Prevalence of hypertension in people living in coastal areas of Bangladesh

M. Abu Sayeed[1], AH Syedur Rahman[2], Md. Hazrat Ali[2], Subrina Afrin[2], Mir Masudur Rhaman[1], Mohammad Mainul Hasan Chowdhury[3] and Akhter Banu[4]

[1]Department of Community Medicine, Ibrahim Medical College (IMC), Dhaka; [2]Department of Ophthalmology, Bangladesh Institute of Research and Rehabilitation in Diabetes and Endocrine Metabolic Disorders (BIRDEM); [3]Internal Medicine, Bangobandhu Sheikh Mujib Medical University (BSMMU); [4]Akhter Banu, Institute of Nutrition and Food Science (INFS), University of Dhaka

Abstract

The prevalence of hypertension was reported higher in the coastal areas in different populations of the world. There was no study on the prevalence of hypertension among the coastal people in Bangladesh. This study addressed the prevalence and risk of hypertension among people living in the coastal areas of Bangladesh.

Total 32 different coastal communities were selected purposively in the six coastal districts (Barisal, Borguna, Vola, Pirojpur, Potuakhali and Jhalukathi) of Bangladesh. All people over 18 years were considered eligible. Social, clinical and family histories were taken. Height, weight, waist- and hip-girths were measured including systolic and diastolic blood pressure (SBP and DBP). Fasting blood glucose and lipids were also estimated. The accepted cut offs for systolic hypertension (sHTN) was ≥135mmHg and diastolic hypertension (dHTN) was ≥85 mmHg.

Overall, 7058 (m / f = 2631 / 4427) people volunteered to participate in the study. The crude prevalence of sHTN was 17.8% [95% CI, 17.39 – 18.21] and dHTN was 19.0% [95% CI 18.08 – 19.92]. Compared to female, the male participants had higher prevalence of both sHTN (16.4 v. 20.2 %, $p<0.001$) and dHTN (17.4 v. 21.5%, $p<0.001$). The prevalence rates of sHTN were 14.6, 18.5 and 24.6% in the poor, the middle and in the rich class, respectively ($p<0.001$). Similar trend was observed with dHTN. Both types of HTN increased with increasing age ($p<0.001$), BMI ($p<0.001$), WHR ($p<0.001$) and WHtR ($p<0.001$). Logistic regression analyses proved that the participants of higher social class, of advancing age and with higher obesity had excess risk of hypertension. Positive family history of HTN, DM and stroke had also increased risk for HTN.

We found higher prevalence of HTN in Bangladeshi coastal population compared to people living in other areas of Bangladesh. Family history of DM, HTN and stroke were significantly related to sHTN and dHTN. Increasing age, higher obesity and higher social class had excess risk for developing HTN. Further study may be undertaken to address other unexplored risks like physical inactivity, unhealthy diet or psychosocial stress affecting the coastal people. Salt content of water and food consumed by these people should also be investigated.

Ibrahim Med. Coll. J. 2015; 9(1): 11-17

Introduction

The people living adjacent to sea shore are likely to be exposed to high salt (sodium chloride) intake. This may be due to consumption of drinking water containing salt exceeding the recommended limits. In addition, local agricultural products like cereals, fruits, vegetables and sea food may have excess salt content

Address for Correspondence:

Prof. M. Abu Sayeed, Department of Community Medicine, Ibrahim Medical College, 122 Kazi Nazrul Islam Avenue, Shahbag, Dhaka-1000. email: sayeed@imc.ac.bd

which may contribute further to high salt intake.[1] In china, about one-fifth of the coast people have hypertension, which has been increasing in both men and women.[2] An increased morbidity related to vascular damage in pre-hypertensive and hypertensive people was found in the coastal areas of Fujian province.[3] A recent study in Bangladesh reported the prevalence of pre-hypertension and hypertension in rural community as 31.9% and 16.0%, respectively among the adults of age 25 years or more.[4] Again, hypertension was found higher in the higher socio-economic (affluent) than in the non-affluent class irrespective of geographical locations.[5] The prevalence of hypertension has been increasing in Iran,[6] Taiwan[7] and in 6 European countries, Canada, and the United States.[8] So, the global burden of hypertension and its relation to cardio-vascular morbidity and mortality is of great concern.[9] Even more concern is that *high normal* blood pressure has been related to cardiovascular risk.[10] A meta-analysis of randomized trial reported that an early detection of hypertension and intervention by blood pressure-lowering agent maintaining baseline level proved to be beneficial.[11] However, there was no study on the prevalence of hypertension in the population of coastal area of Bangladesh adjoining Bay of Bengal. This study addressed the prevalence of hypertension and the risks related to hypertension among the people living in the coastal areas of Bangladesh.

