elderly. The male and female elderly show similar blood pressure measures. To understand the age change with regard to these variables the elderly representatives have been divided into two age groups. The first age group consists of elderly between 60 and 69 years, and the second age group comprise of elderly in the age group of 70 and above (Table 3). Prevalence of obesity by BMI shows significant difference in female elderly with decline in the older age group. Among male elderly with increase in age individuals having obesity by Fat Percentage and abdominal obesity by WHtR increases significantly. In case of the other variables the distribution does not show statistically significant difference with increase in age.

The proportion of elderly Karbis who show obesity from Fat percent is relatively high in comparison to Body Mass Index and Fat Mass Index. It is an indicator of higher fat amount in their bodies. The high amount of fat could be the result of their diet and other cultural practices of regular drinking of their traditional rice beer '*hor*' and smoking. This aspect, however, needs to be extensively analysed. There is a gender difference in the prevalence of Fat percent. More male

Table 3: Prevalence of obesity and hypertension by age

		Male			*Female*		
Categories	*Age group*	*Non obese (no & %)*	*Obese (no & %)*	*X^2(Age difference)*	*Non obese (no & %)*	*Obese (no &%)*	*X^2(Age difference)*
BMI	60-69yrs	68(86.1)	11(13.9)	0.3881p>.05	104 (77.0)	31 (23.0)	**4.6127P<.05**
	70+ yrs	43(91.5)	4 (8.5)		126 (97.7)	3 (2.3)	
FMI	60-69yrs	79(94.0)	5 (6.0)	0.2397p>.05	126 (97.7)	3 (2.3)	0.0939p>.05
	70+ yrs	46(90.2)	5 (9.8)		28 (96.6)	1 (3.4)	
Fat %	60-69yrs	45(52.9)	40(47.1)	**4.1816P<.05**	86 (64.7)	47 (35.3)	0.0162p>.05
	70+ yrs	17(33.3)	34(66.7)		19 (65.5)	10 (34.5)	
WC	60-69yrs	68(81.0)	16(19.0)	0.006p>.05	83 (61.5)	52 (38.5)	0.1971p>.05
	70+ yrs	42(82.4)	9(17.6)		21(67.7)	10 (32.3)	
WHR	60-69yrs	38(45.8)	45(54.2)	3.1361p>.05	28 (21.2)	104 (78.8)	0.1486p>.05
	70+ yrs	14(28.6)	35(71.4)		5 (16.1)	26 (83.9)	
WHtR	60-69yrs	50(60.2)	33(39.8)	**4.7861P<.05**	61 (45.2)	74 (54.8)	0.258p>.05
	70+ yrs	20(39.2)	31(60.8)		11 (37.9)	18 (62.1)	
	Age	*Non hypertensive*	*Hyper- tensive*		*Non hypertensive*	*Hyper- tensive*	
Systolic Blood Pressure	60-69yrs	30 (34.09)	58(65.91)	0.098p>.05	45 (31.91)	96 (68.09)	3.2806p>.05
	70+ yrs	18 (31.58)	39(68.42)		9 (18.37)	40 (81.63)	
Diastolic Blood Pressure	60-69yrs	46 (52.27)	42(47.73)	0.761p>.05	69 (48.94)	72 (51.06)	1.528p>.05
	70+ yrs	34 (59.65)	23(40.35)		29 (59.18)	20 (40.82)	

*Significant p< 0.05

elderly Karbis show obesity by Fat percent than female elderly Karbis. This difference is statistically significant. Prevalence of abdominal obesity is found to be higher among elderly female Karbis. With regard to Waist Circumference and Waist to Hip Ratio the difference is statistically significant.

Hypertension is another age related factor, the prevalence of which also puts people at risk for metabolic syndrome along with factors like high blood glucose level and obesity. The hypertension classifications have recently been modified and pre-hypertensive category has been removed. WHO in their directive for assessment of Metabolic Syndrome categorises systolic pressure >130mm/Hg and diastolic > 85mm/Hg as hypertensive. As per this classification 69.55 percent of the elderly Karbis are hypertensive as per their systolic blood pressure and 47.0 percent of them are hypertensive by their diastolic blood pressure. 71.6 percent and 48.7 percent of the elderly female Karbis are hypertensive according to systolic and diastolic blood pressure. The percentage of hypertensive elderly male Karbis is lower at 66.9 percent and 44.8 percent systolic and diastolic blood pressure. Prevalence of hypertension by both systolic and diastolic blood pressure though higher among female elderly the difference is statistically not significant. There is also no statistically significant difference in the prevalence of systolic and diastolic blood pressure between the two broad age groups used for comparison.

