Plant Archives Volume 20 No. 2, 2020 pp. 7334-7338 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

METABOLIC SYNDROME IN TYPE II DIABETES MELLITUS PATIENTS: ANTHROPOMETRIC ESTIMATION AND RISK FACTORS

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Abstract

Metabolic Syndrome (MetS) is a rising health issue in the modern world that owe to modernization and a sedentary living style that has brought considerable trouble to healthcare. The study's objective was to assess the different metabolic risk factors and anthropometric estimation in type II diabetic patients. A cross-sectional study was conducted in 350, type II diabetic patients within the age of 30-80 years. Anthropometric indices and clinical data were collected by direct interview method and patient's medical records. MetS were analyzed by using International Diabetic Federation guidelines. The prevalence of MetS in diabetes patients was 42.28% and it was found that Fasting Blood Sugar (p=0.002), Triglycerides (p=0.000), SBP (p=0.001), DBP (p=0.019), waist circumference (p=0.000) and BMI (p=0.000) were significantly higher in patients with MetS than without MetS group. Apart from high-density lipoprotein (HDL), the mean values of biochemical elements were higher in female patients compared to male patients. There was a significant difference in the mean waist circumference of males and females (p=0.000). The risk factors analysis shows that abdominal obesity was the most prevalent risk factor, followed by HDL and the least prevalent risk was physical activity. This study concludes that significant risk factors of MetS were abdominal obesity and HDL, which will increase the cardiovascular burden and other complexities in DM patients. Early identification of MetS and healthy lifestyle alterations will help reduce premature morbidity and mortality and improve the quality of life of the population.

Key words: Metabolic Syndrome, Type II DM, Risk Factors, Anthropometric Estimation.

Introduction

About 88 million adults in South-East Asia were identified with diabetes. This figure is expected to rise to 153 million by 2045; 1.2 million deaths in South-East Asia were due to diabetes. In this area, there is an escalating trend in type II DM, especially between the age group of 20-70 years. About 77 million adults are diagnosed with diabetes in India. Thus, India stands 1st in terms of having many diabetes patients (Piemonte, L., 2019). Metabolic syndrome (MetS) comprises a group of abnormalities such as central obesity, high blood sugar level, elevated blood pressure (BP), low high-density lipoprotein (HDL) cholesterol and increased triglyceride level (Srikanthan, K. *et al*., 2016 and Singh, N., 2018). MetS considerably increases the risk of cardiovascular disease (CVD) by two-fold and type II DM from three to five-fold than an individual without the syndrome. Undoubtedly, this pandemic has become a leading health issue around the world (Etchegoyen, M. *et al*., 2018). Decreased physical activity and an unhealthy way of living due to westernization are one of the main issues of this escalating rate in MetS (Aljabri, K.S. *et al*., 2018).

Numerous definitions were formed by different organizations to identify MetS since its origin. But usage of various criteria makes the comparison more strenuous in studies, mainly when comparing the population with different ethnic specificity (McCracken, E. *et al*., 2018). Among the various definitions, the most widely used diagnostic criteria is the International Diabetes Federation (IDF) (Aljabri, K.S. *et al*., 2018).

Around the world, the prevalence of MetS ranges from 10% to 84%. This variation arises due to differences in the definition used and also the domiciliary status,

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region, genetic composition, lifestyle and nutritional modification of the population. In India, the occurrence of MetS is recorded from 11% to 41% due to differences in lifestyle and cultural dissimilarities (Khan, Y. *et al*., 2018). Early detection would help in the treatment and management of the syndrome resulting in lower catastrophic outcomes of MetS (DeFronzo, R.A. *et al*., 1991). The primary method to manage MetS is to initiate lifestyle interventions that target living style risks such as obesity, atherogenic diet, physical inactivity and smoking, which would reduce the risk of CVD and type II DM (Aquilante, C.L. *et al*., 2000).

A hike in the rate of MetS in DM patients is seen day by day, which could lead to premature morbidity and mortality of the patients. Therefore the study aims to assess the different metabolic risk factors in type II DM patients.

Materials and Methods

A cross-sectional study was carried out in 350, type II DM patients admitted in the General Medicine Department of a Charitable Hospital. Institutional ethical approval was obtained prior to initiating the study. Only the subjects who gave informed consent were included in the study. The detailed sample size calculation and study criteria are mentioned in the part of the study previously published in J. Diabetes Metab Disord. (James, M. *et al*., 2020).

