ECRONICON OPEN ACCESS

EC ENDOCRINOLOGY AND METABOLIC RESEARCH

Research Article

Frequency of Metabolic Syndrome in Normal Body Weight Saudi Population

Khalid S Aljabri[1]*, Samia A Bokhari[1], Muneera A Alshareef[1], Patan M Khan[1], Hesham M Abu Elsaoud[1], Mohammad M Jalal[1], Rania F Safwat[1], Rehab Borae[1] and Bandari K Aljabri[2]

[1]Department of Endocrinology, King Fahad Armed Forces Hospital, Jeddah, Kingdom of Saudi Arabia

[2]College of Medicine, Um Al Qura University, Makkah, Kingdom of Saudi Arabia

***Corresponding Author:** Khalid S Aljabri, Department of Endocrinology, King Fahad Armed Forces Hospital, Jeddah, Kingdom of Saudi Arabia.

Received: August 31, 2018; **Published:** September 27, 2018

Abstract

Background and Objective: Metabolic syndrome (MetS) is a cluster of metabolic factors. The prevalence of MetS is increasing worldwide. The aim of this study was to determine the frequency of MetS in normal body weight Saudi population.

Methods: We analyzed 396 participants whom are equal to or older than 20 years old with body mass index (BMI) between 18.5 to 24.9 kg/m2. All cases were from the population of the primary health clinics at King Fahad Armed Forces Hospital. All data were collected by personal interview and on the basis of a review of electronic medical records. Physician and nurse interviewers measured and recorded weight (kg) and height (cm). Metabolic risk factors were defined using the 2006 International Diabetes Federation criteria that define elevated triglyceride as ≥ 150 mg/dL (≥ 1.7 mmol/L) and reduced HDL as < 40 mg/dL (< 1.03 mmol/L) for male and as < 50 mg/dL (< 1.29 mmol/L) for female. Abnormal glucose metabolism was con-sidered when HbA1c (≥ 5.7) or when patients were known to have type 2 diabetes. A combination of two or more of these risk factors was used to define MetS. BMI values were classified as normal weight if BMI = 18.5 - 24.9 kg/m^2. The total number of cases were separated on basis of age values into five groups: < 30 years, 30 - 39 years, 40 - 49 years, 50 - 59 years and ≥ 60 years.

Results: Out of 396 participants analyzed, 158 (39.9%) were male and 238 (60.1%) were female. Mean age was 51.6 ± 16.3 years (minimum 20 years and maximum 98 years). MetS was present in 198 cases (50.0%) where 89 (44.9%) were male and 109 (55.1%) were female with female to male ratio 1.2:1, P = 0.04. Patients with MetS patients were significantly older, 58.1 ± 14.0 vs. 44.9 ± 15.6 respectively, p < 0.0001. BMI was not significantly higher in females than males with MetS patients (22.9 ± 1.5 vs. 22.6 ± 1.7 respectively, p = 0.8). Patients with and without MetS had similar age, gender prevalence, and BMI. Patients with HbA1c > 5.6 or Type 2 diabetes mellitus [OR = 4.9; 95% confidence interval [CI] = 3.2, 7.4, (p < 0.0001)], elevated plasma TG levels (OR = 2.6; 95% CI = 2.2, 3.1, p < 0.0001), or low levels of HDL (OR = 2.4; 95% CI = 2.0, 3.0, p < 0.0001) were more likely to present MetS. The frequency of MetS is consistently increasing with increasing age until the sixth decade. MetS is more frequent in male at the age group (≥ 60 years). The frequency of MetS is consistently increasing with increasing BMI with male predominant. The mean of BMI among MetS is not statistically significant positively correlated with increasing with advanced age (r = 0.1, p = 0.4).

Conclusion: It can be concluded that the frequency of MetS among normal body weight Saudis is relatively high. Old age and higher normal body weight can be regarded as related factors.

Keywords: *Metabolic Syndrome; Normal Body Weight*

Introduction

Metabolic syndrome (MetS) is associated with metabolic factors. MetS was described as clusters of hypertension, hyperglycaemia in 1923 [1]. A definition of MetS put forward by the World Health Organization (WHO) in 1999. There have been several definitions of MetS, but the most commonly used criteria for definition at present are from the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III), the International Diabetes Federation (IDF), and the World Health Organization (WHO) [2-4].