Relation of Obesity Indicators and Blood Pressure

Studies have demonstrated that there may be significant variation in Fat percentage for the same BMI range among different populations and even between individuals of the same population (Deurenberg et al. 1998; Deurenberg et al. 2000; Anjos et al. 2013). BMI under such circumstances may not always be an accurate diagnostic tool for obesity, as it is does not take into account the amount of fat in the body. In the present study elderly individuals who are obese by their Fat percentage are found in all ranges of BMI. Among male elderly who are obese by their Fat percentage, 20.3 percent have a BMI <18.5, 39.0 percent are normal, 23.2 percent are overweight with a BMI of >23, and 17.4 percent are obese with a BMI >25 (Table 4). Elderly Karbi females who are obese by their Fat Percentage are mostly obese (49%) by their BMI. Females with BMI <18.5 rarely showed obesity by Fat percentage. There is a

Table 4: Fat percentage and obesity indicators of BMI, FMI and abdominal obesity indicators of WC, WHR and WHtR

Fat percentage	*BMI <18.5*	*18.5-22.9*	*23–24.9*	*≥25*	*Total*	*χ^2 (Sex difference)*
≥ 25% (M)	14 (20.3)	27 (39.1)	16 (23.2)	12 (17.4)	69	**20.9859p<.05**
≥32% (F)	01 (1.8)	21 (36.8)	07 (12.3)	28 (49.1)	57	
	FMI <3	**3 – 6**	**>6 - 9**	**>9**	**Total**	
≥25% (M)	-	34 (45.9)	30 (40.5)	10 (13.5)	74	1.4792p>.05
	FMI <5	**5 -9**	**>9 -13**	**>13**		
≥32% (F)	-	27 (47.4)	26 (45.6)	04 (7.0)	57	
Fat percentage	*WC <85*		*>85*		*Total*	
≥ 25%(M)	53 (72.6)		20 (27.4)		73	**29.5771P<.05**
	WC<80		≥80			
≥ 32%(F)	14 (24.6)		43 (75.4)		57	
	WHR <90		≥90			
≥ 25%(M)	18 (25.7)		52 (74.3)		70	**4.1648P<.05**
	WHR <80		≥80			
≥ 32%(F)	6 (11.1)		48 (88.9)		54	
	WHtR<.50		≥.50			
≥25%(M)	28 (38.4)		45 (61.6)		73	**11.0615P<.05**
≥32%(F)	7 (12.3)		50 (87.7)		57	

*Significant p< 0.05

significant gender difference in the frequencies in BMI ranges and obesity by Fat Percentage as deduced from the chi square test.

In case of FMI, among male elderly who are obese by Fat Percentage, 45.9 percent are normal by FMI, 40.5 percent belong to the excess fat category and 13.5 percent are obese. Similarly, among female elderly highest percentage (47.4%) are normal by FMI, 45.0 percent have excess fat and 7.0 percent are obese. The gender difference regarding prevalence by fat percentage and FMI obesity is statistically insignificant.

The abdominal obesity indicators examined against individuals who are obese by their Fat Percentage mostly shows abdominal obesity with exception to WC in male. The gender difference for all the three indicators is statistically significant. Higher percentages of female elderly who are obese by their Fat Percentage are also obese by their WC, WHR and WHtR.

The Pearson correlation coefficient between BMI, Fat Percentage and high systolic and diastolic blood pressure with other variables has been calculated (Table 5). BMI shows significant negative correlation with age in both male and female elderly. Correlation of BMI with Fat Percentage, FMI, WC, WHR, WHtR, SBP and DBP is positively significant in case of female elderly. Among male elderly with exception to SBP and DBP, the variables show significant positive correlation. Fat Percentage shows negative correlation in female elderly and positive in male elderly, though not statistically significant. With the other variables the correlation is statistically significant in case of female elderly but among male elderly the correlation is significant with other variables with exception to systolic and diastolic blood pressure. Systolic and diastolic blood pressure in female elderly show significant correlation with FMI, WC and WHtR while none of the variables show significant correlation with systolic and diastolic pressure among male elderly. The logistic regression analysis has been done to assess the odds of being hypertensive by systolic and diastolic pressure separately with the other obesity indicators. Increase of Fat Percentage from non-obese to obese in female elderly shows significant odds of being hypertensive in both systolic and diastolic blood pressure (Table 6). Among male elderly the odds for being hypertensive by systolic blood pressure is significant for Fat Percentage and by WC for both systolic and diastolic blood pressure.

