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PREVALENCE OF METABOLIC SYNDROME AMONG PATIENTS WITH TYPE 2 DIABETES

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ABSTRACT

Background: diabetic mellitus is an endocrinological and/ or metabolic syndrome with an increasing global prevalence and incidence. Objectives: To assess the prevalence of metabolic syndrome among the patients with diabetes using ATP-3 criteria and other different criteria for the assessment of metabolic syndrome. **Method:** A cross-sectional study of 150 diabetics in the outpatient department of Merjan Medical City in Al-Hilla, Babylon. A pre-designed questionnaire was used to collect data on socio-demographic status, disease history, and other chronic diseases, followed by clinical examination and anthropometric measurements of the patients' height, weight, mid-upper arm circumference, waist circumference, hip circumference, and neck circumference. Than Each participant gave ten millilitres of venous blood following an overnight fast to assess lipid profiles and fasting plasma glucose. Students were split by metabolic syndrome and employed SPSS's Student's t-test and Chi-square test to detect relationships between factors. **Results:** In the research, 65.33% of individuals had metabolic syndrome, with a mean age of 54.26 ± 10.86. Significant difference in BMI between metabolic syndrome patients (34.02 ± 6.53) and non-metabolic syndrome patients (27.77 ± 5.11), P-value < 0.001. smoking history was associated with metabolic syndrome, although gender and physical activity were not. In metabolic group, chronic illness and diabetes complications were more common. The metabolic group had considerably greater anthropometric parameters. **Conclusion:** metabolic syndrome was relatively high among diabetic patients, obesity and smoking were predictive factors.

KEYWORDS: Diabetes metabolic syndrome, Biochemical estimation, Statistical analysis.

INTRODUCTION

Diabetes mellitus is a prevalent chronic metabolic disorder, characterized by persistent high blood sugar levels and disturbances in the metabolism of carbohydrates, proteins, and fats. Its global prevalence is on the rise, posing a significant public health challenge, with estimates indicating over 450 million individuals affected in 2017, expected to escalate to over 690 million by 2045. The Middle East, particularly Iraq, exhibits one of the highest prevalence rates of diabetes, significantly impacting the elderly population. According to the Iraq Family Health Survey 2006/7, the prevalence rate among Iraqis aged 50 years or older is 143.8 per 1000 persons.[1-3] Metabolic syndrome, a cluster of metabolic conditions including hypertension, insulin resistance, central obesity, and dyslipidemia, is closely linked with the development of cardiovascular disorders, especially atherosclerosis. It represents a spectrum of cardiovascular disease risk factors rather than a single disease, first identified by the World Health Organization (WHO) in 1998, with subsequent definitions provided by the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III in 2001 and a joint definition by the International Diabetes Federation (IDF) with the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) in 2005. These definitions vary slightly in their criteria but share common elements such as glucose intolerance, high blood pressure, abnormal cholesterol levels, and obesity.[4,5] The pathogenesis of metabolic syndrome is complex and multifactorial, with lifestyle and environmental factors like excessive calorie intake and reduced physical activity playing a significant role. Visceral adiposity is considered a primary trigger for the pathways involved in the development of metabolic syndrome, highlighting the critical role of excessive

calorie consumption. The global prevalence of metabolic syndrome is highly variable and closely corresponds to the prevalence of obesity, with notable differences among various regions and age groups. For instance, in 2010, the prevalence in the United States exceeded one fifth of the total population (22.9%), while Europe saw about a quarter of its population affected. In contrast, Southeast Asia reports a lower but rapidly increasing prevalence.[4,6] Complications associated with metabolic syndrome significantly affect the quality of life, leading to substantial social and economic burdens. These include both macrovascular and microvascular complications, with macrovascular complications often preceding hyperglycemia, underscoring the importance of early intervention. A range of complications arises from metabolic syndrome, including type 2 diabetes, cardiovascular disease, coronary heart disease, and chronic renal disease, further emphasizing the syndrome's impact on public health and the need for comprehensive management and prevention strategies.[7-9] The aim of this study to assess the prevalence of metabolic syndrome among the patients with diabetes using ATP-3 criteria and other different criteria for the assessment of metabolic syndrome.

