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METABOLIC SYNDROME AND ITS RELATIONSHIP WITH ASSOCIATED RISK FACTORS

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ABSTRACT

Objectives: Metabolic syndrome is a cluster of several vascular risk factors. Prevention of cardiovascular diseases is related to early diagnosis of metabolic syndrome. Little information is available about the prevalence of the metabolic syndrome and its associated risk factors in Pakistan.

Material and Methods: A matched case control study included 150 adults patients diagnosed with acute myocardial infarction and 150 healthy controls, aged 40 years and above. The patients were selected from Khyber Teaching Hospital, Lady Reading Hospital and Hayatabad Medical Complex in Peshawar and controls were selected from the general population. Metabolic syndrome and its relationship with associated risk factors such as obesity, physical inactivity, smoking status, education and socioeconomic status were assessed.

Results: It was found that 55% of the patients had diagnostic criteria of metabolic syndrome compared to 17% of controls. It was more common in age group 51-60 years. 66% of males and 34% of females had metabolic syndrome. Obesity, physical inactivity and current smoking were associated risk factors with increased odds of metabolic syndrome.

Conclusion: Metabolic syndrome is more common in patients with acute myocardial infarction. Increased physical activity and cessation of smoking may decrease the prevalence of metabolic syndrome.
Key words: Metabolic syndrome, associated, risk factors.

INTRODUCTION

The concurrence of disturbed glucose and insulin metabolism, overweight and abdominal fat distribution, mild dyslipidemia, and hypertension have given rise to the concept of the metabolic syndrome, also known as the insulin resistance syndrome.[1,2] Metabolic syndrome is associated with subsequent development of type 2 diabetes mellitus and cardiovascular disease[1,2] Coronary heart disease (CHD) is a major public health concern and accounts for more deaths than any other disease worldwide.[3] Age appears to have a linear relationship with CHD.[3]

The Asia-Pacific region currently accounts for approximately half the global burden of cardiovascular diseases, and future projections suggest this proportion will increase.[4] The prevalence of cardiovascular risk factors in the Asian population is high.[3] According to data from the National Health Survey of Pakistan, the prevalence of hypertension and diabetes is approximately 33% and 25% respectively, in persons over the age of 45 years.[3]

The associated risk factors with metabolic syndrome can be divided into modifiable and non-modifiable types.[5] The major modifiable types include high blood pressure, abnormal blood lipids, tobacco use, physical inactivity, obesity, and unhealthy diets.[6,7] The other modifiable types are low socioeconomic status, mental ill health, psycho social stress, use of alcohol etc. On the other hand, the non modifiable risk factors include age, sex, ethnicity, family history and previous stroke and heart attack. Primary prevention refers to risk reduction in patients without evidence of CHD.[6] The Third Report of the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III) has recommended appropriate measures to identify individuals with the metabolic syndrome and to manage their care prior to development of cardiovascular complications.[8,9,10] For example, abdominal obesity has been found to promote insulin resistance, which further predisposes individuals to type 2 diabetes and contributes to an increase in cardiovascular risk factors.[11,12,13]

Very few such data are available from Asia, and precise population-specific estimates of the nature and magnitude of the associations between risk factors and cardiovascular diseases in the region are lacking.[4]

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Although modification of lifestyle-associated risk factors is known to be essential for preventing and managing the metabolic syndrome, there is currently insufficient information available on the prevalence of the metabolic syndrome and associated risk factors in Asian countries.[8] We therefore investigated the prevalence of the metabolic syndrome and lifestyle factors contributing to the development of this syndrome in Peshawar, Pakistan.

MATERIAL AND METHODS

The study was conducted in three tertiary care hospitals of Khyber Pakhtoonkhwa i.e. Post Graduate Medical Institute Lady Reading Hospital (P.G.M.I L.R.H), Khyber Teaching Hospital (K.T.H) and Hayatabad Medical Complex (H.M.C) Peshawar, in year 2006. The facilities of Pakistan Medical Research Council (P.M.R.C), Khyber Medical College (K.M.C) were used for various investigations. 150 patients and 150 controls (adult men and women aged 40 years and above) were included in the study. Convenient hospitalized patients with the diagnosis of acute myocardial infarction were taken for this study. Apparently healthy controls were both age and sex matched. The controls were taken from the general population. Patients on steroids and with chronic renal, lung, hepatic disease and gynecological disorder were excluded. Controls with previous history of myocardial infarction, hypertension and diabetes were excluded.

