

CARDIOMETABOLIC PROFILE IN PATIENTS OF ACUTE CORONARY SYNDROME*Saish Pradip Alegaonkar¹, Sourya Acharya², Samarth Shukla³*

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ABSTRACT

BACKGROUND

The aim is to study cardiometabolic profile in patients with acute coronary syndrome (ACS) with reference to metabolic syndrome (MS).

MATERIALS AND METHODS

This study was carried out in Acharya Vinoba Bhave Rural Hospital of Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha from September 2014 to August 2016. A total of 200 diagnosed patients of ACS admitted in medicine intensive care unit were enrolled in study and investigated for serum fasting blood sugar (FBS), serum high density lipoprotein (HDL), serum triglyceride (TG) and serum C- reactive protein (CRP). Anthropometric measures like height, weight, body mass index (BMI) and waist circumference (WC) were calculated.

RESULTS

Mean age of males in study subject was 55.26 ± 13.05 and in females 60.25 ± 12.82 . BMI and WC were significantly higher in males than females ($p < 0.0001$). Percentage of MS was higher in males than females ($p = 0.009$). Of the total study population, 16 (11.27%) males and 16 (8%) females had metabolically obese normal weight (MONW). BMI, WC, HDL value had significant differences in all 3 presentations of ACS. DM and HTN were more common in MS than NMS. BMI, WC, FBS and TG values were higher in MS than non-metabolic syndrome (NMS). HDL values were lower in both genders with MS than NMS.

CONCLUSION

We conclude that ACS is a major burden of public health. MS is a key association with ACS. Appropriate preventive strategies focusing on population in general and high risk groups should be undertaken aggressively. More population based studies encompassing subgroups like "MONW" should be done that may throw more light on evidence based practice to prevent future cardiovascular diseases (CVD).

KEYWORDS

ACS, MS, MONW, NMS.

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BACKGROUND

Acute coronary syndrome (ACS) refers to a spectrum of clinical events that result from acute myocardial ischaemia. It encompasses unstable angina (UA), ST- segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (Non-STEMI).¹

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In India, heart attack is about 10 times more common in younger population, with 30% of deaths occurring in people <40 years of age.^{2,3}

In the last twenty years, constant advances have been made in the classification and improvement of modifiable and non-modifiable risk factors predisposing to CVD such as cigarette smoking, high blood pressure, elevated serum cholesterol, decreased serum HDL, diabetes, obesity, elevated serum C-reactive protein and sedentary habits. Though diabetes has a proven role in CVD, it has been found that insulin resistance leads to atherosclerosis even before it produces frank diabetes, hence insulin resistance is an independent risk factor for atherothrombosis.^{4,5}

Metabolic syndrome (MS) confers increased incidence of coronary artery disease (CAD) of all forms due to enhanced atherosclerosis, endothelial dysfunction, and a number of other biochemical modifications in coronary

milieu. The prevalence of metabolic syndrome in CAD patients is often found to be very high.

New focus is being shifted to a subgroup of individuals, who are not obese on the basis of height and weight, Body mass index (BMI), but who like people with overt obesity, are hyperinsulinaemic, insulin resistant, and predisposed to type 2 diabetes, hypertriglyceridaemia, and premature coronary heart disease. These people are known as metabolically obese normal-weight (MONW) individuals. Evidences suggest that this group probably represents one end of the spectrum of people with the insulin resistance syndrome and premature acute coronary syndromes.⁶

Elevated levels of serum CRP are associated with CVD events. Several meta-analyses have found high concentrations of serum CRP to be strongly associated with an increased risk of stroke, coronary heart disease, and vascular mortality.⁷⁻¹⁰ The existence of a causal relationship, however, is subject to great debate. Few studies are available till date which have studied and established the association of MS with ACS.

Thus, it will be interesting to study the various cardiovascular risk factors, including the MS and MONW in cases of ACS.

