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Obesity and Hypertension: A Cross-sectional Study among the Adult Individuals of Sonowal Kachari Tribe of Hatimora Village, Assam, India

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ABSTRACTA cross-sectional study was conducted among the Sonowal Kachari tribe of Hatimora Village, Dibrugarh, Assam from 27th December 2018 to 4th January 2019 to determine the prevalence of obesity and hypertension in the population and to determine any association between the two. Out of the total Sonowal Kachari population, 240 adult individuals (102 male and 138 females) were studied through a door to door investigation. It was observed that 35.42 percent of the individuals had stage-2 hypertension and 1.67 percent had stage-3 hypertension. It was also observed that only 12.92 percent of the individuals were obese. A higher incidence of central obesity was found among females. A significant association was found between hypertension and high BMI. A significant association was also found between hypertension and central obesity.

INTRODUCTION

Overweight and obesity can be defined as abnormal or excessive fat accumulation that may impair health (WHO 2019). According to the World Health Organization (2019), the prevalence of obesity has increased almost three times throughout the world since 1975. It was found that in 2016, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 650 million were obese; 41 million children under the age of 5 were overweight or obese; over 340 million children and adolescents aged 5-19 were overweight or obese (WHO 2004). Obesity has now become one of the major problems in public health with a rapid increase in prevalence in both developing and developed countries. There are examples of many patients suffering from overweight and obesity, hypertension and diabetes left undiagnosed and the management of these chronic disorders is limited (Price 2018). It has been estimated that of around 7.1 million deaths globally, 13 percent has been attributed to hypertension and about 62 percent to cardiovascular disease and 49 percent of ischaemic heart disease are attributed to suboptimal blood pressure (systolic greater than 115 mmhg) (Tesfaye et al. 2007). Overweight and obesity increase the risk of high blood pressure, coronary heart disease, ischaemic stroke, type II diabetes mellitus and cancer.

One of the standard measures for estimating overweight and obesity among adults is Body Mass Index (BMI). It is defined as the weight of an individual in kilograms divided by the square of his/her height in meters (kg/m2). Body Mass Index more than or equal to 25 is considered as overweight and Body Mass Index more than or equal to 30 is considered as obese (WHO 2019). There is a positive association between Body Mass Index (BMI) and morbidity and mortality due to hypertension, cardiovascular disease, type II diabetes mellitus and other chronic diseases (Pi-Sunyer1993). Worldwide, about 58 percent of diabetes mellitus and 21 percent of ischaemic heart disease are attributable to Body Mass Index above 21 kg/m^2 (WHO 2002). A strong association has been found between Body Mass Index (BMI) and mortality among various populations of the world (Hoffmans et al. 1988; Stevens et al. 1998; Bei-Fan 2002; Ni-Mhurchu et al. 2004; Weng et al. 2006).

Apart from Body Mass Index, other measures such as waist circumference, waist-hip ratio and waist-height ratio also reflect abdominal adiposi-

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ty and it has been suggested that these measurements can be superior to BMI in predicting CVD risk (WHO 2008). Studies done among various populations suggest central obesity to be significantly associated with hypertension (Casonatto et al. 2011; Kumar et al. 2016; Onuoha et al. 2016; Zhao et al. 2017). For the Indian population it has been found that to understand the association between various risk factors and hypertension, greater emphasis must be placed on waist-circumference and waist-to-height ratio than body mass index for both the genders (Taing et al. 2016).

A substantial portion of India's population belongs to various tribal groups. According to the Census of India (2011), around 8.6 percent of the entire population of India belongs to the scheduled tribes. The frequency of the Scheduled Tribe population in the state of Assam is 12.4 percent (Census 2011). Studies have found that among the various traditional populations of the entire world the blood pressure is often relatively low (systolic blood pressure less than 120mmHg and diastolic pressure less than 80mmHg) (Dressler 1999). However, in a recent study, the prevalence of overweight/obesity, under nutrition, and hypertension was found to be increasing at an alarming rate among the indigenous populations of India (Kshatriya and Acharya 2016). Such studies reveal the need to understand the various transitions that the tribal populations of India are going through to come up with better health management policies. Despite such need, very few studies have been conducted, especially in the state of Assam to understand the burden of obesity and various cardiovascular risk factors among the tribal populations. But no such studies have been conducted among the adult Sonowal Kachari people of Dibrugarh District of Assam.