Body mass index (BMI) and waist circumference are two most popular indicators for assessing obesity, which are relatively inexpensive and easy to use. BMI is strongly associated with body fat content, but has the limitation of overestimating the degree of fatness for very muscular man and underestimating those who have low muscle mass; as in the case of elderly people. In addition, there is gender, age and ethnicity related variations in body fat for a given BMI. Over 30 years ago, metabolic disorders were observed in some patients with normal BMI (18.5 - 24.9 kg/m^2), similar to disorders which characterized obese individuals. Such patients were described as being a metabolically obese normal weight (MONW) phenotype [5]. In MONW individuals, an increase in visceral adipose tissue mass, fasting hyperglycemia, lower insulin sensitivity of target tissues, hyperinsulinemia, dyslipidemia and hypertension are usually diagnosed [5-7].

There was no uniform criteria for identification of a MONW phenotype, and examination of different ethnic and age groups, it is difficult to make an actual assessment of the scale of the problem [5-12]. In a longitudinal study, identified MONW only in 7.1% of those who had BMI < 25 kg/m^2 [6]. The occurrence of MONW in 20.4% of males and 23.8% of females aged 45 - 74 was reported [13]. Early identification of individuals at risk is hindered because of the lack of diagnostic criteria of MONW. Therefore, the objective of the study was to assess the frequency of MetS in normal body weight Saudi adults.

Methods

We included 396 participants whom are equal to or older than 20 years with BMI between 18.5 to 24.9 kg/m^2 at the primary health clinics at King Fahad Armed Forces Hospital. All data were collected by personal interview and review of the medical records. Weight (kg) and height (cm) were measured by nurses. Metabolic risk factors were defined using the 2006 IDF criteria that define elevated triglyceride as ≥ 150 mg/dL (≥ 1.7 mmol/L) and reduced HDL as < 40 mg/dL (< 1.03 mmol/L) for male and as < 50 mg/dL (< 1.29 mmol/L) for female. Abnormal glucose metabolism was considered when HbA1c (≥ 5.7) or when patients were known to have type 2 diabetes (T2DM). A combination of two or more of these risk factors was used to define MetS. BMI values were classified as normal weight if BMI = 18.5 - 24.9 kg/m^2. Cases were divided into five groups; < 30 years, 30 - 39 years, 40 - 49 years, 50 - 59 years and ≥ 60 years.

Statistical Analysis

Unpaired t-test analysis and Chi square (X^2) test were used between variables to estimate the significance of different between groups for demographic and clinical laboratory. Chi square (X^2) was used to estimate the odds ratio of having MetS. All statistical analyses were performed using SPSS Version 22.0. The difference between groups was considered significant when $P < 0.05$.

Results

396 participants were analyzed, 158 (39.9%) were male and 238 (60.1%) were female. Mean age was 51.6 ± 16.3 years (20 - 98 years) (Table 1). MetS was present in 198 cases (50.0%), 89 (44.9%) were male and 109 (55.1%) were female with female to male ratio 1.2:1, P = 0.04 (Table 2). Patients with MetS were significantly older (58.1 ± 14.0 vs. 44.9 ± 15.6 respectively, p < 0.0001). BMI in patients with MetS was not significantly higher in females compared to males (22.9 ± 1.5 vs. 22.6 ± 1.7 respectively, p = 0.8). Patients with MetS had higher prevalences of HbA1c > 5.6, low HDL and high triglycerides levels (Table 2).

Parameters		Total
n (%)		396
Age (years)		51.6 ± 16.3
Gender	Male	158 (39.9)
	Female	238 (60.1)
Body mass index (kg/m^2)		22.8 ± 1.6
HbA1c > 5.6 or Type 2 diabetes mellitus		256 (64.6)
Triglyceride (≥ 1.7 mmol/l)		112 (28.3)
High density lipoprotein (< 1.29 mmol/l)		168 (42.4)

Table 1: *Basic characteristics of the population under study (means ± SD or number (%)).*