MATERIALS AND METHODS

The study was carried out for a period of two years from September 2014 to August 2016 in the Department of Medicine, Acharya Vinoba Bhave Rural Hospital of Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha. Subjects who were ready to give consent were studied in detail as per the proforma and following information was collected.

Sources of Data

Patients of ACS admitted to MICU were studied after categorising the type of ACS, appropriate treatment was given as per protocol.

General information- name, age, sex, address was noted; History- A detailed history regarding alcohol, smoking, tobacco, diabetes mellitus, hypertension, drug intake (antidiabetic, antihypertensive, antidyslipidaemic), prior treatment was taken.

OBSERVATION AND RESULTS

ACS	Male	Female	Total (200)	x ² -value	p-value
NSTEMI	11 (5.5%)	12 (6%)	23 (11.50%)	7.18	0.028
STEMI	103 (51.5%)	34 (17%)	137 (68.50%)		
UA	28 (14%)	12 (6%)	40 (20.00%)		
Total	142 (71%)	58 (29%)	200 (100%)		

Table 1. Distribution of Gender of the Patients according to Type of ACS

x²=7.18; p=0.028 S-Significant.

Chi-square (x²) test showed that there was significant association between type of ACS and gender of the patients (p=0.028). Proportion of patients with STEMI was significantly higher among both males and females.

Clinical Examination

A detailed general physical examination of the patient was done, vital signs, pallor, Icterus, clubbing, cyanosis and jugular venous pressure were seen.

Anthropometric measurement-Waist circumference, height, weight were taken.

Body mass index (Quetelet's formula).

BMI = weight in kg/height in m².

Cut of value for waist circumference in Indian male is <90 cm and for female <80cm.

According to ASIAN Classification categories of Body Mass Index (BMI).¹¹

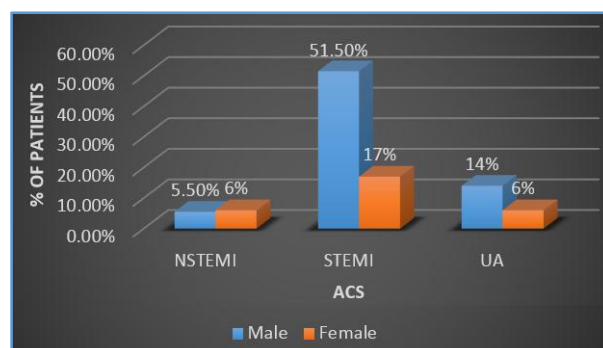
BMI (kg / m ²)	Category
<18.5	Underweight
18.5 – 22.9	Healthy/normal
23 – 24.9	Overweight
>25	OBESE

BMI <23kg/m², includes non-obese patients and ≥23kg/m² include both overweight and obese patients.

Laboratory Parameter

Blood sugar measurement, Fasting lipid profile (HDL, TG) measurement and serum C reactive protein assessment.

- Positive serum CRP- visible agglutination observed on slide (CRP concentration greater than 0.6 mg/dl).
- Negative serum CRP- no agglutination observed on slide (CRP concentration less than 0.6 mg/dl).¹²



Graph 1. Distribution of Patients according to Type of ACS

	Male(n=142)	Female(n=58)	t-value and Z-value	p-value
Age (Years)	55.26 ± 13.05	60.25 ± 12.82	t ₁₉₈ =2.46	0.014*
Smoking	56 (39.44%)	1 (0.50%)	5.36	<0.0001*
Alcohol	38 (26.76%)	3 (1.50%)	3.43	0.0001,S
Tobacco	55 (38.73%)	6 (3.00%)	3.95	0.0001,S
DM	44 (30.99%)	21 (10.50%)	0.71	0.47,NS
HTN	61 (42.96%)	23 (11.50%)	0.42	0.073,NS
BMI (kg/m ²)	23.42 ± 2.27	21.98 ± 2.49	t ₁₉₈ =3.95	<0.0001*
WC (cm)	90.50 ± 5.66	83.17 ± 7.01	t ₁₉₈ =7.73	<0.0001*
FBS (mg%)	124.60 ± 55.13	123.29 ± 47.52	t ₁₉₈ =0.15	0.87,NS
TG (mg%)	138.38 ± 31	138.51 ± 21.05	t ₁₉₈ =0.02	0.97,NS
HDL (mg%)	38.59 ± 5.65	43.25 ± 6.57	t ₁₉₈ =5.04	0.0001,S
Serum CRP	62 (43.66%)	22 (11%)	0.74	0.45,NS
MS	68 (47.89%)	35 (17.5%)	1.59	0.009,S
MONW	16 (11.27%)	16 (8%)	2.85	1.00,NS

