Original Article

Body Fat Distribution and Metabolic Syndrome in Bangladeshi Urban Adults

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Abstract

Background : Metabolic syndrome patients are having increased risk of developing into cardiovascular diseases & diabetes in their later life.

Objective : To determine the risk factors of metabolic syndrome and to identify the most potential risk factor that helps in early diagnosis of metabolic syndrome and prevention of Coronary Heart Disease (CHD), diabetes by early intervention.

Methods : A case control study was carried out during March-December 2011. The purposive sampling method with face to face interview using questionnaire, measurement tools were applied among 48 diagnosed metabolic syndrome patients in national Heart Foundation Hospital, Dhaka & 47 healthy controls in Shaheed Shaikh Abu Naser Hospital, Khulna in the study. Metabolic syndrome patients were confirmed according to NCEP ATP III criteria. Body fat distribution was measured and waist to height ratio (WHtR), Body mass index (BMI),wasit to hip ratio (WHR) was used as the markers of body fat distribution. Unadjusted odds ration was generated for all the variables with 95% confidence interval and only significant factors were considered as candidate for multivariate analysis. A binary logistic regression model was generated to assess risk factor of metabolic syndrome in comparison to non metabolic syndrome control adjusting for possible confounders. The statistical analysis was performed with SPSS 16 version.

Results : Among the participants significant increased risk of metabolic syndrome was evident in increased WHtR (OR 420.3, 6.3 -27664.0), increased WHR (OR 155.5. 3.8 -6338.9), increased BMI (OR 53.1, 2.5-1119.0), increased age > 50 years (OR 44.0, 1.5-1225.8), doing low level of physical activity (PAL) (OR 35.4, 1.5-788.7) and inadequate fruits and vegetables in diet (OR 576.8, 7.0- 47185.0. Among the anthropometric risk factors WHtR appeared as an independent and highest risk for metabolic syndrome with an odds ratio of 420.3 which was statistically significant. Area under the receiver operating characteristics (ROC) curve was 97.7% and was statistically significant.

Conclusion : Not only BMI also WHtR and WHR were strongly and positively associated with metabolic syndrome among Bangladeshi urban adults and they are the markers of metabolic syndrome diagnosis. The study recommended that WHtR, BMI, WHR as predictors should be routinely examined in metabolic syndrome diagnosis to prevent cardiovascular diseases and diabetes in the later life.

Key Words : BMI, WHR, WHtR, PAL, SFT.

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Introduction

Metabolic syndrome is a group of conditions that put a person at risk for heart diseases and diabetes. These conditions are- high blood pressure, high blood sugar levels, high levels of triglycerides (TG), low levels of high density lipoprotein (HDL), too much fat around the waist. When at least any three of the above five criteria are present then it is called metabolic syndrome and the risk of cardiovascular diseases and diabetes is increased by 1.5 to 2 folds. The metabolic syndrome has been proposed as an indicator of cardiovascular disease risk, type 2 diabetes.[1] Beyond CVD and type 2 diabetes, individuals with metabolic syndrome are susceptible to other conditions, notably polycystic ovary syndrome, fatty liver, gallstones, asthma, sleep disturbances, and some forms of cancer. In Bangladesh around 12.5% of all deaths are caused due to various types of cardiovascular diseases. The prevalence of ischemic heart diseases among the rural population is around 3.4%, prevalence of hypertension to be 17.9% which is increased in times.[2] In urban people prevalence of hypertension is more particularly in the slum population, have even higher prevalence (37.5% in men and 24.5% in women).[2,3] 1.1millions people died from diabetes in the year 2005.[2] Another report by ICDDRB suggests that in urban area the prevalence of diabetes is just double (10%) the rural area (5%).[4] According to the ICDDRB the risk of these diseases are increasing with urbanization. In general, the International Diabetes Federation estimates that one-quarter of the world's adult population has Metabolic Syndrome. Metabolic syndrome was found to be frequent (2.9%) in Bangladeshi rural women.[5] Increasing prevalence of obesity is also evident in our country and that is 8.9%.[3] Metabolic syndrome needed to be studied more among the urban adults of Bangladesh because of their mechanical life style and more proneness to become obese.