Parameters		Metabolic syndrome		P value
		Yes	No	
n (%)		328 (30.9)	732 (69.1)	0.7
Age (years)		58.1 ± 14.0	44.9 ± 15.6	< 0.0001
Gender	Male	89 (44.9)	69 (34.8)	0.04
	Female	109 (55.1)	129 (65.2)	
Body mass index (kg/m^2)		22.9 ± 1.5	22.6 ± 1.7	0.1
HbA1c > 5.6 or Type 2 diabetes mellitus		178 (89.9)	78 (39.4)	< 0.0001
Triglyceride (≥ 1.7 mmol/l)		101 (51.0)	11 (5.6)	< 0.0001
High density lipoprotein (< 1.29 mmol/l)		127 (64.1)	41 (20.7)	< 0.0001

Table 2: *Characteristics of the population with metabolic syndrome (means ± SD or number (%)).*

There were no significant correlation in patients with MetS when applying the IDF criteria numbers according to age, gender and BMI (Table 3). Patients with HbA1c>5.6 or Type 2 diabetes mellitus [OR = 4.9; 95% confidence interval [CI] = 3.2, 7.4, (p < 0.0001)], elevated plasma TG levels (OR = 2.6; 95% CI = 2.2, 3.1, p < 0.0001), or low levels of HDL (OR = 2.4; 95% CI = 2.0, 3.0, p < 0.0001) were more likely to present (Table 4).

Parameters		Number of International Diabetes Federation criteria		P value
		2	> 2	
n (%)		142 (1.7)	56 (28.3)	
Age (years)		58.3 ± 15.0	58.1 ± 11.0	0.9
Gender	Male	62 (43.7)	27 (48.2)	0.6
	Female	80 (56.3)	29 (51.8)	
Body mass index (kg/m^2)		22.9 ± 1.5	23.3 ± 1.5	0.6

Table 3: *Comparison of age, gender and BMI in patients with and without the Metabolic Syndrome.*

Parameters	Odd Ratio	P value
HbA1c > 5.6 or Type 2 diabetes mellitus	4.9 (3.2 - 7.4)	< 0.0001
Triglyceride (≥ 1.7 mmol/l)	2.6 (2.2 - 3.1)	< 0.0001
High density lipoprotein (< 1.29 mmol/l)	2.4 (2.0 - 3.0)	< 0.0001

Table 4: *Odds ratio for the presence of Metabolic Syndrome in patients with elevated HbA1c >5.6 or Type 2 diabetes mellitus, elevated Triglycerides and low HDL.*

The frequency of MetS is consistently increasing with increasing age until the sixth decade, figure 1A. MetS is more frequent in male in age group ≥ 60 years, figure 1B. The frequency of MetS is consistently increasing with increasing BMI, figure 2A with male predominant, figure 2B. A non-significant positive correlation between the mean of BMI among MetS and increasing age (r = 0.1, p = 0.4).