It was a comparative (case control) study. Written informed consent was obtained from all the patients and controls. The patients underwent a clinical assessment, which included a history (questionnaire) and a clinical examination.

The questionnaire, in which demographic variables were included: age, sex, race, marital status, personal history (occupation, education, socioeconomic status, smoking status, alcohol status and physical activity history), disease history (hypertension, diabetes etc), menstrual history and family history (including hypertension, diabetes, other).

Education level was divided into 4 categories: nil, less than 8 years, 8 to 12 years, greater than 12 years. Socioeconomic status depending upon monthly income, Pakistani rupee (PKR) was divided into three categories: low (< 5,000 Rs), middle (5,000–20,000 Rs), and high (>20,000 Rs.). Smoking Status was considered as non-smokers, current smokers, and previous smokers. Alcohol Status was graded as none, light (< 10 drinks/month), moderate (10-30 drinks/ month), or heavy (>30 drinks / month). Physical Activity was graded as being none, low (4-10) times/ month), moderate (11-19 times / month), or heavy (19 times or more/ month).

Anthropometric measurements on individuals wearing light clothing and without shoes were conducted. Height was measured to the nearest 0.1 cm using the portable Health Scale ZT-120. Weight was measured in the upright position to the nearest 0.1 kg using portable Health Scale ZT-120. Body mass index was calculated by Quelelet's formula i.e. dividing weight (kg) by height squared (m2). Asian criteria of BMI i.e. normal weight (18-23 kg/m2), overweight (23-25 kg/m2), and obesity (> 25 kg/m2) was considered. Waist circumference was taken at the midpoint between the lowest rib and the iliac crest in standing position. Blood Pressure was recorded as the mean of three readings in relaxed, resting and sitting position using a manual mercury sphygmomanometer (Baumanometer® Japan).

Criteria for the diagnosis of metabolic syndrome was according to NCEP ATPIII criteria based on Asian guidelines,[8] participants having three or more of the five following components were defined as having the metabolic syndrome: high blood pressure (> 130 / 85 mmHg), elevated fasting blood glucose (>110 mg/dl or 6.05 mmol/l), hypertriglyceridaemia (> 150 mg/dl or 1.65 mmol/l), low high density lipoprotein (HDL)-cholesterol (men, < 40 mg/dl or < 1.05 mmol/l; women, < 50 mg/dl or < 1.30 mmol/l), and abdominal obesity, as measured by a waist circumference of >90 cm for men and >80 cm for women. Participants who were on anti hypertensive or anti diabetic drugs were considered as hypertensives and diabetics. Dyslipidemia was considered in those already on lipid lowering drugs.

All the patients and the controls underwent the following specific investigations, fasting blood sugar, triglycerides level, high density lipoprotein level and total cholesterol level. Blood collection of about 5ml samples were obtained from an antecubital vein of patients and controls, into vacutainer tubes containing ethylene diamine tetra acetic acid (EDTA) in the morning after an overnight fasting period. Samples were subsequently analyzed after being centrifuged at 3000 revolution per minute for 5 min at room temperature for serum at certified PMRC laboratory at K.M.C. All these investigations were done using enzymatic lab technique (Elitech) by micro lab 200 (Merck).

The study was approved by our local Khyber Medical College ethical committee. For partial financial funding, it was approved by Pakistan Medical Research Council, Ministry of Health, Islamabad for research on human subjects.

The data was analyzed using statistical software Epi info version 6 and SPSS 10. Covariates included age, marital status, education level, occupation, economic status, BMI, alcohol consumption, cigarette smoking, and physical exercise. The Chi square test was used to analyze the significance of categorical variables at <0.05 level. Logistic regression model was run and the most parsimonious model was obtained.

