

Comparison of CAD risk factors in abdominal obesity versus General obesity with normal WC in adult males

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Abstract

Objective: To compare the presence of coronary artery disease risk factors in patients with abdominal obesity versus generalised obesity and to determine the probability of developing the disease in both groups.

Methods: The cross-sectional study was carried out at the Department of Medicine, Combined Military Hospital, Okara, from January 2012 to April 2013. Using consecutive sampling, 785 outdoor healthy adult males were enrolled. Body mass index $>25\text{kg/m}^2$ and waist circumference $>90\text{cm}$ defined obesity and abdominal obesity respectively. Blood pressure $>140/90\text{mmHg}$ defined Hypertension. All the subjects underwent BSF, electrocardiogram, Lipid profile, personality and physical activity assessment. Risk estimation was done using Eric Brittain scoring system. Data was analysed using SPSS 16.

Results: In patients with abdominal obesity, 583 (99.2 %) individuals had at least 1 risk factor for coronary artery disease, while in those with generalised obesity this prevalence was 96.5% (n=191). In patients with abdominal obesity, 52.9% had more than 4% risk of developing the disease in the next 6 years compared to 36.9 % individuals with generalised obesity.

Conclusion: Both increasing body mass index and waist circumference are associated with increased risk of developing coronary artery disease, with significantly higher risk prevalence in the latter group. Moreover, those with abdominal obesity had a higher risk of developing CAD in next 6 years as compared to those with generalised obesity. Thus waist circumference offers additional prognostic information beyond body mass index.

Keywords: Obesity, Central obesity, CAD, Risk factors. Hypertension, Diabetes. (JPMA 64: 394; 2014)

Introduction

Waist circumference (WC) is a better predictor of Coronary Artery disease (CAD) than generalised obesity.¹⁻³ probably owing to the fact that body mass index (BMI) cannot differentiate between fat mass and muscle mass. BMI is usually taken as marker of general obesity, whereas WC is used to document abdominal obesity. For Asians, general obesity is BMI $>25\text{kg/metre square}$,⁴ whereas abdominal obesity is WC $>90\text{cm}$.⁵ CAD is projected to become the leading cause of global morbidity and mortality by 2020.⁶ There is a high prevalence of CAD risk factors in Pakistan with more than 30% of population over 45 years of age affected by the disease.⁷ No study in Pakistan has been carried out to re check prevalence of CAD after 1998, but a large study in 2007 compared prevalence of CAD risk factors between South Asian and other countries which concluded much higher prevalence of each of the CAD risk factors among South Asians.⁸ However, no study is carried out in Pakistan to compare abdominal obesity with general obesity for prevalence of CAD risk factors. Different CAD

risk factors as brought out by previous studies include obesity, physical inactivity, smoking, type "A" personality, Hyperlipidaemia, hypertension, diabetes mellitus (DM), and positive family history of CAD. These eight risk factors plus alcohol consumption/dietary patterns were studied at a large scale in CAD patients from 52 countries in INTERHEART study. These nine factors accounted for over 90 per cent of the population attributable risk (PAR) of a first myocardial infarction (MI).⁹ General obesity and exclusive abdominal obesity not only directly increase risk of CAD but also predispose to other CAD risk factors like hypertension (HTN), stroke and DM.¹⁰ Different scoring systems to determine probability of developing CAD in preceding years in individuals with one or many CAD risk factors have been devised in the past, notably third report on National Cholesterol Education Programme (NCEP),¹¹ first Framingham study,¹² SCORE¹³ and scoring system of Erica Brittain technical report at Stanford University on probability of developing coronary heart disease.¹⁴ The purpose of this study was to find out prevalence of CAD risk factors in apparently healthy adult males having general obesity without abdominal component versus those with abdominal obesity, and estimation of chances of developing CAD in the following 6 years in both study groups.

