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## ORIGINAL RESEARCH

# Prevalence of metabolic syndrome in type 2 diabetes mellitus using who, harmonised and CDS definitions: A cross sectional study

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## ABSTRACT

**The metabolic syndrome is defined as a clustering of key cardiovascular risk factors, namely, abdominal obesity, dyslipidemia, hyperglycemia and hypertension in a single individual. Gerald Reaven introduced the concept of the syndrome in 1988.This cross-sectional study was conducted in 120 in which 60 non diabetic and 60 type 2 diabetic patients, 2013 to 2015 in the department of biochemistry, Mediciti Institute of Medical Sciences, Hyderbad. Ethical clearance was obtained for the study. Informed consent was obtained. 60 subjects with type 2DM were included in the study. Subjects in the age group of 30-65 yrs in both genders, meeting the Type 2DM, FBS and PLBS meeting the criteria were taken up in the study. Maximum prevalence of Metabolic syndrome was observed in diabetic male harmonised criteria (73.3%) and diabetic female WHO criteria (76.6 ). A fair agreement was observed between WHO and HAR criteria by Kappa statistics. A two tailed significant correlation were found in diabetic male patients (using WHO,HAR criteria ) than female patients (using CDS) criteria.**

**Keywords: Diabetes mellitus, triglyceride (TG), Waist to hip ratio (WHR), Chinese diabetes society (CDS).**

## INTRODUCTION

The metabolic syndrome is defined as a clustering of key cardiovascular risk factors, namely, abdominal obesity, dyslipidemia, hyperglycemia and hypertension in a single individual. Gerald Reaven introduced the concept of the syndrome in 1988. Afterwards this constellation of cardiovascular disease (CVD) risk factors has been given a number of names, such as Syndrome X, dysmetabolic syndrome, insulin resistance syndrome and deadly quartet. However, till today its' observational and epidemiological investigation has long been prevented by the absence of internationally accepted criteria for its diagnosis. To defeat this problem, in 1998, Alberti and Zimmet (1998) proposed for the first time a more unified descriptive "definition" for the diagnosis of metabolic syndrome which they called as World Health Organization (WHO) criteria. [1-3]

Besides, the WHO criterion has not been consistently used because of the requirement to measure serum insulin and urinary microalbumin. This problem is overcome by the Third Report of the National Cholesterol Education Program (NCEP) the Adult Treatment Panel III

(ATP III) in 2001. This definition uses only simple clinical measurements of waist circumference (WC), fasting plasma glucose, (FPG), triglyceride (TG) and high density lipoprotein cholesterol (HDL-C) levels as well as blood pressure. The ATP III criteria is more practical and found to be a better predictor of coronary heart disease(CHD) risk in the US population. Unlike WHO criteria microalbuminurea is not required for ATP III criteria. Recently the ATP III definitions for MetS were renewed ,in which the new cut-off waist circumference for the Asia and Pacific Region and new cut-off for fasting glucosewas introduced. Recently, International Diabetes Federation (IDF) in 2005 proposed a newworld wide definition of the metabolic syndrome. The above threedefinitions are the most popular and commonly used for the diagnosis of Metabolic syndrome. The main focus of this definition is central obesity defined by waist circumferenceand has specific cut-off value for different ethnic populations as a mandatory component in MetS definition.Besides, data on the agreement between the definitions of MetS (WHO, IDF and ATP III) in T2DM populationis even more diverse, which make the estimation of MetS difficult to those prognosisthe T2DM for risk ofcardiovascular disease. [4,5]Until now, there is no specific criteria for defining MetS in type 2 diabetic populationspecially for India region, So we have examined MetS prevalence as stated above Gwalior-Chambal' region ofIndia using all three well known (WHO, IDF and ATP III) definitions and also its validity by concordance between the definitions. The aim of study was to determine the prevalence of metabolic syndrome (MetS) in people with type 2 diabetes mellitus (T2DM). WHO , Harmonised and CDS definitions were used in quantifying the metabolic syndrome and also the concordance between these three criteria's used for identifying metabolic syndrome were analysed.
Aim:To evaluate and analyse the components of metabolic syndrome in subjects with type 2 diabetes mellitus.

## METHODOLOGY

This cross-sectional study was conducted between in 60 type 2 diabetic patients, 2013 to 2015 in the department of biochemistry, Mediciti Institute of Medical Sciences, Hyderabad. Ethical clearance was obtained for the study. Informed consent was obtained. 60 subjects with type 2DM were included in the study. Subjects in the age group of 30-65 yrs in both genders, meeting the Type 2DM, FBS and PLBS meeting the criteria were taken up in the study. Plasma glucose estimated by GOD POD method, Blood lipids (Total-cholesterol by CHOD POD method, triglyceride by GPO PAP method, HDL and LDL by precipitation methods ) were assessed and anthropometry, blood pressure were measured from all the subjects. The individual components of metabolic syndrome are evaluated.