Table 2. Baseline Characteristics in Study Population and their Comparison in both Genders

*Statistically Significant.

	STEMI(n=137)	NSTEMI (n=23)	UA (n=40)	p-value	CD ₅	CD ₁
Age (Years)	56.89 ± 14.20	57.17 ± 10.39	55.80 ± 10.83	F _{2,197} =0.12;p=0.88	3.74	50.70
Smoking	46 (33.6%)	6 (26.1%)	5 (12.5%)	χ ² =6.82;p=0.033*		
Alcohol	29 (21.2%)	3 (13.0%)	9 (22.5%)	χ ² =0.92;p=0.63		
Tobacco	43 (31.4%)	7 (30.4%)	11 (27.5%)	χ ² =0.22;p=0.89		
DM	49 (35.8%)	6 (26.1%)	10 (25.0%)	χ ² =2.12;P=0.34		
HTN	64 (46.7%)	13 (56.5%)	17 (42.5%)	χ ² =1.16;p=0.55		
BMI (kg/m ²)	22.58 ± 2.23	24.35 ± 2.13	23.66 ± 2.82	F _{2,197} =7.51;p=0.0007*	1.52	9.02
WC (cm) Male	91.28 ± 5.71	88.27 ± 5.33	88.50 ± 5.02	F _{2,139} =3.713;p=0.027*	78	105
WC (cm) Female	83.52 ± 7.77	82.08 ± 7.24	83.25 ± 4.43	F _{2,55} =0.184;p=0.833,NS	74	101
FBS (mg%)	119.54 ± 56.04	138.56 ± 37.33	132.00 ± 47.89	F _{2,197} =1.82;p=0.16	13.61	20.27
TG (mg%)	136.64 ± 30.89	139.30 ± 24.79	143.97 ± 20.09	F _{2,197} =1.04;p=0.35	4.42	9.05
HDL (mg%)Male	38.62 ± 5.68	37.81 ± 6.55	38.82 ± 5.34	F _{2,139} =0.126;p=0.882,NS	27	52
HDL (mg%)Female	41.97 ± 6.69	45.41 ± 5.97	44.75 ± 6.45	F _{2,55} =1.642;p=0.203,NS	30	55
Serum CRP	62 (45.3%)	8 (34.8%)	14 (35.0%)	χ ² =1.89;p=0.38		
MS	76 (55.5%)	11 (47.8%)	16 (51.5%)	χ ² =3.10;p=0.12		
MONW	23 (16.8%)	3 (13.0%)	6 (15.0%)	χ ² =0.24;p=0.88		

Table 3. Baseline Characteristics in Study Population and their Comparison in Different Presentations of ACS

F = F-Value with degrees of freedom found through ANOVA, χ²= Chi – Square test, * - Statistically Significant.

