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PREVALENCE OF METABOLIC SYNDROME AND ITS RELATION TO BODY COMPOSITION IN A SAUDI FEMALE POPULATION

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ABSTRACT

The prevalence of MS has been reported to be on the rise globally, and was mainly attributed to changes in diet and lifestyle, in addition to genetic factors and metabolic susceptibility. The prevalence of T2DM in Saudi Arabia is increasing, making it an epidemic health hazard. Intervention programs to decrease the risk of progression from MS to full T2DM, and later CVD have been successful in many countries. Therefore, diagnosing MS is important to address risk factors and to prevent progression to the more serious chronic conditions. To find out the prevalence of MS in the given population of Saudi females. 528 female subjects, belonging to different professional and academic backgrounds from Ha'il region of Saudi Arabia. The study was carried out using the following tools for finding out the prevalence of MS in a female Saudi population using different anthropometric and bio-chemical parameters and cutoff points taken from WHO reference standards. SPSS Statistic 17 was used for statistical processing. Means and standard deviations were calculated for each variable using descriptive statistics. Stepwise regression model was used to perform correlations between different predictors of MS. Our results showed high positive association of FBG with FM and PBF in over-weight and obese females of the study sample. Similar positive association of FBG with BMI and WC was observed in overweight-obese girls. Our findings are in line with available data from previous studies on the relationship between adiposity and blood glucose level. Metabolic syndrome has high prevalence in our population and its prevalence increases with increasing age and BMI. Women are at higher risk for MS than men.

Key Words:- Metabolic syndrome, Diabetes, Hypertension, Abdominal circumference, Blood glucose, Prevalence, Saudis.

INTRODUCTION

Metabolic syndrome (MS) or X syndrome refers to simultaneous occurrence of cardiovascular risk factors or type 2 diabetes such as abdominal obesity, high blood pressure and abnormal carbohydrate and lipid metabolism (hypertriglyceridemia, elevated blood glucose) and decrease in high density lipoprotein (HDL) level (Gharipour M *et al.,* 2006). Although there are various definitions for metabolic syndrome, but the most practical method in clinical diagnosis is using Adult treatment Panel III_(ATPIII). According to this definition the person must have at least three factors of cardiovascular risk factors at the same time. Studies have shown that there is a coincidence of metabolic factors in different individuals, and coexistence of these factors is more harmful than one of them (Sadrbafoghi SM *et al.*, 2007). As a matter of fact metabolic syndrome is like a bridge between diabetes and cardiovascular disease (Gharipour M *et al.*, 2006). About 50% of patients with type 2 diabetes are suffering from metabolic syndrome and these people have more chances for stroke, retinopathy, neuropathy and microalbminuria (Gharipour M *et al.,* 2006). Studies have shown that more than half people with Acute Coronary syndrome have three or more Components of metabolic syndrome

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(Zaliūnas R *et al*., 2007). High prevalence of metabolic syndrome (95%) has been reported in patients with Peripheral Arterial Disease (Qadan LR *et al*., 2008). Prevalence of metabolic syndrome is increasing in different region like Asia and developing countries (Lameira D *et al.*, 2008). Prevalence of metabolic syndrome has been reported between 12.8% to 41.1% in different part of the world (Ramachandran A *et al*., 2003).

The prevalence of MS has been reported to be on the rise globally, and was mainly attributed to changes in diet and lifestyle, in addition to genetic factors and metabolic susceptibility. The risk of cardiovascular disease (CVD) has almost doubled and the risk of developing type 2 diabetes mellitus (T2DM) has increased fivefold in individuals diagnosed with MS. The prevalence T2DM in Saudi Arabia is increasing, making it an epidemic health hazard.

The prevalence of MS in Saudi adults varies from 16% to 40% depending on the definition used and the study location. Use of the consensus definition might decrease the number of missed cases. However, in the absence of local cutoff points for various risk factors for MS, the use of ratios such as waist/hip ratio and low-density lipoprotein cholesterol/high-density lipoprotein cholesterol ratio, and family history of diabetes and CVD might aid diagnosis. Priority should be given to establishing national normal ranges, screening programs for hyperglycemia and hypertension, and community-directed programs to combat obesity and inactivity.

