



**STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETES
MELLITUS**

**Chandrasekhar Valupadas*¹, Pavan Kumar Muttineni¹, Vasanth Kumar Suram¹,
Chandana Naliganti²**

¹Department of Medicine, Kakatiya Medical College/ MGM Hospital, Warangal, Telangana
State, India.

²Department of Pharmacy Practice, Vaagdevi College of Pharmacy, Warangal, Telangana
State, India.

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***Correspondence for**

Author

Dr. Chandrasekhar

Valupadas

Department of Medicine,
Kakatiya Medical College/
MGM Hospital, Warangal,
Telangana State, India.

drcvmed67@gmail.com

ABSTRACT

Background & Objectives: Metabolic syndrome is a cluster of the most dangerous cardiovascular risk factors namely diabetes, abdominal obesity, high cholesterol and elevated blood pressure. For defining metabolic syndrome, there are several criteria's like AHA, EGIR, NCEP/ATP III, WHO and IDF. The present study was undertaken to understand the clinical profile and associated risk factors of metabolic syndrome in Type 2 Diabetes Mellitus (T₂DM) patients based on WHO criteria. **Methods:** A prospective cohort study was conducted for a

period of October 2012 to September 2013 in patients who are attending Out Patient Department (OPD) at Mahatma Gandhi Memorial Hospital, Warangal with T₂DM according to WHO criteria. Two hundred T₂DM patients were subjected to detailed history, clinical examination and biological investigations were conducted, data was collected, tabulated and interpretation was done. **Results:** Our study included 200 participants with Type 2 Diabetes mellitus for screening. The overall mean age of the study population was 53.68 ±8.8 years with range of (37-76) years. Out of 200 screened populations, a total of 152(76%) patients were identified with Metabolic Syndrome according to WHO (1999) criteria. Among 152, 108(71.05%) were males and 44(28.95%) were females. Metabolic syndrome was found to be more in male(77.14%) compared to female(73.33 %). The more common risk factors found in the study population were, low HDL-C(73.68%), high Triglycerides(57.89%),

increased waist to hip ratio(52.63%) and elevated blood pressure(50.00%); microalbuminuria(13.16%) being the least common risk factor. **Interpretation & Conclusion:** This study proved that metabolic syndrome was found highly prevalent in T₂DM patients using WHO criteria. Low level of HDL-C, high triglyceride levels, increased waist to hip ratio, hypertension and microalbuminuria are significantly associated with T₂DM.

Keywords: Diabetes mellitus, Metabolic Syndrome, WHO criteria, NCEP/ ATP III criteria.

INTRODUCTION

“Metabolic syndrome is a cluster of the most dangerous cardiovascular risk factors namely diabetes, abdominal obesity, high cholesterol and elevated blood pressure”.

The metabolic syndrome (also called as syndrome X, insulin resistance syndrome) consists of a constellation of metabolic abnormalities that confer increased risk of cardiovascular disease (CVD) and diabetes mellitus (DM).

Non communicable diseases which include Diabetes mellitus and cardiovascular disease are world’s biggest killer diseases, estimated to cause 3.5 million deaths each year. Eighty percent of them are found in the low and middle income countries. ^[1] The WHO has developed an action plan for implementation of global strategies in prevention and control of non-communicable diseases. ^[1]

The metabolic syndrome is characterized by a group of metabolic risk factors in one person. The dominant underlying risk factors for this syndrome appear to be abdominal obesity and insulin resistance. Insulin resistance is a generalized metabolic disorder, in which the body can’t use insulin efficiently. This is why the metabolic syndrome is also called the insulin resistance syndrome.

Worldwide, the metabolic syndrome is a major health problem associated with increased morbidity and mortality. There has been a lot of debate about whether metabolic syndrome should be considered a syndrome at all. As it was well known that, a syndrome defines a group of signs and symptoms with a common underlying pathology, but the real pathology of metabolic syndrome is still not yet fully known. ^[2]

There are several existing criteria in use for defining the metabolic syndrome like the definition used by the American Heart Association (AHA), European Group for the Study of Insulin Resistance (EGIR), National Cholesterol Education Program-Adult Treatment Panel III (NCEP/ATP III), World Health Organization (WHO) and International Diabetes Federation (IDF). The most commonly used definition of MS was described by the (WHO) and ATP III criteria (National Cholesterol Education Program Expert Panel (NCEP)).^[3]

World Health Organization Criteria (1999)^[4]

Presence of any one of T₂DM tests like impaired glucose tolerance, impaired fasting glucose or insulin resistance and two of the following:

1. Blood pressure: $\geq 140/90$ mmHg
2. Dyslipidemia: fasting triglycerides (TG): ≥ 150 mg/dl and high density lipoprotein cholesterol (HDL-C), < 35 mg/dl (Male), < 39 mg/dl (Female)
3. Central obesity: Waist: Hip ratio > 0.90 (Male); > 0.85 (Female), or body mass index > 30 kg/m²
4. Microalbuminuria: urinary albumin excretion ratio ≥ 20 μ g/min or albumin: creatinine ratio ≥ 30 mg/g.

