Original Research Article

# Anthropometric measures of abdominal obesity like waist circumference and waist-to-hip ratio as predictors of cardiovascular events in acute coronary syndromes among Indians

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## Abstract

**Background:** Advances in the prevention and treatment of CV risk factors have lead to significant reductions in CVD related mortality in the India during the last several decades. Considering these facts, in this study we attempted to determine the association between wide arrays of risk factors especially anthropometric measures of abdominal obesity and ACS and also compared them with age and sex matched controls. **Materials & Methods:** The present hospital based case-control study was carried out in a tertiary care centre. The study period was two years from November 2009 to November 2011. About 100 cases of acute coronary syndrome and an equal number of age and sex matched controls were studied. All the subjects of ACS and controls were evaluated by following cardiometabolic risk factors: anthropometric measures like BMI, waist circumference and WHR. **Results:** Chest pain was the predominant presenting symptom (98%). Out of the 100 patients with acute coronary syndrome, 31 had unstable angina, 17 had NSTEMI and 52 had STEMI. Patients of acute coronary syndrome had a significantly higher WHR (0.88±0.17 vs. 0.82±0.08) and BMI (24.59±2.99 vs. 22.63±2.22kg/$m^2$) (p=0.0114 and 0.000 respectively). **Conclusion:** It can thus conclude that female cases of acute coronary syndrome were older than male cases. Raised WHR, BMI, Hypertension, diabetes, alcohol consumption, smoking, raised total cholesterol, serum triglycerides, LDL, Non-HDL cholesterol, serum uric acid and decreased HDL were the risk factors associated with acute coronary syndrome.

**Keywords:** Acute coronary syndrome (ACS), abdominal obesity, cardiovascular disease (CVD), anthropometric measures, body mass index (BMI), waist circumference (WC), waist-to-hip ratio, metabolic risk factors.



## Introduction

Abdominal obesity is increasingly recognized as a major risk factor for cardiovascular disease (CVD) compared with body mass index (BMI), anthropometric measures of abdominal obesity (e.g waist circumference (WC), waist-to-hip ratio, sagital abdominal diameter appear to be more strongly associated with metabolic risk factors, incident CVD events, and death.The cardio-metabolic risk associated with abdominal obesity is attributed to the presence of visceral adipose tissue (VAT), which promotes insulin resistance, dyslipidemia, and hypertension. Body mass index (BMI) has been routinely used in clinical and public health practice for decades to identify individuals and populations at risk of future cardiovascular disease and diabetes. However, in recent years, BMI has been criticized as a measure of risk because it reflects both fat and lean mass and because it does not identify fat distribution [1]. WC and WHR are most common proxy measures of VAT. Both measures are correlated with VAT (Visceral adipose tissue), however, WC is more strongly associated with VAT [2]. Adipose tissue is now recognized to be significant endocrine organ secreting a variety of hormones and cytokines. Data suggests that some of these cytokines arising from adipose tissue may be partly responsible for the metabolic, hemodynamic and haemostatic abnormalities associated with IR, Like CRP, TNF, and IL-6. TNFα inhibits the action of Lipoprotein lipase and simulates lipolysis TNFα promotes monocyte admission to the endothelium and inhibits endothelial nitric oxide synthase (ENOS). TNF also impairs the function of the insulin signaling pathway by effects on phospharylation of both the insulin receptor and insulin receptor substrate-I. IL-6 may also induce endothelial expression of cytokines, therby contributing to endothelial dysfunction [3]. Koning L., et al (2007) [2] in their meta-regression analysis of prospective studies showed abdominal obesity as measured by WC and WHR is significantly associated with the risk of incident CVD events. A 1 cm increase in WC is associated with a 2% increase in risk of future CVD and 0.01 increases in WHR are

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associated with a 5% increase in risk. Meenakshisundaram R. et al (2010)[4] in their study observed that low BMI, smoking, diabetes, hypertension and dyslipidemia were found to be an independent risk factor for MI. In the present report, higher prevalence of risk factors and MI were seen in patients even with BMI < 23 kg/$m^2$.Mahaffey KW et al (2010) [5] in a study on ACS found thirty-two percent of patients were obese (BMI> or =30), with a greater proportion of patients with obesity from North America (36%) compared with other regions. Enoxaparin was dosed as 1 mg/kg regardless of body weight without maximum. The first dose of enoxaparin was underdosed in 15% of patients' assigned enoxaparin, and obese patients were more likely to be under dosed than non-obese patients. Obese patients were younger, less often white, had more diabetes, hypertension, hyperlipidemia, family history of coronary artery disease, and congestive heart failure but fewer strokes, less peripheral vascular disease, and less often smoked. After adjustment, increased BMI was not an independent predictor of bleeding outcomes or 30-day death/myocardial infarction (MI), but increased BMI was predictive of lower 1-year mortality in the subgroup of patients with BMI at baseline below approximately 30 kg/m.