Baseline Characteristics	Metabolic Syndrome (n=103)	Non-metabolic Syndrome(97)	Test Statistic	p-value
Age (years)	56.31 ± 11.79	57.13 ± 14.50	t ₁₉₈ =0.43	0.19
Gender	Male	74 (76.29%)	χ ² =2.56	0.11
	Female	23 (23.71%)		
Smoking	30 (29.13%)	27 (27.84%)	Z=0.20	0.84
Alcohol	26 (25.24%)	15 (15.46%)	Z=1.71	0.087
Tobacco	32 (31.07%)	29 (29.90%)	Z=0.17	0.857
DM	53 (51.46%)	12 (12.37%)	Z=5.89	<0.0001*
HTN	68 (66.02%)	26 (26.80%)	Z=5.55	<0.0001*
BMI (kg/m ²)	23.76 ± 2.48	22.20 ± 2.09	t ₁₉₈ =4.79	<0.0001*
Waist Circumference (cm)	Male	87.97 ± 5.27	t ₁₉₈ =7.46	<0.0001*
	Female	79.95 ± 5.30	t ₁₉₈ =5.89	<0.0001*
FBS (mg%)	140.73 ± 53.90	106.41 ± 45.86	t ₁₉₈ =4.83	<0.0001*
TG (mg%)	145.32 ± 35.10	131.09 ± 16.12	t ₁₉₈ =3.64	<0.0001*
HDL (mg%)	Male	41.74 ± 4.63	t ₁₉₈ =10.07	<0.0001*
	Female	48.04 ± 5.86	t ₁₉₈ =10.35	<0.0001*
Serum CRP	69 (66.99%)	15 (15.46%)	Z=7.37	<0.0001*

Table 4. Baseline Characteristics of Study Population according to Subjects with Metabolic Syndrome and Non-Metabolic Syndrome

*Statistically Significant.

Baseline Characteristics	Metabolic Syndrome (n=103)		Test Statistic	p-value
	Male	Female		
Age (Years)	54.02 ± 11.19	60.74 ± 11.83	t ₁₉₈ =4.18	0.006*
Gender	68 (66%)	35 (34%)	Z=4.59	
BMI (kg/m ²)	24.32 ± 2.12	22.67 ± 2.79	t ₁₉₈ =4.77	<0.001*
Waist Circumference (cm)	93.25 ± 4.73	85.28 ± 7.26	t ₁₉₈ =9.33	<0.0001*
FBS (mg%)	141.32 ± 55.15	140.45 ± 52.06	t ₁₉₈ =0.11	0.952
TG (mg%)	146.86 ± 39.95	142.31 ± 23.16	t ₁₉₈ =0.99	0.0536
HDL (mg%)	35.17 ± 4.59	40.11 ± 4.96	t ₁₉₈ =7.41	<0.0001*
Serum CRP	49 (72.06%)	20 (57.14%)	Z=4.28	0.127
DM	35 (51.47%)	18 (51.43%)	Z=2.70	0.997
HTN	43 (63.24%)	25 (71.43%)	Z=2.66	0.406
Smoking	30 (44.12%)	0 (0%)	Z=5.92	<0.0001*
Alcohol	24 (35.29%)	2 (5.71%)	Z=4.61	<0.0001*
Tobacco	29 (42.65%)	3 (8.57%)	Z=5.00	<0.0001*

Table 5. Characteristics of Metabolic Syndrome in Male and Female

*Statistically Significant.

	Mean	Percentage
Smoking	-	3 (9.37%)
Alcohol	-	4 (12.5%)
Tobacco	-	8 (25%)
DM	-	9 (28.12%)
HTN	-	22 (68.75%)
WC (cm)		
>90 cm male	87	1 (3.12%)
>80 cm female	79.25	5 (15.62%)
FBS (mg%)> 100 mg%	140.9	27 (84.37%)
TG (mg%)>150 mg%	146.75	18 (56.25%)
HDL (mg %)		
<40 mg% male	34.93	15 (46.87%)
<50 mg% female	39.18	16 (50%)
Serum C-Reactive Protein	-	12 (37.5%)

Table 6.Characteristics of Patients in MONW Subgroup

DISCUSSION

In the Indian subcontinent, incidence of CAD is rising. Often with the first presentation the disease is in the form of acute coronary syndrome. Various risk factors (modifiable and non-modifiable) for acute coronary syndrome were studied in Asian population, but the association between cardiovascular risk factors especially metabolic syndrome and ACS has been inadequately studied. Since MS which has a cluster of risk factors which may proceed to diabetes mellitus, hypertension, CAD, atherosclerotic disease and other complications, the correlation with ACS needs to be studied in a definite manner.