RESULTS

The study consisted of 300 subjects, 150 controls and 150 diagnosed patients of acute myocardial infarction (M.I). Each group contained 112 males and 38 females. The study participants showed that maximum participants were in the age group 51-60 years i.e. 47%, while 27% in group 40-50 years and 26% in 61-70 years.

Table 1: Demographic and Conventional Risk Factors of Metabolic Syndrome in Patients and Controls

Demographic characteristics	Patients n=150	Controls n=150
Mean Age	56.36 +7.57	56.36 +7.57
Ethnicity		
Pakhtuns	135 (90%)	134 (89%)
Hindkowans	15 (10%)	16 (11%)
BMI		
Normal	55 (37%)	122 (81%)
Overweight	27(18%)	19 (13%)
Obesity	68 (45%)	9 (6%)
Physical Activity		
No	87 (58%)	77 (51%)
Yes	63(42%)	73 (49%)
Smoking Status		
Smokers	78 (52%)	41 (27%)
Non-smokers	72 (48%)	109 (73%)
Education		
Illiterate	77 (51%)	78 (52%)
Literate	73 (49%)	72 (48%)
Socioeconomic		
Poor	89 (59%)	91 (61%)
Middle	59 (39%)	56 (37%)
High	2 (1.3%)	3 (2%)
Disease History		
Hypertension	52 (34%)	—
Diabetes	32 (14%)	—
Menopause Status		
Menopause	11 (29%)	4 (37%)
Post-Menopause.	27 (71%)	24 (63%)

The demographic characteristics of the study population is showed in Table 1. The mean age was 56 years (S.D + 7.57) among patients and controls. Among the study participants maximum were Pakhtuns, only 10% were Hindkowans.More than 90% of subjects were married. Both the patients and the controls were educated about 49%.Socio economically most of the patients and the controls belonged to the poor and middle classes. Obesity was seen more in patients (45%) than controls(6%). Physical inactivity was more in patients than controls. 52% patients and 27% controls were smokers.

Patients had a higher prevalence of high blood pressure, high fasting blood glucose level, and high triglyceride content, low HDL-cholesterol with increased central obesity as compared to controls (Table 2).

Table 2: The Different Component of Metabolic Syndrome in patients and controls

Component of Metabolic Syndrome	Patients n=150	Controls N=150	P-value
Triglycerides			<0.01
Abnormal	75 (50.0%)	52 (35.0%)	
Normal	75 (50.0%)	98 (65.0%)	
HDL			<0.000
Abnormal	71 (47%)	36 (24%)	
Normal	79 (53%)	114 (76%)	
Waist Circum-ference			<0.000
Abnormal	96 (64%)	47 (31%)	
Normal	54 (36%)	103 (69%)	
Fasting Blood Sugar			<0.000
Hyperglycemic	60 (40.0%)	27 (18%)	
Normal	90 (60.0%)	123 (82%)	
B.P			<0.000
Hypertension	79(53%)	35 (23.3%)	
Normal	71 (47%)	115 (76.6%)	

P-value <0.001= Highly Significant

Table 3: Frequency and Relationship of Associated Risk Factors with Metabolic Syndrome

Associated Factors	MS (+) n=108, %	MS (-) n = 192, %
Physical Activity		
No	74 (69%)	90 (47%)
Yes	34 (31%)	102 (53%)
Smoking		
Yes	54 (50%)	65 (34%)
No	54 (50%)	127(66%)
Education		
Illiterate	58 (54%)	97 (51%)
Literate	50 (46%)	95 (49%)
Socioeconomic Status		
Poor	70 (59%)	110 (61%)
Middle +High	49 (41%)	71 (39%)
BMI		
Normal	60 (56%)	163 (85%)
Obesity	48 (44%)	29 (15%)

MS = Metabolic syndrome, (+) = Positive, (-) = Negative

Metabolic syndrome according to ATPIII criteria i.e. those who had three or more risk factors, was 55% (n=83) in patients while the proportion in controls with the metabolic syndrome was only 17% (p-value < 0.001, odds ratio 6.19) showing a highly significant difference. Overall 108 study participants out of 300 had metabolic syndrome.