Methodology

A case control study was carried out during March-December 2011. A total of 46 cases and 47 controls to detect two folds or higher odds ratio, with the prevalence of obesity 0.089 among the general population at 80% power and at a case control ratio of one to two instead of a total of 34 cases and 68 controls due to the resource constraints. Cases were the consecutive hypertensive patients having at least any two metabolic syndrome criteria as defined by National colesterol education programme Adult treatment panel (NCEP ATP III) (like increased TG level, increased blood sugar level or frank diabetes, decreased HDL level, increased waist circumference) reported in hypertensive department of NHFH, Dhaka. Controls were the patients reported in the out patient department of Shaheed Sheikh Abu Naser Specialized Hospital, Khulna for any minor ailment, diagnosed as healthy controls free of metabolic syndrome or any other diseases later on by laboratory tests. Controls were selected purposively matched for age, sex and residence from Shaheed Sheikh Abu Naser Specialized Hospital, Khulna.

Data was collected with the semi-structured interview questionnaire, through face to face interview after taking informed consent from the participants. Interview was taken in patients coming regularly in the Hospital departments for hypertension and controls (healthy people) previously diagnosed correctly after biochemical testing of their blood for sugar and triglyceride. Information regarding risk factors and behaviors were inquired taking effort to minimize the recall bias. The protocol received ethical clearance from National heart foundation and Shaheed Sheikh Abu Naser Specialized Hospital. Blood pressure was measured through sphygmomanometer at sitting position thrice after taking 30 min. rest and average B.P was taken. Height was measured by measuring scale and weight by standard bathroom scale. BMI was calculated as kg/m2. Waist circumference was measured by measuring tape removing folds of clothing at the site one inch above the umbilicus. Hip circumference was measured at the maximum protrusion of hip. Waist to hip ratio (WHR) was calculated. Triceps skin fold thickness was measured by slide caliper.

After data collection variables were entered in SPSS 16. Data was checked for out of range errors, consistency etc and screened and cleaned for any missing value and discrepancies. Then variables were sorted as categorical and numeric. Then proportion of each of the risk factors was compared in between metabolic syndrome and non metabolic syndrome groups; association was sought for socio demographic variables, Behavioral factors, Family diseases factors, Anthropometric factors. Unadjusted odds ration was generated for all the variables with 95% confidence interval and only significant factors were considered as candidate for multivariate analysis. A binary logistic regression model was generated to assess risk factor of metabolic syndrome in comparison to non metabolic syndrome control adjusting for possible confounders.

Data was presented in the form of tables and ROC curve.

Results

A total 95 subjects were interviewed for the case-control study. Average age of the case was 46.44 years and control was 42.87 years and 54.7% were men. All the participants were from urban residence. Then proportion of each of the risk factors was compared in between metabolic syndrome and non metabolic syndrome groups; association was sought for socio demographic variables, Behavioral factors, Family diseases factors, Anthropometric factors. Unadjusted odds ration was generated for all the variables with 95% confidence interval. Among the variables monthly family income, Ever use of tobacoo, Table salt intake, Fruit. & vegetable intake, Physical activity level, Family history of chronic heart disease, Family history of hypertension (HTN), Waist to hip ratio, Body mass index, Waist to height ratio found statisticaly significant during univariant analysis and were considered as candidate for multivariate analysis & metabolic syndrome risk model was developed.

Table -I : Metabolic Syndrome Risk

Table - I	case [No,%]	Control [No,%]	OR (95% CI)	P Value
W Ht R (increased)	46(95.8)	25(53.2)	420.3(6.3,27664.0)	0.005*
WHR(increased)	44(91.7)	33(70.2)	155.5 (3.8, 6338.9)	0.008*
B M I (increased)	33(68.8)	22(46.8)	53.1 (2.5, 1119.0)	0.01*
Increased Age(>50yrs)	20(41.7)	13(27.7)	44.0 (1.5,1225.8)	0.02*
Low PAL	35(72.9)	25(53.2)	35.41 (1.5, 788.7)	0.02 *
Inadequate fruits & vegetables intake	42(87.5)	25(53.2)	576.8(7.0, 47185.0)	0.005*
Positive F/H of CHD	23(47.9)	10(21.3)	0.7(0.0, 0.6)	0.83
Positive F/H of HTN	24(50,0)	13(27.7)	6.8 (0.3, 118.8)	0.18
Family income (>20,000 tk)	13(27.0)	19(40.4)	0.2(0.0, 2.8)	0.25
Education level(S.S.C & illiterate)	33(68.8)	25(53.2)	2.0(0.1, 24.2)	0.58
Tobacco ever user	27(56.2)	9(19.1)	7.2 (0.6, 79.9)	0.10
SFT			0.8 (0.7, 1.0)	0. 10
Table Salt non user	26(54.2)	37(78.7)	0.0(0.0, 1.0)	0.05
Sex (female)	21(43.8)	22 (46.8)	0.1(0.0, 1.5)	0.10

Nagelkerke R Square 0.843

Metabolic syndrome risk model

Metabolic syndrome risk factors had been assessed through binary logistic regression model. The model explained 84% of the variability in the metabolic syndrome status.