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Patients and Methods

The cross-sectional study was conducted at the Medicine Department, Combined Military Hospital, Okara, from January 2012 to April 2013. Each patient was briefed about the purpose and nature of the study and an informed written consent was taken from each patient. Permission from the hospital ethical committee was also obtained. The study comprised 785 adult obese males over 18 years of age, presenting in our hospital for routine review. The sample size was calculated using Raosoft sample size calculator using 5% margin of error, confidence level of 95%, and response distribution of 50%. Patients were selected by consecutive sampling. Those with secondary causes of obesity were excluded. Detailed history and examination of each individual was conducted and data entered in a pre-designed proforma. Each patient was asked about age, education status, physical activity, smoking history, marital status, personality type, family history of obesity and CAD. Weight and height measurement of each subject were recorded; WC was measured with the measuring tape at the level of anterior superior iliac spine and was recorded in cm to document abdominal obesity. Abdominal obesity was defined as WC >90cm.⁴ BMI was calculated for each individual using formula weight (kg)/ height (m²) to document generalised obesity. Those with BMI of 23-24.9kg/m² were labelled as overweight, while those having BMI more than 25 were considered obese.⁴ Obese subjects were divided into two groups; those with abdominal obesity and those with BMI over 25kg/m² but with normal WC. Individuals whose first degree relatives had any of the conditions, like exertional angina, old or recent myocardial infarction, diagnosis of ischaemic heart disease (IHD) or sudden death were considered to be having positive family history for CAD and regarded 'at risk'. A self-administered adjective checklist consisting of

39 adjectives for type A personality and 26 adjectives for type B personality was used.¹⁵ Persons with score of below 228 were considered to be belonging to personality type B and those with score of 228 or above belonging to personality type "A". Physical activity level was judged by profession of the patients. Clerks, munshi, painters, drivers, laboratory workers, Khateebes, vehicle mechanics and office workers were considered physically inactive. Blood pressure was measured three times by the same physician with a table sphygmomanometer and the mean of the three measured values was noted. All the participants of the study underwent fasting blood sugar (BSF) and serum Total Cholesterol (TC). Serum cholesterol > 200 mg/dl, BSF >126mg/dl were considered abnormal for the purpose of the study. Electrocardiogram (ECG) was done in all subjects to document the presence of ECG evidence of left ventricular hypertrophy (LVH).

Variables included in study were age, education, smoking, physical activity, blood glucose, lipid profile, family history, blood pressure recording, WC, obesity and BMI. Individual risk factor for developing CAD was calculated using scoring system of Eric Brittain technical report on probability of developing coronary heart disease.¹³ Continuous variables were derived as means and standard deviation while categorical variables were described in percentages/frequencies. To assess simple bivariate associations, we used t test and Pearson chi square test as appropriate to the nature and distribution of the variables. Multivariate analysis was done by best subset selection technique. All the data was analysed using SPSS version 16. P value of less than 0.05 was considered statistically significant.

Results

The age of 785 subjects ranged from 18 to 52 years with a mean of 31.69±3.591 years. BMI ranged from 25.1 to

Table-1: Demographic characteristics.

Characteristic	Generalized obesity with normal WC n= 198	Abdominal obesity n=587	OR (95% CI)	p-value
Age (years) mean (SD)	31.78 (±3.12)	32.91(±3.29)	1.32 (0.76-1.72)	0.41
Active smoking n(%)	85 (42.9%)	215(36.6%)	1.01(0.94-1.51)	0.25
Physically inactive n(%)	147 (74.2%)	493(83.7%)	1.51(1.1-2.3)	0.04
Family history of CAD n(%)	35 (17.6%)	177 (30.1%)	1.08(1.26-2.3)	0.02
Waist circumference (cm) mean (SD)	87.2 (±.74)	95.7(±.52)	1.04(1.17-1.92)	0.03
BMI kg/m ² mean (SD)	26.7(± 2.15)	29.1(± 1.45)	1.02(.76-1.23)	0.38
TYPE A personality n(%)	128 (64.6%)	369 (62.6%)	1.01(.82-1.31)	0.78
HTN n(%)	38 (19.1%)	160 (27.2%)	1.53(1.32-1.91)	0.01
DM n(%)	22 (11.1%)	92(15.6%)	1.41(1.16-1.97)	0.04
ECG evidence of LVH n(%)	5 (2.5%)	28 (4.7%)	1.06(.91-1.43)	0.81

WC: Waist Circumference. DM: Diabetes Mellitus. OR: Odds Ratio. ECG: electrocardiogram. SD: Standard Deviation. LVH: Left Ventricular Hypertrophy. CAD: Coronary Artery Disease. BMI: Body Mass Index. HTN: Hypertension.

Table-2: BMI and WC in relation to presence of CAD risk factors.