METHOD

This cross-sectional study was conducted over six months, from March to August 2020, at the outpatient department of the Diabetic and Endocrine Center in Merjan Medical City, Al-Hilla, Babylon. It included 150 diabetic patients over 35 years of age who attended the outpatient clinic, with the sample size calculated based on the 10% prevalence of diabetes mellitus (DM) in Iraq. The study focused on patients diagnosed with type 2 diabetes mellitus (T2DM), excluding those with type 1 diabetes, chronic renal failure, liver cirrhosis, abdominal or neck masses affecting measurements, non-fasting state, or acute illness. Data collection involved a pre-designed questionnaire covering socio-demographic status, disease history, and other chronic conditions, complemented by clinical examinations and anthropometric measurements (height, weight, mid-upper arm circumference (MUAC), waist circumference, hip circumference, and neck circumference) using standard techniques and modern instruments. Specific measurements included MUAC at the midpoint between the shoulder tip and elbow tip, waist circumference between the last palpable rib and the iliac crest, hip circumference at the hips' widest portion, and neck circumference midway between the mid-cervical spine and the mid-anterior neck. Body mass index (BMI) was calculated from the weight and height of the subjects to classify their obesity status according to NCEP ATP III criteria. Biochemical analyses for lipid profiles and fasting blood glucose were conducted after overnight fasting, using centrifugation for plasma separation and specific assays for HDL cholesterol (HDL-C) and triglycerides. Metabolic syndrome was diagnosed based on ATP III criteria, identifying patients with three or more of the following: abdominal obesity, hypertriglyceridemia, low HDL-C, high blood pressure, and elevated fasting plasma glucose or treatment for high blood glucose. Statistical analysis was performed with SPSS® version 23.0, presenting quantitative variables as mean ± standard deviation and qualitative variables in numbers and percentages, using Student's t-test for continuous variables and Chi-square test for categorical comparisons. A p-value of ≤0.05 was considered statistically significant. Ethical approval for the study was obtained from the department of family and community medicine at the College of Medicine, University of Babylon, with additional approvals from Merjan Teaching Hospital/Diabetic and Endocrine Center. Verbal informed consent was secured from all participants, ensuring confidentiality of the collected data throughout the study.

RESULTS

A total of 150 diabetic patients enrolled in this study. Demographic characteristics of study participants are summarized in Table (1) demonstrate most of patients with DM are obese (55.3%). A total of 150 diabetic patients enrolled in this study. The mean ± standard deviation age of the patients was 53.63 ± 10.52 years, ranged between 35 years and 78 years, figure 1 illustrate age group distribution among study participants. The number of diabetic patients with metabolic syndrome was 98 patients, giving the prevalence of metabolic syndrome among study participants (65.33%). Risk factors for obesity are summarized in table 2 demonstrate that most of patients with DM were physically inactive (87.33%).

Table 1: Demographic characteristics of study participants.

Characteristics		Frequency	%
Gender	Male	70	46.67%
	Female	80	53.33%
BMI Group	Normal (18.5-24.9) kg/m^2	22	14.67%
	Overweight (25.0-29.9) kg/m^2	45	30.00%
	Obese Class I (30.0-34.9) kg/m^2	37	24.67%
	Obese Class II (35.0-39.9) kg/m^2	31	20.67%
	Obese Class III (>39.9) kg/m^2	15	10.00%
Smoking	Smoker	32	21.33%
	Non-smoker	104	69.33%
	Ex-smoker	14	9.33%

Table 2: Risk factors for obesity among patients.

Characteristics	Frequency	%
Physical Inactivity	131	87.33%
Family History of Obesity	45	30.00%
Use sugar in food	38	25.33%
Eat sweet fruits	84	56.00%
East fast food	24	16.00%

Table 3: Comparison of BMI classification between patients with metabolic syndrome and patients without metabolic syndrome show that 71.43 % of patient with metabolic syndrome are obese and only 25% of patient without metabolic syndrome are obese.