Kadakia M B (2011) [6] investigated the relationship between two measures of obesity—body mass index (BMI) and waist circumference (WC)—and 30-day and 1-year outcomes after ACS. 6560 patients with non-ST elevation ACS in the MERLIN-TIMI 36 trial were followed for 1 year. Patients were stratified into three BMI groups (<25, 25–30, ≥30 kg/m2) and gender-specific tertiles of WC. The primary endpoint was cardiovascular death, myocardial infarction or recurrent ischaemia. Patients with BMI ≥30 kg/m2 had a significantly lower risk of the primary endpoint than those with BMI <25 kg/m2 (HR 0.64; 95% CI 0.51 to 0.81, p<0.0001) at 30 days. However, after the 30-day acute phase, landmark analysis from 30 days to 1 year showed no difference in risk between BMI groups (HR 1.09; 95% CI 0.92 to 1.29, p=0.34). WC tertiles demonstrated a similar relationship. When BMI groups were stratified by WC there was a trend towards more adverse outcomes in higher WC groups among those in lower BMI groups. The group with the lowest BMI and highest WC had the highest risk (HR 2.8; 95% CI 0.93 to 8.3; p=0.067).Advances in the prevention and treatment of CV risk factors have lead to significant reductions in CVD related mortality in the India during the last several decades. Considering these facts, in this study we attempted to determine the association between wide arrays of risk factors especially anthropometric measures of abdominal obesity and ACS and also compared them with age and sex matched controls.

**Materials & Methods**

The present hospital based case-control study was carried out in a tertiary care centre. The study period was two years from November 2009 to November 2011. About 100 cases of acute coronary syndrome and an equal number of age and sex matched controls were studied after getting approval from institutional ethical committee. All the subjects were interviewed, examined and investigated according to proforma that was pre-designed. Cardiometabolic risk factors were studied in cases and controls. About 100 consecutive cases of acute coronary syndrome admitted in intensive care unit of the tertiary care centre during the study period were included in the study.

**Inclusion Criteria for Cases**

Diagnosis of acute coronary syndrome was made by the presence of atleast 2 of the following 3 criteria:

Typical clinical symptoms: Chest pain is most common presenting complaint in patient of myocardial infarction. The pain is deep and visceral; heavy, crushing and squeezing. Most commonly it involves central portion of chest and/or epigastrium, and on occasion may radiate to arm may be associated with dyspnoea, syncope and vomiting.

ECG diagnosis of Unstable angina/ NSTEMI/STEMI

Cardiac enzymes: CPKMB values raised by more than 2 and half times the normal value.

**Exclusion criteria for cases**

Cases that had significant chronic illness (e.g. - liver disease, untreated hyper or hypothyroidism, renal disease, bleeding tendency or malignancy) were excluded as these conditions would have led to change in lifestyle or alteration in the risk factors of acute coronary syndrome.Cases who did not give consent were not included in the study.

**Selection of controls**

Age and sex matched healthy controls were randomly selected. Controls were randomly selected from the patients attending OPD or IPD for minor ailments (like headache, fever, gastritis or for physical checkup). Unrelated attendance or neighborhood healthy subjects who visited the cases, who had no history or evidence of heart disease were selected.

**Exclusion criteria for controls**

Controls having evidence of ischemic heart disease, significant chronic illness (e.g.-liver disease, hyper or hypothyroidism, renal disease, bleeding tendencies or malignancy).Symptoms suggestive of angina or past history of acute coronary syndrome.Those who were not willing to participate in the study. About 100 patients of ACS fulfilling the inclusion and exclusion criteria were include in the study along with age and sex matched controls. Five cardiometabolic risk factors were evaluated in the present study: obesity, hypertension, hyperglycemia, dyslipidemia and smoking**).** All the subjects of ACS and controls were evaluated by following cardiometabolic risk factors: anthropometric measures like BMI, waist circumference and WHR. Blood pressure, dyslipidemia (total cholesterol, LDL, TG and HDL) and fasting blood sugar level was also noted.