Objectives

The present investigation aims to determine the prevalence of obesity and hypertension (with respect to age and gender) among the individuals of Sonowal Kachari tribe of Hatimora village of Dibrugarh District, Assam, India, and to understand the relation between obesity (with both body mass index and waist circumference as indicators) and hypertension among them.

MATERIAL AND METHODS

A cross-sectional study was conducted among the members of the Sonowal Kachari tribe of the Village, from 27th December 2018 to 4th January 2019. Out of the total Sonowal Kachari population, 240 individuals (102 male and 138 females) of age 19 and above were studied through a door to door investigation. Informed consent was taken from the participants by explaining to them both the purpose of the study as well as the techniques to be used. Based on age the participants were divided into three age groups.

Blood pressure was measured using a prechecked Aneroid Sphygmomanometer. The participants were asked to sit in a relaxed position, on comfortable chairs with their left arm resting comfortably on a flat surface at heart level for about 5 to 10 minutes before taking the measurement. The cuff was placed around a bare arm (left) 2-3 cm above the elbow joint. The forearm was propped to keep the device at heart level. The diaphragm was positioned over the brachial artery below the cuff. The cuff was inflated rapidly to approximately 200mmhg until the pulse could no longer be heard. The cuff was deflated at a speed of 2-4mmhg /sec. The first perception of the pulse/Korotkoff sound (K-1 Sound) was recorded as systolic pressure and the level at which the sound ceased (K-5) was recorded as diastolic pressure. Then the cuff was deflated completely. Blood pressure was measured twice at an interval of 5 minutes and the average of the two measurements was recorded (Spiteri 2014).

Height, waist circumference and weight measurements were taken by following protocols of New Zealand Health Monitor (NZHM) Surveys (Anonymous 2008). Stature was measured using a portable stadiometer measuring up to 210cm and with a least count 0.1cm. The participants were asked to stand on the center of the base with their back to the stadiometer, their feet together and heels touching the bottom of the stadiometer. Their buttocks and upper part of their back also touched the stadiometer. The participant's head was kept in the Frankfort plane. Weight was measured using a Digital Body Weighing Scale (PS 126) with 5-180 kg capacity with an accuracy of ±0.1 kg. Waist circumference was measured using an anthropometric

measuring tape. While measuring the stature, waist circumference and weight the participants were asked to remove shoes, excess clothing and any kind of headgear. Height and weight to the nearest .5 cm and 100gm respectively was recorded (Anonymous 2008).

For the assessment of central obesity waist circumference of the individuals was measured. In the case of male individuals cutoff for central obesity was taken to be more than or equal to 90cm and in the case of female individuals the cut-off for central obesity was taken as more than or equal to 80cm. It was observed that the frequency of individuals with central obesity was 55.88 percent in case of male and 74.64 percent in case of female. Thus a higher incidence of central obesity was found among the females.

Body Mass Index was calculated using the standard formula body mass in kilograms divided by square of the stature in meter. Data collected were entered into an MS Excel 2007 spreadsheet and was analyzed using the Statistical Package for Social Science (SPSS) version 16.0 software. Statistical significance was set at p less than 0.05 [WU1].

RESULTS

In the present investigation, 240 individuals were studied out of which 102 (42.50%) were male and 138 (57.50%) were female. The population was divided into three age groups. Frequencies of male (40.20%) as well as female (46.38%) individuals were highest in the age group 18-39 years (Table 1).The mean ages of all female and male individuals were 43.96 ± 15.74 and 44.3 ± 16.65 years respectively.