The present study, therefore, was designed and aimed to study this association in setting of intensive care unit of all patients presenting with ACS. The detailed findings in the study are discussed herewith.

Age and Sex

(Table: 1, Graph: 1) In the present study, there was a significant association between type of ACS and gender of the patients (p=0. 028). Proportion of patients with STEMI was significantly higher among both males (51.5%) and

females (17%). Similar results were found in studies conducted by Yadav P et al,¹³ Singh PS et al,¹⁴ Dhakhada V et al¹⁵ and Gupta S et al.¹⁶

(Table: 2) In the present study, mean age of the study population in males was 55.26 ± 13.05 years and in females was 60.25 ± 12.82years.

Similar result was found in the study by Gupta S et al,¹⁶ Mijares AH et al¹⁷ and Yadav P et al.¹³

Modifiable Risk Factors

(Table: 2) In the present study, the percentage of modifiable risk factors (smoking, alcohol, tobacco) were significantly higher in males than in females (P- value <0.0001, 0.0001, 0.0001 respectively). Likewise Gupta S et al¹⁶ and Mijares AH et al¹⁷ found that the maximum number of smokers were males as compared with females. Gupta S et al found that tobacco chewing was common in males than in females, but it was statistically non-significant. Yadav P et al¹³ found 65% patients had a history of tobacco consumption in some form.

Non Modifiable Risk Factor Diabetes Mellitus

(Table: 2) In the present study, there was no significant association between diabetes mellitus and gender. Of total patients with ACS, 32.5% had diabetes mellitus.

A similar result was found in a study conducted by Gupta S et al.¹⁶ Similar results were reported in the CREATE Registry (30.4%), but higher than the reported prevalence (10.5%) in a similarly aged population of South Asian countries in the INTERHEART study.^{18,19}

Hypertension

(Table: 2) In the present study, 42% patients with ACS had hypertension, but there was no significant association between hypertension and gender.

Similar result was found in a study conducted by Gupta S et al.¹⁶ where 40.4% patients had hypertension. The CREATE Registry¹⁸ shows similar results (37.7%), but higher than the reported prevalence (17.8%) in a similarly aged population of South Asian countries in the INTERHEART¹⁹ study.

Anthropometric Measures-Body Mass Index (BMI)

(Table: 2) In the present study, there was a significant association between BMI and gender in patients with ACS. Mean BMI for males was 23.42 ± 2.27 and for females was 21.98 ± 2.49 . Mijares AH et al.¹⁷ and Yasmin S et al.²⁰ found comparatively higher BMI in both genders.

This difference in BMI in our study may be explained by the fact that our study population was from rural background with more patients coming from low socioeconomic background.

Waist Circumference

(Table: 2) In the present study, there was a significant difference in waist circumference of males and females.

Mean WC in males was 90.50 ± 5.66 and in females 83.17 ± 7.01

Yasmin S et al.²⁰ Mijares AH et al.¹⁷ found higher waist circumference in both genders.

This reflects the importance of WC over BMI. Visceral adiposity indicated by increase in WC is more dangerous for CVD than BMI.

Blood Investigation-Fasting Blood Sugar (FBS)

(Table: 2) In the present study, there was no significant difference in FBS values of male and female (P value - 0.87). Mean FBS level in males was 124.60 ± 55.13 and in females was 123.29 ± 47.52 .

Mijares AH et al.¹⁷ found mean baseline glycaemia in study population was 132.24 ± 2.35 of which in males it was 130.30 ± 48.27 and in females 138.28 ± 67.77 .