BMI was calculated according to the following formula- BMI= (Weight in Kg)/ (Height in $m)^2$according to WHO- BMI- <18 – Underweight; 18.1-24.9- Normal; 25-29.9- Overweight and >30- Obese. Waist circumference was measured to the nearest of 0.1cm using a non-stretchable standard tape. Measurements were taken over the unclothed abdomen at the smallest diameter between the costal margin and the iliac crest. The tape measure was kept horizontal. Subject was made to relax with the arms held loosely by the sides. Two measurements were recorded. It was measured to the nearest of 0.1cm using a non-stretchable standard tape. Measurements were taken over light clothing at the level of greater trochanter (usually the widest diameter around the buttocks). The tape measure was kept horizontal. Subject was made to relax with the arms held loosely by the sides. Two measurements were recorded. Waist hip ratio (WHR) was calculated by dividing waist measurement by hip measurement.

WHR = (Waist circumference in cm)/ (Hip circumference in cm)

According to the WHO, WHR should be <0.9 for males and WHR<0.85 for females. More than that was taken as a risk factor for coronary artery disease.

Continuous variables (age, anthropometry, biochemical and clinical parameters) were presented as Mean ± S.D. Categorical variables were expressed in percentages. Continuous variables were compared between cases and controls by performing unpaired t- test. Categorical variables were compared by Chi-2 statistics. Chi-2 test for linear trend was used to assess trend between cardiometabolic risk factors and mortality. Odd's ratio (OR), 95% confidence interval (C.I.) were estimated for various risk factors. Multiple logistic regression analysis was performed to identify the independent risk factors for acute coronary syndrome. p<0.05 was considered as statistically significant. Data was analyzed using statistical software STATA version 10.0.

**Results**

The study group comprised of 100 patients of acute coronary syndrome admitted at the tertiary care centre over a period of 2 years from November 2009 to November 2011 and an equal number of age and sex matched controls. The mean age of cases was 55.9±10.40

years and mean age of controls was 55.32±10.71years. The difference was not statistically significant (p=0.6982), hence they were comparable [Graph 1].

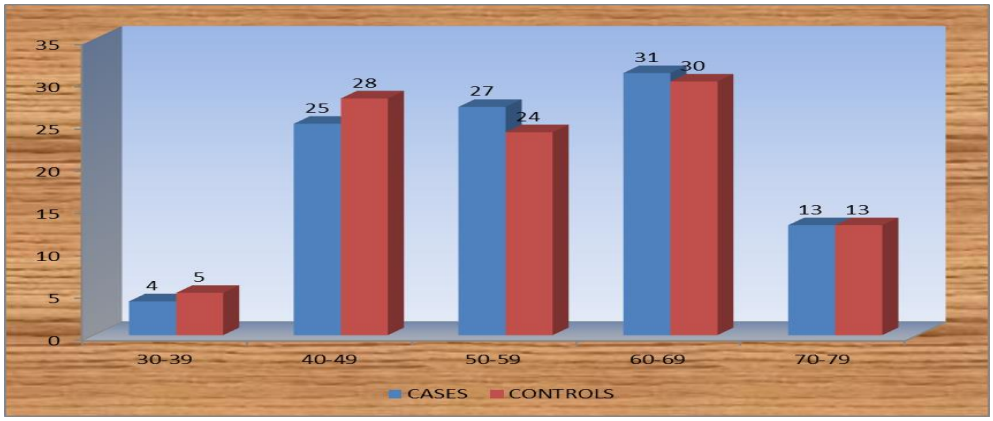


**Fig 1: Showing age distribution of cases and controls**

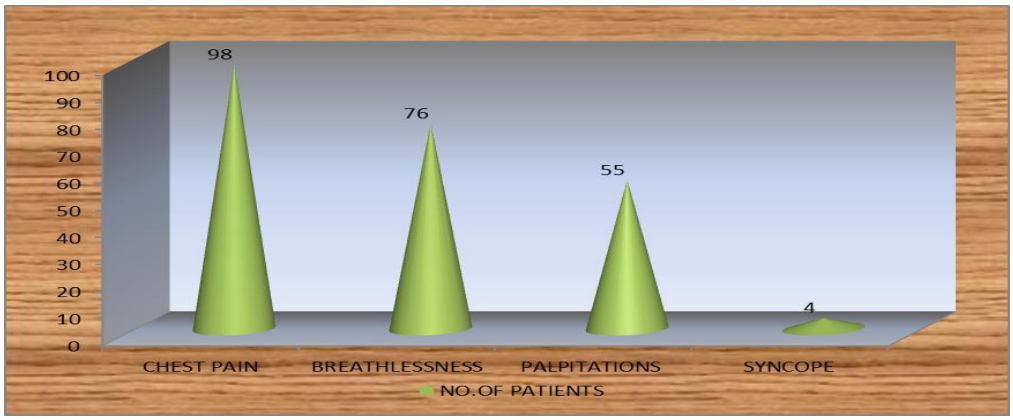


**Fig 2: Showing presenting complaints of patients**

Fig 2 shows the presenting symptoms in patients of acute coronary syndrome. It was seen that in the 100 patients with acute coronary syndrome, 98 (98%) had presented with chest pain, 76 (76%) breathlessness, 55 (55%) palpitations and 4 (4%) had syncope on presentation.