The study revealed that the mean value of stature was highest in the age group of 18-39 years (1.60 m) and lowest in the age group 'above 60' years (1.57 m). Mean stature decreased in successive age groups after the age of 39 years. However, the difference was not found to be statistically significant (p greater than .05). The highest and lowest mean body weights were found among the individuals of age 40-59 years (65.66 kg) and 'above 60' years (58.90 kg) respectively. It was observed that body weight increased with age till the age of 59 years and thereafter it decreased. However, the difference was also not found to be statistically significant (p greater than 0.05). A similar trend was also observed in mean body mass index and mean waist circumference in different age groups. The difference was found to be statistically significant only in case of waist circumference (p less than 0.05). Lowest mean systolic as well as diastolic blood pressures were 123.05 mmHg and 82.76 mmHg respectively and both were found in the age category of 18-39 years. The highest mean systolic as well as diastolic blood pressures were found in age the category of '60 and above' years (141.22 mmHg) and 40-59 years (89.53 mmHg) respectively. Systolic blood pressure was found to increase with age while diastolic blood pressure increased with age till the age of 59 years after which it decreased. The difference was found to be statistically significant (p less than 0.05) only in case of systolic blood pressure (Table 2).

The present study showed that 42.92 percent of the individuals had a normal body mass index while 12.50 percent of the individuals were underweight. Frequencies of overweight and obese individuals were 31.67 percent and 12.92 percent respectively. Highest frequency of underweight individuals was found to be in the age group '60 and above' years. Frequency of individuals with normal Body Mass Index decreased with age. On the other hand frequencies of overweight individuals, individuals with general obesity as well as individuals with central obesity increased with age till the age of 59 years and thereafter decreased. (Table 3). The

Table 1: Age and gender distribution of the Sonowal Kachari individuals

Age in years	*Female*		*Male*	
	Frequency	*Percentage*	*Frequency*	*Percentage*
18-39	64	46.38	41	40.20
40-59	48	34.78	38	37.25
60 and above	26	18.84	23	2.55
Total	138	57.50	102	42.50

Table 2: Group statistics of the individuals of the Sonowal Kachari population on the basis of age

Age in years	*Variables*	*Stature (m)*	*Weight (kg)*	*Body mass index*	*Waist circumference (cm)*	*Systolic blood pressure*	*Diastolic blood pressure*
18-39	Mean	1.60	60.64	23.68	84.52	123.05	82.76
	Std. deviation	0.08	13.64	4.51	11.39	11.10	9.04
	Minimum	1.39	35.4	13.47	50	100	60
	Maximum	1.82	95.6	35.51	112	160	110
40-59	Mean	1.59	65.66	25.85	95.37	139.77	89.53
	Std. deviation	0.09	12.25	4.11	11.28	16.09	10.84
	Minimum	1.385	28.6	14.47	65.5	110	70
	Maximum	1.777	93	35.66	120	180	120
60 and above	Mean	1.57	58.90	23.61	89.85	141.22	86.33
	Std. deviation	0.09	15.01	5.13	14.61	14.94	9.94
	Minimum	1.36	33	15.29	60	110	70
	Maximum	1.742	88	34.34	116	180	110
Total	Mean	1.59	62.08	24.44	89.49	132.75	85.92
	Std. deviation	0.09	13.68	4.61	12.95	16.26	10.31
	Minimum	1.359	28.6	13.47	50	100	60
	Maximum	1.823	95.6	35.66	120	180	120
	F-Test Value	1.34	1.05	1.036	2.049	2.806	1.178
	p-value	0.075	0.392	.419	0.000	0.000	.209

difference was found to be statistically significant (χ^2 equals to 18.23, d.f equals to 6, p less than 0.05; χ^2 equals to 20.91, d.f equals to 2, p less than 0.05) (Table 3).

It was found that only 9.58 percent of the population had normal blood pressure while 28.33 percent showed an elevated blood pressure level. 35.42 percent of the individuals had stage-2 hypertension and 1.67percent of the individuals had stage-3 hypertension. Highest frequency of individuals with normal blood pressure was in the age group 18-39 years while the lowest frequency was in the age group 40-59 years. On the other hand, highest frequency of individuals with stage II hypertension was in the age group '60 and above' years while the highest frequency of individuals with stage III hypertension was in the age group 40-59 years. Frequency of individuals with stage II hypertension increased with age (Table 4). The difference was found to be statistically significant (x^2 equals to 60.78, d.f equals to 4, p less than 0.05) (Table 3).