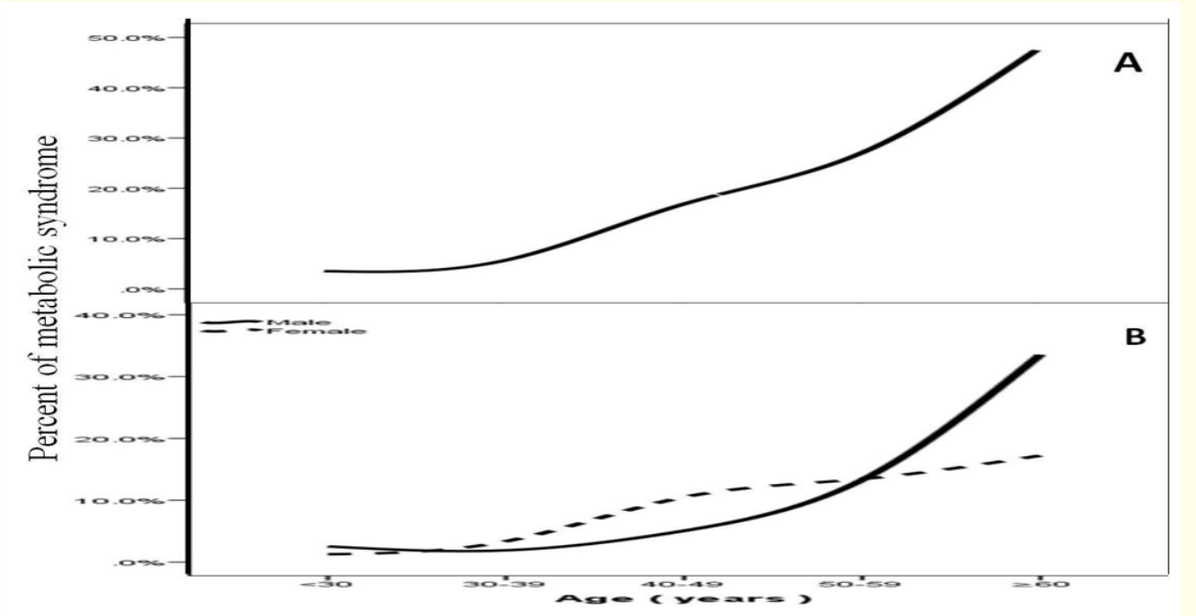

Figure 1: *Percentages of metabolic syndrome across different age groups (A) and in relation to gender (B).*

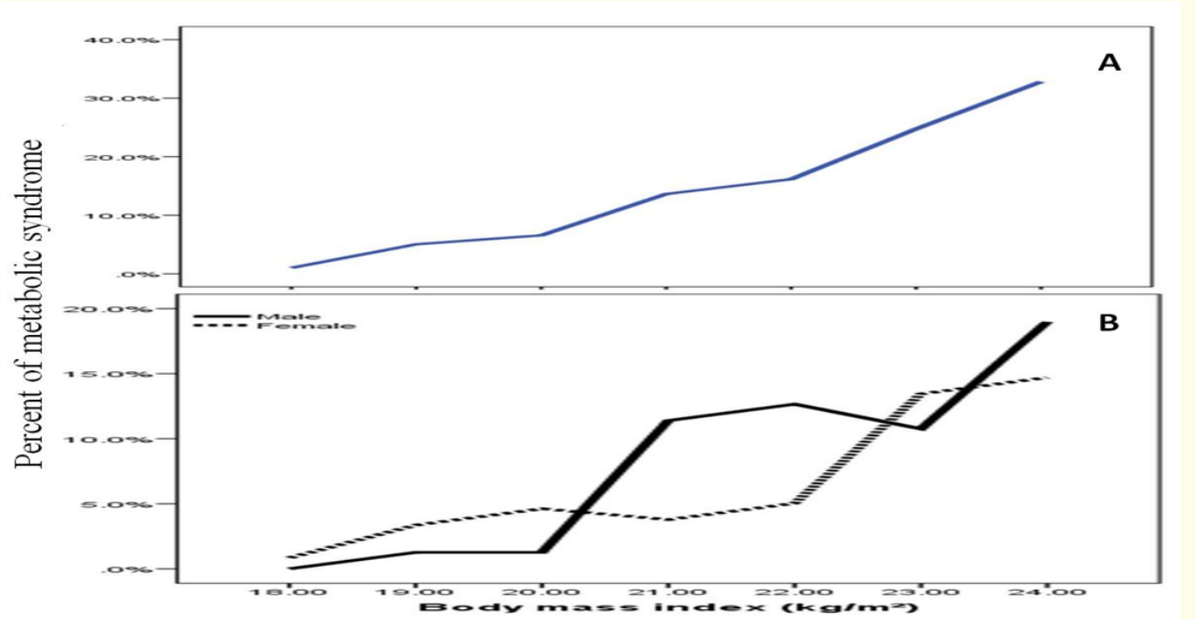

Figure 2: *Percentages of metabolic syndrome across different body mass index groups (A) and in relation to gender (B).*