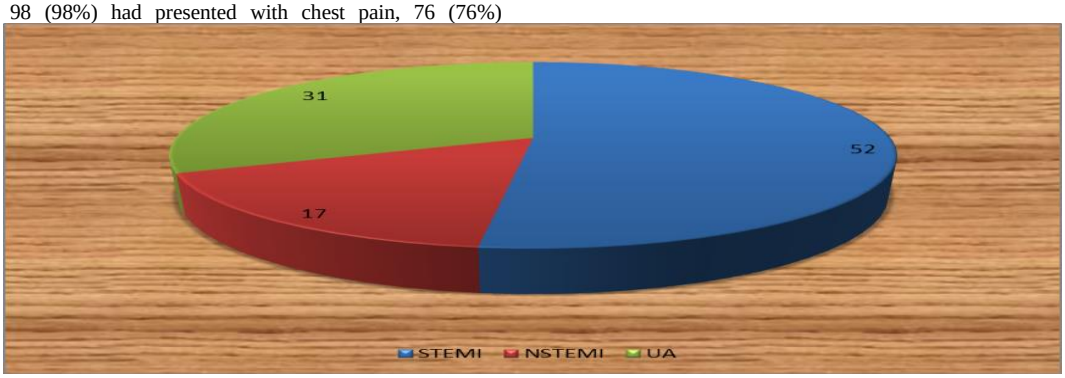


**Fig 3: Showing different presentations of the acute coronary syndrome**

Fig 3 shows the different presentations of acute coronary syndrome. Out of 100 cases, 31 (31%) presented with unstable angina, 17 (17%) with Non-ST Elevation Myocardial Infarction (NSTEMI) and the majority i.e.52 (52%) with ST Elevation Myocardial Infarction (STEMI).

**Table 1: Association of conventional risk factors with gender**

| Risk Factor | Male (N=70) | Female (N=30) | P-Value |
|---|---|---|---|
| Tobacco Chewing | 32 (45.7%) | 8 (26.7%) | 0.075 |
| Alcohol | 28 (40%) | 0 (0%) | 0.000 |
| Smoking | 43 (61.4%) | 0 (0%) | 0.000 |

| | | | |
|---|---|---|---|
| Hypertension | 36 (51.4%) | 11 (36.7%) | 0.175 |
| Diabetes | 30 (42.9%) | 19 (63.3%) | 0.061 |
| Past History of IHD | 10 (14.3%) | 5 (16.7%) | 0.760 |
| Family History of IHD | 14 (20%) | 3 (10%) | 0.222 |

Table 1/graph 4 shows the association of conventional risk factors with gender. Alcohol consumption was seen in 40% of males and smoking was seen in 61.4% of males while there were no female alcohol drinkers or smokers. Hence alcohol consumption and smoking were significantly associated with the male sex (p=0.000 and p=0.000 respectively). It was seen that tobacco chewing was more prevalent in males (45.7%) as compared to females (26.7%). However this was not statistically significant (p=0.075). The prevalence of diabetes in females (62.9%) was higher as compared to males (42.9%). This was however not statistically significant (p=0.061). Prevalence of other risk factors like hypertension (51.4% vs.36.7%), past history of IHD (14.3% vs.16.7%) and family history of IHD (20% vs.10%) was not significantly different among male patients as compared to female patients (p=0.175, p=0.760 and p=0.222 respectively).