Triglycerides (TG)

(Table: 2) In present study, mean triglyceride level in males was 138.38 ± 31 and in females 138.51 ± 21.05 . This difference was statistically not significant (p value - 0.97). Mijares AH et al.¹⁷ found mean triglyceride level in study

population was 144.01 ± 93.43 of which in males it was 141.41 ± 94.38 and in females 152.40 ± 90.98 .

High Density Lipoprotein (HDL)

(Table: 2) In the present study, we found statistically significant difference between HDL level in both males and females (P value - 0.0001).

Mean HDL level in males was 38.59 ± 5.65 and in females was 43.25 ± 6.57 .

Mijares AH et al.¹⁷ found mean HDL level in the study population was 44.03 ± 11.15 of which in males it was 42.01 ± 9.98 and in females 50.55 ± 12.32 . Gupta S et al.¹⁶ found dyslipidaemia in 56% females and in 58.1% males this difference was not statistically significant (P value - 0.772).

Serum C-reactive Protein (CRP)

(Table: 2) Out of total males, 43.66% had a positive serum CRP and of total females 11% had positive serum CRP. This difference was statistically not significant.

Metabolic Syndrome

(Table: 2) Frequency of metabolic syndrome was more in males (47.89%) as compared to females (17.5%). This difference was statistically significant (p value 0.009).

Study by Yasmin S et al.²⁰ found frequency of metabolic syndrome was 32% for males and 28% for females. Gupta S et al.¹⁶ found frequency of metabolic syndrome was 15.33% for males and 36% for females.

Metabolically Obese Normal Weight (MONW)

(Table: 2) In our study, we found frequency of MONW in males was 11.27% and in females was 8%.

(Table: 3) In our study, we found that mean age of patients presenting with STEMI, NSTEMI and UA was 56.89 ± 14.20 , 57.17 ± 10.39 , 55.80 ± 10.83 respectively. This difference of mean age in all three groups was not statistically significant. Similar results were found in study conducted by Mohanan PP et al and Brunori EH et al.²¹

(Table: 3) In our study, we found that non-modifiable risk factors (smoking, alcohol, tobacco) not shows significant association with different presentations of ACS.

Study conducted by Mohanan PP et al found significant association between smoking and different presentations of ACS. Misiriya KJ et al.²² conducted a study and found that 46.65% of patients with STEMI were smokers and 60% of patients with NSTEMI were smokers.

(Table: 3) In our study, we found that there was no significant association between DM and HTN with type of ACS. Study done by Misiriya KJ et al.²² and Mohanan PP et al found significant association between DM and HTN with different presentation of ACS (p - 0.001).

(Table: 3) In our study, we found that mean BMI in NSTEMI was 24.35 ± 2.13 , STEMI was 22.58 ± 2.23 , UA was 23.66 ± 2.82 . This difference in BMI was statistically significant. Similar results were found in study conducted by Mohanan PP et al.

(Table: 3) In our study, we found waist circumference was significantly higher in males with STEMI than with NSTEMI and UA. Though WC was higher in females with STEMI, no significant association found in WC and different presentation of ACS in females.

(Table: 3) There was no significant difference in FBS and TG of the patients who had STEMI, NSTEMI and UA. Fasting blood glucose level of 119.54 ± 56.04 , 138.56 ± 37.33 , 132.00 ± 47.89 were found in STEMI, NSTEMI and UA respectively ($p=0.16$). Triglyceride level of 136.64 ± 30.89 , 139.30 ± 24.79 , 143.97 ± 20.09 were found in patients who had STEMI, NSTEMI and UA respectively. ($p=0.35$). Study conducted by, Brunori EH et al²¹ found similar result. Mohanan PP et al found significant difference in FBS levels of the patients who had STEMI, NSTEMI and UA.