Discussion

We found MetS was present in 50.0% of the total number of participants, 89 cases (44.9%) ~~of~~ were males; 109 cases (55.1%) were females. This percentage can be considered as a relatively high percentage, considering the accepted definition of the syndrome, i.e. BMI < 25.0 kg/m^2, but not < 26 - 27 kg/m^2 as reported by others [10]. In previous studies, MetS, defined according to the IDF, was diagnosed in 12.3%, 30.8% of males and 26.8% of females. These studies included a younger population (age of 20 years) [14,15]. The high percentage of MetS reported in our study could be explained by the sample selection. The study group could have covered an overrepresentation of individuals in whom the frequency of occurrence of MetS risk factors was higher than in the general population. In addition, the frequency of MetS is consistently increasing with increasing age until the sixth decade, dominated in those aged ≥ 60 years. Moreover, we found the occurrence of MetS was increased together with advanced age, from 3.5% in the age group 20 - 29 to 47.5% in the age group ≥ 60. According to the result of studies conducted in the USA, the occurrence of MetS was increased with age, from 6.7% in the age group 20 - 29 to 43.5% in age group 60 - 69, and 42% in the group of individuals aged ≥70 [16].

A specific type of obesity defined as MONW was described in early eighties [17]. These individuals were characterized by normal body weight and BMI, hyperinsulinemia, insulin resistance, type 2 diabetes and high triglyceride level [9,18]. In a study of the US population, individuals aged 20 years with MONW were four times more likely to develop MetS than those with normal BMI [9]. A study from Switzerland included only females of Caucasian origin aged 35 - 75 years, female with MONW had a higher cardiometabolic risk and higher prevalences of low high density lipoprotein, high triglycerides and hyperglycaemia and a similar prevalence of hypertension compared to lean female [19].

In this report, we advance the notion that MONW individuals are those with a normal BMI who fulfill the criteria for the MetS as defined by the ATP III guidelines. We observed that men and women higher than or equal to 21 kg/m^2 normal BMI range are more likely to have the MetS compared with those with BMI 18.5 - 20.9 kg/m^2. The phenomenon could only partially be explained by their older age. It is well known that for a given BMI, older persons often have more fat than younger persons, and women may have more body fat than men. Our age and gender-specific MetS prevalence data was not only supported this view, but also depict an even more apparent age and gender in concordance with others [20,21]. Males and females could have different risk factors which might contribute to gender-related differences in the risk of metabolic complications. [23] Despite the total frequency of occurrence of MONW was noted in both genders, an increased risk of this syndrome was noted among females even at lower BMI values. Several studies showed higher body fat and low lean mass in the MONW individuals [22,23].

The other aspect of our data that we found interesting was that, in this study population that may be considered non-obese by existing recommendations (BMI < 25 kg/m^2), the features of the MetS remained very common with 71.7% were exhibiting at least two feature of the MS. This is in line with the finding that BMI significantly underestimates the degree of adiposity in several Asian populations and the recommendation that lower 'action levels' should be set in these populations [24].

Identifying country-specific prevalence of MetS is important. One reason for this finding is that the population of Saudi Arabia is changing from its traditional lifestyle to we sternised ways and so becoming more subject to similar diseases, the young being more prone in this regard. In contrast, older people, who are less inclined to change their habits, reflected healthier findings. It would be beneficial to identify lifestyle changes among the elderly that could determine the increased tendency to develop risk factors for the diseases of developed countries. It would also be interesting to determine to what extent these risk factors are associated with cardiovascular disease, stroke and/or type 2 diabetes among Saudi population, since most studies have been conducted in Caucasian populations.

Limitations of the Study

First, most of the patients enrolled were already on treatment for diabetes and dyslipidemia. We tried to overcome these by obtaining the necessary sample size and by using data prior to treatment. The present study was hospital based study, retrospective study, the findings do not represent the whole Saudi population or the local community. Further larger population-based studies are necessary to support our findings. Finally, the included subjects were only overall normal weight (assessed by BMI) and not abdominal obesity, which is known to bear a close relationship with the target diseases.

Conclusion

It can be concluded from this study that the frequency of MetS among normal weight Saudis is relatively high. Old age and higher normal body weight can be regarded as related factors.

Acknowledgments

We are grateful to the staffs from the Primary care department at King Fahad Armed Forces Hospital for their valuable contributions in data collection. The authors have no conflict of interest to disclose.

Bibliography

1. Kylin E. "Studien ueber das Hypertonie-Hyperglykamie -Hyperurikamiesyndrom". *Zentrallblatt fuer Innere Medizin* 44 (1923): 105-127.

2. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). "Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report". *Circulation* 106.25 (2002): 3143-3421.