A previous diagnosis of type 2 diabetes mellitus is considered as sufficient to fulfill this criterion.

NCEP: ATPIII 2001 criteria for Metabolic Syndrome^[3, 5, 6, 7]

Three or more of the following:

1. Central obesity: Waist circumference ≥ 102 cm (Male), ≥ 88 cm (Female)
2. Hypertriglyceridemia: Triglycerides ≥ 150 mg/dL
3. Low HDL cholesterol: < 40 mg/dL (Male), < 50 mg/dL (Female),
4. Hypertension: Blood pressure ≥ 130 mm of Hg systolic or ≥ 85 mm of Hg diastolic
5. Fasting plasma glucose: ≥ 100 mg/dL

Our study aimed to obtain clinical profile of Type 2 Diabetes mellitus patients and to identify components of the Metabolic Syndrome among the patients diagnosed to have Type 2 Diabetes Mellitus as per WHO criteria.

MATERIALS AND METHODS

For all the patients who fulfilled the inclusion and exclusion criteria; detailed history, clinical examination (Body mass Index, Waist to Hip ratio and blood pressure) findings and the results of investigations were recorded. All patients were interviewed regarding duration of diabetes, presence of other co-morbidities and anti diabetes drugs respectively.

Waist/Hip ratio (M <0.90, F <0.85), fasting blood sugar level <100 mg/dL, triglycerides level <150 mg/dL, HDL level (M >35mg/dl, F >39mg/dl), Blood pressure <140/90mm of Hg, Microalbuminuria <20 mg/dL are considered as normal ranges. Overnight fasting samples were drawn for estimation of lipid profile and sugar levels in blood and albumin in urine using standard methods.

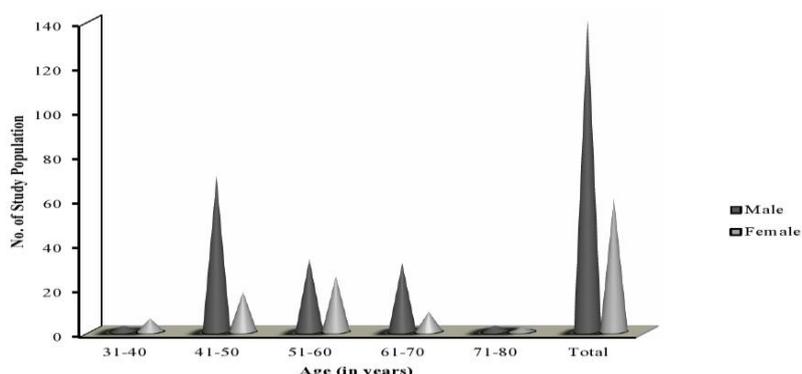
Analysis was done using Epi info Version 7.1.2.0. The descriptive statistics was computed, comparisons of variables were done using chi-square test (parametric and non-parametric). Two sided p-value of less than 0.05 were considered to indicate statistical significance. Microsoft word and Excel have been used to generate graphs, tables etc.

Study design: This is a Cross-sectional study of metabolic syndrome in Type 2 Diabetes mellitus patients during the October 2012- September 2013 using WHO criteria. Patients who come to MGM Hospital with established type 2 diabetes mellitus, and who are on oral hypoglycaemic agents were included. Patients with all other types of diabetes and with concomitant complications were excluded.

RESULTS

About 200 diabetes patients were studied based on inclusion and exclusion criteria, among which 140 were males and 60 were females with a mean age of 53.68 ± 8.79 years within the range of 37-76 years. The age and gender distribution is shown graphically in figure I.

Fig I: Age and Gender Distribution of study population (n=200)



According to the WHO criteria (1999) out of 200, 152 (76%) patients were found to have metabolic syndrome. Table I shows the clustering of various risk factors for metabolic syndrome in total study population. Based upon the level of risk factors 152 patients were identified as metabolic syndrome.

Table I: Percentage of population with number of risk factors according to WHO Criteria (n=200)

| WHO criteria | No risk | 1 risk | 2 risks | 3 risks | 4 risks | 5 risks | TOTAL |
|------------------|---------|---------|---------|---------|---------|---------|-----------|
| Population% | 12(6%) | 36(18%) | 68(34%) | 52(26%) | 28(14%) | 4(2%) | 200(100%) |
| Type 2 DM | Present | Present | Present | Present | Present | Present | |
| Met. S | Absent | Absent | Present | Present | Present | Present | |

In 152, the gender distribution was found to be 108 males and 44 females. Males accounted for 71.05% and females accounted for 28.95%.

