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Research

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Socio-Economic and Demographic Correlates of Overweight and Obesity: A Study on the Karbi Women of Assam, Northeast India

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ABSTRACT

Background: Excess adiposity is a chronic condition that contributes to non-communicable disease (NCD) related morbidities, mortalities and causes public health problems.
Objectives: The objectives of the present community based cross-sectional study were to assess the prevalence of overweight and obesity and its socio-economic and demographic concomitants among a group of Karbi women of Assam, Northeast India.
Material and Methods: The study was carried out among 600 Karbi married women aged 20-49 years in Karbi-Anglong district of Assam, Northeast India. Height and weight were recorded and body mass index (BMI= weight (kg)/ height^2 (m^2)} was calculated. The prevalence of overweight (BMI≥23.00-24.99 kg/m^2) and obesity (BMI≥25.00 kg/m^2) were assessed using the Asian-Pacific population reference cut-offs. Data on the socio-economic, demographic and lifestyle variables were collected using a pre-structured questionnaire.
Results: The prevalence of overweight and obesity were 17.33% and 14.33%, respectively. Binary logistic regression (BLR) analysis showed that age at the time of interview, family size, ≥4 number of dependent children, alcohol consumption, tobacco use and monthly per-capita income were the significantly risk factors for both combined overweight-obesity and obesity independently (p<0.05). Step-wise multiple logistic regression showed that age at the time of interview (30-39 years) (p<0.01), consumption of alcohol (p<0.05) and use of tobacco (p<0.05) remain the significant risk factors for combined overweight-obesity; and age at the time of interview (30-39 years) (p<0.01), monthly per-capita income (p<0.05) and number of dependent children (p<0.01) for obesity.
Conclusion: Prevalence of overweight and obesity is emerging as a public health issue among the indigenous Karbi women of Assam. The results suggest that increase in age, alcohol consumption, tobacco use, number of dependent children and family income were the major predictive variables that increases the prevalence of excess adiposity. Appropriate healthcare strategies and intervention programmes are required to reduce subsequent complications of excess adiposity in this population.

KEY WORDS: BMI; Obesity; Socio-demographic; Karbi population; Assam.

ABBREVIATIONS: NCD: Non-Communicable Disease; ANOVA: One way analysis of variance; BLR: Binary Logistic Regression; CIs: Confidence Intervals.

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INTRODUCTION

Overweight or obesity is a serious chronic condition contributing to non-communicable disease (NCD) related mortalities, morbidities and causes major public health problems. The World Health Organization (WHO) has declared that obesity is one of present day's most blatantly visible, yet most neglected public health problems that require urgent interventions.[1] A recent global data shows that approximately 1.5 billion and 500 million adults (aged ≥20 years) were observed to be overweight and obese, respectively.[2] Studies have also confirmed the existence of 'double nutritional burden' which is becoming increasingly apparent in addition to double burden of NCDs affecting several developing countries.[3-8] It has been reported that a number of socio-economic, demographic, biological, socio-cultural, genetic, environmental and behavioural factors are responsible for these events in population.[5,9,10] Excess adiposity is usually attributed to genetic predisposition and this along with an obesogenic environment is considered to be the major promoting factor for overweight and obesity among individuals. For example, factors such as lifestyle (e.g., alcohol consumption, tobacco use), demographic (e.g., age, family size) and higher socio-economic status (e.g., higher education and family income) increases the prevalence of excess adiposity among such individuals.[10,11] The determination of these factors that appear to have the potential to affect overweight and obesity may be very constructive to design specific intervention programme and prevention strategies across populations.