Study design

The study protocol was approved by the Ethical Review Committee of the Bangladesh Diabetes Association (BADAS).

The study was conducted in 32 communities scattered in the six coastal districts of Bangladesh adjoining Bay of Bengal. The districts were Barisal, Barguna, Bhola, Pirojpur, Patuakhali and Jhalokhati. The investigation sites were sixteen secondary schools, five primary schools, five Madrasahs (religious schools), four Union Councils (UC) and two colleges in different communities (Fig 1 & 2). The community participation was ensured involving the elected members of the local government body of UCs and social and religious leaders. The teachers and students of academic and religious institutes were also involved. The local leaders, the teachers and the students were discussed about the proposed study. They were informed about the objectives and the procedural details of the investigations. These people helped to prepare the list of the interested individuals. All interested individuals of age 18 years or above were considered eligible. Then, informed consent was taken from those who agreed to participate in the study. They were advised to attend a specified venue in the next morning with an overnight fast. On arrival in the next morning, according to the list, each participant was interviewed about occupation, education, income, illness and medication. Family history of hypertension (HTN), diabetes mellitus (DM), stroke and coronary heart diseases (CHD) was also taken.

After the interview, height, weight, and waist - and hip-girth were measured with light clothes and without shoes. The weighing tools (stadiometer) were calibrated daily by known standard weight. For height, the subject stood erect keeping the occiput, back, hip, and heels touching the wall behind, while gazing in front with the tragus and lateral orbital margin in the same horizontal plane. Waist-girth was measured by placing a plastic tape horizontally mid-way between 12th rib and iliac crest in the mid-axillary line and the umbilicus

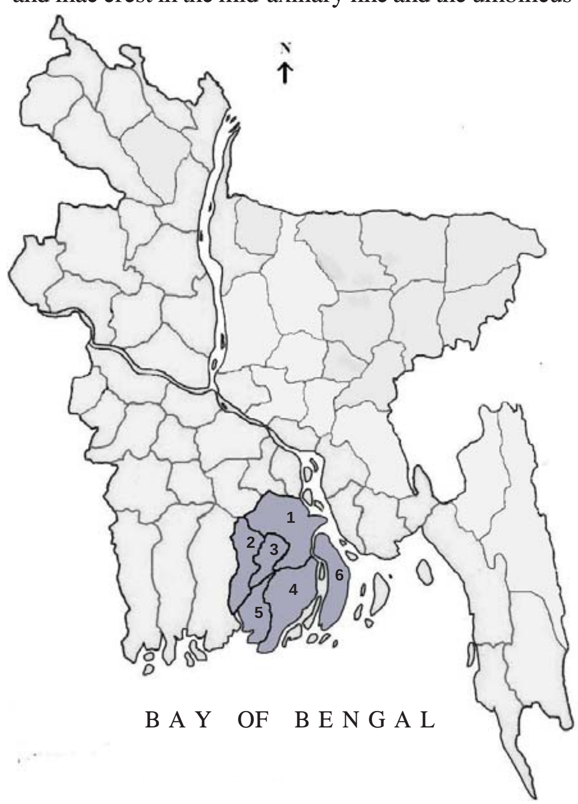

Fig.1: *Map of Bangladesh showing the location of six coastal districts included in the study.*
Note: *1–Barisal, 2–Pirojpur, 3–Jhalokhati, 4–Patuakhali, 5–Barguna, 6–Bhola*

Fig.2: *Map showing the study sites in each coastal district. Each Dot (●) indicates location of study site.*

in front. Similarly, hip-girth was measured by taking the extreme end posteriorly and the symphysis pubis anteriorly. Body mass index was calculated (BMI = weight in kg/height in met sq). Waist-to-hip (WHR) and waist-to-height (WHtR) ratios were measured for the assessment of central obesity.