The clustering of risk factors predisposing an individual to cardiovascular morbidity and mortality are usually referred to as ‘metabolic syndrome’ (MS). A considerable disagreement between different expert groups over the terminology and the clinical criteria for its diagnosis is noted, leading to some confusion on the part of clinicians regarding how to identify patients with the syndrome. More recently, several major organizations agreed to unify criteria and came up with a consensus definition stating that abdominal obesity should not be a prerequisite for diagnosis, so that the presence of any three of five risk factors [abdominal obesity, elevated triglyceride, reduced high-density lipoprotein cholesterol (HDL-C), elevated blood pressure, and elevated fasting glucose] constitutes a diagnosis of MS (Alberti K *et al*., 2009).

Cutoff points for each of these risk factors were also defined, taking into account ethnic variations in the thresholds for abdominal obesity. Nevertheless, the prevalence of MS, using different definitions, has been reported to be on the rise globally, and this was mainly attributed to changes in diet and lifestyle (Park Y *et al*., 1994). However, genetic factors and metabolic susceptibility were also reported to play an important role (Grundy S, 2007)

The risk of cardiovascular disease (CVD) has almost doubled in individuals diagnosed with MS (Despres J & Lemieux I, 2006). Furthermore, the risk of developing type 2 diabetes mellitus (T2DM) is increased fivefold in the presence of the syndrome (Ford E, 2005). Diabetes mellitus is considered to be one of the most costly medical disorders globally due to its chronic complications that can exhaust the health resources of any given country. Studies show that the medical costs for people with diabetes are 2.4 times those for people without the condition. Chronic cardiovascular complications are the most costly, contributing to 19.2% of the total direct and indirect costs of the disease (Scholze J, 2010).

MATERIALS AND METHODS

This descriptive analytical study performed with random cluster sampling method in hail region. 528 adult females were randomly selected. After obtaining informed consent by volunteers, they were invited to participate in this study.

A questionnaire included: age, sex, marital status, ethnicity, education level, family history of diabetes (DM), Hypertension (HTN) and obesity, smoking and parity and previous history of gestational diabetes Mellitus in women were filled for each person. Blood pressure, weight, height, body mass index (BMI) [Weigh (kg)/Height(m)^2], abdominal and waist circumference were measured in each participant. Blood pressure was measured by a standard sphygmomanometer after 15 minutes rest in a sitting position. The cuff was placed on the right arm at the heart level and then quickly pushes the device until 30 mm Hg above radial pulse disappearance. Blood pressure was measured twice at least 30 minutes interval between two measurement and mean of these two measurements, was taken as blood pressure. Anthropometric measurements were taken after removing shoes and wearing a light dress. Weight and height were measured according to the standard program. Waist circumference was measured at the midpoint between the lowest rib and the upper lateral border of the right iliac crest and hip circumference at the point of maximum hip diameter.

After 12 h of fasting, blood samples were taken in the morning, and checked for glucose levels using a standard glucometer. BMI was calculated as weight in kilogram divided by the square of height in meter (Kg/m^2). WC was measured to the nearest 0.1 cm in standing position at the midpoint between the lowest rib and the iliac crest and at the end of normal expiration, using a measuring tape.Using these measurements and the new WHO growth reference 5–19 years (Kassi E, 2011), the weight status of each subject was categorized: obese (z-score > +2SD, equivalent to BMI > 30 kg/m² at 19 years), overweight (z-scores > +1SD, equivalent to BMI > 25 kg/m² at 19 years), and normal weight (−2SD ≤ z-scores ≤ +1SD, equivalent to 18 ≤ 25 kg/m² < BMI ≤ 25 kg/m² at 19 years).

For diagnosis of metabolic syndrome at least three of the following five components were considered necessary (according to ATP III criteria update 2005) (Amos A *et al*., 2007; Eriksson K *et al*., 1991).

- Abdominal obesity (Waist circumference ≥ 102 cm in men and ≥ 88 cm in women).
- TG ≥ 150 mg/dl or history of drug consumption for hypertriglyceridemia.
- HDL ≤ 40 mg/dl in men and ≤50 mg/dl in women or history of drug consumption.
- BP Siastolic ≥ 130 mmhg or BP diastolic ≥ 85 mmhg or history of anti hypertensive drug consumption.
- FBS ≥100 mg/dl, history of diabetes mellitus history or using anti diabetic drugs.