BMI Classification	Metabolic Syndrome		Total	P-value
	Yes	No		
Mean ±SD	34.02 ± 6.53	27.77 ± 5.11	31.8±6.7	< 0.001*
Normal (18.5-24.9)	6 (27.27%)	16 (72.73%)	22 (100%)	
Overweight (25.0-29.9)	22 (48.89%)	23 (51.11%)	45 (100%)	
Obese Class I (30.0-34.9)	28 (75.68%)	9 (24.32%)	37 (100%)	
Obese Class II (35.0-39.9)	29 (93.55%)	2 (6.45%)	31 (100%)	
Obese Class III (>39.9)	13 (86.67%)	2 (13.33%)	15 (100%)	
Total	98 (65.33%)	52 (34.67%)	150 (100%)	

***Student's t-test, Significant at P < 0.05**

Association of metabolic syndrome status with smoking status had shown that there was significant association between smoking status (smoker or ex-smoker) and presence of metabolic syndrome, P-value = 0.068, while there were no significant association between physical activity and metabolic syndrome (p=0.466) table.[4]

Table 4: Association of metabolic syndrome status with smoking status and physical activity.

Variables		Metabolic Syndrome		Total	P-value
		Yes	No		
Smoking	Smoker/ Ex-smoker	36 (78.26%)	10 (21.74%)	46 (100%)	0.027#
	Non-smoker	62 (59.62%)	42 (40.38%)	104 (100%)	
Physical Activity	Physically active	11 (57.89%)	8 (42.11%)	19 (100%)	0.466
	Physically inactive	87 (66.41%)	44 (33.59%)	131 (100%)	
Total		98 (65.33%)	52 (34.67%)	150 (100%)	

chi-square test, Significant at P < 0.05

Relation of metabolic syndrome status with certain risk factors is provided in Table (5) However, no significant relationship was found between metabolic syndrome and use of sugar in food, eating sweet fruits, or eating fast foods (P-value > 0.05).

Table 5: Relation of metabolic syndrome status with certain risk factors.

Risk Factors		Metabolic Syndrome		Total	P-value
		Yes	No		
Use of sugar	Yes	28 (73.68%)	10 (26.32%)	38 (100%)	0.211
	No	70 (62.50%)	42 (37.50%)	112 (100%)	
Eat sweet	Yes	60	24	84	0.077

fruits		(71.43%)	(28.57%)	(100%)	
	No	38 (57.58%)	28 (42.42%)	66 (100%)	
Eat fast foods	Yes	18 (75.00%)	6 (25.00%)	24 (100%)	0.278
	No	80 (63.49%)	46 (36.51%)	126 (100%)	

[#] chi-square test, Significant at P < 0.05

Regarding complications, neuropathy was found to be significantly higher among patients with metabolic syndrome compared to patients without metabolic syndrome, P-value = 0.043. However, no significant relationship was observed between metabolic syndrome and any of nephropathy, cardiovascular complications, or diabetic foot Table (6).

Table 6: Relation of metabolic syndrome status with complications.

Complications		Metabolic Syndrome		Total	P-value
		Yes	No		
Nephropathy	Yes	2 (100%)	-	2 (100%)	0.544[#]
	No	96 (64.86%)	52 (35.14%)	148 (100%)	
Cardiovascular complications	Yes	14 (58.33%)	10 (41.67%)	24 (100%)	0.432[#]
	No	84 (66.67%)	42 (33.33%)	126 (100%)	
Neuropathy	Yes	74 (70.48%)	31 (29.52%)	105 (100%)	**0.043**[#]
	No	24 (53.33%)	21 (46.67%)	45 (100%)	
Diabetic foot	Yes	6 (100%)	-	6 (100%)	0.093[#]
	No	92 (63.89%)	52 (36.11%)	144 (100%)	

Difference between metabolic syndrome patients and non-metabolic syndrome patients regarding mean anthropometric measurements were performed using Student's t-test in male diabetic patients. There was significant difference between the two groups regarding hip circumference, waist circumference, Waist/ hip ratio and neck circumference Table (7).

Table 7: Difference in mean anthropometric measurement in male diabetic patients according to metabolic syndrome status.

Measurements (Mean ± SD)	Metabolic Syndrome		P-value
	Yes	No	
Hip circumference	104.8 ± 10	98.38 ± 11.5	< 0.016[*]
Waist circumference	104.8± 9.2	95.9± 9.5	< 0.001[*]
Waist/ hip ratio	1 ±0.03	0.97 ±0.04	0.019*
Neck circumference	40.22 ± 3.4	38.26 ± 4.3	0.039[*]
Mid-upper arm circumference	33.56 ± 3.68	32.6 ± 2.7	0.25[*]

* Student T test, Significant at P < 0.05

Difference between metabolic syndrome patients and non-metabolic syndrome patients regarding mean anthropometric measurements were performed using Student's t-test in female diabetic patients. There was significant difference between the two groups regarding hip circumference, waist circumference, neck circumference and Mid-upper arm circumference Table (8).