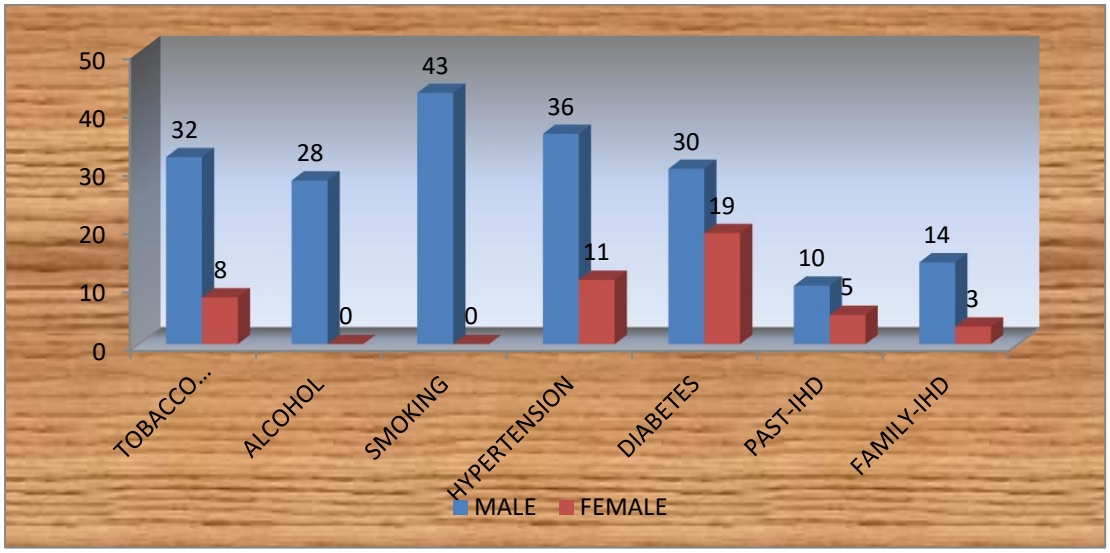


**Table 4: Showing association of conventional risk factors according to gender**

**Table 2: Frequency of conventional risk factors according to presentation of acute coronary syndrome**

| Risk Factor | Unstable Angina(n=31) | NSTEMI(n=17) | STEMI(n=52) | p-value |
|---|---|---|---|---|
| Smoking | 10 (32.3%) | 4 (23.5%) | 29 (55.7%) | 0.023 |
| Alcohol | 9 (29%) | 1 (5.9%) | 18 (34.6%) | 0.072 |
| Tobacco | 11 (35.5%) | 7 (41.2%) | 22 (42.3%) | 0.824 |
| Hypertension | 10 (32.3%) | 9 (52.9%) | 28 (53.8%) | 0.141 |
| Diabetes | 19 (61.3%) | 15 (88.2%) | 6 (11.5%) | 0.000 |
| Past history of IHD | 7 (22.6%) | 2 (11.8%) | 9 (17.3%) | 0.636 |
| Family history of IHD | 5 (16.1%) | 3 (17.6%) | 9 (17.3%) | 0.987 |
| Obesity (BMI>30Kg/$M^2$) | 2 (6.5%) | 5 (29.4%) | 0 (0%) | 0.398 |

Table 2 shows the frequency of conventional risk factors according to the presentation of acute coronary syndrome. It was seen that smoking was more common in patients presenting with STEMI (55.7%) as compared to unstable angina (32%) and NSTEMI (23.5%). The difference was statistically significant (p=0.023). Diabetes was more commonly associated with patients with NSTEMI (88.2%) as compared to unstable angina (61.3%) and STEMI (11.5%). This difference was found to be highly significant (p=0.000). The prevalence of other risk factors like alcohol consumption, tobacco chewing, hypertension, obesity, past and family history of ischemic heart disease was not significantly different among patients with different presentations of acute coronary syndrome.

**Table 3: Association of acute coronary syndrome with the metabolic syndrome**

| Metabolic Syndrome | Cases(N=100) | Controls(N=100) | OR | 95%C.I. | Chi-2 | p-value |
|---|---|---|---|---|---|---|
| Present | 30 (30%) | 14 (14%) | 2.6 | 1.23 – 5.78 | 7.46 | 0.0063 |
| Absent | 70 (70%) | 86 (86%) | | | | |

Table 3/Fig 5 shows the association of the acute coronary syndrome with the metabolic syndrome. It was seen that the prevalence of the metabolic syndrome in cases was 30% and in controls it was 14%. Therefore patients with the metabolic syndrome have a 2.6 times higher risk of developing acute coronary syndrome (p=0.0063).