3. International Diabetes Federation: The IDF Consensus Worldwide Definition of the MS (2006).

4. WHO (World Health Organization). "Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of a WHO Consultation. Part 1: Diagnosis and Classification of Diabetes Mellitus". Department of Non-communicable Disease Surveillance. Geneva, Switzerland (1999).

5. Ruderman N., *et al*. "The metabolically obese, normal-weight individual revisited". *Diabetes* 47.5 (1998): 699-713.

6. Meigs JB., *et al*. "Body mass index, metabolic syndrome, and risk of type 2 diabetes or cardiovascular disease". *Journal of Clinical Endocrinology and Metabolism* 91.8 (2006): 2906-2912.

7. Hyun YJ., *et al*. "Atherogenecity of LDL and unfavorable adipokine profile in metabolically obese, normal-weight woman". *Obesity* 16.4 (2008): 784-789.

8. Dvorak RV., *et al*. "Phenotypic characteristics associated with insulin resistance in metabolically obese but normal-weight young women". *Diabetes* 48.11 (1999): 2210-2214.

9. Romero-Corral A., *et al*. "Normal weight obesity: a risk factor for cardiometabolic disregulation and cardiovascular mortality". *European Heart Journal* 31.6 (2010): 737-746.

10. Park YW., *et al*. "The metabolic syndrome: prevalence and associated risk factor findings in the US population from the Third National Health and Nutrition Examination Survey, 1988-1994". *Archives of Internal Medicine* 163.4 (2003): 427-436.

11. Geetha L., *et al*. "Prevalence and clinical profile of metabolic obesity and phenotypic obesity in Asian Indians". *Journal of Diabetes Science and Technology* 5.2 (2011): 439-446.

12. Lopez-Miranda J and Perez-Martinez P. "It is time to define metabolically obese but normal-weight (MONW) individuals". *Clinical Endocrinology* 79.3 (2013): 314-315.

13. Pajunen P., *et al*. "Metabolically healthy and unhealthy obesity phenotypes in the general population: the FIN-D2D Survey". *BMC Public Health* 11 (2011): 754.

14. Sygnowska E., *et al*. "Socioeconomic factors and the risk of metabolic syndrome in the adult Polish population: the WOBASZ study". *Kardiologia Polska* 70.7 (2012): 718-727.

15. Edyta Suliga., *et al*. "Prevalence of metabolic syndrome in normal weight individuals". *Annals of Agricultural and Environmental Medicine* 23.4 (2016): 631-635.

16. Ford ES., *et al*. "Prevalence of the metabolic syndrome among US adults: findings from the Third National Health and Nutrition Examination Survey". *Journal of the American Medical Association* 287.3 (2002): 356-359.

17. Ruderman NB., *et al*. "The ''metabolically-obese,'' normal-weight individual". *American Journal of Clinical Nutrition* 34.8 (1981): 1617-1621.

18. De Lorenzo A., *et al*. "Normal-weight obese (NOW) women: An evaluation of a candidate new syndrome". *Nutrition, Metabolism and Cardiovascular Diseases* 16.8 (2006): 513-523.

19. Marques-Vidal P., *et al*. "Normal weight obesity: relationship with lipids, glycaemic status, liver enzymes and inflammation". *Nutrition, Metabolism and Cardiovascular Diseases* 20.9 (2010): 669-675.

20. Stevens J., *et al*. "Changes in body weight and girths in black and white adults studied over a 25 year interval". *International Journal of Obesity* 15.12 (1991): 803-808.

21. Perissinotto E., *et al*. "Anthropometric measurements in the elderly: age and gender differences". *British Journal of Nutrition* 87.2 (2002): 177-186.

22. Beigh SH and Jain S. "Prevalence of metabolic syndrome and gender differences". *Bioinformation* 8.13 (2012): 613-616.

23. Tanaka S., *et al*. "Is adiposity at normal body weight relevant for cardiovascular disease risk?" *International Journal of Obesity and Related Metabolic Disorders* 26.2 (2002): 176-183.

24. P Durenberg., *et al*. "Asians are different from Caucasians and from each other in their body mass index/body fat percent relationship". *Obesity Review* 3.3 (2002) 141-146.

Volume 3 Issue 5 October 2018