The distribution of risk factors in this population is detailed in table II.

Table II: Risk Factor Distribution among Metabolic Syndrome (n=152)

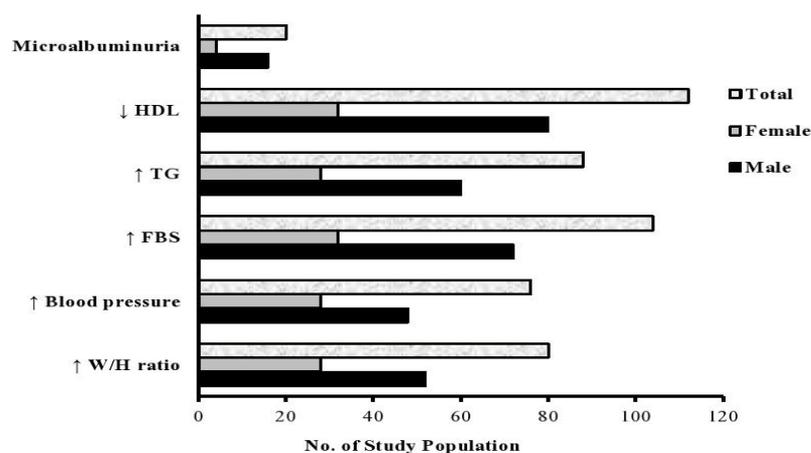
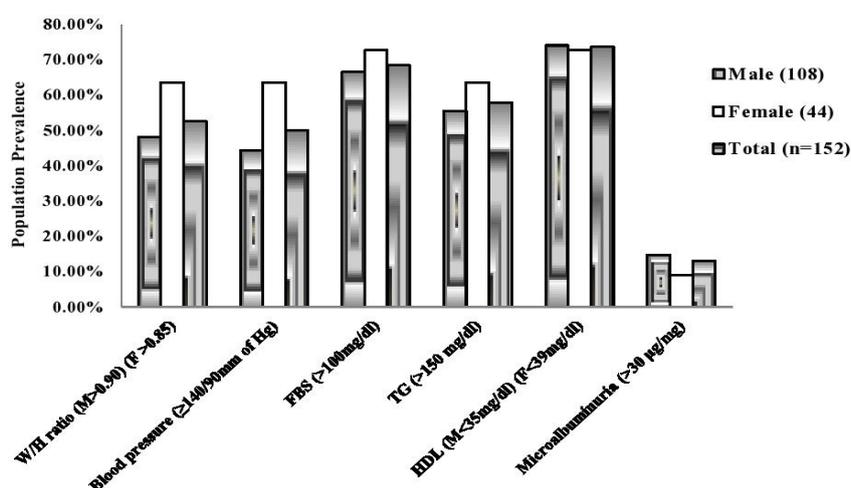
| Criteria | Male (n=108) | Female (n=44) | Total (n=152) |
|-----------------------|--------------|---------------|---------------|
| D+W/H+TG | 24 | 16 | 40 |
| D+W/H+HDL | 36 | 20 | 56 |
| D+TG+HDL | 36 | 20 | 56 |
| D+HTN+W/H | 20 | 16 | 36 |
| D+HTN+TG | 20 | 12 | 32 |
| D+HTN+HDL | 32 | 20 | 52 |
| D+HTN+TG+HDL | 4 | 4 | 8 |
| D+HTN+W/H+TG | 4 | 0 | 4 |
| D+W/H+TG+HDL | 12 | 12 | 24 |
| D+HTN+W/H+TG+HDL | 4 | 4 | 8 |
| D+HTN+TG+HDL+M Alb | 4 | 0 | 4 |
| D+HTN+W/H+TG+HDL+MAlb | 4 | 0 | 4 |

D-Diabetes, Will-Waist-hip ratio, TG-Triglycerides, HDL-High density lipoprotein, HTN-Hypertension, MAlbMicroalbuminuria.

In 152 patients who were identified with metabolic syndrome, the prevalence of metabolic risk factors observed was W/H ratio ($M > 0.90$ and $F > 0.85$) in 80 patients (52.63%); blood pressure values recorded high in 76 patients (50.00%); elevated fasting blood sugar levels in 104 (68.42%) patients; low levels of HDL-C present in 112 (73.68%) patients; raised triglyceride levels in 88 (57.89%) patients and microalbuminuria ($> 30 \mu\text{g}/\text{mg}$) noted in only 20 (13.16%) patients (Table III, Fig IIa & IIb). All the parameters were analyzed and found statistically significant, except microalbuminuria between males and femlaes.