Table 3: Age-wise distribution of the Sonowal Kachari individuals on the basis of different adiposity indices

Body Mass Index category	*Age in years*							
	Total		*18-39*		*40-59*		*60 and above*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Under weight	30	12.50	14	13.33	4	4.65	12	24.49
Normal weight	103	42.92	52	49.52	33	38.37	18	36.73
Over weight	76	31.67	29	27.62	36	41.86	11	22.45
Obesity class I	29	12.08	9	8.57	12	13.95	8	16.33
Obesity class II	2	0.83	1	0.95	1	1.16	0	0
Total	240	100.00	105	43.75	86	35.83	49	20.42
Waist Circumference Category								
Central obesity	160	66.67	55	52.38	72	83.72	33	67.34
Normal	80	33.33	50	47.62	14	16.28	16	32.65
Total	240	100.00	105	43.75	86	35.83	49	20.42

Table 4: Age wise distribution of the Sonowal Kachari individuals on the basis of blood pressure

Blood pressure category	*Age in years*							
	Total		*18-39*		*40-59*		*60 and above*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Normal	23	9.58	20	19.05	1	1.16	2	4.08
Elevated	68	28.33	48	45.71	16	18.60	4	8.16
Stage 1	60	25.00	26	24.76	22	25.58	12	24.49
Stage 2	85	35.42	11	10.48	44	51.16	30	61.22
Stage 3	4	1.67	0	0	3	3.49	1	2.04
Total	240	100.00	105	43.75	86	35.83	49	20.42

Mean value for Stature, Weight, Waist Circumferences, Systolic Blood Pressure and Diastolic Blood Pressure were higher among male than among female individuals. However, the difference was not found to be statistically significant. On the other hand mean Body Mass Index was higher in females than in males. However, the difference was also not found to be statistically significant (p greater than 0.05) (Table 5).

Frequency of underweight as well as normal individuals on the basis of Body Mass Index was higher in case of male than in case of female. However, frequencies of overweight individuals, individuals with general obesity and individuals with central obesity were higher in case of female than in case of male. However the difference was not found to be statistically significant in case of body mass index categories (χ^2 equals to 1.75, d.f equals to3, p greater than 0.05) (Table 6). However in case of central obesity the difference was found to be statistically significant (χ^2 equals to 9.28, d.f equals to 1, p less than 0.05).

Frequency of individuals with normal blood pressure was higher in case of female (15.20 percent) than in case of male (and 2%). Frequency of individuals with stage II hypertension was higher in case of male (41.20%) than in case of female (31.20%). Frequency of individuals with stage III hypertension was higher in case of female (2.90%) than in case of male (0 %) (Table 7). The difference was found to be statistically significant (χ^2 equals to 12.05, d.f equals to 2, p less than 0.05).

Among the individuals of both genders who were normal, overweight or had class I general obesity prevalence of hypertension was higher than among individuals who were underweight. However the difference was not found to be statistically significant (χ^2 equals to 10.88, d.f equals to 6, p greater than 0.05; χ^2 equals to 11.13, d.f equals to 2, p greater than 0.05). Similarly, among the individuals with central obesity, prevalence

Table 5: Group statistics of the individuals of the Sonowal Kachari population on the basis of gender

Variables	*Stature (m)*		*Weight (Kg)*		*Body mass index*		*Waist circumference (cm)*		*Systolic blood pressure*		*Diastolic blood pressure*	
Gender	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*
Mean	1.54	1.66	58.77	66.57	24.66	24.15	89.04	90.1	131.52	134.41	84.86	87.35
Std. deviation	0.07	0.06	13.24	13.04	4.80	4.34	13.84	11.683	17.505	14.321	10.957	9.22
Min	1.36	1.39	29	35	14.47	13.47	50	66	100	110	60	70
Max	1.75	1.82	94	96	35.66	31.94	120	116	180	170	120	120
F-Test value	0.99		0.085		0.97		2.74		3.131		1.93	
p-value	0.320		0.77		0.325		0.10		0.078		.167	

F- Female, M-Male

Table 6: Gender wise distribution of the Sonowal Kachari individuals on the basis of different adiposity indices