In India, the prevalence of overweight and obesity is currently becoming one of the major public health issues. On one hand, studies indicated that such prevalence is more pronounced among those individuals residing in the urban and sub-urban areas when compared to the rural areas of the country.[3-6,11-14] On the other hand, few studies reported the effects of different socio-economic, demographic and lifestyle factors related to overweight and obesity among Indian populations.[3,4,11,13,15,16] Therefore, there appears to be a need to study the possible association of socio-economic and demographic factors affecting the excess adiposity patterns among individuals. The identification of potential risk factors(s) for excess adiposity is a very challenging task for any researcher focused on population-specific investigations. The idea that attainment of higher education, socio-economic status and development and lifestyle modification (especially sedentary lifestyle and/or decreasing the physical activity and alcohol consumption) with increasing age leads to the development of excess adiposity among women constituted the research question of the present study. The objectives were to determine the prevalence of overweight and obesity and also to ascertain the associations of socio-economic, demographic and lifestyle-related factors with overweight and obesity among women belonging to an indigenous tribal population of Northeast India.

METHODS

Subjects and Study Area

The present community-based cross-sectional study was conducted on 600 adult ever married women belonging to the Karbi population, a scheduled tribe residing in the Karbi-Anglong district of Assam, Northeast India. Ethnically, the Karbi population belongs to the Tibeto-Mongoloid population and speaks Tibeto-Burman language. They are mainly concentrated in the Karbi-Anglong, Dima Hasao, Kamrup, Morigaon, Nagaon, Golaghat, Karimganj, Lakhimpur and Sonitpur districts of the state of Assam, Northeast India. They are also found to inhabit the states of Nagaland, Arunachal Pradesh and Meghalaya. All the study participants were the residents of Karbi-Anglong district (25°33′ N to 26°35′ N latitude and 92°10′ E to 93°50′ E longitude) of the state of Assam, Northeast India. A total of seven villages mainly inhibited by a homogeneous Karbi tribal population situated approximately 160 km from the district town of Diphu, Karbi-Anglong were covered in course of the present study. The Karbi-Anglong is the largest district amongst the 28 districts of Assam and covers an area of 10,434 km^2. According to the National Census[17], the district had a population of 9,65,280 individuals (males: 4,93,482; females: 4,71,798) with an average literacy rate of 59.52% (males: 56.82%; females: 43.18%).

The minimum number of individuals required for reliably estimating the prevalence of overweight and obesity in the present study was calculated following a standard method of estimating sample size.[18] In this method, the anticipated population proportion of 50%, absolute precision of 5% and confidence interval of 95% were taken into consideration. The prevalence of overweight and obesity among Indian adult women as reported by Sen et al[13], Rengma et al[16], Asthana et al[19] and Bhadra et al[20] were kept in mind while calculating the minimum sample size. This prevalence was observed to be up to 50% in these aforementioned studies. The minimum sample size, thus estimated by the method[18] was 384 individuals. In the first stage, the households of those individuals belonging to the Karbi population were identified based on the surnames and cultural traits. In the second stage, a total of 400 Karbi households were identified and finally 684 ever married Karbi women in the age group of 20-49 years of those households were finally selected for the present study. The age of the participants at the time of interview were subsequently recorded and verified from the birth certificates, identity cards and other official documents issued by the Government of India. A total of 684 Karbi women belonging to the selected age group 20-49 years were then approached for voluntarily participat in the study. The objectives of the study were explained to them before participation in the study. A section of the participants (12.28%) refused to participate. Hence, the final sample size was 600 women in the age group of 20-49 years, and this was appreciably higher than the minimum sample size calculated earlier following the standard method.[18] A verbal consent was obtained from the participants prior to collection of the data. Each woman was interviewed and measured at her respective household. Permission to conduct the research was obtained from the village level local authorities (the village headmen) and the Department of Anthropology, Assam University (Diphu campus) prior to conducting the study. The study was conducted in accordance with the ethical guidelines for human experimen-

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tal research as laid down in the Helsinki Declaration of 2000.[21] The data were collected during the period from October 2011 to November 2012.