Table III: Gender-wise distribution of metabolic risk factors in study population

| Risk Factors of Metabolic syndrome | Male (108) | Female (44) | Total (n=152) | 'P' Value |
|------------------------------------|-------------|-------------|---------------|-----------|
| W/H ratio (M>0.90) (F >0.85) | 52 (48.14%) | 28 (63.63%) | 80 (52.63%) | < 0.0001 |
| Blood pressure (2.140/90mm of Hg) | 48 (44.44%) | 28 (63.63%) | 76 (50.00%) | < 0.0001 |
| FBS (>100mg/dl) | 72 (66.66%) | 32 (72.72%) | 104 (68.42%) | < 0.0001 |
| TG (>150 mg/dl) | 60 (55.55%) | 28(63.63%) | 88 (57.89%) | < 0.0001 |
| HDL (M<35mg/dl) (F<39mg/dl) | 80 (74.07%) | 32(72.72%) | 112 (73.68%) | < 0.0001 |
| Microalbuminuria (>30 pg/mg) | 16 (14.81%) | 4 (9.09%) | 20 (13.16%) | 0.0045 |

Fig IIa: Gender-wise distribution of individual metabolic risk factor in study population**Fig IIb: Population Prevalence of risk factors in metabolic syndrome**

DISCUSSION

The present study aimed to determine the prevalence of metabolic syndrome in patients with established type 2 diabetes mellitus who attended Out-patient department in Mahatma Gandhi Memorial hospital, Warangal, T.S, during October 2012- September 2014.

There are several existing criteria in use for defining the metabolic syndrome globally like American Heart Association (AHA), European Group for the Study of Insulin Resistance (EGIR), National Cholesterol Education Program-Adult Treatment Panel III (NCEP/ATP III), World Health Organization (WHO) and International Diabetes Federation (IDF) in which WHO criteria and NCEP/ ATP III are most commonly used.

In our study we utilized the standard WHO criteria to define metabolic syndrome in type 2 diabetes mellitus.

A total of 200 patients with type 2 diabetes mellitus were included in our study with a mean age of 53.68 ± 8.79 years within the range of 37-76 years.

Out of 200 patients, 70% (n=140) were males, 30% (n=60) were females, 41.5% (n=83) are having past history of hypertension, 34.5% (n=69) are smokers and 44.5% (n=89) are alcoholics.

All the components in the WHO criteria were estimated in all the included study population (n=200) and were screened for metabolic syndrome. Out of total population (n=200), 152 were identified with metabolic syndrome.

Our results agree with the study conducted by Motala A *et al* (2009)^[8] and Fezeu *et al* (2007)^[9], which concluded that the prevalence of metabolic syndrome was found to be high by using WHO criteria compared with ATP-III criteria and IDF.

The prevalence of metabolic syndrome was found to be high in male population (71.05%) compared to female population (28.95%) in our study. Additionally low levels of HDL-C (73.68%), high levels of fasting blood sugar (68.42%), high levels of triglycerides (57.89%), increased waist/ hip ratio (52.63%), high blood pressure (50%) were most common criteria of metabolic syndrome and microalbuminuria (13.16%) being the least prevalent criteria.

Our study shows that high blood pressure is found mostly in female population (63.63%) than male population (44.44%). Hence, these findings were similar to the study conducted by Alebiosu Christopher *et al* (2004)^[10] and Fezeu L *et al* (2007).^[9]

This study revealed metabolic syndrome was found to high in type 2 diabetes patients using WHO criteria and thirty four percent of type 2 diabetes patients found to have at least two

risk factors of metabolic syndrome. Low level of HDL-C, high triglyceride levels, increased W/H ratio and Hypertension were common among them. In our study low level of HDL-C, high triglyceride levels, increased W/H ratio and Hypertension and microalbuminuria are significantly associated with metabolic syndrome.

Metabolic syndrome as being found to be associated with killer disease, i.e. type 2 diabetes mellitus, therefore, there is a need of positive reinforcement and education on benefits of reducing and prevention of the risk factors of metabolic syndrome by increasing physical activities and diet modification, (i.e. reduce intake of saturated fat and calories diet) in this population.

Multiple risk factors are associated with cardiovascular disease in patients with diabetes including hypertension, hyperlipidemia, obesity and microalbuminuria which are key components of metabolic syndrome. They have a risk of death with cardiovascular disease that is 2-6 times more than non-diabetes. Our study identified the prevalence of these risk factors in study population. Thus, efforts should be taken to reduce the level of risk factors to prevent the high probability of being susceptible to develop metabolic syndrome and further cardiovascular disease.

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