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Association between measures of obesity and hypertension in premenopausal urban Bengali women

P. Das[1], A.R. Bandyopadhyay[2] and J.R. Ghosh[3]

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[1]Priyanka Das, Department of Anthropology, UCSTA, University of Calcutta, Kolkata-700019. Email: priyanka_160188@rediffmail.com

[2]Arup Ratan Bandyopadhyay, Department of Anthropology, UCSTA, University of Calcutta, Kolkata-700019. Email: arbaner@rediffmail.com

[3]Jyoti Ratan Ghosh, Department of Anthropology, Vidya-Bhavana, Visva-Bharati, Santiniketan-731235. Email: jrghosh@rediffmail.com

Corresponding Author: Jyoti Ratan Ghosh, Department of Anthropology, Vidya-Bhavana, Visva-Bharati, Santiniketan- 731235, West Bengal, India. Email: jrghosh@rediffmail.com

Measures of obesity and hypertension in premenopausal women

ABSTRACT

Elevated blood pressure is now recognized globally as a major public health burden. The objective of the present study was to understand the associations of obesity measures with blood pressure and hypertension in adult Bengali women of West Bengal, India. The present cross-sectional study includes 450 adult Bengalee premenopausal women. Anthropometric measurement includes height, weight, waist circumference (WC) and hip circumference. Systolic (SBP) and diastolic (DBP) blood pressures were obtained. Body mass index and waist hip ration were calculated. Statistical analysis includes correlation, linear and logistic regression. There was a significant positive correlation of anthropometric variables with both blood pressures. WC explained 12% and 14% of variance of SBP and DBP, respectively. However, logistic regression analysis revealed that overweight and obese women were more than three times (OR, 3.24) more likely to be hypertensive than those who were normal weight.

Key Words: *Anthropometry, blood pressure, Bengali, female, obesity*

INTRODUCTION

Globally hypertension is one of the leading causes of cardiovascular morbidity and mortality (Benjamin *et al.,* 2018). High blood pressure is a major independent risk factor for the development of coronary artery disease (CAD), stroke, and renal failure (Rosendorff *et al.,* 2007). Raised blood pressure is estimated to have caused 9.4 million deaths and 7% of disease burden – as measured in DALYs – in 2010 (WHO, 2014). The global prevalence of high blood pressure in adults aged 18 years and over was around 22% in 2014 (WHO, 2014).Though there are several factors associated with high blood pressure (Schall, 1995; Mungreiphy *et al.,* 2011; Chowdhury and Roy, 2016), obesity has long been recognized as strongly linked with high blood pressure (Cassani *et al.,* 2009). In a recent study Anwar *et al.,* (2019) also demonstrated a stronger association of BMI with hypertension among Omnai adults. In another study among adult males living in Porto Alegre, it revealed that waist circumference (WC) was more effective than body mass index (BMI) for predicting the incidence of hypertension (Gus *et al.,* 2004). Study in Ethiopia (Wai *et al.,* 2012) also reported that SBP (systolic blood pressure) was most strongly associated with WC in women. Similarly, study in elderly citizens in Dhaka (Moni *et al.,* 2010) showed a higher tendency of being hypertensive with high WC and waist hip ratio (WHR). It was also observed that the number of persons with hypertension was higher in low and middle income countries compared to high income countries (WHO, 2013). A north Indian study demonstrated that increasing age, BMI and central obesity were significantly associated with both hypertension and pre-hypertension (Yadav *et al.,* 2008). Study in central India (Desmukh *et al.,* 2006) also showed that both BMI and WC had strong correlation with SBP and DBP (Diastolic blood pressure). Study also demonstrated that the prevalence of hypertension significantly varies with ethnicity (Chowdhury and Roy, 2016) and gender (Schall, 1995; Gupta and Kapoor, 2010; Anwar *et al.,* 2019). As female are the carriers of future generation so it is very important to give attention to their health and health seeking behaviors (Gudmundsdottir *et al.,* 2012). However, the literature review revealed that limited number of studies (Ghosh and Bandyopadhyay, 2007; Chakraborty *et al.,* 2009; Ghosh and Bandyopadhyay, 2013; Chowdhury and Roy, 2016; Suman *et al.,* 2018) has been done in West Bengal to understand the associations between obesity and hypertension, especially in Adult women. So in view of the above present study aims to understand the associations of obesity measures with blood pressure and hypertension in adult Bengali women of West Bengal, India.