DISCUSSION

Studies have demonstrated that relationship between BMI and Fat Percentage differs by age, gender and ethnicity. There may be significant variation in Fat Percentage for the same BMI range among different populations and even between individuals of the same population. Anjos et al. (2013) in their study among adults of Niteroi, Rio de Janeiro, Brazil estimated lower BMI values

Table 5: Correlation between BMI, Fat percentage, systolic and diastolic blood pressure with age and anthropometric indices

		Age	*Fat%*	*FMI*	*WC*	*WHR*	*WHtR*	*SBP*	*DBP*
BMI	Female	-.207*	.839*	.953*	.749*	.220*	.720*	.182*	.171*
	Male	-.290*	.548*	.719*	.645*	.369*	.570*	.142	.107
		Age	*BMI*	*FMI*	*WC*	*WHR*	*WHtR*	*SBP*	*DBP*
Fat%	Female	-.089	.839*	.948*	.731*	.292*	.710*	.248*	.190*
	Male	.020	.548*	.939*	.498*	.368*	.586*	.045	.006
		Age	*BMI*	*FMI*	*Fat%*	*WC*	*WHR*	*WHtR*	
SBP	Female	.157	.182*	.213*	.248*	.177*	.043	.213*	
	Male	-.043	.142	.090	.045	.051	.081	.126	
DBP	Female	-.032	.171*	.165*	.190*	.154*	.060	.183*	
	Male	-.134	.107	.086	.006	.093	.049	.193	

*significant

Table 6: Hypertension prevalence according to age and anthropometric indices along with logistic regression values

					Female					
Variables	*Systolic >130*					*Diastolic >85*				
Age	*60-69 years*	*≥70 years*	*Total*	*B value and sig.*	*C.I.*	*60-69 years*	*≥70 years*	*Total*	*B value and sig.*	*C.I.*
No. & (%)	96 (70.6)	40 (29.4)	136	.480 (.074)	.215-1.074	72 (78.3)	20 (21.7)	92	1.461 (.262)	.754-2.832
Categories	*Non Obese*	*Obse*	*Total*	*B value and sig.*	*C.I.*	*Non Obese*	*Obese*	*Total*	*B value and sig.*	*C.I.*
BMI	88 (77.2)	26 (22.8)	114	.942 (.922)	.282 -3.142	60 (76.9)	18 (23.1)	78 (.712)	.825 2.294	.296-
FMI	106 (96.4)	4 (3.6)	110	.000		74 (98.7)	1 (1.3)	75	5.798 (.154)	.517-65.015
Fat%	66 (58.4)	47 (41.6)	113	.389* (.047)	.153-.989	43 (55.8)	34 (44.2)	77	.432 *(.037)	.196-.951
WC	69 (59.5)	47 (40.5)	116	1.004 (.993)	.370-2.724	45 (56.2)	35 (43.8)	80	.762 (.543)	.318-1.827
WHR	25 (22.1)	88 (77.9)	113	2.315 (.093)	.870-6.158	16 (20.5)	62 (79.5)	78	1.425 (.434)	.586-3.465
WHtR	45 (39.5)	69 (60.5)	114	.432 (.098)	.160-1.167	29 (37.2)	49 (62.8)	78	.629 (.321)	.252-1.571
					Male					
Variables	*Systolic >130*					*Diastolic > 85*				
Age	*60-69 years*	*>70 years*	*Total*	*B value and sig.*	*C.I.*	*60-69 years*	*>70 years*	*Total*	*B value and sig.*	*C.I.*
No. and (%)	58 (59.8)	39 (40.2)	97	.892 (.754)	.438-1.88	42 (64.6)	23 (35.4)	65	1.350 (.384)	.688-.2650
Categories	*Non Obese*	*Obse*	*Total*	*B value & sig.*	*C.I.*	*Non Obese*	*Obese*	*Total*	*B value & sig.*	*C.I.*
BMI	71 (87.7)	10 (12.3)	81	1.071 (.927)	.248-4.624	46 (86.8)	7 (13.2)	53	.664 (.563)	.166-2.661
FMI	82 (92.1)	7 (7.9)	89	1.095 (.922)	.177-6.763	56 (93.3)	4 (6.7)	60	1.492 (.648)	.268-8.318
Fat%	35 (38.9)	55 (61.1)	90	.429* (.033)	.197-.934	28 (45.9)	33 (54.1)	61	1.026 (.946)	.489-2.152
WC	69 (75.8)	22 (24.2)	91	.159* (.024)	.032-.785	45 (73.8)	16 (26.2)	61	.265* (.020)	.087-.808
WHR	30 (33.7)	59 (66.3)	89	.458 (.108)	.177-1.186	22 (36.7)	38 (63.3)	60	.901 (.817)	.370-2.192
WHtR	45 (50.0)	45 (50.0)	90	1.929 (.191)	.721-5.163	30 (50.0)	30 (50.0)	60	1.416 (.466)	.556-3.605