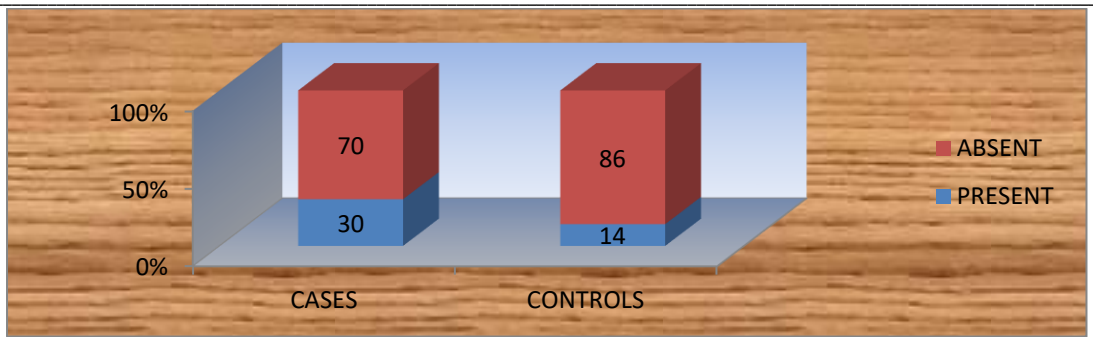


**Fig 5: Showing association of acute coronary syndrome with the metabolic syndrome**

**Table 4: Association of acute coronary syndrome with body mass index (BMI)**

| BMI (Kg/M$^{2)}$ | Cases (N=100) | Controls (N=100) | OR | 95% C.I. | Chi-2 | p-value |
|---|---|---|---|---|---|---|
| <25 | 56 (56%) | 86 (86%) | - | - | - | - |
| 25-29.9 | 37 (37%) | 13 (13%) | 4.37 | 2.03 -9.71 | 4.038 | 0.000 |
| 30-39.9 | 7 (7%) | 1 (1%) | 10.75 | 1.30 -89.89 | 2.193 | 0.007 |
| >40 | 0 (0%) | 0 (0%) | - | - | - | - |

Table 4 shows association of acute coronary syndrome with Body mass index (BMI). 37% of cases were overweight (BMI =25-29.9) and 13% of the controls were overweight. 7% of cases were obese (BMI=30-39.9) and 1% of controls were obese. There were no morbidly obese patients in either the cases or controls. Thus overweight individuals had a 4 times higher risk of developing acute coronary syndrome (p=0.000), while obese individuals had a 10 times higher risk of developing the acute coronary syndrome (p=0.007

**Table 5: Association of acute coronary syndrone with waist-hip ratio (WHR)**

| WHR | Cases (N=100) | Controls (N=100) | OR | 95%C.I. | Chi-2 | p-value |
|---|---|---|---|---|---|---|
| >0.9(M) >0.85(F) | 52 (52%) | 22 (22%) | 3.84 | 1.99 – 7.47 | 19.31 | 0.000 |
| ≤0.9(M) ≤0.85(F) | 48 (48%) | 78 (78%) | | | | |

Table 5 shows the association of acute coronary syndrome with waist-hip ratio (WHR). 52% of cases had an increased WHR while only 22% of controls had an increased WHR. Thus male subjects with a WHR of more than 0.9 and female subjects with a WHR of more than 0.85 had an almost 4 times higher risk of developing acute coronary syndrome (p=0.000).

**Table 6: Association of acute coronary syndrone with waist circumference (WC)**

| WHR | Cases (n=100) | Controls (n=100) | OR | 95%C.I. | Chi-2 | p-value |
|---|---|---|---|---|---|---|
| >90(M) >80(F) | 42 (42%) | 33 (33%) | 1.47 | 0.79 – 2.72 | 1.73 | 0.1887 |
| ≤90(M) ≤80(F) | 58 (58%) | 67 (67%) | | | | |

Table 6 shows the association of acute coronary syndrome with waist circumference (WC). It was seen that 42% of cases had a raised waist circumference and 33% of controls had a raised waist circumference. Therefore waist circumference was not associated with acute coronary syndrome (p=0.1895).