High Density Lipoprotein (HDL)

(Table: 3) In our study, we found that there was no significant association between HDL value and different presentation of ACS in both genders. Similar results found in study conducted by Brunori EH et al.²¹

Serum C-reactive Protein

(Table: 3) In our study, serum CRP was positive in 45.3% patients with STEMI, in 34.8% patients with NSTEMI and in 35% patients with UA. There was no significant association between serum CRP and different presentation of ACS.

(Table: 3) In our study, percentage of MS was higher in patients with STEMI, than NSTEMI and UA,

This difference was not statistically significant.

In our study, we found that 23 (16.8%), 3 (13.08%), 6 (15.0%) patients with STEMI, NSTEMI, UA respectively had MONW.

As far as baseline characteristic of study population according to subjects with MS and without MS was concerned.

(Table: 4) We found that mean age of patients with MS was 56.31 ± 11.79 and it was 57.13 ± 14.50 in patients of NMS. Of total population, maximum number of patients (105) were in age group (41–60 years). Similar results were found in the studies conducted by Dhakhada V et al,¹⁵ Sattar N et al²³ and Yasmin S et al.²⁰

(Table: 4) In our study of 200 patients with ACS, 103 had MS and 97 had NMS. Of total 103 patients with MS, 68 (66%) were male and 35 (34%) were female. Percentage of MS was higher in males which was similar to the study done by Dhakhada V et al.¹⁵

(Table: 4) In our study, we found that 30 patients (29.13%) with MS had a history of smoking and 27 patients (27.84%) of NMS had history of smoking, this difference was statistically insignificant. Higher percentage of smokers were found in a study done by Dhakhada V. et al¹⁵ (51%) and lower percentage were found in a study done by J. Olijhoek JK et al.²⁴

In our study, we found that 31.07% patients of MS had risk factor of tobacco chewing and 29.90% patients of NMS had risk factor of tobacco chewing. History of alcoholism

was present in 25.24% patients of MS and 15.46% patients of NMS.

(Table: 4) In our study, we found that diabetes mellitus and hypertension had significant association with metabolic syndrome (P value <0.0001). Sixty-eight (66.02%) patients of MS had HTN as compared to 26 (26.80%) in NMS, this difference was statistically significant (P value <0.0001).

Olijhoek JK et al²⁴ found higher percentage of DM in patients with MS than with NMS (p value <0.001) and also found percentage of patients taking antihypertensive medication was higher in patients with MS than with NMS (p value <0.001).

Sattar N. et al²³ conducted a study and found higher percentage of history of HTN in patients with MS than NMS (p value <0.0001).

Body Mass Index (BMI)

(Table: 4) In our study, we found that BMI was higher in patients with MS (23.76 ± 2.48) than NMS (22.20 ± 2.09) ($<0.0001^*$).

Though BMI values were higher in the studies conducted by Olijhoek JK et al²⁴ and Sattar N. et al²³ than our study, they found higher range of BMI in MS than NMS.

Waist Circumference (Males)

(Table: 4) In our study, we found that WC was higher in MS (93.25) patients than NMS (P value <0.0001). In MS with subgroup of non-obese patients, 1 (1.47%) had WC > 90 cm.

Similar results were found in studies conducted by Sowdagar MA et al²⁵ and Olijhoek JK et al.²⁴

Waist Circumference (Females)

(Table: 4) In our study, we found that WC was higher in MS (85.28 ± 7.26) patients than NMS (79.95 ± 5.30) which was statistically significant (P value <0.0001). In MS with subgroup of non-obese patients 6 (17.14%) had WC ≥ 80 cm.

Fasting Blood Sugar (FBS)

(Table: 4) In our study, we found that mean level of FBS was higher in patients with MS (140.73 ± 53.90) than NMS (106.41 ± 45.86), this difference was statistically significant (p-value: <0.0001). Out of total patients with MS, 27 (26.24%) had FBS levels >100 mg% in non-obese subgroup.

Olijhoek JK et al²⁴ found similar results. Dhakhada V et al¹⁵ conducted similar study and found that FBS levels were elevated in MS patients than NMS patients.