*Significant at p<.05

corresponding to Percent Body Fat cut-offs for obesity. BMI values corresponding to Percent Body Fat cut-offs for obesity to be 20.5 and 25.7 kg/m2 for women and men respectively in their study population. Meeuwsen et al. (2010) found this relationship to be curvilinear among a large self-selected sample of adults above age of 20 years in UK. This is true especially in higher BMI values and is affected by age. Deurenberg et al. (1998) in their meta analysis of literature data found that for the same level of Percent Body Fat, age and gender, Chinese, Ethiopians, Indonesians and Thais, BMIs are lower than compared to Caucasians. In a study among Chinese, Malay and Indians of Singapore Percent Body Fat was found to be under predicted by BMI, sex and age (Deurenberg et al. 2000). The Indians showed the highest Percent Body Fat and the Chinese the lowest for the same BMI. Overt obesity in Asians is relatively low despite high prevalence of metabolic risks (Hsieh and Muto 2006). Studies on relationship between BMI and Percent Body Fat are relatively few in Indian populations and considering the wide population level variation within the country, it is expected that there may be regional variation to this relationship. Misra et al. (2019) tried to assess the relationship between BMI and Percent Body Fat among north Indian adult females across various age strata and level of BMI. The study was part of the Ballabgarh Health and Demographic Surveillance Site and it showed that correlation was maximum between the two variables in 18-35 years age group and among obese individuals. In the present context, obesity by Fat Percentage is found in all ranges of BMI among elderly male. It is not the case with elderly female Karbis, as obesity by Fat Percentage is higher among those are also obese by BMI but are also found among normal and overweight range of BMI.

Asian populations have a different association between BMI and Percent Body Fat and health risk than European population. The cut-off point for observed risk varies from 22kg/m^2 to 25kg/m^2 in different Asian populations and for high risk it varies from 26kg/m2 to 31kg/m^2 (WHO 2004). Pan and Yeh (2008) on the basis of the data from Nutrition and Health Survey in Taiwan (1993-1996) found that sixty-seven percent of people with a BMI above 23.3kg/m2 have at least one elevated cardiovascular disease or metabolic risk factor. Such associations have not been examined among traditional communities of northeast India following cultural practices that may have an adverse effect on their health.

Abdominal obesity indicators are significant in elderly, as they put them at risk for various metabolic disorders or complicacies concomitant to ageing. Increased age along with obesity is a risk factor for metabolic syndromes. WC alone is a predictor for incident diabetes (Schulze et al. 2006), adverse metabolic profile (Valsamakis et al. 2004) and predicting Metabolic Syndrome. WHtR is useful for identifying cardiometabolic risk and stronger predictor for diabetes in men (Schulze et al. 2006).

Anjos et al. (2013) in their study on body composition among adults (>20 years) tried to assess the adequacy of WHO recommended BMI cut-off values for identifying obesity in this population. The study was conducted in Niteroi, State of Rio de Janeiro, Brazil. BMI values corresponding to the percent BF cut-off for obesity (30% for women and 25% for men) were 20.5 and 25.7 kg/m^2 for women and men respectively, which are considerably lower than the WHO recommended cut-offs for obesity.