Body mass index category	*Total*		*Female*		*Male*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Under weight	30	12.50	16	11.60	14	13.70
Normal weight	103	42.92	57	41.30	46	45.10
Over weight	76	31.67	44	31.90	32	31.40
Obesity class I	29	12.08	19	13.80	10	9.80
Obesity class II	2	0.83	2	1.40	0	0.00
Total	240	100.00	138	57.50	102	42.50
Waist Circumference Category						
Central obesity	160	66.67	103	74.60	57	55.90
Normal	80	33.33	35	25.40	45	44.10
Total	240	100.00	138	57.50	102	42.50

Table 7: Gender wise distribution of the Sonowal Kachari individuals on the basis of blood pressure

Blood pressure category	*Total*		*Female*		*Male*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Normal	23	9.58	21	15.20	2	2.00
Elevated	68	28.33	38	27.50	30	29.40
Stage 1	60	25.00	32	23.20	28	27.50
Stage 2	85	35.42	43	31.20	42	41.20
Stage 3	4	1.67	4	2.90	0	0.00
Total	240	100.00	138	57.50	102	42.50

of hypertension was higher (75.40% and 64.10% respectively). However, the difference was found to be statistically significant only in case of female (χ^2 equals to 8.28, d.f equals to 2, p less than 0.05; χ^2 equals to 2.82, d.f equals to 2, p greater than 0.05) (Tables 8-9).

Significant positive correlation of age was found with waist circumference and both systolic and diastolic blood pressure in case of female and only waist circumference and systolic blood pressure in case of male (p less than 0.05). Magnitude of correlation was found to be higher in between age and systolic blood pressure than in between age and diastolic blood pressure in both the genders. No significant relation was found between age and body mass index. There was significant positive correlation of body mass index with waist circumference and both systolic as well as diastolic blood pressure only in case of the female individuals (p less

Table 8: Body mass index and hypertension among the Sonowal Kachari individuals

Body Mass Index category	*Age in years*							
	Total		*18-39*		*40-59*		*60 and above*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Under weight	8	50	8	50	7	50	7	50
Normal weight	29	50.88	28	49.12	37	80.43	9	19.57
Over weight	29	65.91	15	34.10	20	62.5	12	37.5
Obesity class I	12	63.16	7	36.84	6	60	4	40
Obesity class II	1	50	1	50	0	0	0	0
Total	79	57.25	59	42.75	70	68.63	32	31.37

Table 9: Waist circumference and hypertension among the Sonowal Kachari individuals

	Female				*Male*			
	Hypertension		*Normal*		*Hypertension*		*Normal*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Central obesity	66	64.10	37	35.90	43	75.40	14	24.60
Normal	13	37.10	22	62.90	27	60	18	40
Total	79	57.25	59	42.75	70	68.63	32	31.37

than 0.05). This reveals that blood pressure increased with the increase in body mass index among females. The relationship of body mass index was stronger with diastolic blood pressure (Correlation coefficient 0.357) than with systolic blood pressure (Correlation coefficient 0.307) (Table 10). In case of male individuals though positive correlation was seen in case of body mass index with waist circumference and blood pressure, it was statistically significant only for waist circumference (p less than 0.05). Significant positive correlation of waist circumference was found with both systolic and diastolic blood pressure in case of female. On the other hand in case of male, significant positive correlation of waist circumference was found only with systolic blood pressure. Thus it shows that with the increase of waist circumference both the systolic as well as diastolic blood pressure increased in case of female and only systolic blood pressure increased in case of male. It was observed that waist circumference was more strongly related to systolic blood pressure than diastolic blood pressure in case of both the genders. Correlation coefficient showed that relationship of both systolic blood pressures as well as diastolic blood pressure was higher with waist circumference than body mass index in case of male individuals. In case of female individuals relationship of systolic blood pressures was higher with waist circumference and the relationship of diastolic blood pressures was higher with body mass index (Table 10).