## WHO CRITERIA

Elevated arterial blood pressure ≥140/90 mmHg.
Raised plasma triglyceride (≥150 mg/dl).
Low HDL-cholesterol, (<35 mg/dl for men and <39 mg/dl for women).
Central obesity (WHR: >0.90 for men and >0.85 for women) and/or BMI (>30 kg/m2).
Microalbuminurea (urinary albumin excretion rate ≥20 min or albumin: creatinine ratio ≥30 mg/g).

**Table 1: Criteria for clinical diagnosis of metabolic syndrome**

| Variables | Recommended thresholds | | |
|---|---|---|---|
| | IDF 2005 | Harmonising criteria 2009 | CDS 2013 |
| Abdominal obesity (waist circumference) | ≥90 cm (male); ≥80 cm (female) | ≥85 cm (male); ≥80 cm (female) | ≥90 cm (male); ≥85 cm (female) |
| Triglycerides | ≥1.7 mmol/L or treatment | ≥1.7 mmol/L or treatment | ≥1.7 mmol/L |
| Plasma high-density lipoprotein cholesterol | <1.03 mmol/L (male); <1.29 mmol/L (female) or treatment | <1.0 mmol/L (male); <1.3 mmol/L (female) or treatment | <1.04 mmol/L |
| Blood pressure | Systolic ≥130 or diastolic ≥85 mm Hg or treatment | Systolic ≥130 and/or diastolic ≥85 mm Hg or treatment | BP ≥130/85 mm Hg or treatment |
| Fasting plasma glucose | ≥5.6 mmol/L or previously diagnosed T2DM | ≥5.6 mmol/L or treatment | ≥6.1 mmol/L, and(or) 2hPG≥7.8 mmol/L or treatment |

CDS, China Diabetes Society; IDF, International Diabetes Federation; T2DM, type 2 diabetes mellitus.

## STATISTICAL ANALYSIS

Statistical data analysis was done using SPSS version 21.0.Descriptive statistics like frequency and percentages were also used to describe data. Categorical variables were expressed as percentages and continuous data as mean (M±SD). The agreements among the definitions of WHO, HAR and CDS criteria were assessed with kappa statistics. The level of agreement (kappa statistics) was categorized as poor with $\kappa \leq 0.20$, fair with $\kappa = 0.21$ to 0.40, moderate with $\kappa = 0.41$ to 0.60, substantial with $\kappa = 0.61$ to 0.80, and very good with $\kappa > 0.80$. P-value of less than 0.05 was considered as statistically significant. Pearson's correlation done.

## RESULTS

**Table 2: Demographic and anthropometric parameters of the study population**

| Parameters | NM (n=30 ) | NF (n=30 ) | NM+NF (Total :60) | DM (n=30 ) | DF (n=30 ) | DM+DF (Total: 60 ) |
|---|---|---|---|---|---|---|
| AGE | 45±10 | 42 ± 10 | 43 ± 10 | 49± 13 | 52± 8 | 50 ± 11 |
| FBS | 87±8 | 92 ± 7 | 90 ± 8.5 | 191± 61 | 162± 38 | 176 ± 52 |
| SYS | 127± 18 | 114 ± 16 | 120 ± 18 | 132± 61 | 133±22 | 133± 21 |
| DIA | 82± 12 | 77 ± 11 | 79 ± 12 | 85±11 | 84±11 | 84 ± 11 |
| Wt | 62± 13 | 58 ± 10 | 60 ± 12 | 64±10 | 61±9 | 62 ± 9 |
| Ht | 163 ± 4 | 151 ± 4 | 156 ± 7 | 159±8 | 150±8 | 155 ± 9 |
| BMI | 24.9± 4 | 25 ± 4 | 25 ± 4 | 25±3 | 27±3 | 25.6±4.7 |
| WC | 82 ± 13 | 86 ± 9 | 84 ± 11 | 88±10 | 89±10 | 89.05± 10.66 |
| HC | 90 ± 13 | 98± 20 | 94 ± 17 | 95±9 | 106±10 | 101.01± 11.31 |
| WHR | 0.89± 0.08 | 0.83 ± 0.07 | 0.86 ± 0.08 | 0.91±0.04 | 0.83±0.05 | 0.87 ± 0.06 |
| TC | 171 ± 36 | 180 ± 29 | 176 ± 32 | 203±55 | 197±41 | 200 ± 48 |
| HDL | 38.5 ±7.5 | 40 ± 7 | 39 ± 7 | 36±7 | 38±9 | 37 ± 8 |
| TG | 113 ± 45 | 105 ± 39 | 109 ± 42 | 337±73 | 227±72 | 282 ± 82 |