Increased BMI, increased WHR, increased WHtR, inadequate fruit and vegetable intake, low physical activity level (PAL), increased age (>50 years) appeared as significant predictors of metabolic syndrome in comparison with referent healthy

control. Significant increased risk of metabolic syndrome was evident in inadequate fruit and vegetable intake (OR 576.8, 7.0 -47185.0), low level of physical activity (OR 35.4, 1.5 - 788.7), increased age >50 years (OR 44.0, 1.5 -1225.8). Anthropometric factors like WHtR was statistically significant risk with the highest OR (420.37, 6.3-27664.0). Other anthropometric factors like WHR (OR 155.5, 3.81-6338.9) and BMI (OR 53.1, 2.5 -1119.0) were also statistically significant increased risk for metabolic syndrome. However increased skin fold thickness (SFT) was not appeared as a statistically significant risk for metabolic syndrome. On the other hand F/H of HTN, F/H of CHD, tobacco use, table salt intake, education level, income and sex factors were not significant risks or predictors of metabolic syndrome in the current study. (Table-I)

Table-II : Correlation of WHR, BMI, SFT, WHtR with each other

	Constant	WHR_(1)	BMI_gr(1)	SFT	WHtR(1)
Step 1 Constant	1.000	-.682	-.627	.230	-.744
WHR_(1)		1.000	.682	-.408	.325
BMI_gr(1)	-.627	.682	1.000	-.474	.296
SFT	.230	-.408	-.474	1.000	-.073
WHtR(1)	-.744	.325	.296	-.073	1.000

Correlation matrix : It showed that WHR and BMI correlated with each other (0.6). So either WHR or BMI could be used for the same purpose. WHtR (0.3 with WHR and 0.2 with BMI) was an independent predictor and can be used independently for metabolic syndrome diagnosis. SFT (0.4) was also an independent predictor but it was not statistically significant. (Table II)

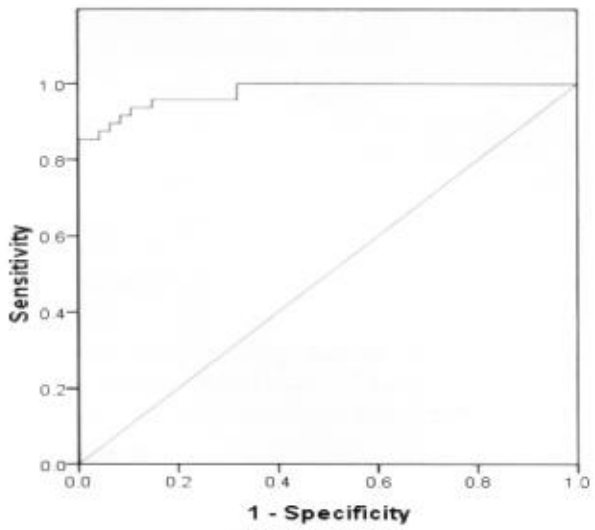

Figure-1

This ROC curve can generate risk for metabolic syndromeup to 97.7% (0.95-0.99).

Discussion

In the current study increased BMI and Increased WHR, increased WHtR, low level of physical activity, having inadequate fruits and vegetable in diet and increased age (>50 years) appeared as significant risk factors of metabolic syndrome in general. The ROC curve (Fig. I) can generate risks upto 97.7% and that was statistically significant.

Metabolic syndrome Risk

The correlation matrix (Table-II) in the current study showed that WHtR was an independent and better marker. BMI and WHR both acted as the same predictors of metabolic syndrome. SFT was also an independent predictor of metabolic syndrome but it was statistically non significant.