Table 8: Difference in mean anthropometric measurement in female diabetic patients according to metabolic syndrome status.

Measurements (Mean ± SD)	Metabolic Syndrome		P-value
	Yes	No	
Hip circumference	106.2 ± 14.5	99.26 ± 12.9	< 0.04*
Waist circumference	103.4 13.9	95.26 13.8	< 0.012*
Waist/ hip ratio	0.97 0.07	0.96 0.08	0.34*
Neck circumference	38.44 ± 3.2	35.88 ± 2.2	0.025*
Mid-upper arm circumference	34.22 ± 3.9	31.3 ± 7.5	0.001*

* Student T test, Significant at P < 0.05

DISCUSSION

This study found the prevalence of metabolic syndrome among diabetic patients to be 65.33%, aligning with a Nigerian study's prevalence of 62.5% and a higher rate of 86% in Basra, while a Saudi Arabian study reported a lower prevalence of 56%. Variations in these rates may be attributed to differences in definitions, population demographics, and screening techniques, yet all highlight a higher prevalence of metabolic syndrome in diabetics compared to the general population. In Asia, the prevalence ranges from 21.9% in Thailand to 49.4% in Malaysia, indicating significant regional disparities likely due to genetic factors, lifestyle changes, urbanization, and dietary habits that promote obesity and metabolic syndrome.[10-12] The study participants with metabolic syndrome had an average age of 54.2 years, reflecting findings similar to a Nigerian study, where the mean age was 53 ± 7 years, and a Saudi study with a mean age of 60 ± 13 years. These results confirm that the risk of metabolic syndrome increases with age. The gender analysis revealed more females than males had metabolic syndrome, though no direct association between gender and metabolic syndrome was established within the diabetic cohort. This higher incidence in females could be attributed to factors such as greater healthcare-seeking behavior among Iraqi women, postpartum obesity, reduced physical activity, and metabolic changes during menopause. Studies from Baghdad, India, and Tunisia also report higher prevalence rates of metabolic syndrome among women, indicating a global trend that necessitates targeted interventions for females.[13-15] The majority of the study's respondents (87.33%) reported not engaging in regular physical exercise, reflecting a broader trend within Iraqi society possibly due to social norms, climate, and security concerns. However, the Baghdad study found no significant link between exercise and metabolic syndrome, contrasting with findings from the HERITAGE family study in the United States, which demonstrated that exercise training could significantly improve metabolic profiles and reduce the prevalence of metabolic syndrome. This suggests the potential benefits of physical activity in managing metabolic syndrome, particularly as primary prevention.[15] A significant association was found between cigarette smoking and metabolic syndrome, echoing findings from a study among healthcare personnel in Erbil, Iraq, where 51.7% of patients with metabolic syndrome were smokers. This underscores the need for public health initiatives to address smoking as a modifiable risk factor for metabolic syndrome.[16] Anthropometric measurements revealed that individuals with metabolic syndrome had significantly higher mean BMI than those without, indicating an association between body mass index, central obesity (measured by waist circumference and waist-to-hip ratio), and the prevalence of metabolic syndrome. This relationship persisted even after stratifying by gender, highlighting the importance of addressing obesity as a key factor in metabolic syndrome management. Additionally, a study suggested modifying the definition of metabolic syndrome for early detection of coronary artery disease in patients with type 2 diabetes, emphasizing the need for tailored diagnostic criteria to improve patient outcomes.[17]

CONCLUSION

The prevalence of metabolic syndrome in type 2 DM patients in Babil, Iraq was high, Majority of patients were not practicing exercise and had bad food habits, Majority of diabetic patient with metabolic syndrome are obese, Increase BMI was associated with increased risk of metabolic syndrome in diabetic patients, All anthropometric measurement (except mid-arm in male and waist to hip ration in female) was significantly higher in diabetic patients with metabolic syndrome than patients without metabolic.

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