**Discussion**

**Anthropometric and biochemical parameters in cases and controls**

In present study it was seen the BMI was significantly more (24.59±2.99 vs. 22.63±2.22kg/m$^2$) in cases as compared to controls (p=0.000). The Waist-Hip ratio in cases (0.88±0.17) was higher as compared to controls (0.82±0.08). The difference was statistically significant (p= 0.0114). Burazeri G. et al [7] in their case control study showed that ACS patients had a higher body mass index. In men this difference (27.2±3.7 vs. 26.6±3.5) was significant (p=0.006), whereas in women it was not significant (27.9±3.8 vs. 26.6±3.9, p<0.0001).Lanas F et al [8] (INTERHEART Study) showed increased WHR (OR, 2.49, 95% CI-1.97 to 3.14) was associated with higher risk of AMI. In the present study the total cholesterol was significantly (p=0.000) increased in cases (179.60± 41.11 vs. 143.45±21.11 mg/dl). Serum triglycerides (123.19±37.29 vs. 109.35±22.86 mg/dl), LDL (109.05±37.62 vs. 69.02±19.30 mg/dl) and Non-HDL (133.71±40.52 vs. 90.99±20.20 mg/dl) were also significantly raised in cases as compared to controls (p=0.0018, p=0.000 and p=0.000 respectively). HDL levels were significantly (p=0.0001) lower in cases (45.89±14.90 mg/dl) in comparison to controls (52.44±8.52 mg/dl). Thus patients with ACS had dyslipidemia.This correlated with the study by Manurung et al [9] wherein they found the patients with ACS to have dyslipidemia; the mean value of total cholesterol was 205.23±54.84 mg/dl, LDL was 136.16±47.29 mg/dl, HDL was 42.84±10.28 mg/dl and TG was 157.25±10.16 mg/dl. In the present study the mean serum uric acid level in cases was 5.17±2.55 mg/dl, while in the controls it was 3.78±1.54 mg/dl. This difference was statistically significant (p=0.000). This result correlated with the study by Nadkar M Y et al [10], found that in 100 cases of acute myocardial infarction the mean serum uric acid level was 5.22±1.94 mg/dl, compared to 50 controls having mean serum uric acid level of 3.77±0.74mg/dl.

**Comparison of anthropometric and biochemical parameters according to gender in patients of acute coronary syndrome**

It was seen that 25 (83.3%) female patients with acute coronary syndrome had decreased HDL level, while 26 (37.1%) male patients had decreased HDL levels. This difference was statistically significant (p=0.001). It was seen that 18 (60%) females had a raised waist circumference (>80 cm), while only 23 (32.8%) of males had a raised waist circumference (>90cm). This difference was statistically

significant(p=0.0114). Otherwise there was no statistically significant difference in levels of Total cholesterol, serum triglycerides, LDL, non-HDL, serum uric acid, BMI and WHR according to gender. In the study by Burazeri G. et al [7], WHR in men and obesity (BMI) in women was strongly associated with ACS.

Kabagambe EK et al [11] showed that male MI patients had a lesser Waist circumference than females. Khot UN. et al [12] showed that hyperlipidemia was more prevalent in women with ACS than in men.Butt Z. et al [13] found no difference. Menyar A.E. et al [14] showed that dyslipidemia more prevalent in older women (40-59 yrs) than males. Kurtulumus N. et al [15] showed that high Cholesterol and LDL and low HDL are very important risk factors for IHD, and were found to be significantly present in both genders.

**Association of conventional risk factors with gender**

In present study, we found that very few of the risk factors are different in males and females. It was found that Tobacco chewing (45.7% vs. 26.7%), Cigarette Smoking (61.4% vs. 0%) and Alcohol intake (40% vs. 0%) were more prevalent in males than females but only alcohol intake (p= 0.000) and smoking (p= 0.000) were statistically significantly different.Although the results about smoking and alcohol prevalence in women in the present study were in the expected direction, it cannot be confidently said that no female in the present study had every smoked or consumed alcohol. This may be explained by fear of disclosure of their smoking and drinking habits and hesitation.In the study by Kurtulmus N.et al [15] it was seen that smoking was 2.5 times higher in male population (77.0% vs. 31.6%), (p=0.0001). Prevalence of Alcohol consumption was 7.8% in men and this was 6 times higher than in women (1.3%, p=0.021). Berazeri G. et al [7] in their study upon adjustment for covariates, cigarette smoking was found to be a strong predictor of acute coronary syndrome in men (P<0.001). In the study by Butt Z. et al [13] it was seen that in men, but not in women, there was significant association of ACS with smoking (p=0.000). Kabagambe E.K. et al [11] in their study showed that compared to women, men were more likely to smoke (31% vs. 10%). The study by Menyar A.E. et al [14] showed that the prevalence of smoking was higher in Arabian men, but it was relatively in uncommon in women (48% vs. 7% respectively). In the present study, it was found that prevalence of diabetes in females was higher than in males, but it was not statistically significant (p=0.061 and respectively). A study done by Menyar A.E. et al [14] showed that women with ACS were more likely to have Diabetes Mellitus and hypertension as compared to men (p=0.001 and p=0.001 respectively). Howard BV et al [16] showed in their study that diabetic women had significantly higher prevalence of MI then diabetic men. Kurtulmus N. et al [15] in their study showed that diabetes was present in 51% of female subjects and 14.3% of male subjects. They also showed that prevalence of hypertension was higher in women than men (58.2:28.1, p=0.0001). Butt Z. et al [13] in their study demonstrated that hypertension (p=0.003) and diabetes (p=0.009) was more prevalent in women with ACS than in men. In the study by Burazeri G. et al [7] it was seen that men with ACS had a significant association with hypertension (p=0.01), but diabetes was not significantly associated with either sex.