**TABLE 3: Individual components of the metabolic syndrome according to WHO, Harmonized and CDS definitions**

| MetS components | DM-WHO (21 ) | DF_ WHO (23 ) | DM+DF_ WHO (44) | DM_ HAR (22) | DF_HAR (15) | DM+DF _HAR (37 ) | DM_ CDS (12 ) | DF_ CDS (21) | DM+DF _CDS (33 ) |
|---|---|---|---|---|---|---|---|---|---|
| FBS (mg/dl) | 177±36 | 171±31 | 174±33 | 179±41 | 176±33 | 178±37*** | 172±35 | 169±31 | 170±32 |
| SYS (mmHg) | 133±17* | 134±23 | 133±20 | 136±21 | 139±24 | 137±22** | 137±16 | 136±22 | 137±19 |
| DIA(mmHg) | 87±10 | 86±12 | 87±11 | 88±11 | 85±13 | 87±12 | 87±12 | 87±12 | 87±12 |
| WC (cm) | 90±10** | 91±9 | 25.8±5 | 89±12 | 92±9 | 91±11** | 91±9 | 89/11 | 90±10 |
| WHR | 0.91±0.04* | 0.84±.05 | 0.87±0.06 | NA | NA | NA | NA | NA | NA |
| HDL (mg/dl) | 34±6 | 35±8 | 34±7 | 34±6 | 32±8 | 33±7 | 35±4 | 35±8 | 35±6 |
| TG (mg/dl) | 370±70** | 264±63 | 322±92 | 370±70 | 307±65 | 344±74 | 205±83 | 278±72 | 241±77 |

**Table 4: Pearson's correlations among the WHO, Harmonized and CDS**

| MetS components | DM-WHO (21 ) | DF_WHO (23 ) | DM_HAR (22) | DF_HAR (15) | DM_CDS (12 ) | DF_CDS (21) |
|---|---|---|---|---|---|---|
| FBS (mg/dl) | -0.672** | | -0.632** | 0.541* | | |
| SYS (mmHg) | 0.630** | | | | | -0.461* |
| DIA(mmHg) | 0.667** | 0.463* | 0.639** | | | |
| WC (cm) | 0.904** | | 0.450* | 0.621* | | |
| WHR | 0.486* | 0.440* | | | | |
| HDL (mg/dl) | | | 0.596* | 0.741** | -0.641* | |
| TG (mg/dl) | | -0.468* | | | | |

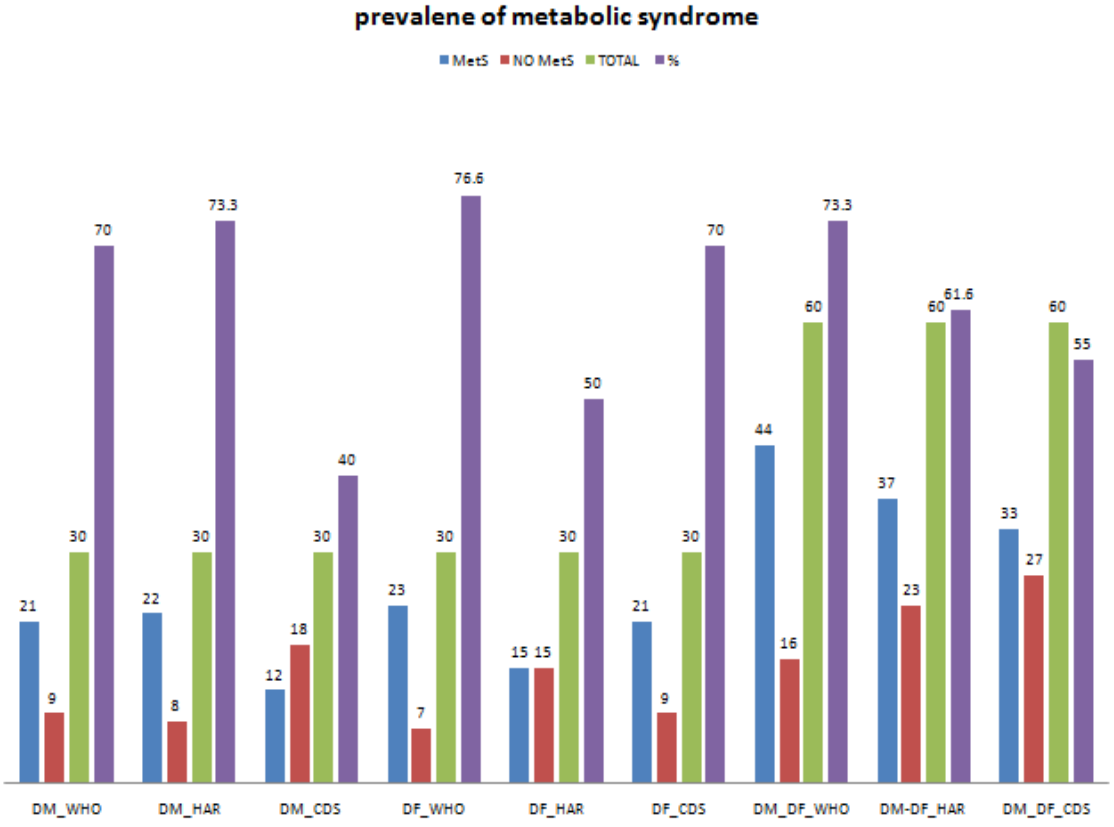
*.Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