STATISTICAL ANALYSIS

Sample size was calculated as 528 and descriptive statistics was used to provide figures and tables. Means and standard deviations were calculated for each variable using descriptive statistics. Two-way ANOVA was used to examine the effect of BMI, BGL and weight status, and their interaction. Chi-square test, stepwise regression and trend test was used for correlation assessment. SPSS software 17 and descriptive statistics was used to provide figures and tables. P = 0 < 0.05 was considered as significant.

RESULTS

From total 528 (P = 0. participant, all were women. The mean age of all participants was 42.27 ± 14 years. Prevalence of metabolic syndrome based on ATPIII criteria (update2005) was 22.8% that showed significant difference 0001). Our study revealed the following findings, presented in the form of tables and figures.

Table 1. Distribution of Subjects according to Age

Age groups (years)	Frequency	Percent
18-20	216	41.0
21-24	235	44.6
25-28	22	4.2
29-32	14	2.7
33+	40	7.6

Table-1 represents the distribution of subjects according to age groups. It was found that majority of the subjects (44.6%) belonged to 21-24 years and the least (2.7%) to 29-32 years.

Table 2. Demographic and Anthropometric Profile of the Study Population

Age (years)	18	60	39	5.97
Height (cm)	145	176	158	5.1
Weight (kg)	35	119	63.9	16.3
BMI (kg/m²)	14.79	50.33	25.54	6.28

Table 1 depicts the distribution of subjects according to age, height, weight and BMI. Average age of participants was 39±5.97yrs. Average height was 158 ±5.1cm; average weight was 63.9 ±16.3kg; average BMI 25.54 ±6.28kg/m2.

Table 3. Prevalence of Obesity by Age in the Study population

	BMI Categories				Chi square significance (*sig P<0.05)
Age groups	**Underweight**	**Normal**	**Over Weight**	**Obese**	
18-20yrs	34	99	50	33	0.000
21-24yrs	24	116	59	36	
25-28yrs	0	5	7	10	
29-32yrs	0	2	4	8	
33+yrs	0	1	11	28	

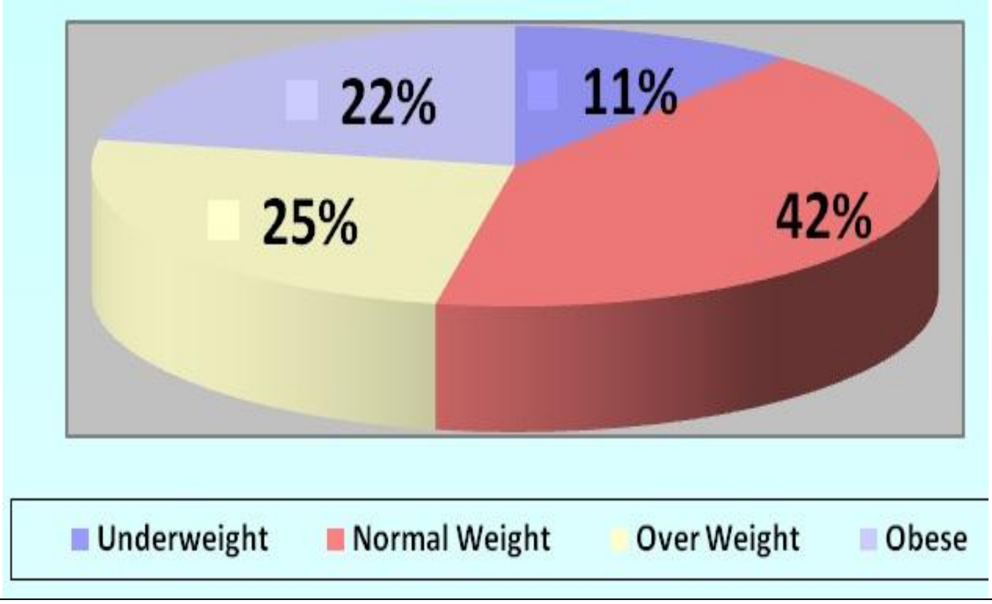
Table-3 presents the distribution of subjects according to obesity by age groups. The ratio of obesity in18-20yrs was 33 out of 21-24yrs were 36/; 25-28yrs was10/22; 29-32yrs was 8/14; 33+yrs was 28/40. The findings were highly significant at p=0.000.