DISCUSSION

One of the most important public health challenges being faced globally is cardio vascular disease and thus it is very important to understand the various risk factors involved. The present investigation aimed to determine the prevalence of obesity and hypertension (with respect to age and gender) among the adult individuals of Sonowal Kachari tribe of Hatimora village of Dibrugarh District, Assam, India and to understand the relation between obesity (with

Table 10: Binary correlation between age, body mass index, waist circumference, and blood pressure

Gender	*Variables*	*Age*	*Body mass index*	*Waist circumference*	*Systolic blood pressure*	*Diastolic blood pressure*
Female	Age	1	.056	.172*	.522**	.302**
	Body Mass Index	.056	1	.768**	.307**	.357**
	Waist circumference	.172*	.768**	1	.344**	.320**
	Systolic blood pressure	.522**	.307**	.344**	1	.753**
	Diastolic blood pressure	.302**	.357**	.320**	.753**	1
Male	Age	1	.019	.346**	.388**	.043
	Body Mass Index	.019	1	.840**	.110	.083
	Waist circumference	.346**	.840**	1	.316**	.105
	Systolic blood pressure	.388**	.110	.316**	1	.697**
	Diastolic blood pressure	.043	.083	.105	.697**	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

both body mass index and waist circumference as indicators) and hypertension among them.

The present study revealed high frequency of overweight (31.67%) and obese (12.92%) individuals on the basis of body mass index. This was quite higher than observed among tea garden workers of Assam,the Tangkhul Naga males as well as the Nyishi tribal women of Arunachal Pradesh, Northeast India (Biswas et al. 2002; Mungreiphy et al. 2011; Bharali et al. 2017). However, the frequency of obese individuals was lower than among the Punjabi community residing in Delhi (Dua et al. 2014). Frequency of individuals with central obesity was found to be 66.67 percent. It was also observed that the mean systolic blood pressure was 134.41±14.32 mmHg and 131.52±17.50 mmHg for male and female respectively. Similarly the mean diastolic blood pressure was found to be 87.35±9.22 mmHg and 84.86±10.96 mmHg for male and female respectively. The observed values were found to be higher than the findings of Onuoha et al. among an adult Nigerian population (Onuoha et al. 2016). It was observed that more than half of the population showed various stages of hypertension. 35.42 percent of the individuals were found to have stage-2 hypertension and 1.67 percent of the individuals had stage-3 hypertension. These values were found to be quite higher than the values recorded in studies done among the tea garden workers of Assam and among the Tangkhul Naga males of Northeast India (Biswas et al. 2002; Mungreiphy et al. 2011).Thus, variation in the prevalence of obesity and hypertension was revealed in this study when compared to studies done among different population by other authors.

In the present investigation it was observed that the body weight increased with age till the age of 59 years and thereafter it decreased. Similar trend was also observed in case of mean body mass index and waist circumference in the different age groups. Significant positive correlation of waist circumference was found with age. Such results has also been reported from various other studies (Kapoor and Tyagi 2002; Tandon 2006; Mungreiphy et al. 2011). The frequency of individuals with normal body mass index decreased with age. On the other hand it was observed that the frequency of overweight individuals, individuals with general obesity and individuals with central obesity increased with age till the age of 59 years and thereafter decreased. Studies have found that younger individuals have a larger appetite; this leads to increased intake of energy, a diet rich in fat and relatively less energy expenditure (Mungreiphy et al. 2011). With advancing age, there is a decrease in one's ability to release or mobilize stored fatty acids from adipose tissue for energy fuel and this result in less fatty acids being burned up. Thus, there is a general tendency to accumulate and increase in body fat with advancing age (Shave 1981). Studies have also found that with the more advancement of age, that is, after the 60's there is decrease in muscle mass as a result of decline in number and size of muscle fibers due to degenerative diseases associated with the advancing age (Mungreiphy et al. 2011).