Blood pressure was taken after 10 min rest with standard cuff, fitted with mercury sphygmomanometer while the participant sitting face to face and talking comfortably with relax mood. A mean of the two measures was accepted. The cut-off values for systolic and diastolic hypertension (sHTN, dHTN) were >135 and >85mmHg, respectively.

Taking an aseptic measure five ml of fasting blood sample was collected for estimation of fasting blood glucose (FBG mmol/l) and lipids (total cholesterol [T-chol], triglycerides [TG], low-density lipoprotein [LDL], high-density lipoproteins [HDL]. The collected samples were transported in an iced chamber and stored at -20^{0}C. Finally, all biochemical tests were carried out in BIRDEM central Laboratory. Plasma glucose was measured by glucose oxidase-peroxidase method using Technicon M-II auto-analyzer. To reduce the cost, a randomized sample was drawn (n=300) for the estimation of Chol, TG and HDL by auto-analyzer (Hitachi-704) using enzymatic method. The coefficient of variation (CV) was allowed ≤5%.

Statistical analyses

The biophysical characteristics (mean with standard deviation) were compared between participants with and without hypertension (both sHTN, dHTN). The *Chi-sq* test estimated the association of hypertension with age-groups, sex, social class and obesity. Logistic regression estimated the effect of risk factors (sex, age, income, BMI, WHR and WHtR) in different models with different combinations taking sHTN and dHTN as dependent variables. Family history of HTN was also included in the models. The quantitative variables (age, BMI, WHR, WHtR) were transformed into quartiles (Q1, Q2, Q3, Q4) and entered in the regression analyses where the Q1 was taken as a reference category. All statistical tests were considered significant at a level of ≤5%. SPSS version 20.0 was used.

Results

Eight thousand five hundred individuals were invited to participate in the study, and 7058 (m / f =2631 / 4427) finally volunteered to participate. The response rate was 83%.

Biophysical characteristics were compared between subjects with and without hypertension. Compared with the non-sHTN (SBP: <135 vs. ≥135 mmHg) the participants with sHTN had significantly higher age ($p<0.001$), higher obesity (BMI, WHR, WHtR for all $p<0.001$) and higher FBG ($p<0.001$). There was no significant difference for T-chol, TG, HDL and LDL [table 1]. Likewise, compared with the non-dHTN (DBP: <85 vs. ≥85 mmHg) the participants with dHTN had significantly higher age and higher obesity though no difference was observed in lipids (table not shown).

Table-1: *Prevalence (%) of systolic and diastolic hypertension (sHTN, dHTN) of the study population according to sex and social class*

Characteristics	n	sHTN % (95% CI)	dHTN % (95% CI)
Sex			
Total	7058	17.8 (16.91–18.69)	19.0 (18.08 – 19.92)
Men	2631	20.2 (18.61–23.79)	21.5 (19.93–23.07)
Women	4427	16.4 (15.31–17.49)	17.4 (16.28–18.52)
Social class			
Poor	3035	14.6 (13.34–15.86)	14.3 (13.05–15.55)
Middle	2826	18.5 (17.07–19.93)	20.6 (19.11–22.09)
Rich	1047	24.6 (21.99–27.21)	27.6 (24.89–30.31)

Chi-sq tests: men vs. women, p<0.001;
Social class comparison, for all p<0.001.

Table-2: *Comparisons between non-hypertensive (non-sHTN: SBP<135mmHg) and hypertensive (sHTN: SBP ≥135mmHg) study participants based on systolic blood pressure.*

Characteristics	Non-sHTN (n=5801)		sHTN (n=1257)		p
	Mean	SD	Mean	SD	
Age (y)	41.6	14.6	53.9	13.3	<0.001
BMI	22.1	3.8	23.4	4.2	<0.001
WHR	0.86	0.07	0.91	0.08	<0.001
WHTR	0.47	0.06	0.51	0.07	<0.001
FBG (mmol/l)	5.14	1.96	5.9	2.6	<0.001
CHOL (mg/dl)†	205	61	210	65	ns
TG (mg/dl)†	160	96	163	111	ns
HDL (mg/dl)†	43.6	10.6	45.2	11.4	ns
LDL (mg/dl) †	129	53	133	57	ns

†- comparisons were made on the randomized sample of 137 from non-sHTN and 87 from sHTN groups.