Variable	No of CAD risk factors*	Hazard Ratio (95% CI)	
	Mean (SD)	Adjusted**	Additional adjustment for BMI
BMI(kg/m ²)			
25.1-27	1.4 (±.12)	1.52(1.25-3.16)	
27.1-29	2.3(± .37)	2.15(1.29-3.57)	
29.1-31	3.7(±.19)	2.38(1.13-2.79)	
>31	4.2 (± .78)	2.56(1.69-3.29)	
Waist Circumference(cm)			
90-100	2.1 (±.42)	1.58(1.19-2.32)	1.23(.78-1.82)
100-110	3.2 (±.93)	2.14(1.74-2.97)	2.11(1.39-2.48)
110-120	3.5(±.96)	2.38(1.83-3.17)	2.34(1.48-2.82)
>120	4.6(±1.32)	2.74(1.48-3.44)	2.67(1.17-3.43)

*As per Eric Brittain scoring system from multiple logistic functions in Framingham study.

**Hazard ratio was adjusted for age, marital status and education.

CAD: Coronary Artery Disease. SD: Standard Deviation. BMI: Body Mass Index. CI: Confidence Interval.

Table-3: Probability of developing IHD within 6 years* (n=785).

% Probability of CAD in 6 years	Abdominal obesity n(%) n=587	Generalised obesity with normal WC n(%) n =198	P value
0-4	277 (47.1%)	125 (63.1%)	0.04
5-9	155 (26.4%)	50 (25.2%)	0.02
10-15	77 (13.1%)	17 (8.5%)	0.001
16-20	35 (5.9%)	4 (2%)	0.03
21-25	30 (5.1%)	2 (1%)	0.02
25-30	12 (2%)	-	
30-33	6 (1%)	-	

*Based on Eric Brittain scoring system from multiple logistic functions in Framingham study.

CAD: Coronary Artery Disease. WC: Waist Circumference. IHD: Ischaemic Heart Disease.

39.6kg/m² with a mean of 28.7±1.59kg/m². Overall, 587 (74.7%) patients were having abdominal obesity with WC>90cm and 198 (25.3%) patients were obese with normal WC. Out of 587 patients with abdominal obesity (WC > 90cm), 510 (86.8%) had both BMI >25kg/m² and WC > 90cm. In our study, 678 (86.3%) individuals were physically inactive, while 105 (13.7%) were physically active. We had 300 (38.2%) individuals who were current active smokers for more than 5 years, while 485 (61.8%) were current non-smokers. BSF ranged from 86.4mg/dl to 340.2mg/dl with a mean value of 103.5±15.9mg/dl, blood sugar random (BSR) ranged from 132.2mg/dl to 426mg/dl with a mean of 176.4±9.8mg/dl. As per the diagnostic criteria, 114 (14.5%) patients were found to be suffering from diabetes mellitus (DM). Mean cholesterol levels were 187±1.89mg/dl ranging from 117mg/dl to 357mg/dl. There were 455 (57.9%) patients with hypercholesterolaemia. As per the questionnaire for personality assessment, 497 (63.3%) individuals were

having type "A" personality. We had 212 (27%) participants with history of CAD among first degree relatives. Mean systolic blood pressure of the study group was 128±12.43mmHg and mean diastolic blood pressure was 81±9.76mmHg. Overall 198 (25.2%) patients were found to be hypertensive. Comparison among patients with abdominal and generalised obesity was conducted (Table-1).

Overall 98% patients were having at least 1 risk factor for CAD. In patients with abdominal obesity, 583 (99.2%) individuals were having at least 1 risk factor for CAD while in those with generalized obesity this prevalence was low in 191 (96.5%). In subgroup of those with both BMI >25kg/m² and WC > 90 cm, all 510 individuals had at least 1 risk factor for CAD. We observed a curvilinear association between BMI and number of CAD risk factors with lowest number of risk factors in BMI range 25.1-27kg/m². Multivariable adjusted hazard ratio for higher categories of BMI increased from 1.52 (BMI 25.1-27kg/m²) to 2.56 (BMI >31kg/m²) (p <0.002). Larger WC was associated with increase in number of CAD risk factors after adjusting for covariates (p<0.001) (Table-2). The association of high BMI or large WC with increased risk of CAD risk factors was validated when applied using Eric Brittain scoring system. Those with abdominal obesity had a higher probability of developing CAD in the next 6 years as compared to those with generalised obesity and normal WC.