Socio-economic, Demographic and Lifestyle Variables Recorded

A structured schedule was utilized to obtain the necessary information on age at the time of interview, family size, number of dependent children, monthly family income (in Indian rupees or INR), educational status, marital status, alcohol consumption and tobacco use among the individuals. Per-capita monthly family income (INR) was calculated by dividing the monthly family income by the total number of family members. This schedule has been validated in an earlier community-based cross-sectional study among adult individuals belonging to the Rengma population of Assam, Northeast India.[16] Individuals who consumed alcohol least once in a week comprised the alcohol-consumed category. The tobacco-used group comprised of those who had a daily habit of tobacco chewing or smoking.[13] In order to elicit valid responses ample care (e.g., day/weekly consumption of alcohol or tobacco use) was taken while briefing the questions to the participants at the time of interview. The schedule was completed by interviewing participants by one of the author (RT) in their respective households.

Anthropometric Measurements Recorded

Anthropometric measurements of height and weight were recorded using standard procedures.[22] Height was recorded with the help of an anthropometer rod, with the participant standing erect, looking straight and the head oriented in the Frankfort horizontal plane. It was measured to the nearest 0.10 cm. Weight was taken using a portable weighing machine with the participant wearing minimum clothing to the nearest 0.10 kg. The subjects covered in the course of this study were measured with ample precision to avoid any possible systematic errors (e.g., instrumental or definition of landmarks) in the process of anthropometric data collection.[23]

Intra-observer and inter-observer technical errors of the measurements (TEM) were calculated to determine the accuracy of the measurements using the standard procedure.[24] The TEM was calculated using the following equation:

$TEM=\sqrt{(\Sigma D^2/2N)}$, [D=difference between the measurements, N=number of individuals].

The co-efficient of reliability (R) was subsequently calculated from TEM using the following equation:

$R=\{1-(TEM)^2/SD^2\}$, SD=standard deviation of the measurements.

For calculating TEM, height and weight were recorded from 50 Karbi women other than those selected for the study by two of the authors (NM and RT). Very high values were observed of R (>0.975) for both height and weight and these values were within the acceptable limits of 0.95 as recommended.[24] Hence, the measurements recorded by NM and RT were considered to be reliable and reproducible. All the measurements in the course of the present study were subsequently recorded by both of them.

Assessment of Nutritional Status

The prevalence of overweight and obesity was determined using body mass index (BMI). This index has been calculated using the following formula[25]:

$BMI\ (kg/m^2) = Weight\ (kg)/Height^2\ (m^2)\}$

The WHO[25] had proposed a redefined classification for overweight and obesity based on BMI applicable for the Asia-Pacific populations so as to evaluate their prevalence. These new BMI cut-offs have been used to determine overweight ($BMI \geq 23.00$-$24.99\ kg/m^2$) and obesity ($BMI \geq 25.00\ kg/m^2$). The combined overweight-obesity category comprised those with a $BMI \geq 23.00\ kg/m^2$.

Statistical Analysis

The statistical analyses were done using the Statistical Package for Social Science (SPSS, Inc., Chicago, IL, USA, version 17.0). The *p*-value of <0.05 was considered to be statistically significant. Homogeneity of variance was tested using Levene's test of equality of variance. The women were grouped into three age-specific categories (i.e., 20-29 years, 30-39 years and 40-49 years) to understand the effect of age on the anthropometric variables. One way analysis of variance (ANOVA) using the Scheffe post hoc multiple comparisons was done to assess differences in the anthropometric variables among different age groups. A binary logistic regression (BLR) analysis was undertaken to estimate the odds ratios (ORs), minimum of 95% confidence intervals (CIs) and to assess the possible differences in risk factors associated with those individuals being combined-overweight and obesity ($BMI \geq 23.00\ kg/m^2$) and obese ($BMI \geq 25.00\ kg/m^2$) separately. In the BLR analysis, the different socio-economic, demographic and lifestyle predictor variables were used as univariate independent regression model analyses. To create the dichotomous dependent variables, women who were overweight (combined overweight: $BMI \geq 23.00\ kg/m^2$) were coded as '1' in the respective BLR model. Similarly, women who happen to be obese ($BMI \geq 25.00\ kg/m^2$) were also coded as '1' in the respective BLR model. Women who exhibited normal BMI were coded as '0' in the BLR models. These different regression models were utilized to identify the possible risk factor(s) associated with different excess adiposity levels (overweight and obesity). A step-wise multiple logistic regression analysis (Forward conditional model) was also undertaken to determine the most effective independent factor(s) risk associated with overweight and obesity from those determinant variables considered in the BLR