Table 4. Stepwise Regression Model for MS Potential predictors

Model Summary							
Model	**Variable**	**R Square**	**Adjusted R Square**	**df**	**F**	**Std. Error of the Estimate**	**Significance**
1	Waist to hip ratio	.824	.823	1	2445.630	.400	0.000***
2	Weight	.848	.847	2	1454.016	.372	0.000***
3	Visceral fat	.859	.858	3	1059.671	.358	0.000***
4	Percent Body fat	.869	.868	4	865.429	.345	0.000***

a. Predictors: (Constant), Waist to hip ratio
b. Predictors: (Constant), Waist to hip ratio, weight
c. Predictors: (Constant), Waist to hip ratio, weight, Visceral fat
d. Predictors: (Constant), Waist to hip ratio, weight, Visceral fat, Percent body fat
e. Dependent Variable: BMI

Fig 1. Prevalence of BMI categories in the study



Correlation and multiple regression analyses were conducted to examine the relationship between BMI and various potential predictors for MS. Table-4 summarizes the descriptive statistics and analysis results.

As can be seen each of the variables is positively and significantly correlated with the criterion, indicating that those with higher percentage on these variables tend to have higher association with MS. However, it is negatively correlated with fitness score, indicating that it might not be a reliable predictor.

The multiple regression model 1 with all four predictors produced $R^2 = .824$, $F(1,523) = 2445$, $p < .001$. Stepwise regression results of the study population for potential predictors of MS, viz, waist to hip ratio, weight, visceral fat and percent body fat. Waist to hip ratio A highly significant correlation,0.000, was found to exist between the dependant variable-BMI and the independent variables.

DISCUSSION

In the absence of effective interventions for the prevention of diabetes, the frequency will escalate worldwide, with the main impact being seen in developing nations such as Saudi Arabia and the disadvantaged minorities in developed nations. Thus, the prevention of diabetes and its micro- and macrovascular complications should be an essential component of future public health strategies for all nations, and especially in Saudi Arabia, or diabetes is likely to remain a huge threat to public health in the years to come.

The results from studies of disease etiology have been successfully used in different countries to develop intervention programs to decrease the risk of progression from MS, impaired glucose tolerance or prediabetes to full T2DM (Eriksson K *et al*., 1991) or to prevent noncommunicable diseases, especially CVD (Papadakis S, Moroz I, 2008). Therefore, it is of utmost importance to identify individuals with MS so that their multiple risk factors can be addressed and reduced in the hope of preventing progression to the more serious chronic conditions that cannot be reversed once established, namely CVD and T2DM. Present controversies, as well as the importance of establishing clear criteria to define MS, are discussed in a review by Kassi and colleagues (Kassi E *et al*., 2011).

Obesity was found to have a positive correlation with age of the subjects; as age advanced obesity percentage also increased, with maximum prevalence seen in 33+ age group of females.

This indicates a lack of physical inactivity or lack of concern towards diet and accumulation of a positive energy balance in the females once they settle down in life.

The current study aimed to test the effectiveness of FM, PBF, BMI, and WC in predicting high levels of FBG as health risk related to excess body fat in females of different age groups. Many studies support the hypothesis that the relationship between adiposity and risk of disease begins early in life. The increased intra-abdominal adipose tissue is the most clinically relevant type of body fat that is associated with metabolic complications and adverse health effects including hyper-insulinemia and type 2 diabetes in childhood. However, it is not yet clear whether this association can be found in females of all ethnic groups.