Triglyceride (TG)

(Table: 4) In our study, we found that mean TG level was higher in MS (145.32 ± 35.10) than NMS (131.09 ± 16.12). This difference was statistically significant. Out of total patients with MS, 18 (17.48%) had TG levels ≥ 150 mg%.

Olijhoek JK et al²⁴ found similar result. Dhakhada V et al¹⁵ found significantly higher proportion of patients with MS (66.1%) had high level of TG than NMS (24.39%).

High Density Lipoprotein (HDL) (For both Genders)

(Table: 4) In our study, we found that lower level of HDL in patients of MS (for males 35.17 ± 4.59 and for females 40.11 ± 4.96) than NMS (for males 41.74 ± 4.63 and for females 48.04 ± 5.86), this difference was statistically significant <0.0001 (for both genders). In subgroup of non-obese patients, 15 (22.06%) males and 16 (45.71%) females had HDL levels of <40 mg% and <50 mg% respectively.

Study conducted by Dhakhada V et al¹⁵ found higher proportion of patients with MS had low HDL than NMS patients for both genders. This difference was statistically non-significant. Olijhoek JK et al²⁴ found similar result.

Serum C-Reactive Protein

(Table: 4) In our study, we found that CRP was positive in 66.99% patients of MS and 15.46% patients of NMS. This difference was statistically significant. Of total patients of MS with non-obese subgroup, 12 (11.65%) had positive CRP value.

Likewise in a study conducted by Sattar N et al²³ CRP levels were significantly high in patients of MS than NMS.

(Table: 5) In this study, (Table 5, graphs 5.1/5.2) we separately compared the characteristics of MS in both genders and found that except for BMI (24.32 ± 2.12 in males and 22.67 ± 2.79 in females), all other risk factors like DM, HTN, serum CRP, TG, FBS were equally distributed in both sexes. Smoking, alcohol and tobacco intake was more in males as expected.

(Table: 6) We had done subgroup analysis in the study population and found out patients of MONW.

Here, we discussed various parameters in this subgroup.

A total of 32 patients were identified as MONW of which smoking, alcohol, tobacco was seen in 3 (9.37%), 4 (12.5%), 8 (25%), 9 (28.12%) respectively.

Out of total patients, 9 had diabetes mellitus, but 27 (84.37%) had FBS >100 mg%. 22 (68%) patients had hypertension which was more than overall percentage of HTN in MS (66.02%).

Abnormal waist circumference was found in 1 (3.12%) male and 5 (15.62%) females.

TG levels of > 150 mg% were found in 18 (56.25%) patients.

Abnormal HDL levels (<40 mg% for male and <50 mg% for female) were found in 15 (46.87%) male and 16 (50%) female patients respectively.

Serum CRP was positive in 12 (37.5%) patients whereas in NMS with non-obese subgroup, 4 (6.15%) had positive serum CRP.

Considering the above values, it is clear that MONW population though they have normal BMI, still should be considered as risk group for future CVD, as also supported by recent literature.

As newer terms like pre-diabetes, pre-hypertension, are coined to increase the level of awareness for utmost prevention of the risk factors for CVD, we suggest researchers may come up with a new terminology like pre-metabolic syndrome that may cater to these specific subgroups of population having MONW.

CONCLUSION

We conclude that ACS is a major burden of public health. MS is a key association with ACS. Appropriate preventive strategies focusing on population in general and high risk groups should be undertaken aggressively. More population based studies encompassing subgroups like "MONW" should be done that may throw more light on evidence based practice to prevent future CVDs.

Limitations

1. The study holds the limitation of a small sample size and single-centred study.
2. More accurate presentation of prevalence of MS and MONW could be possible by using multiple parameters in the same set of population, like tests for insulin resistance (HOMA IR) and triglyceride index (Ty G).
3. Quantitative serum CRP levels were not done.

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