The prevalence of sHTN was 17.8 with 95% CI, 16.89 – 18.71 and dHTN was 19% with 95% CI, 18.07 – 19.93. Compared with the women the men had significantly higher prevalence of both sHTN (16.4 vs. 20.2%, $p<0.001$) and dHTN (17.4 vs. 21.5%, $p<0.001$) [table 2]. Regarding the social class comparison, compared with the poor, the middle and the rich had higher prevalence for both (sHTN 14.6, 18.5 and 24.6%, $p<0.001$; dHTN 14.3, 20.6 and 27.6%, $p<0.001$) [table 2].

The risk variables like age, BMI, WHR and WHtR were categorized into quartiles to estimate the association of both sHTN and dHTN with higher quartiles of age, BMI, WHR and WHtR [table 3]. Both the prevalence of sHTN and dHTN increased consistently and significantly with the higher quartiles of age, BMI, WHR and WHtR [table 3].

Binary logistic regression analysis quantified the effect of individual risk factor (sex, social class, family-history, age, BMI, WHR, WHtR) on hypertension. The analyses included sHTN and dHTN as dependent variables separately. The risk factors were entered into the equation as the independent variables in different combination of different models (model 1-4). Model 1 included sex, family history of hypertension and social class; Age quartiles were added to model

Table-3: *Prevalence (%) of sHTN and dHTN according to quartile (Q1 – Q4) of age, BMI, WHR and WHtR*

	Age		BMI		WHR		WHtR	
Quartiles	**sHTN**	**dHTN**	**sHTN**	**dHTN**	**sHTN**	**dHTN**	**sHTN**	**dHTN**
Q1	2.9	6.7	12.4	11.1	8.1	9.3	8.9	9.5
Q2	11.1	17.4	14.1	14.2	12.7	13.9	15.1	15.6
Q3	23.6	25.0	19.5	21.4	21.7	23.1	18.7	20.2
Q4	35.1	27.1	25.1	28.7	28.9	30.0	28.5	30.3
Chi Sq	681	290	118	211	310	296	243	262
P	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*

sHTN, ststolic hypertension; dHTN, diastolic hypertension; BMI, body mass index; WHR, waist-to-hip ratio; WHtR, waist-to-height ratio.
Q1 – Q4: Age <30y, – 40y, – 55y, >55y); BMI: <19.5, – 22.0, – 24.9, >24.9; WHR: <0.82, – 0.88, – 0.93, >0.93; WHtR: <0.43, – 0.48, – 0.53, >0.53.

Table-4: *Logistic regression taking systolic hypertension as a dependent and other risk variables as independent variables in four different models in different combinations.*

	Model 1		Model 2		Model 3		Model 4	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Sex: f=1, m=2	1.25	1.09 - 1.42	0.88	0.76 - 1.02	0.88	0.77 - 1.02	0.99	0.86 - 1.15
FHHTN: No=1, yes=2	1.82	1.59 - 2.07	1.82	1.58 - 2.10	1.82	1.58 - 2.10	1.89	1.64 - 2.17
Social class								
Poor	1	-	1	-	1	-	1	-
Middle	1.17	1.02 - 1.35	1.18	1.01 - 1.38	1.18	1.01 - 1.38	1.19	1.02 - 1.40
Rich	1.53	1.28 - 1.84	1.24	1.01 - 1.52	1.24	1.01 - 1.52	1.26	1.04 - 1.55
Age								
Q1			1	-	1		1	-
Q2			3.63	2.68 - 5.04	3.67	2.68 - 5.04	3.37	2.45 - 4.63
Q3			9.67	7.13 - 12.95	9.61	7.13 - 12.9	8.29	6.14 - 11.2
Q4			20.5	15.4 - 28.3	20.9	15.5 - 28.4	16.6	12.3 - 22.5
BMI								
Q1					1	-		
Q2					1.24	1.00 - 1.53		
Q3					1.76	1.43 - 2.16		
Q4					2.54	2.06 - 3.13		
WHtR								
Q1							1	-
Q2							1.63	1.31 - 2.05
Q3							1.92	1.54 - 2.39
Q4							2.86	2.30 - 3.56

CI, confidence interval; OR, odds ratio; FHHTN, family history of hypertension; Q1, Q2, Q3 & Q4, quartile 1 through quartile 4 for age, body mass index (BMI) and waist-to-height ratio (WHtR), Q1 was taken as reference category. Model 1 included sex, family history of hypertension and social class; to this age quartiles were added to model 2; BMI and WHtR quartiles were added to model 3 and 4, respectively.