This finding of current study was somehow similar to the study by Ashwell and Hsieh who suggested global use of WHtR as a rapid screening tool for cardio metabolic risk factors with this simple public health message: 'Keep your waist circumference to less than half your height'.[6] Following six reasons given by Ashwell and Hsieh to defend the superiority of WHtR over other anthropometric indices were- WHtR is more sensitive than BMI as an early warning of health risks, WHtR is cheaper and easier to measure and calculate than BMI, a cut-off point of WHtR 0.5 indicates increased risk for man and woman, WHtR 0.50 is also for different ethnic groups, WHtR boundary values can be converted into a consumer-friendly chart, WHtR may allow the same boundary values for children and adults.[6] In the current study increased WHtR (0.50) in both sexes appeared as a risk factor with an OR of 420.37 which was the highest of all anthropometric factors in the model.

BMI can diagnose metabolic syndrome up to certain limit even in slightly overweight condition than Caucasians as shown by MC. Keigue .et al.[7] However in our study we found WHtR (a proxy to central fat measurement) had diagnosed metabolic syndrome most accurately with the OR of 420.3.

MC. Keigue,et al. stated that waist/hip circumference ratios were higher in South Asians than in Europeans of similar body mass index due to their pattern of body fat distribution -South Asians had more Waist circumference than hip circumference. They confirmed the existence of an insulin resistance syndrome, prevalent in South Asian populations with increased WHR.[8] Current study also unveiled this fact that increased WHR irrespective of sex appeared as a risk factor of metabolic syndrome with an OR of 155.5.

Conversely, St. Pierre, et al found normal-weight men with four or more features of the insulin resistance syndrome had a three-fold increase in the risk of ischemic heart disease. The researchers concluded that BMI alone poorly reflects the risk of ischemic heart disease associated with the features of insulin resistance syndrome.[9] Current study exactly unveiled the same fact that central adiposity was more irrespective of the heights of the cases and the hip circumference was also more in cases as well. Thus the study unveiled WHtR as well

as WHR were more reliable risks of metabolic syndrome along with BMI.

The current study showed having history of inadequate fruits and vegetables intake was a risk factor of metabolic syndrome with an OR of 576.8 and increased age also appeared as a risk for metabolic syndrome.

People in urban area are likely to live a very mechanical life. With the urbanization people are used to less physical activity. Leisure time physical activity is quite absent from their daily life because of lack of time. Lifestyle factors alone or modulated by inherited factors appear to play an important role because obesity and dyslipidaemia become worse with urbanization and migration as stated by Anoop Misra.et al.[10] This urbanization reflected in our study too. As this current study was among urban population, low physical activity level appeared as significant risk against metabolic syndrome with an OR of 35.4.This was similar to findings by studies on Bangladeshi immigrants to the U.K. by mckeigue, et al. showing the high prevalence of metabolic syndrome occurred due to the fact that a large proportion (65%) of women had low HDL cholesterol because of unfavorable environmental triggers such as stress, physical inactivity, and smoking.[8] Current study was also similar to the study findings by Zaman,et al. showing relatively low (<3%) prevalence of metabolic syndrome due to sufficient physical activity protecting the rural women of Bangladesh.[5]

Tobacco use, Table salt intake, Family income (>20000), education level S.S.C or illiteracy, positive family history of CHD, positive family history of HTN, sex (female) were not found as statistically significant risks of metabolic syndrome in the current study.

On the contrary to the findings in the article by La Moreno .et al, SFT of triceps was not found as a risk of metabolic syndrome.[11] This might be due to the fact that all four body site's (Biceps, Triceps, Sub scapular, Abdominal) SFT should be measured and then body fat content should be calculated for risk assessment. But due to the social context SFT could not be measured in all four body sites. Table salt non use did not appear as statistically protective factor of metabolic syndrome. There might be other explanation of such finding or could there be any missing link in the current study.

Limitations and scope of the study

1. This study was conducted among hospital controls in selected hospitals which may give rise to Barkit's Paradox.
2. Due to small sample size we had to take some prevalent cases which may give rise to Neyman's Fallacy.
3. No population specific cut off for Skin fold thickness measurement was available among Bangladeshi population.

Conclusion & Recommendation : This study concluded as– Not only BMI also WHtR and WHR were strongly and positively associated with metabolic syndrome among Bangladeshi urban adults and they are the markers of metabolic syndrome diagnosis. Not only BMI also WHtR, and WHR should be used as routine surveillance in metabolic syndrome diagnosis. Measures should be taken to maintain normal WHtR (0.5), WHR (0.85 in female and o.90 in male), BMI (18-25 in both sexes) by life style modification, increased physical activity level (PAL) and there by prevent metabolic syndrome and cardiovascular diseases risk.

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