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analysis. Those dependent variables have shown the significant associations in the univariate BLR analysis were tested to predict the most effective predictor variables in step-wise multiple logistic regression model analysis. It is to be mentioned here that these predictor variables were arbitrarily grouped into different sub-categories to find out the possible associations with the prevalence of overweight and obesity. The predictor variables of age (20-29 years, 30-39 years and 40-49 years) family size (≤4, 5-6 and ≥7) dependent children (0-1, 2-3 and ≥4), education (≤8th grade and ≥9th grade), alcohol consumption (never and occasional/regular), tobacco use (never and regular), and monthly per-capita income (Rupees <1000 and Rupees ≥1000) were entered into the regression equation as a set of dummy variables and results were obtained by comparing them with the reference categories separately.

RESULTS

The age-specific participant's distribution, descriptive statistics (mean±standard deviation) and 95% CIs of weight, height and BMI among the Karbi married women are shown in Table 1. For the better understanding of the results, the participants were categorized into three different age groups (20-29 years, 30-39 years and 40-49 years). The overall mean of weight, height and BMI were observed to be 49.41±7.15 (kg), 1.50 ±0.05 (m) and 22.06±2.87 (kg/m^2), respectively. Using the Levene's test of equality of variance, it was observed that for weight (Levene=9.34), height (Levene=3.57) and BMI (Levene=14.30), the *p*-values were statistically significant ($p<0.05$). Comparisons of age specific means showed that weight, height and BMI were observed to be higher among the participants aged 30-39 years. The lowest values were obtained among those aged 20-29 years. ANOVA shows that the mean values for weight ($p<0.01$) and BMI ($p<0.01$) differ significantly across the age groups but not for height ($p>0.05$) (Table 1). Using Scheffe post hoc test, the multiple comparisons of mean between the age groups were observed to be statistically significant only for weight and BMI (in 20-29 years *vs*. 30-39 years and 30-39 years vs. 40-49 years) ($p<0.01$).

Prevalence of Overweight and Obesity

The overall prevalence of overweight (BMI≥23.00-24.99 kg/m^2) and obesity (BMI≥25.00 kg/m^2) was observed to be 17.33% and 14.33% respectively. The overall excess adiposity (combined overweight-obesity: ≥BMI 23.00 kg/m^2) was documented to be

Table 1: Age Specific Subject Distribution and Descriptive Statistics of the Anthropometric Variables Among the Karbi Women.

Anthropometric variables	20-29 years (N=326)	30-39 years (N=170)	40-49 years (N=104)	Overall (N=600)	F-value	*p*
Weight (kg)	48.14±5.91 (47.50-48.79)	52.14±8.11 (50.91-53.36)	48.90±7.85 (48.83-49.98)	49.41±7.15 (48.83-49.98)	18.77	0.00
Height (m)	1.49±0.05 (1.49-1.50)	1.50±0.05 (1.50-1.51)	1.49±0.06 (1.48-1.51)	1.50 ±0.05 (1.49-1.50)	2.59	0.07
BMI (kg/m^2)	21.59±2.42 (21.33-21.86)	23.07 ±3.45 (22.54-23.59)	21.85±2.71 (21.32-22.38)	22.06±2.87 (21.83-22.29)	15.85	0.001

Values in parentheses indicate 95% CI of mean±standard deviation.

Table 2: Descriptive Tables Showing the Distribution of Socio-economic, Demographic and Lifestyle Variables and Prevalence of Combined Overweight-Obesity (≥23.00 kg/m^2) and Obesity (≥25.00 kg/m^2) Among the Karbi Women.