The systolic blood pressure increased with age while the diastolic blood pressure increased with age till the age of 59 years after which it decreased. The frequency of individuals with stage II hypertension increased with age. Significant positive correlation of age was found with both systolic and diastolic blood pressure in case of female and only systolic blood pressure in case of male. Similar result was also obtained among the individuals belonging to the Punjabi community residing in Delhi (Dua et al. 2014). Magnitude of correlation was found to be higher in between age and systolic blood pressure than in between age and diastolic blood pressure in both the genders. This reveals that there is association between age and blood pressure. Similar results have been obtained in various other studies (Dressler and Bindon 1994; Schall 1994). Association of age with blood pressure was also found among the Tangkhul Naga males of Northeast India by N. K. Mungreiphy et al. in the year 2011 (Mungreiphy et al. 2011). No significant relation was found between age and body mass index. Thus, age was found to be associated significantly with blood pressure and not with body mass index. This varied from the observations made among the Tangkhul Naga males of Northeast India by N. K. Mungreiphy et al. in the year 2011 (Mungreiphy et al. 2011).

The frequency of individuals with central obesity was found to be higher in case of female

than in case of male. This was similar to the result obtained by Kumar et al. (2016) among a rural population of Jharkhand.Similar results have also been found in various other studies where female have been found to be more obese than the males. Studies have found that the nutrition transition taking place in many developing countries have affected excess weight gain among both genders, but has had an even greater impact on the physical activity levels of women (Kanter and Caballero 2012). The frequencies of individuals with normal blood pressure were found to be higher in case of female (15.20%) than in case of male (2%) while the frequency of individuals with stage II hypertension was found to be higher in case of male (41.20%) than in case of female (31.20%).

In the present study it was observed that among females, there was significant positive correlation of body mass index with both systolic as well as diastolic blood pressure.This reveals that blood pressure increased with increase in body mass index. Similar result was also obtained among adolescent population of Tripura (Sarkar and Sil 2015; Sutradhar and Choudhury 2015). The relationship of body mass index was stronger with diastolic blood pressure than with systolic blood pressure.Among males, though positive correlation of body mass index with blood pressure was found, it was not statistically significant. This varied from observations made among the Tangkhul Naga males of Northeast India by N. K. Mungreiphy et al. in the year 2011 where significant positive correlation was found between body mass index and blood pressure (Mungreiphy et al. 2011). Among females with central obesity, prevalence of hypertension was higher. Significant positive correlation of waist circumference was found with both systolic and diastolic blood pressure in case of female. On the other hand in case of male, significant positive correlation of waist circumference was found only with systolic blood pressure. Thus it shows that with the increase of waist circumference both the systolic as well as diastolic blood pressure increased in female and only systolic blood pressure increased in male. It was observed that waist circumference was more strongly related to systolic blood pressure than diastolic blood pressure in case of both the genders. Correlation coefficient showed that relationship of both systolic as well as diastolic blood pressure was higher with waist circumference than body mass index in male individuals. Similar result was also obtained in a study done among the Ao tribe of North East India (Maken and Varte 2013). In female individuals relationship of systolic blood pressures was higher with waist circumference and relationship of diastolic blood pressures was higher with body mass index. This differed from the result obtained in a study done in Assam Medical Collegewhere it was found that waist circumference was a better predictor of blood pressure than body mass index in both the genders (Khanikar and Konwar 2016).

CONCLUSION

The present study revealed that the prevalence of obesity and hypertension among the Sonowal Kachari individuals was quite high. Significant correlation of age was found with central obesity and blood pressure. Both general obesity as well as central obesity was found to be significantly associated with hypertension among the females. Among males central obesity was found to be associated with systolic blood pressure. The study also reveals that magnitude of correlation between the adiposity indices and blood pressure varied from other populations studied by other authors. Thus, the present study adds to the knowledge that although traditional population groups throughout the globe were known to have low rate of obesity and hypertension, there has been changes in the scenario due to some reasons which may be related to the change of the socioeconomic status of the population. The study also revealed that with the increase in one's age and high adiposity the chances of acquiring high blood pressure also increased. Further study is needed in order to have an understanding of the underlying causes of such changes in the population.

RECOMMENDATIONS

Comparatively high prevalence of hypertension was observed among the individuals of the population. Therefore proper programs aiming at awareness about hypertension as well as weight management are very important for the population.

LIMITATIONS

A limitation of this investigation was the limited sample size in the village. Large scale intensive study in more villages is needed to understand the association of obesity and high blood pressure better.

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