The weight was taken by using a standard electronic weighing machine provided that the subject was wearing light garments and the height was measured by using a stadiometer when the subject was not wearing shoes. The same electronic weighing machine and stadiometer were used in all the patients throughout the study to maintain uniformity. Body Mass Index (BMI) of the subjects were calculated manually from the measured weight and height using the formula BMI = weight in kg/ height in m^2. The central obesity was evaluated by calculating the waist circumference (WC) with the help of a measuring tape at the near intermediate between the inferior margin of the last palpable rib and the top of the iliac crest at the end of a relaxed expiration, while the patient is standing upright. The auscultator method of blood pressure measurement was used in consonance with the guidelines of the Eighth Report of the Joint National Committee (JNC8).

Patient demographics data such as age, sex, family history and lifestyle details like physical activity, smoking, alcohol use and substance abuse were collected through direct interview method. Fasting Blood Sugar (FBS), Triglycerides (TG), High-Density Lipoprotein (HDL) and Blood Pressure (BP) were obtained from the patient medical records. The evaluator measured anthropometric indices of the patients. Assessment of MetS was analyzed by using the International Diabetic Federation (IDF) criteria (IDF, 2017).

Statistical analysis

The data collected were entered into an excel sheet and analyzed using SPSS v.20. Mean and standard deviation were used to describe quantitative data. Categorical data were presented in percentage/counts (frequency). The odds ratio was used for the risk factor assessment. An independent sample t-test was used to compare the quantitative data with p-value < 0.05 is considered as statistically significant.

Table 1: Analysis of sociodemographic parameters of the study population.

		Without MetS N=202 (%)	With MetS N=148 (%)	p value
Gender	Male	151 (69.90)	65(30.09)	0.001
	Female	51 (38.05)	83 (61.94)	
Alcoholic	No	163 (80.69)	105 (70.94)	0.04
	Yes	39 (19.30)	43 (29.05)	
Smoker	No	178 (88.11)	120 (81.08)	0.07
	Yes	24 (11.88)	28 (18.91)	
Substance Use	No	194 (96.03)	136 (91.89)	0.10
	Yes	8 (3.96)	12 (8.10)	
Physical Activity	No	169 (83.66)	126 (85.13)	0.76
	Yes	33 (16.33)	22 (14.86)	
Body Mass Index	Underweight	2 (0.99)	-	0.000
	Normal	135 (66.83)	41 (27.70)	
	Overweight	65 (32.17)	94 (63.51)	
	Obese	-	13(8.78)	
	Present	118 (58.14)	121 (81.75)	
Waist Circumference	Normal	180 (89.10)	-	0.000
	Increased	22 (10.89)	148 (100)	

Results

Out of 350 patients, according to the IDF criteria, the prevalence of MetS in diabetes patients was 42.28% (n=148). The age-wise distribution results were mentioned in the previously published study (James, M. *et al*., 2020). The other patient demographics data of diabetic patients with MetS and without MetS are presented in table 1. The significantly higher mean value of FBS, TG, SBP, DBP, WC and BMI was observed in patients with MetS compared to without

Table 2: Mean differences of biochemical parameters in DM patients with and without MetS.

Components of MetS	Without MetS (N=202) Mean ± SD	With MetS (N=148) Mean ± SD	p value
FBS	153.16 ± 69.25	184.09 ± 77.07	0.002
TG	130.47 ± 69.44	187.09 ± 115.84	0.000
HDL	41.99 ± 12.99	33.98 ± 10.58	0.000
SBP	124.88 ± 17.98	131.80 ± 19.49	0.001
DBP	80.09 ± 7.658	82.16 ± 8.32	0.019
WC	83.46 ± 5.75	92.47 ± 7.35	0.000
BMI	23.98 ± 2.17	26.44 ± 3.32	0.000

FBS-Fasting Blood Sugar; **TG**-Triglyceride; **HDL**-High Density Lipoprotein; **SBP**-Systolic Blood Pressure; **DBP**- Diastolic Blood Pressure; **WC**- aist Circumference; **BMI**-Body Mass Index.

MetS group. Whereas, the significantly lesser mean value of HDL was observed in patients with MetS compared to without MetS group. The results of the metabolic components parameters in DM patients with and without MetS are presented in table 2.