Variables		Frequency (N=600)	Combined Overweight (≥23.00 kg/m^2) [N=190 (31.67%)]	Obesity (≥25.00 kg/m^2) [N=86 (14.33%)]
Age at the time of interview (years)	20-29	326 (54.33)	83 (25.46)	29 (8.90)
	30-39	170 (28.33)	79 (46.47)	45 (26.47)
	40-49	104 (17.33)	28 (26.92)	12 (11.54)
Family size (Number of Individuals)	≤4	240 (40.00)	62 (25.83)	26 (10.83)
	5-6	214 (35.67)	75 (35.05)	37 (17.29)
	≥ 7	146 (24.33)	53 (36.30)	23 (15.75)
Number of Dependent Children	0-1	204 (34.00)	55 (26.96)	18 (8.82)
	2-3	256 (42.67)	77 (26.96)	41 (16.02)
	≥4	140 (23.33)	58 (41.23)	27 (19.29)
Education	≤8th standard	406 (67.67)	119 (29.31)	47 (11.58)
	≥9th standard	194 (32.33)	71 (36.59)	39 (20.10)
Alcohol Consumption	Never	242 (40.33)	51 (20.07)	19 (7.85)
	Occasional/Regular	358 (59.67)	139 (38.83)	67 (18.72)
Tobacco Use	Never	363 (60.50)	102 (28.10)	47 (12.95)
	Regular	237 (39.50)	88 (37.13)	39 (16.46)
Monthly per-capita income (Indian Rupees or INR)	Rs. <1000	316 (52.67)	89 (28.16)	30 (9.49)
	Rs. ≥1000	284 (47.33)	101 (35.56)	56 (19.72)

*$p<0.05$, **$p<0.01$, Values in parentheses indicates percentage.

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31.67% (Table 2). The age-specific prevalence of overweight and obesity among the women was observed to be higher among the age groups 30-39 years and 40-49 years, respectively. However, lower prevalence of overweight and obesity was noticed among those in the age group 20-29 years. The distribution of socio-economic, demographic and lifestyle variables with the prevalence of combined overweight-obesity and obesity among Karbi women is depicted in Table 2. The prevalence of combined overweight-obesity and obesity was observed to be higher among women of 30-39 years and among those with ≥4 number of dependent children. The prevalence of overweight and obesity were observed to be higher among women who attended education up to ≤8th grade, consumed alcohol, regularly used tobacco and belonged to a higher per-capita monthly income category (≥Rupees 1000).

The results of the BLR analysis showed that in case of combined overweight-obesity, significantly higher odds were observed among the age group 30-39 years (odds: 2.54; $p<0.01$), in case of participants with family size (5-6) (odds 1.55, $p<0.05$) and ≥7 (odds 1.64, $p<0.05$) independently, ≥4 dependent children (1.92, $p<0.01$), those who regularly used tobacco (odds 1.51, $p<0.05$) and occasionally/regularly consumed alcohol (odds 1.87, $p<0.05$). Similarly, the likelihood of obesity increases for participants belonging to the age group 30-39 years (odds: 3.69, $p<0.01$), ≥9th grade education (odds: 1.92, $p<0.01$), and live with 2-3 (odds $p<0.01$), who consumed alcohol occasionally/ regularly (odds: 1.83, $p<0.05$) and fall in the monthly per-capita income category ≥Rupees 1000 (odds 2.34, $p<0.01$) (Table 3).

The results of the step-wise multiple logistic regression analyses (Forward conditional model) were undertaken to determine the most independent socio-economic and demographic predictor variables for combined overweight-obesity (BMI ≥23.00 kg/m^2) and obesity (BMI ≥25.00 kg/m^2) (Table 4). The result of the final model showed that age category 30-39 years (odds 2.25, $p<0.01$), occasional/regular consumption of alcohol (odds 1.68, $p<0.01$) and regular use of tobacco (odds 1.44, $p<0.05$) remain the significant risk factors for combined overweight-obesity. Similarly, the age group 30-39 years (odds 2.95, $p<0.01$), fall in the monthly per- capita income category ≥Rupees 1000 (odds 1.99, $p<0.05$) and live with 2-3 (odds 2.82, $p<0.01$) and ≥ 4 number of dependent children (odds 3.02, $p<0.01$) remain as a significant risk factors for obesity.