2; BMI and WHtR quartiles were added to model 3 and 4, respectively. Considering all the models, family history of hypertension, higher social class, advancing age and increasing obesity were found to have excess risk for systolic hypertension. The increasing WHtR was proved to be an important obesity indicator, which profoundly reduced the effect of higher age (model 3 vs. 4); whereas, the increasing BMI, an indicator for general obesity had no such effect on age for developing sHTN. The findings of logistic regression taking sHTN as a dependent variable were found almost similar to dHTN (Table not shown).

Discussion

This epidemiologic study on HTN in a coastal area of Bay of Bengal is the first of its kind in Bangladesh. It was conducted in 32 communities widely spread over different geographical sites in six coastal districts. These areas are separated by estuaries and not easily accessible. The investigation team had to travel by boat from one place to the other crossing the estuaries of rivers. Sometimes, the river and the sea turned so rough due to adverse weather that the team used to postpone scheduled program. However, the coastal people were cooperative and did extend their help in all respects. They helped organizing the reception and maintaining discipline of the participants at the venues.

The response rate was satisfactory (80.2%). The prevalence of hypertension in the coastal population is higher (19%) than that of rural (16.8%) and urban (11.3%) native Bangladeshis.[4,5] It is lower than the Chinese study,[2,3] which reported an increasing trend over time. In China, the observed prevalence of hypertension was 9.8% in the 1980s, 18.5% in the 1990s and 30.0% in the 2000s. We have no previous report. Hence, it is not possible to assess the trend in the study population. Yadav *et.al* observed a higher prevalence of hypertension (32.2%) in India,[12] but the study participants were affluent people and older (age ≥30y). Another Indian study by Anchala *et.al*[13] that included population from different areas reported prevalence of hypertension similar to this study.

Regarding risk factors, usually, hypertension is more prevalent in men than women.[14] In the present study we also found that the prevalence was significantly higher in men than in women ($p<0.001$; table 2). But employing logistic regression it was found that both sexes had equal risk. As regards the comparisons of socio-economic classes our findings showed that higher social class had excess risk for hypertension which was consistent with other studies.[4-7,12,13,15] Advancing age and central obesity (higher WHR, WHtR) were also found to be significantly related to hypertension. This finding is consistent with other studies.[5,6,10,12] Interestingly, central obesity (higher WHtR) but not general obesity (higher BMI) was proved again to be the significant predictor for hypertension.[16]

The study had some limitations. The determination of accurate age was difficult. Most of the participants did not know their date of birth. The age of the participant was approximated based on some national political and / or historical events like liberation war of Bangladesh and worst disasters faced by the coastal people. We could not also assess the grading of physical activities due to different types of lifestyle and occupational heterogeneity. Furthermore, we had to abandon the history taking on dietary habit – firstly, because of diversity in different communities and secondly, it was a time consuming exercise. Again, it would have been better if we could have estimated the salt content of the local drinking water and the locally produced food products.

Conclusions

The prevalence of both systolic and diastolic hypertension was higher among the coastal population of Bangladesh. Higher age, higher obesity and higher social class had excess risk for developing HTN. The participants with known family history of DM, HTN, CHD and stroke had increased risk for both sHTN and dHTN. Further study may be undertaken to address other unexplored risks like physical inactivity, unhealthy diet or psychosocial stress affecting the coastal people. Excess salinity of water and food may also be considered as an important variable for investigation.

Acknowledgements

We are indebted to The Fred Hollows Foundation (FHF) for the financial support. We are grateful to the Principal of Barisal Medical College for making arrangements of temporary laboratory room in his college premises. We acknowledge the help extended by the leaders, the teachers, students and the participants of coastal communities. We appreciate the cooperation and support given by the authority of the Ibrahim Medical College and the Department of Community Medicine, Ibrahim Medical College.