**Frequency of conventional risk factors according to presentation of acute coronary syndrome**

Prevalence of smoking, alcohol consumption, tobacco chewing, hypertension, diabetes, obesity and past and family history of IHD were compared in the different presentations of ACS. It was seen that among all these risk factors, smoking was significantly associated with STEMI (p = 0.023) where as Diabetes was statistically significantly associated with NSTEMI (p = 0.000). Menyar A.E. et al[14] in their study showed that STEMI patients were more often smokers and NSTEMI were more often diabetic, hypertensive, dyslipidemic and obese. In the study by Khot et al [12]current smoking was more prevalent among patients with ST elevation AMI then among patients with non STEMI or unstable angina. Rosengren A. et al [17] showed in their study that among patients with ACS, presentation with STEMI was strongly associated with smoking where as Hypertension, high BMI are associated with NSTEMI and unstable angina.

**Association of acute coronary syndrome with the metabolic syndrome**

In the present study it was seen that the prevalence of the metabolic syndrome in cases was 30% and in controls it was 14%. Therefore acute coronary syndrome was significantly associated with the metabolic syndrome (p=0.0074). Mathavan A et al [18] in a cross sectional survey done on 4000 physicians, identified 49% of female physicians and 41% of male physicians to have the metabolic syndrome. Only 17% were physically active. Cabrera M.S. et al [19], Tsai CRet al [20], Defronzo et al[21], Isomaa B et al [22], and Al-Suwaidi J et al [23] found that the presence of multiple metabolic derangements in patients has been associated with increased risk of CHD.

**Association of acute coronary syndrome with body mass index**

In the present study it was seen that overweight (BMI=25-29.9) individuals had a 4 times higher risk of developing acute coronary syndrome (p=0.000), while obese (BMI>30) individuals had a 10 times higher risk of developing the acute coronary syndrome (p=0.007). Rosengren A. et al [17], Menyar A E et al [14], Kurtulmus N et al [15] and Burazeri G et al [7] showed that obesity was strongly associated with acute coronary syndrome. Sodjinou R et al [24], Jenson M K et al [25] and Mandal S et al [26] also showed that obesity was strongly associated with acute coronary syndrome. However Meenakshisundaram R et al [4] and Vikram et al [27] showed that BMI cannot be considered as a lone independent risk factor for ACS.

**Association of acute coronary syndrome with WHR and waist circumference**

The present study shows that male subjects with a WHR of more than 0.9 and female subjects with a WHR of more than 0.85 had an almost 4 times higher risk of developing acute coronary syndrome (p=0.000). However there was no significant association of acute coronary syndrome with waist circumference (p=0.1895). This correlated with many other studies reported in literature. Burazeri G.et al [7], Koning L et al[2] and Yusuf S. et al[28] found that WHR was strongly associated with MI. Lanas F. et al [8](INTERHEART study) showed that increased waist-to hip ratio (OR 2.49, 95% CL, 1.97 -3.14) was associated with higher risk of acute myocardial infarction. Burazeri G. et al [7] showed that raised waist hip ratio in men (OR- 4.03; 2.83-5.73) was strongly associated with acute coronary syndrome. Studies by Yusuf S. et al[28] and Pais P.et al [29] also support the results of the present study. Kadakia M. et al [6] showed that WC out of proportion to BMI (suggestive to significant central adiposity) may be a higher risk following acute coronary syndrome. Lawrence et al [2] concluded both WHR and WC are significantly associated with risk of incident CVD events. Yusuf S.et al [28] in their case control study (INTERHEART Study) found that WHR was more strongly associated with MI than BMI in both men and women.

**Conclusion**

It was seen that 18 (60%) females had a raised waist circumference (>80 cm), while only 23 (32.8%) of males had a raised waist circumference (>90cm). This difference was statistically significant (p=0.0114).It was seen that there were 31 (44.3%) males and 13 (43.3%) females with raised BMI. This difference was not statistically significant (p=0.9299).About 37 (52.8%) of male patients had a raised WHR (>0.9) and 15 (50%) of females had a raised WHR (>0.85). This difference was also not statistically significant (p=0.7933). Overweight individuals had 4 times higher risk of developing ACS (p=0.000), while obese individuals had a 10 times higher risk of developing ACS (p=0.007). The present study showed that male subjects with a WHR > 0.9 and female subjects with a

WHR> 0.85, had an almost 4 times higher risk of developing ACS (p=0.000).

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