DISCUSSION

The increase in the prevalence of excess adiposity (i.e., overweight and obesity) varies across populations and has increased alarmingly during the past two decades with obesity rates being tripled in the developing countries.[26] There has also been a shift in the prevalence of excess adiposity (e.g., obesity) towards poorer socio-economic groups and women.[3-6,8,27] Excess adiposity among women could lead to an increase in obesity during pregnancy, lower the reproductive success, increase infant mortality and the frequency of fetal growth abnormalities and non-communicable diseases (e.g., gestational diabetes, hypertension and cardiovascular diseases).[28-30] Studies reported that the prevalence of gender specific overweight and obesity was observed to be higher among women than men in India.[11,13,14,16,20] The general population trend has shown that the prevalence of overweight and obesity increased slightly over the past decade in the country, but the prevalence rate has increased in urban and

Table 3: Binary Logistic Regression Analysis and Socio-economic, Demographic and Lifestyle Factors Affecting Combined Overweight-Obesity (≥23.00 kg/m^2) and Obesity (≥25.00 kg/m^2) Among the Karbi Women.

Variables		Combined overweight-obesity(≥23.00 kg/m^2) [N=190 (31.67%)]	Obesity (≥25.00 kg/m^2) [N=86 (14.33%)]
		Crude Odds (95%CI)†	Crude Odds (95%CI) †
Age at the time of interview (years)	20-29®	-	-
	30-39	2.54** (1.72-3.76)	3.69** (2.21-6.15)
	40-49	1.08 (0.65-1.78)	1.34 (0.66-2.72)
Family size (Number of Individuals)	≤4®	-	-
	5-6	1.55* (1.04-2.55)	1.72* (1.03-2.95)
	≥7	1.64* (1.05-2.55)	1.54 (0.84-2.81)
Number of Dependent Children	0-1®	-	-
	2-3	1.17 (0.77-1.75)	1.97* (1.10-3.54)
	≥4	1.92** (1.21-3.03)	2.47** (1.30-4.69)
Education	≤8th grade®	-	-
	≥9th grade	1.39 (0.97-2.00)	1.92** (1.21-3.06)
Alcohol Consumption	Never®	-	-
	Occasional/Regular	1.87* (1.31-2.65)	1.83* (1.15-2.94)
Tobacco Use	Never®	-	-
	Regular	1.51* (1.07-2.14)	1.32 (0.84-2.10)
Monthly per-capita income (Indian Rupees or INR)	Rs. <1000®		
	Rs. ≥1000	1.41 (1.00-1.99)	2.34** (1.45-3.77)

®Reference category, *$p<0.05$, **$p<0.01$, CI: Confidence interval,
Values in parentheses indicate the 95% CI of Odds ratio,
† Binary logistic regression analysis considering effect of one explanatory factor (i.e., univariate analysis).

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Table 4: Factors Associated with Combined Overweight-Obesity and Obesity Among the Karbi Women: Stepwise Logistic Multiple Regression.

Variables		Combined Overweight-obesity (≥23.00 kg/m²) [N=190 (31.67%)]			Obesity (≥25.00 kg/m²) [N=86 (14.33%)]		
		Step-1	Step-2	Step-3	Sept-1	Step-2	Step-3
		Odds¶ (95%CI)	Odds¶ (95%CI)	Odds¶ (95%CI)	Odds¶ (95%CI)	Odds¶ (95%CI)	Odds¶ (95%CI)
Age at the time of interview (years)	20-29®		-		-	-	
	30-39	2.54** (1.72-3.76)	2.25** (1.51-3.36)	2.25** (1.50-3.36)	3.69** (2.21-6.15)	3.77** (2.24-6.34)	2.95** (1.72-5.08)
	40-49	1.08 (0.65-1.78)	0.89 (0.53-1.49)	0.88 (0.52-1.48)	1.34 (0.66-2.72)	1.26 (0.61-2.59)	0.95 (0.45-2.02)
Alcohol Consumption	Never®		-	-			
	Occasional/Regular		1.74** (1.20-2.51)	1.68** (1.16-2.44)			
Tobacco Use	Never®						
	Regular			1.44* (1.00-2.06)			
Monthly per-capita income (Indian Rupees or INR)	Rs. <1000®					-	-
	Rs. ≥1000					2.44** (1.50-3.99)	1.99* (1.06-3.72)
Number of Dependent Children	0-1®						-
	2-3						2.82** (1.37-5.83)
	≥4						3.02** (1.80-5.07)