Except for HDL, the mean values of biochemical elements were higher in female participants and a significantly higher presence of TG was found in female patients compared to male patients. There was a significant difference in the mean WC of males and females. The detailed data are depicted in table 3.

Out of 350 patients, the majority of them have at least any two (31.14%) of the metabolic risk components and 11.14% of the population in this study were detected with all the five risk factors. The distribution of MetS abnormality, according to gender, showed that 7.87% of men and 16.41% of women had the presence of all the MetS components. The majority of the male population has at least any two of the MetS risk factors, whereas most of the female population has at least any three of the components (Table 4).

Table 3: Gender related difference in the components of metabolic syndrome.

Components of Metabolic Syndrome	Male (n= 216) Mean ± SD	Female (N=134) Mean ± SD	p value
WC	88.38 ± 6.89	85.23 ± 8.80	0.000
SBP	126.90 ± 19.02	129.27 ± 18.74	0.255
DBP	80.85 ± 8.20	81.16 ± 7.69	0.725
HDL	37.87 ± 1.78	36.35 ± 12.90	0.431
TG	153.71 ± 107.2	176.39 ± 94.21	0.017
FBS	159.89 ± 76.67	176 ± 69.74	0.094
BMI	24.94 ±2.84	25.1 ± 3.1	0.647

FBS-Fasting Blood Sugar; **TG**-Triglyceride; **HDL**-High Density Lipoprotein; **SBP**-Systolic Blood Pressure; **DBP**- Diastolic Blood Pressure; **WC**- aist Circumference; **BMI**-Body Mass Index.

Table 4: Clustering of MetS Components in the study population.

No. of Components of MetS	Male	Female	Total N (%)
None	5 (2.31)	2 (1.49)	7 (2.00)
Any 1	45 (20.83)	9 (6.71)	54 (15.43)
Any 2	78 (36.11)	31 (23.13)	109 (31.14)
Any 3	44 (20.37)	42 (31.34)	86 (24.57)
Any 4	27 (12.5)	28 (20.89)	55 (15.71)
All Components	17(7.87)	22 (16.41)	39 (11.14)

The odds ratio analysis of DM patients with MetS revealed that except physical activity all the factors such as gender, abnormal WC, high blood sugar level, elevated BP, low HDL cholesterol, increased triglyceride level, smoking and alcoholism were found to be the major risk elements of DM patients with MetS. Among these risk factors, abdominal obesity (95% CI = 5.232-11.412) was the prevalent risk factor in patients with MetS, which was followed by low HDL (95% CI = 3.933-10.402). The

Table 5: Risk factors in DM patients with MetS.

Variables N (%)		p value	Odds ratio	95% CI
Gender		0.000	3.781	2.401-5.953
Male	65 (30.09)			
Female	83 (61.94)			
Smoking		0.070	1.731	0.957-3.129
Non smoker	120 (81.08)			
Smoker	28 (18.91)			
Alcoholic		0.041	1.712	1.040-2.816
Non-alcoholic	105 (70.945)			
Alcoholic	43 (29.05)			
Physical activity		0.76	0.894	0.497-1.608
Do Exercise	126 (85.13)			
Do not Exercise	22 (14.86)			
FBS		0.001	5.907	1.734-20.129
Elevated	145 (97.97)			
Normal	3 (2.02)			
TG		0.000	6.095	3.544-10.481
Elevated	83 (56.08)			
Normal	65 (43.91)			
BP		0.000	3.190	1.931-5.272
Elevated	121 (81.75)			
Normal	27 (18.24)			
HDL		0.000	6.396	3.933-10.402
Decreased	86 (58.10)			
Normal	62 (41.89)			
WC		0.000	7.727	5.232-11.412
Increased	148 (100)			
Normal	-			

FBS-Fasting Blood Sugar; **TG**-Triglyceride; **HDL**-High Density Lipoprotein; **BP**-Blood Pressure; **WC**- aist Circumference

patients with abdominal obesity and HDL were 7 and 6 times more likely to develop MetS. The least prevalent risk factor was physical activity (95% CI= 0.497-1.608) and it was less likely to develop MetS (Table 5).

Discussion

Metabolic syndrome is a globally rising health issue in both developing and developed countries. This study assessed the metabolic risk and its components in 350 diabetic patients. The sample group consisted of 216 males and 134 females.