Association between BMI and hypertension among different ethnic groups has been demonstrated to vary by studies. Increased risk of hypertension is found to be associated with both extremely low and high BMI levels in certain populations (Tesfaye et al. 2007). Association between BMI and hypertension were reported to be consistent across various sub groups within populations across three countries of Bangladesh, India and Nepal (Hossain et al. 2019). A meta analysis of studies conducted in India found that obesity showed significant, potentially plausible association with hypertension and Type 2 Diabetes Mellitus (Babu et al. 2018).

In the study among ageing Tiwas Das and Sarmah (2017) found the prevalence of overweight as per BMI to be 19.23 percent among elderly male Tiwas and 14.39 percent among elderly female Tiwas. Hypertension prevalence was found to be 16.54 percent among male and 21.37 percent among female Tiwas. 20.83 percent overweight (including obese category) ageing male Tiwas and 36.84 percent ageing female Tiwas were hypertensive. Sarmah (2019) in her study on health status of elderly Karbis in the district of Morigaon, Assam found the prevalence of overweight (which include the obese category as well) to be 6.72 percent among male and 9.06 percent among female elderly Karbi people. While in the current study prevalence of obesity as per BMI is relatively higher. For the study the overweight category as per the Asian Standard has been excluded and only obese determined by the category BMI >25 has been used.

Hazarika et al. (2004) in their study on hypertension among native rural population of Assam found the prevalence of hypertension to be 33.3 percent. The sample of the study included individuals of >30 years of age from 25 villages from five districts of Assam. 10.2 percent of individuals who are obese (BMI > 25) were found to be hypertensive. Hazarika et al. (2003) in their study on hypertension among elderly people of Assam found the overall prevalence to be 63.63 percent (64.2% in males and 62.89% in females). Mungreiphy et al. (2011) studied the association between BMI, blood pressure and age among the Tangkhul Nagas in the age group of twenty to seventy years. Mean systolic and diastolic pressure was found to be higher among subjects with elevated BMI and among older subjects. Significant positive correlation was found among BMI, age, and systolic and diastolic blood pressure. Borah and Sarmah (2012) studied nutritional status and blood pressure among Karbi women of Garchuk area of Kamrup district, Assam. The sample of the study consisted of women above 20 years of age. Prevalence of overweight was found to be 9.88 percent and hypertension to be 15.63 percent. Twenty-four percent of the overweight Karbi women of Kamrup district were found to be hypertensive and forty-four percent in the pre-hypertensive category.

Correlation between BMI and systolic and diastolic blood pressure among elderly Karbi female of the present study is positive and significant but elderly male do not show significant positive correlation. Greater percentage of elderly female Karbis who are hypertensive by SBP and DBP are not obese by their BMI, FMI, Fat Percentage and WC. Similarly, higher percentage of male elderly who are hypertensive by both systolic and diastolic blood pressure are not obese by their BMI, FMI and WC.Hypertension among elderly Karbi people of Karbi Anglong may be influenced by other prevalent factors concomitant to age.

CONCLUSION

From the above findings it can be concluded that prevalence of obesity by BMI and FMI are low among the elderly Karbis in comparison to obesity by Fat Percentage. There is a gender difference in the occurrence of obesity by Fat Percentage and abdominal obesity by WC and WHR. Elderly males are more vulnerable to obesity by Fat Percentage and elderly females to the two abdominal obesity indicators. Hypertension prevalence is high and the individuals are unaware about their hypertensive condition. Among the obesity indicators, Fat Percentage is found to have a significant effect on the prevalence of hypertension in elderly female Karbis. Among the elderly male Karbis, Fat Percentage significantly influences hypertension by systolic blood pressure and WC on both systolic and diastolic blood pressure.

RECOMMENDATIONS

Considering the difference in obesity prevalence by BMI and Fat Percentage in the present context, an independent population specific scale of BMI derived from Fat Percentage may be a more appropriate indicator of obesity from BMI among the elderly Karbis. Moreover, as most of the obesity indicators can predict risk of metabolic syndromes, there may be prevalence of metabolic syndromes among the elderly Karbi people of Karbi Anglong. The people are not aware about such conditions due to lack of preventive health measures. Awareness needs to be created for reducing risk through lifestylechanges.

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