®Reference category *p<0.05, **p<0.01; **p<0.01; CI: Confidence intervals.
Values in parentheses indicate the 95% CI of Odds ratio

in high- socio-economic groups.[5] Therefore, overweight-obesity is becoming a major public health challenge for the healthcare providers and certainly contributes to an ill-health condition in the foreseeable future for the nation.

The present study is probably the first of its kind reporting the prevalence of obesity and its associated risk factors among women belonging to the indigenous Karbi population of Assam, Northeast India. It has been observed that the prevalence of obesity was observed to be slightly lower than that of overweight (14.33% *vs*. 17.33%). The comparison of the prevalence of overweight in the present study was observed to be significantly lower than the Bengalee,[20] Indian urban[31] and Tangkul Naga[11] populations. A lower prevalence of obesity has been reported than the present study among the Bengalee[13] and Kayastha[32] populations. In contrast, the prevalence of overweight was significantly higher than those reported for Indian[33], Rengma Naga[16] and Nyishi tribal[8] women. The prevalence of obesity was observed to be significantly higher than those reported from Tangkul Naga[11] and Nyishi tribal[8] women. Studies have already reported that the existence of population-specific burden of excess adiposity (overweight and obesity) was more likely to occur among women belonging to the high inequality states in India.[3,4,6,27] Such changes in nutritional conditions could be attributed to major shifts in patterns of diet and physical activities occurring over time. Therefore, the population-specific variation in excess adiposity (i.e., obesity) may be due to an improvement of socio-economic status. It may be cause due to the population experiencing a major demographic, socio-economic and nutritional transition at varying rates.[6,34,35] The possible inequalities in their nutritional status are attribute to some segments may have insufficient resources to meet their calorie requirements and/or others have more than enough resources to meet these requirements.[3,4]

The variation in excess adiposity may be attributed to being the complex interaction of genetic factors, physical activity, lifestyle and dietary habits which are related to the socio-economic environment in population.[10,13,16] Several researchers have reported that an increase in the prevalence of obesity is described as an age-related effect.[3,4,13,16,36] In the present study, the BLR and step-wise multiple logistic regression analyses have come up with some interesting observations. It has been observed that the participants who belong to age group (30-39 years) are at significantly greater risk for both combined overweight-obesity and obesity (p<0.01). A similar study among adults belonging to the indigenous Rengma Naga[16] population of Northeast India has shown that individuals belonging to age groups 30-39 years and 40-49 years had significantly greater risks of being obese (p<0.05). Studies have reported that the amount of muscularity begins to decrease and the proportion of adiposity continuously increases with an increase in age.[11,36] The increase in odds relating to overweight and obesity can thus, be related to age-affects on body adiposity.[11,13,16] The increase in overweight and obesity

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among the mid-aged (e.g., 30-39 years) women in the present study could be attributed to the accumulation of body adiposity, increased energy intake, a fat-rich diet and relatively less energy expenditure due to lesser involvement in physical activities and a general modification in lifestyles. Therefore, individuals belonging to the higher age groups are likely to develop a greater risk of adiposity that leads to a higher prevalence of overweight-obesity among adults.