MATERIALS AND METHODS

A cross sectional study was carried out among adult Bengali Hindu women from in and around Kolkata, West Bengal, India. A total of 450 healthy adult (32.02±8.06 years) premenopausal women were participated in this study. All participants were asked to complete a questionnaire that included specific information on age and menopausal status. Anthropometric measurements like height, weight, circumferences {WC and hip circumference (HC)} and blood pressures (SBP and DBP) were taken on all participants using standard techniques (Weiner and Lourie, 1981). Height and weight were measured to the nearest 0.1 cm and 0.1 kg respectively. WC and HC were measured to the nearest 0.1 cm by using non elastic steel tape. All the measurements were taken by the same investigator to avoid inter-observer error. Indices such as BMI, and WHR were then calculated using standard equation BMI (kg/m^2) = weight (kg) / height (m^2), WHR = WC (cm)/HC (cm). BMI was further categories using WHO (2004) cut-off i.e. normal (18.5-24.9 kg/m^2), overweight (25.00-29.99kg/m^2), and obese ($\geq$30.00kg/m^2). For present study overweight and obese groups were combined and thus two categories were used; normal (18.5 to 24.9 kg/m^2) and overweight and obese ($\geq$25 kg/m^2). WC and WHR were categories using the cut-off of 80cm and 0.85, respectively (WHO, 2008). Physiological variables e.g. SBP and DBP were measured using Omron blood pressure monitor strictly following instructional manual. Pregnant women, women on hormone therapy, under medication and with chronic disease were not considered for present study. Informed written consent was obtained from each participant. Ethical clearance for the study was obtained from the Institutional Ethics Committee, University of Calcutta. Statistical analysis includes partial correlation, linear and logistic regression and were performed using Statistical Package for Social Sciences (SPSS, Version 16.0). A *p*-value of < 0.05 was considered as significant.

RESULTS

Characteristics of the studied population are represented in Table 1. It shows that the mean age of the participants is 32.02±8.06 years. However, the prevalence of hypertension in the studied population was 21.8%. Partial correlation (controlling for age) analysis of obesity measures with blood pressures are presented in table 2. It shows that all obesity measures (WC, HC, BMI and WHR) are significantly and positively correlated with both SBP and DBP. The result also revealed

strongest correlation of WC with both SBP (r=0.302, *p<0.01*) and DBP (r=0.342, *p<0.01*) followed by BMI with SBP (r=0.263, *p<0.01)* and DBP (r=0.343, *p<0.01*). The results (table 3) of linear regression analysis of obesity measures with blood pressure demonstrated that all anthropometric variables are significant predictor of both SBP and DBP. It revealed that WC explained 12% and 14% of variance of SBP and DBP, respectively. Logistic regression analysis of obesity measures with hypertension is presented in table 4. Hypertension showed the strongest association with overweight and obesity (BMI ≥25.00 kg/m^2) with an odds ratio (OR) of 3.242 ($p<0.05$) followed by central obesity (WC ≥ 80cm), OR 1.478 ($p<0.05$).

DISCUSSION

Obesity, a disorder characterized by extensive fat accumulation, which is distributed in such a way that health and wellbeing are affected (Mohammad, 2011). Obesity is increasing rapidly through the World. World Health Organization estimated that more than 1.9 billion adults were overweight in 2016, and that more than 650 million were obese (WHO, 2019). Obesity can be measured by different anthropometric measurements and indices (Wang *et al.,* 2018; Ghosh and Bandyopadhyay, 2007). However, there has been an increasing interest over which measure of obesity predicts hypertension better, as the results of previous studies on this remain controversial. In a study Feng *et al.,* (2012) demonstrated that BMI was more strongly associated with hypertension than WC in Chinese adults. Dutra *et al*., (2018) showed a stronger correlation between WC and blood pressure compared to WHR in sarcopenic obese women. Wu *et al.,* (2018) demonstrated that WHR was more strongly associated with hypertension in young women. But, in middle-aged women BMI was better in association with hypertension. Khashayar *et al*. (2017) in a recent study in Iranian population found that general obesity rather than abdominal obesity was directly linked with higher blood pressure levels. In view of the above present study was undertaken to find out the associations of different obesity measures with blood pressure and hypertension in adult Bengali women of West Bengal, India.