Our results showed high positive association of FBG with FM and PBF in over-weight and obese females of the study sample. Similar positive association of FBG with BMI and WC was observed in overweight-obese girls. Our findings are in line with available data from previous studies on the relationship between adiposity and blood glucose level. It has been reported that the level of FBG was found to be higher in overweight and obese females compared to the normal females and that adolescents with high levels of overall and abdominal adiposities had the least favorable glucose levels. Independently of the amount of fat mass, intra-abdominal fat accumulation was found to be strongly related to insulin resistance and hyperglycemia in obese. Moreover, it was indicated that overweight and obesity were associated with increased risk for developing Type 2 Diabetes. The high significant relationship of FBG to BMI, WC, FM and PBF seen in the current study, especially in overweight and obese girls, may be due to the decreased insulin sensitivity which was found to be strongly associated with excess body fat in previous studies, while weight loss was found to be associated with a decrease in insulin concentration and an increase in insulin sensitivity in adolescents. Also such positive relationship in overweight-obese group of girls may be explained by the clustering of metabolic syndrome factors which place individuals at risk for Type 2 diabetes.

Therefore, it is apparent that the prevalence of MS in our studied population of apparently healthy subjects is quite high, and appeared to be dependent on definition as reported previously. Moreover, prevalence was age and sex dependent, being higher in women and increasing with age, as noted previously (Al-Nozha M *et al*., 2005). Age continued to be an important predictor following regression analysis when the consensus definition and NCEP ATP III definition were used. Aging is usually associated with decreased physical activity, leading to loss of muscle mass and increased adiposity.

Obesity is reported to increase insulin resistance, a key feature of MS (Alberti K *et al*., 2009). However, some individuals diagnosed with MS were neither overweight nor obese according to the BMI cutoff points used for Europeans. These cutoff points might not be suitable for the Saudi population because the relationship between percentage body fat and BMI is different among different ethnic groups (Deurenberg P *et al*., 1998). However, central rather than general obesity is believed to be the major cause of MS (Eckel R *et al*., 2010). Therefore, BMI need not be increased as long as there is visceral adiposity.

However, not all people diagnosed with MS using the NCEP ATP III definition or the consensus definition had abdominal obesity according to IDF cutoff points.

To clarify this, further studies are needed in the Saudi region to define appropriate cutoff points for general and central obesity, and overweight. Meanwhile, it might be useful to use waist to hip ratio, which was found to be a strong predictor of MS when the IDF definition was used.

CONCLUSION

BMI and WC were closely associated with FM and PBF, in a sample of Saudi females from Ha'il. It should be noted, however, that these associations depend on gender and weight status, and that BMI may provide a better proxy estimate of overall obesity than WC. Nevertheless, both of them appear to be reasonable surrogate for FM and PBF, particularly in epidemiological studies, as screening tools to identify adolescents at increased risk of developing excess body fat and high levels of fasting blood glucose.

For all definitions used, the calculated prevalence of MS was found to be high in the Saudi population of healthy subjects, raising alarm about the overall prevalence in the general population. Using the latest consensus definition might help to decrease the number of cases that are missed using the other definitions. In the absence of local cutoff points for risk factors of MS, it might be appropriate to use the waist/hip ratio or LDL-C/HDL-C ratio to aid diagnosis. A family history of diabetes or CVD might also be indicative. Priority should be given to establishing national normal ranges, screening programs for hyperglycemia and hypertension, and community-directed programs to combat obesity and inactivity.

Further research is needed for this group of population and should include (1) investigation of the association of overall and central obesity with fasting blood glucose level among females in different age, and (2) relationship of BMI, WC, FM, and PBF with other metabolic abnormalities for early prevention of health risks related to overweight and obesity.

REFERENCES

Akbar D. Metabolic syndrome is common in Saudi type 2 diabetic patients. *Diabetes Int*, 12, 2002, 47–49

Alberti K, Eckel R, Grundy S, Zimmet P, Cleeman, Donato K, *et al*. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation*, 120, 2009, 1640–1645

Al-Daghri N, Al-Attas O, Alokail M, Alkharfy K, Sabico S, Chrousos G. Decreasing prevalence of the full metabolic syndrome but a persistently high prevalence of dyslipidemia among adult Arabs. *PLoS One*, 5, 2010, 12159.