References

1. Khan AE, Ireson A, Kovats S, Mojumder SK, Khusru A, Rahman A, Vineis P. Drinking Water Salinity and Maternal Health in Coastal Bangladesh: Implications of Climate Change. *Environ Health Perspect* 2011; **119**(9): 1328–1332
2. Chen X, Wei W, Zou S, Wu X, Zhou B, Fu L, Wang H, Shi J. Trends in the prevalence of hypertension in island and coastal areas of china: a systematic review with meta-analysis. *Am J Hypertens* 2014; **27**: 1503-10.
3. Huang F, Zhu PL, Xiao HZ, Lin F, Yuan Y, Gao ZH, Li JW, Chen FL. Cardiovascular disease risk and vascular damage status in pre- and hypertension population in coastal areas of Fujian province. *Zhonghua Xin Xue Guan Bing Za Zhi* 2013; **41**(10): 876-81.
4. Khanam MA, Lindeboom W, Razzaque A, Niessen L, Milton AH. Prevalence and determinants of pre-hypertension and hypertension among the adults in rural Bangladesh: findings from a community-based study. *BMC Public Health* 2015; **15**: 203.
5. Sayeed MA, Banu A, Khanam PA, Mahtab H and Azad Khan AK. Prevalence of Hypertension in Bangladesh: effect of socioeconomic risk on difference between rural and urban community. *Bang Med Res Coun Bull* 2002; **28**(1): 7-18.
6. Khosravi A, Emamian MH, Shariati M, Hashemi H, Fotouhi A. The prevalence of pre-hypertension and hypertension in an Iranian urban population. *High Blood Press Cardiovasc Prev* 2014; **21**(2): 127–35.
7. Tsai PS, Ke TL, Huang CJ, Tsai JC, Chen PL, Wang SY, *et al*. Prevalence and determinants of prehypertension status in the Taiwanese general population. *J Hypertens* 2005; **23**(7): 1355–60.
8. Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, *et al*. Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. *JAMA* 2003; **289**(18): 2363–9.
9. Danaei G, Finucane MM, Lin JK, Singh GM, Paciorek CJ, Cowan MJ, Farzadfar F, Stevens GA, Lim SS, Riley LM, Ezzati M. Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Blood Pressure). National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5·4 million participants. *Lancet* 2011; **377**(9765): 568-77.
10. Vasan RS, Larson MG, Leip EP, Evans JC, O'Donnell CJ, Kannel WB, *et al*. Impact of high-normal blood pressure on the risk of cardiovascular disease. *N Engl J Med* 2001; **345**(18): 1291–7.
11. Czernichow S, Zanchetti A, Turnbull F, Barzi F, Ninomiya T, Kengne AP, *et al*. The effects of blood pressure reduction and of different blood pressure-lowering regimens on major cardiovascular events according to baseline blood pressure: meta-analysis of randomized trials. *J Hypertens* 2011; **29**(1): 4–16.
12. Yadav S, Boddula R, Genitta G, Bhatia V, Bansal B, Kongara S, Julka S, Kumar A, Singh HK, Ramesh V, Bhatia E. Prevalence & risk factors of pre-hypertension & hypertension in an affluent north Indian population. *Indian J Med Res* 2008; **128**(6): 712-20.
13. Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, Prabhakaran D. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens* 2014; **32**(6): 1170-7.
14. Maric-Bilkan C, Manigrasso MB. Sex differences in hypertension: contribution of the renin-angiotensin system. Gend Med. 2012;9(4):287–91.
15. Sampson UK, Edwards TL, Jahangir E, Munro H, Wariboko M, Wassef MG, Fazio S, Mensah GA, Kabagambe EK, Blot WJ, Lipworth L. Factors associated with the prevalence of hypertension in the southeastern United States: insights from 69,211 blacks and whites in the Southern Community Cohort Study. *Circ Cardiovasc Qual Outcomes* 2014; **7**(1): 33-54.
16. Sayeed MA, Mahtab H, Latif ZA, Khanam PA, Ahsan KA, Banu A, and Azad Khan AK. Waist-to-height ratio is a better obesity index than body mass index and waist-to-hip ratio for predicting diabetes, hypertension and lipidemia. *Bang Med Res Coun Bull* 2003; **29**(1): 1-10.