The prevalence of hypertension in the studied population was 21.8%, which was higher than the recently published studies by Thapliyal *et al*., (2018) (9.7%) and Nahimana *et al*., (2017) (14.4%). Compared to the present study, a higher prevalence of hypertension was observed in adult women of Namibia (46.0%) (Craig *et al*., 2018) and Korea (30.8%) (Choi *et al*., 2017). However,

Prabhakaran *et al.* (2017) reported that 26.8% of women were hypertensive at baseline in their study population. The result also revealed that all obesity measures were significantly and positively correlated with both blood pressures. However, the strongest association of both SBP and DBP was with WC. Similar positive association of obesity measures with blood pressures were also observed in other studies (Zhang *et al.,* 2013; Ononamadu *et al*., 2017; Suman *et al.*,2018; Anwar *et al*.,2019). In accordance with the present study, WC was not only the significant independent predictor of blood pressures (Cassani *et al.,* 2009) but was also the best screening measure for cardiovascular risk factor, compared to BMI and other obesity measures (Esmaillzadeh *et al.,* 2006). Interestingly, logistic regression analysis revealed that overweight and obese women (BMI ≥25kg/m^2) were more than three times (3.24) more likely to be hypertensive than those who were normal weight. Contrary to that, centrally obese women (WC ≥80cm) were 1.48 times more likely to be hypertensive than centrally non obese women. Leenen *et al*. (2010) also observed similar higher risk for developing hypertension among overweight and obese adults in Ontario population. Higher odd ratios for hypertension in obese compared to lean subjects were also reported by Redon *et al*. (2008).The stronger association between BMI and hypertension in the present study might be due to the fact that an increase in BMI was associated with increase peripheral resistance, body fluid volume and cardiac output (Tuan *et al.,* 2010; Naqib *et al*., 2018). In conclusion, the present cross-sectional study allows us to demonstrate the association between obesity measures and blood pressure in adult women. Further studies with larger samples to determine cut-off values of obesity measures are needed.

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Table 1. Characteristic of studied population

Variables	Mean	SD
Age (year)	32.02	8.06
Height (cm) (HT)	151.55	5.61
Weight (kg) (WT)	60.53	11.10
Waist circumference (cm) (WC)	76.38	9.10
Hip circumference (cm) (HC)	92.76	9.55
Body Mass Index (kg/m^2) (BMI)	26.33	4.76
Waist-hip ratio (WHR)	0.83	0.07
Systolic Blood Pressure (SBP) (mmHg)	118.72	16.49
Diastolic Blood Pressure (DBP) (mmHg)	80.79	10.98

Table 2. Partial correlation (controlling for age) of obesity measures with blood pressure

Variables	SBP (mmHg)		DBP (mmHg)	
	r	***p***	**r**	***p***
Waist circumference (cm)	0.302	p<0.01	0.342	p<0.01
Hip circumference (cm)	0.194	p<0.01	0.250	p<0.01
BMI (kg/m^2)	0.263	p<0.01	0.343	p<0.01
Waist-hip ratio	0.179	p<0.01	0.167	p<0.01

Table 3. Linear regression analysis of obesity measures with blood pressure

Variables		***R²***	***t***	***P***
SBP	WC (cm)	0.12	8.01	<0.01
	HC (cm)	0.04	4.32	<0.01
	BMI (kg/m^2)	0.08	6.31	<0.01
	WHR	0.06	5.47	<0.01
DBP	WC (cm)	0.14	8.69	<0.01
	HC (cm)	0.06	5.58	<0.01
	BMI (kg/m^2)	0.12	8.14	<0.01
	WHR	0.04	4.80	<0.01

Table 4. Logistic regression analysis of obesity measure with hypertension

Variables		**OR**	***p***
WC (cm)	<80cm	Reference	
	≥80cm	1.478(0.759-2.879)	<0.05
HC (cm)		1.009(0.972-1.048)	>0.05
BMI (kg/m^2)	<24.99 kg/m^2	Reference	
	≥25.00 kg/m^2	3.242(1.548-6.789)	<0.05
WHR	<0.85	Reference	
	≥0.85	1.324(0.706-2.483)	>0.05