Al-Nozha M, Al-Khadra A, Arafah M, Al-Maatouq M, Khalil M, Khan N, *et al*. Metabolic syndrome in Saudi Arabia. *Saudi Med J*, 26, 2005, 1918–1925.

Al-zahrani A, Karawagh A, Al shahrani F, Naser T, Ahmed A, Alsharee A. Prevalence and predictors of metabolic syndrome among healthy Saudi Adults. *Br J Diabetes Vasc Dis*, 12, 2012, 78–80.

Amos A, McCarty D, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections. *Diabet Med* 14(5), 1997, S1–S85.

Barrimah I, Mohaimeed A, Midhat F, Al-Shobili H. Prevalence of metabolic syndrome among qassim university personnel in Saudi Arabia. *Int J Health Sci,* 3, 2009, 133–142.

Despres J, Lemieux I. Abdominal obesity and metabolic syndrome. *Nature*, 444, 2006, 881–887.

Deurenberg P, Yap M, van Staveren W. Body mass index and percent body fat: a meta analysis among different ethnic groups. *Int J Obes Relat Metab Disord*, 22, 1998, 1164–1171.

Eckel R, Alberti K, Grundy S, Zimmet P. The metabolic syndrome. *Lancet*, 375, 2010, 181–183.

Eriksson K, Lindgarde F. Prevention of type 2 (non-insulin-dependent) diabetes mellitus by diet and physical exercise. The 6-year Malmo feasibility study. *Diabetologia*, 34, 1991, 891–898.

Ford E. Prevalence of the metabolic syndrome defined by the International Diabetes Federation among adults in the U.S. *Diabetes Care*, 28, 2005, 2745–2749

Gharipour M, Bagheri A, Boshtam M, *et al*.: Prevalence of metabolic syndrome among the adults of central of areas of Iran (as a part of Isfahan healthy heart study). *Journal of Birjand University of Medical Sciences*, 13(3), 2006, 56-63.

Grundy S. Metabolic syndrome: a multiplex cardiovascular risk factor. *J Clin Endocrinol Metab*, 92, 2003, 399–404.

Kassi E, Pervanidou P, Kaltsas G, Chrousos G. Metabolic syndrome: definitions and controversies. *BMC Med*, 9, 2011, 48

Lameira D, Lejeune S, Mourad JJ: Metabolic syndrome: epidemiology and its risks. *Ann Dermatol Venereol*, 135(4), 2008, 249-253.

Pan WH, Yeh WT, Weng LC. Epidemiology of metabolic syndrome in Asia. *Asia Pac J Clin Nutr* , 17(1), 2008, 37-42.

Papadakis S, Moroz I. Population-level interventions for coronary heart disease prevention: what have we learned since the North Karelia project. *Curr Opin Cardiol*, 23, 2008, 452–461

Park Y, Zhu S, Palaniappan L, Heshka S, Carnethon M, Heymsfield S. The metabolic syndrome: prevalence and associated risk factor findings in the US population from the Third National Health and Nutrition Examination Survey. *Arch Intern Med*, 163, 2003, 427–436.

Qadan LR, Ahmed AA, Safar HA, *et al*.: Prevalence of metabolic syndrome in patients with clinically advanced peripheral vascular disease. *Angiology*, 59(2), 2008, 198-202.

Ramachandran A, Snehalatha C, Satyavani K, Sivasankari S, Vijay V: Metabolic syndrome in urban Asian Indian adults–a population study using modified ATP III criteria. *Diabetes Res Clin Pract*, 60(3), 2003, 199-204.

Sadrbafoghi SM, Salar M, Rafiee M, *et al*. Prevalence and criteria of metabolic syndrome in an urban population: Yazd healthy heart project. *Tehran Univ. Med. J* , 64(10), 2007, 90-96.

Scholze J, Alegria E, Ferri C, Langham S, Stevens W, Jeffries D, *et al*. Epidemiological and economic burden of metabolic syndrome and its consequences in patients with hypertension in Germany, Spain and Italy; a prevalence-based model. *BMC Public Health*, 10, 2010, 529.

Zaliūnas R, Slapikas R, Luksiene D, *et al*.: Prevalence of metabolic syndrome components in patients with acute coronary syndromes. *Medicina*, 44(3), 2008, 182-188.