Age adjusted distribution of 108 participants with metabolic syndrome showed 48 (44%) in the age group of 51-60 years, while rest were 29% in age group 40-50 years and 27% in age group greater than 60 years. Among the study participants 66% of males had metabolic syndrome while the proportion in females with metabolic syndrome was 34%.

The frequency of different associated factors i.e. socioeconomic, education, physical activity, smoking status and BMI (Table 3) showed that there was increased smoking status (p- value < 0.004 and odds ratio 1.95), physical inactivity (p- value < 0.001 and odds ratio 2.47), and obesity (p- value < 0.001 and odds ratio 4.50), in participants with metabolic syndrome.

The odd ratio (OR) and confidence interval (CI) for the association between these associated risk factors and the metabolic syndrome (Table 3) showed that no significant association was found between the metabolic syndrome and education as well as for socioeconomic status.

However obesity was found to be an important risk factor for metabolic syndrome (OR 4.5, 95% confidence interval 2.50-8.12). Similarly physical inactivity had increased odd ratio of 2.47 (95% CI 1.45-4.20). The smoker and ex smokers also had some significant association with metabolic syndrome (O.R 1.95, 95% CI 1.17-3.27).

DISCUSSION

In our study we used NECP Adult Treatment Panel (ATP III) to define the metabolic syndrome as it is more strongly associated with prevalent CHD than the WHO definition of the syndrome.[14,15] We have also used ATPIII criteria with modified cutoff values of Asian waist circumference i.e. > 90cm in men and > 80cm in females, it showed 55% of metabolic syndromes in acute MI patients, similar to the results of metabolic syndrome in Strong Heart study of American Indians.[16] Asian Indians MI patients also revealed 46% of prevalence of metabolic syndrome using ATPIII criteria.[17] Metabolic syndrome was seen more in men than females and it reached a plateau during the middle years of life.

The obesity level was more in our patients (47%) as compared to controls (6%) using the current recommendations for the Asia-Pacific region defined adult overweight at BMI > 23 and obesity at BMI > 25,[12] which highlights the importance of central obesity as a risk factor for metabolic syndrome. The differences among patients and controls regarding the metabolic syndrome were highly significant, MI patients were 6.19 times more likely than healthy controls to have diagnostic criteria for metabolic syndrome.

In our study no significant association was found between the metabolic syndrome and education or socioeconomic status. Although many studies have reported that low socioeconomic status is associated with a higher mortality rate from cardiovascular disease.[2] Similarly in U.S.A no association was seen in education level and odds of metabolic syndrome.[2] However obesity and physical inactivity were found to be a important risk factors for metabolic syndrome.[2] We found that BMI was the most sensitive marker among associated factors for the metabolic syndrome. Since we found a greater preponderence of metabolic syndrome in obese middle aged men in this study, our results point to the need for measures to prevent and treat obesity in this and other high risk groups. This finding is consistent with the results in US adults,[2] Pakistanis[18] and Koreans,[8] in which BMI was shown to be a strong predictor for the metabolic syndrome.

Similarly physical inactivity had increased odds for metabolic syndrome in our study. Moderate

exercise is beneficial to promote weight loss in obese individuals and favorably modifies components of the metabolic syndrome, including promoting loss of abdominal fat accumulation, reduction of blood pressure, improve insulin sensitivity, lower triglyceride levels, and increased HDL cholesterol levels.[8]

The smoker and ex smokers also had slight significant association with metabolic syndrome. Current smoking was found to be a significant independent risk factor for the metabolic syndrome in both men and women, in accordance with previous cross-sectional studies.[2,8] Cigarette smoking may also induce an increase in abdominal obesity, as well as causing high blood pressure by increasing sympathetic activity, and it may elevate triglyceride levels and lower HDL-cholesterol.[8]

CONCLUSION

Our study shows that the high prevalence of metabolic syndrome has serious implication on the health care of under developed countries like Pakistan, as seen in well developed countries. Obesity and physical inactivity are two major associated risk factor of metabolic syndrome.

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