In patients with abdominal obesity, 310 (52.9%) had more than 4% probability of developing CAD in the next 6 years as compared to 73 (36.9%) individuals with generalised obesity. Moreover 82 (14%) patients with abdominal obesity had more than 16 % probability of developing CAD in the next 6 years as compared to only 6 (3%) in those with generalised obesity and the difference was significant statistically (p <0.001) (Table-3).

In subgroup of those with both BMI >25kg/m² and WC >90cm, 290 (56.9%) had more than 4% probability and 88 (17.2%) had more than 16% probability of developing CAD in next 6 years.

Discussion

To the best of our knowledge, the current study is the first major survey for estimation of burden of CAD risk factors among young healthy adults of Pakistan in relation to both abdominal and generalised obesity. Moreover, it is one of the very few community health surveys in Pakistan to give an estimation of knowledge regarding CAD risk factors which can form the basis for future interventional projects and their outcome measures. The study indicates that abdominal obesity is

much more clearly associated with cardiovascular risk factors and subsequent CAD mortality than general obesity as supported by Harald JS et al¹⁶ study in which 6355 individuals from both genders participated. In our study almost all CAD risk factors like physical inactivity, Type "A" personality, positive family history of CAD, presence of HTN and DM and ECG evidence of LVH were more prevalent in adults with abdominal obesity as compared to general obesity and the difference was statistically significant. In our study, smokers were more prevalent in the general obesity group which is contrary to Barrett-CE et al¹⁷ study in 1989 who observed more central adiposity with smoking history. However, further studies are required to conclude any definitive relationship between smoking and central obesity. In our study, 86.3% population was physically inactive as compared to 64.8% in Dodani S et al¹⁸ study which was carried out in urban Karachi area and, hence, had shown different prevalence of CAD risk factors in the population of Pakistan. This difference was due to the fact that we only selected obese individuals whereas in the study by Dodani S et al individuals of all BMI were selected. Besides, 57.9% of our study group had hypercholesterolaemia and 25% had HTN which is compatible with international studies on obese subjects.¹⁹ Moreover, 84% subjects of abdominal obesity were physically inactive as compared to 74% with general obesity owing to the fact that BMI is less sensitive to lifestyle pattern changes than abdominal obesity as reduction of calorie intake and increased physical activity causes reduction of body fat paralleled by an increase in muscle mass. This results in marked changes in measures of abdominal obesity but no change or little change in BMI.²⁰ We observed a curvilinear association between BMI and number of CAD risk factors with lowest number of risk factors in BMI range 25.1-27kg/m². Similar trend of increased prevalence of CAD risk factors among obese people was observed in a large National Health and Nutrition Examination Survey conducted from 1999 to 2004.²¹ On the other hand it was also observed in our study that with increasing WC, numbers of CAD risk factors also increased even at a greater frequency which is the main endpoint of our study. In both groups of obese subjects, the probability of developing CAD in future was calculated by Eric Brattain technical report published in 1979 owing to selection of almost the same variables and simplicity of the scoring system. It was found that those with abdominal obesity had a higher probability of developing CAD in the next 6 years as compared to those with generalised obesity. This probability remains subject for verification by a prospective study which is

very strongly suggested. Our study had many limitations. It was exclusive to the male gender although females are more prone to both forms of obesity in Pakistan. Secondly, blood pressure was measured three times, but only on one occasion, which might have overestimated the prevalence of hypertension. Thirdly, we did not exclude many important confounders like alcohol drinking and dietary habits which are also important CAD risk factors. Fourthly, all participants with BMI>30 had WC>90 as well, so which was more powerful in generating CAD risk factors could not be determined. Fifthly, we only selected people from one city and from one ethnic group so results cannot be generalised. Other important biases in our study are subjective nature of family history, smoking years and rare possibility of co-existing diseases as well as secondary causes of obesity.

Conclusion

The findings show that BMI is not as appropriate for prediction of CAD development and presence of CAD risk factors as WC. Therefore, it is not useful as an indicator of the main health complications associated with obesity. Our observations strongly indicate that BMI alone should no longer be used as a universal measure of obesity in the decision-making for risk stratification and weight-loss strategies.

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