**Table 5: The agreement and disparity in the diagnosis of Metabolic syndrome by using WHO, Harmonized and CDS criteria.**

| Definitions | MetS | Non MetS | Kappa index | Agreement |
|---|---|---|---|---|
| DM_WHO vs DM _HAR<br>MetS<br>Non MetS | 21<br>9 | 8<br>22 | 0.43 | Moderate |
| DM_WHO vs DM_ CDS<br>MetS<br>Non MetS | 21<br>9 | 18<br>12 | 0.10 | Poor |
| DM_HAR vs DM _CDS<br>MetS<br>Non MetS | 22<br>8 | 18<br>12 | 0.13 | Poor |
| DF_WHO vs DF _HAR<br>MetS<br>Non MetS | 23<br>7 | 15<br>15 | 0.49 | Moderate |

| | | | | |
|---|---|---|---|---|
| DF_WHO VS DF _ CDS | 23<br>7 | 9<br>21 | 0.46 | Moderate |
| DF_HAR VS DF _CDS | 15<br>15 | 9<br>21 | 0.42 | Moderate |
| DM_DF _WHO VS DM_DF_ HAR | 44<br>16 | 23<br>37 | 0.21 | Fair |
| DM_DF_WHO VS DM_DF_CDS | 44<br>16 | 27<br>33 | 0.28 | Fair |
| DM_DF_HAR VS DM_DF_ CDS | 37<br>23 | 27<br>33 | 0.16 | poor |




In this study we assessed to evaluate and analyse the components of metabolic syndrome in subjects with type 2 diabetes mellitus. The study also confers the ability to identify cardiovascular risk factors in terms of Metabolic and non metabolic syndrome group of subject These three definitions consist of essential components like glucose intolerance, Hypertension, obesity, and dyslipidemia however they are having different cut-off for each parameter and also exhibited different combinations in variable to diagnosing MetS. Metabolic syndrome consists of a multi-factorial set of indicators. The World Health Organization (WHO) definition was the first to tie together the key components of MetS: insulin resistance, obesity, dyslipidemia and hypertension, where the presence of insulin resistance is mandatory. With that said, this definition also allows patients with T2DM to be diagnosed with MetS if they meet the other criteria.

The Prevalence of metabolic syndrome was found to be (76.6%) in DF WHO ,followed by (73.3 %) in DM HAR and DM + DF HAR, (70 %) in DM WHO and DF CDSand 61.5 % and

60 % in DM+DF HAR ,DM+DF CDS. In Kappa statistics, there was moderate agreement inWHO and HAR criteria of diabetic female showed (κ 0.49) compared to CDS with WHO (κ 0.46) diabetic female and HAR with CDS (κ 0.42) criteria of diabetic female .even in DM of WHO,HAR showed a moderate agreement (k 0.43).A fair agreement was observed in DM,DF of WHO,HAR and CDS criteria,but a poor agreement was found in diabetic male in WHO versus CDS,HAR versus CDS and in both HAR ,CDS criterias of diabetic male and femlale groups. Highest prevalence was observed following harmonised criteria definition.
Pearson's correlation in Diabetic male group in WHO criteria showed a strong correlation in waist circumference followed by hypertension and hyperglycemia, but in diabetic female group correlated with WHR and hypertension .In diabetic male group of HAR criteria there were strong correlations in high blood pressure followed by hyperglycemia and low HDL ,in diabetic female group of HAR criteria strong correlation identified in low HDL followed by high waist circumference and hyperglycemia. In CDS criteria there was correlation in low HDL of diabetic male and high blood pressure of female. Metabolic syndrome was found high in diabetic female group of WHO and CDS criteria in compared with diabetic male high in HAR criteria.