In this study, the prevalence of MetS in type II DM was analyzed and it was found to be 42.28%. This appraised prevalence was statistically significant (p=0.000). A similar trend was outlined in the study conducted by (Mundhe, S.A. *et al.,* 2016 and Ford, E.S., 2005) which indicated 45.3% and 40% respectively. But in the study carried out by (Gyakobo *et al.,* 2012) a prevalence of 35.9% proved to be inconsistent with the current study. A higher presence of MetS in patients with DM was found in the study conducted by (Bakir, M.A. *et al.,* 2019).

In the present study, all the metabolic risk elements were significantly higher in DM patients with MetS when compared to DM patients without MetS (p<0.001). This was inconsistent with the result obtained from the study of (Marjani, A. *et al.,* 2011) The mean value of BMI shows a significant difference in DM patients with MetS and without MetS (p=0.000). A similar trend was observed in the study performed by (Marjani, A. *et al.,* 2011). Except for HDL, all the biochemical parameters' mean values were higher in DM patients with MetS in the present study. A good agreement with our results was observed in the study conducted by (Jain, V. *et al.,* 2018).

In this study, the mean values of biochemical parameters such as TG (p=0.017) and fasting glucose (p=0.094) were significantly higher in female patients. This was similar to the result obtained in the study performed by (Bakir, M.A. *et al.,* 2019). The mean WC was significantly higher in male patients than female patients in this study (p=0.000). But this result was inconsistent with the result derived by (Gyakobo *et al.,* 2012 and Osei-Yeboah *et al.,* 2017).

This study reveals that most of the subjects had at least two components (31.14%) of MetS. However, the study conducted by (Bakir, M.A. *et al.,* 2019) reported that at least three components (42.9%) of MetS were present in the majority of the subjects.

The majority of the female patients in the study showed the presence of at least three MetS components. It was similar to the result observed in the study of (Bakir, M.A. *et al.,* 2019) but proves to be not similar in the study conducted by (Pokharel, D.R. *et al.,* 2014). The case of male patients in the study shows the presence of at least two MetS components. This finding indicates a good agreement with (Sudhera, N. *et al.,* 2018). But the result was dissimilar to the results obtained from the study of (Pokharel, D.R. *et al.,* 2014).

MetS is usually an outcome arising out of different lifestyles, behaviors and genetic factors among individuals. Early assumptions related to physical activity, cigarette smoking and alcohol consumption to MetS resulted in inconsistent conclusions derived through various studies (Yu, M. *et al.*, 2014 and Ekblom, O. *et al*., 2015). In the current study, while analyzing the study participants' social habits with metabolic syndrome, 29.05% were alcoholics and 18.9% were smokers. This conclusion was non-similar with the result observed in (Gyakobo, M. *et al.,* 2012). The current research shows a higher rate of physically inactive patients with MetS than the study of (Damiri, B. *et al.,* 2018).

In the current study, the risk factors analysis using odds ratio shows that abdominal obesity was the prevalent risk factor followed by HDL. The least prevalent risk factor was found to be physical activity. In contrast to the present study, (Gyakobo, M. *et al.,* 2012 and Damiri, B. *et al.,* 2018) reported that BMI (overweight and obese) and family history of DM were more likely to develop MetS, respectively.

Conclusion

The present study evaluated the different risk factors of MetS in type II DM patients. Our study revealed that the most common risk factor in this population was central obesity, followed by low HDL and at least two of the MetS clusters observed in this study population. These factors increase the probability of having significant cardiovascular risk and other chronic diseases in DM patients in the future. This may be due to the modernization, sedentary living style, lack of daily exercise and alteration from a healthy diet. Clinically, MetS remain under-recognized; under diagnosed and undertreated- so early identification of risk factors of MetS is required to reduce the upcoming burden and complexities posed by it.

Declaration of Competing Interest

The author declares that no conflict of interest or personal relationships to the relevant work reported in this paper.

Acknowledgment

The authors are very grateful to the general medicine department and hospital authority, which helped in completing this work.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Limitations

The study design is a cross-sectional study so that the cause-effect relationship cannot be determined. Generalization of our findings is not feasible to the whole diabetic population because of its single centered nature and also we used only one definition to determine MetS.

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