It is evident that the socio-economic development is considered to be the greatest risk factor for excess adiposity among women in the developing countries, including India.[3-5,9,15,16] Studies have indicated significantly higher prevalence being observed in higher socio-economic groups in various developed countries.[4,5,37,38] However, the trend of excess adiposity was also found to be greater among women than men in the developing countries.[3,4,39] The prevalence of obesity is more common among middle-aged individuals belonging to higher socio-economic status and those living in urban-affluent societies.[4,13,34] The results of the regression analysis in the present study showed that individuals belonging to the higher monthly per-capita (INR ≥1000) had two-fold risk for obesity. Similar findings have been reported among Indian adults belonging to the Bengalee Hindu Caste population of West Bengal[13] and indigenous Rengma Naga population of Assam.[16]

Studies on urban adult individuals have reported that education had an inverse effect on excess adiposity.[10,13,15,16,40] Shafique et al[41] reported that the rural women with at least 14 years of education were observed to have an eight-fold increased risk of being overweight as compared to non-educated women in Bangladesh; the result of this study showed greater risk of obesity among women having ≥9 standard education. An earlier study among adult Rengma Naga[16] individuals of Assam had also reported an association of higher education with increased risks of being overweight and obese corroborating the findings of this study. It seems that attainment of higher education and socio-economic status probably leads to more awareness towards nutrition, specific food choices (e.g., high caloric or fat dense) and thus enhanced access to the rich foods leading to excess adiposity within the population. Therefore, further studies need to validate the possible association of detailed dietary intakes and prevalence of excess adiposity in population.

The demographic factor of higher number of dependent children (≥4 number) showed a significant almost 2.5 times and triple risk factor associated with obesity among Karbi women using BLR and step-wise multiple logistic regression analysis, respectively (p<0.01). A similar study of Hossain et al[42] had reported an adverse level of adiposity associated with higher number of ever born children among women of Bangladesh. The results of BLR and step-wise multiple logistic regression analyses also showed that alcohol consumption had a significant higher risk to develop excess adiposity level among the Karbi women, and thus confirming the results of the studies in population.[13,16,40] The results further indicated a significantly higher risk factor in lower adiposity with tobacco use. Although, smoking and excess adiposity (i.e., overweight) are health risk factors, they also appear to be interrelated.[13,15,16] It has also been opined that tobacco users were associated with a lower BMI and cessation was associated with excess adiposity in the form of a substantial increase of regional adiposity in adults.[43] Similarly, in the present study, a significantly greater association between tobacco use and excess adiposity (i.e., combined overweight-obesity) was observed among the women in both BLR and step-wise multiple logistic regression analyses (p<0.05).

CONCLUSION

The present study has reported the prevalence of excess adiposity-related to overweight and obesity among the indigenous Karbi women population of Assam, Northeast India. The prevalence may be related to urbanization, changing dietary habits, sedentary lifestyle and socio-economic status. However, at the moment we do not have any data to substantiate this explanation. The current trend has clearly indicated that a rapid increase of overweight and obesity prevalence, particularly in the vulnerable segments in urban and sub-urban regions requires urgent nutritional interventions. The prevalence of overweight and obesity among Karbi women was observed to be lower as compared to the other populations of India, but reducing such prevalence and associated risk factors require modifying the lifestyle, dietary habits, physical activities and awareness related to the healthy weight management and nutritional status among the Indian women. Although, the cross-sectional design and sample size of the present study represented a difficulty in drawing some major conclusions so as to identify the trends of excess adiposity patterns, the results suggest that increase in age, alcohol consumption, tobacco use, per-capita monthly family income and number of dependent children as major predictive variables are increases the likelihood of the high prevalence of excess adiposity (overweight and obesity). The findings of the present study are important for the effective implementation of any public health programme that needs to be initiated. There appears to be an urgent need to develop suitable health strategies as well as intervention programmes to reduce the prevalence and their subsequent manifestations related to various NCDs among such ethnic populations of Northeast India. The dissemination of adequate nutrition-related knowledge and awareness at the community level could be helpful in reducing the future possibility of increased overweight-obesity prevalence and related consequences of mortalities and morbidities among other ethnic populations of India.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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