## DISCUSSION

This is the first report as per the author's knowledge, which quantifies the prevalence of metabolic syndrome among type 2 diabetic patients in south India and determines the agreement of Chinese diabetic society (CDS 2013 ) definition.
Obesity, elevated blood pressure and dyslipidemia are more common in diabetic patients than in nondiabetic patients; these risk factors for CVD are more prevalent in patients with MetS resulting in the increased prevalence of CVD seen in diabetic patients (Ekoe et al, 2001).
A review suggested that onset of MetS is a serious public health problem owing to changes in lifestyles, and shows a trend towards higher prevalence among young adults. [1-3]
Hence, our study provides important insights into the need to identify MetS for early prevention. Due to lack of a separated threshold of HDL-C between males and females, no option of including hyperlipidaemia treatment, lower cut-off values of WC and higher cut-off values of FPG indicated that MetS prevalence was the lowest using CDS 2013.[4]
Regardless of the MetS criteria used, the increased MetS prevalence trends were related to advanced age and increased BMI, which is consistent with previous studies.[5,6]Abdominal obesity has been reported to be a predisposing factor of insulin resis- tance, hypertension and dyslipidaemia in both male and female patients.[7,8]
WC was a useful predictor of metabolic morbidities and adopted in recent MetS definitions.Previous data reported that obesity, dyslipidaemia and increased FPG were prevalent components of MetS among Han Chinese using CDS 2013.[9,10]
In the past few decades increased attention given to MetS has led to several attempts to develop a definition that is accepted worldwide. However, there is as yet no internationally agreed definition for MetS and, hence, prevalence of MetS varies substantially depending on the criteria used. [11-12]
Metabolic syndrome (MetS) refers to a constellation of metabolic risk factors which includes elevated waist circumstance, insulin resistance, elevated triglyceride (TG) levels, decreased high-density lipoprotein cholesterol levels (HDL-C), and elevated low-density lipoprotein cholesterol (LDL-C) levels.[13]
In 1998 the world health Organization proposed a set of diagnostic criteria.Followed by definition from the National Cholesterol Education program's Adult treatment panel III These definitions agreed that hyperglycemia,Obesity,dyslipidemia, and hypertension are core components of MetS but they differed in the details and criteria.

In 2005, a modification (ATP-III) by the American Heart Association and National Heart, Lung, and Blood Institute (AHA/NHLBI) was proposed with a reduced threshold for hyperglycemia and some minor modifications.[14-17]

## LIMITATIONS

1. Due to a cross-sectional study design, the current sampling came from one medical centre at a specific time period ,may limit generalisability.
2. It will be important to use a larger sample and up-to-date data in future studies on prevalence of MetS among Indian population.
3. EarlyMetS diagnosis, using population-based health data, could increase risk perception and awareness towards a healthier lifestyle.
4. A multicentre investigation would be valuable in future research to examine disease-related outcomes of MetS based on long-term follow-up data in specific populations.

## CONCLUSION

Metabolic syndrome was found to be relatively common in type 2 diabetic patients as demonstrated by the alarmingly high prevalence documented using WHO, NCEP ATP III, IDF and the new Harmonized criteria. The new Harmonized criteria established the highest prevalence of MetS, followed by NCEP ATP III, IDF, and WHO definitions. There was a strong concordance between the WHO and NCEP ATP III criteria. The WHO against NCEP ATP III criteria evinced the highest sensitivity whereas Harmonized criteria against all the other three definitions showed the highest specificity in identifying MetSMaximum prevalence of Metabolic syndrome was observed in diabetic male harmonised criteria (73.3%) and diabetic female WHO criteria (76.6 ). A fair agreement was observed between WHO and HAR criteria by Kappa statistics.A two tailed significant correlation were found in diabetic male patients ( using WHO,HAR criteria ) than female patients (using CDS ) criteria.Since MetS components are all reversible, their early identification using data from health examinations could lead to the development of effective prevention approaches for obesity, cardiometabolic diseases and T2DM.

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## CONFLICT OF INTEREST

None

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