# Metabolic syndrome and its characteristics among obese patients attending an obesity clinic

Termizy H M, Mafauzy M


## ABSTRACT

**Introduction: The increased prevalence of metabolic syndrome worldwide is closely related to the rising obesity epidemic. The objectives of the study were to determine the prevalence and identify the associated and prognostic factors that influence the risk of metabolic syndrome among obese patients attending the Obesity Clinic at Hospital Universiti Sains Malaysia.**

**Methods: A study was conducted involving 102 obese persons who attended the Obesity Clinic from January 1 to December 31, 2005. Metabolic syndrome was defined according to the International Diabetes Federation criteria.**

**Results: The overall prevalence of metabolic syndrome among obese patients was 40.2 percent. The prevalence was higher in females (43.7 percent) than in males (32.3 percent). The prevalence of metabolic syndrome was noted to increase with increasing body mass index class, from class 1 to class 2. However, the prevalence was lower in obesity class 3. The prevalence of metabolic comorbidities of raised blood pressure, reduced high density lipoprotein, high triglyceride and raised fasting blood glucose was 42, 40, 36 and 17 percent, respectively. A quarter of obese patients in this study had no other comorbidity. Based on logistic regression multivariable analysis, age was the only significant associated factor that influenced the risk of having metabolic syndrome.**

**Conclusion: The prevalence of metabolic syndrome was high and the highest comorbidity was high blood pressure. Age was the only significant risk factor of having this syndrome.**


**Keywords: blood glucose, high density lipoprotein, metabolic syndrome, obesity, triglycerides**

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## INTRODUCTION

Epidemiological studies worldwide indicate that the prevalence of obesity is increasing. Obesity is currently the most common metabolic disease in the world. The World Health Organisation estimates that more than one billion people are overweight, and of these, 300 million are obese.[1] Obesity is a public health concern because of its association with a number of medical complications that lead to increased morbidity and mortality. The most common obesity-related complications are type 2 diabetes mellitus, hypertension, dyslipidaemia, cardiovascular diseases, gallstones and cholecystitis, respiratory dysfunction, non-alcoholic chronic liver disease and certain cancers.[2] The metabolic syndrome is a cluster of interrelated risk factors that increase the risk of cardiovascular disease and type 2 diabetes mellitus.[3] The central feature of the metabolic syndrome is obesity. The prevalence of metabolic syndrome is increasing because of the 'obesity epidemic'.[3] The increased prevalence of obesity has been accompanied by a parallel increase in the prevalence of the metabolic syndrome. The metabolic syndrome, which is associated with three-fold and two-fold increases in type 2 diabetes mellitus and cardiovascular disease, respectively, has become a major public health challenge around the world.[4] However, there is very minimal data available on the prevalence of the metabolic syndrome in obese patients, especially in Malaysia.[5] Furthermore, no systematic data is available on the prevalence of the metabolic syndrome in obese persons using the most recent worldwide criteria; the International Diabetes Federation (IDF) metabolic syndrome definition.[6] The objectives of this study were to determine the prevalence of metabolic syndrome among obese patients using the IDF definition and to identify the factors that are associated with the metabolic syndrome among these patients.

## METHODS

In this study, the metabolic syndrome is defined using the IDF definition; which is the presence of central obesity plus any two of the following: (1) hypertriglyceridaemia; (2) reduced high-density lipoprotein (HDL)-cholesterol; (3) raised blood pressure; and (4) raised fasting plasma glucose

**Department of Medicine, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, Kubang Kerian, Kota Bharu 16150, Malaysia**

Termizy HM, MD

Mafauzy M, FRCP
Professor

**Correspondence to:**
Prof Mafauzy Mohamed
Tel: (60) 9 765 4545
Fax: (60) 9 765 2678
Email: mafauzy@kb.usm.my

**Table I. International Diabetic Federation metabolic syndrome worldwide definition.**

Central obesity:
- Waist circumference – ethnicity specific*

Plus any two of the following:
- Hypertriglyceridaemia:
  Triglycerides >150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality.
- Reduced HDL-cholesterol:
  < 40 mg/dL (1.03 mmol/L) for males, < 50 mg/dL (1.29 mmol/L) for females, or specific treatment for this lipid abnormality.
- Raised blood pressure:
  Systolic ≥ 130 mmHg, or diastolic ≥ 85 mmHg, or on treatment for previous hypertension.
- Raised fasting plasma glucose:
  > 100 mg/dL (5.6 mmol/L), or previously-diagnosed type 2 diabetes mellitus.
  If > 100 mg/dL (5.6 mmol/L), oral glucose tolerance test is strongly recommended but it is not necessary to define the presence of the syndrome.

* If BMI is > 30 kg/m$^2$, then central obesity can be assumed and waist circumference does not need to be measured.
Source: IDF, 2005[6] and Zimmet et al, 2005[4]

(Table I).[6] Central obesity refers to the measurement of waist circumference following ethnic-specific cut-off points, or central obesity can be assumed if body mass index (BMI) is ≥ 30 kg/m$^2$.[4] The source population was obese patients who attended the Obesity Clinic at Hospital Universiti Sains Malaysia, Kubang Kerian, Malaysia, during the study recruitment period between January 1 and December 31, 2005. The inclusion criteria were age > 18 years and obesity (≥ BMI 30 kg/m$^2$). Exclusion criteria were underlying endocrine diseases such as Cushing's disease, acromegaly, hypothyroidism, hypogonadism, patients on prolonged steroid use and those who were on active drug treatment for obesity at the time of recruitment.

The source of the data was the patients' outpatient Obesity Clinic record. The list of patients who attended the Obesity Clinic during the recruitment phase from January to December 2005 was captured from the Obesity Clinic's registry book. Based on the list, the medical records were then retrieved from the Record Office. The required information which included demographics, comorbidity characteristics, details of physical and biochemical information and therapy, were reviewed and recorded. The physical and biochemical measurements used in the study were the measurement taken on the first visit. The independent variables of interest were age, gender, ethnicity, smoking, alcohol consumption, family history of cardiovascular disease and obesity BMI class.

Descriptive statistics were calculated for each variable. All continuous variables were expressed as a mean with standard deviation (SD) or median with interquartile range. Frequencies and percentages were obtained for categorical variables. Univariable and multivariable binary logistic regression analyses were used to identify factors that were significantly associated with the metabolic syndrome among obese patients. Findings were presented with adjusted odds ratio (OR), its 95% confidence interval (CI) and corresponding p-values. The level of significance was set at 0.05 using two-sided hypothesis testing. All analyses were performed using the Statistical Package for Social Sciences version 11.5 (SPSS Inc, Chicago, IL, USA).

**Table II. Demographics of the study population.**

| Variable | No. (%) of patients (n = 102) |
|---|---|
| Age group (years) | |
| 18–39 | 47 (46.1) |
| 40–59 | 51 (50.0) |
| ≥ 60 | 4 (3.9) |
| Gender | |
| Male | 31 (30.4) |
| Female | 71 (69.6) |
| Ethnicity | |
| Malay | 94 (92.1) |
| Chinese | 5 (4.9) |
| Indian | 2 (2.0) |
| Others | 1 (1.0) |
| Obesity class | |
| Class 1 | 39 (38.2) [10:29 (9.8:28.4)]* |
| Class 2 | 36 (35.3) [11:25 (10.8:24.5)]* |
| Class 3 | 27 (26.5) [10:17 (9.8:16.7)]* |

Obesity class 1: BMI 30.0–34.9; class 2: BMI 35.0–39.9; class 3: BMI ≥ 40.0
* [No. (%) of male: female]

## RESULTS

Based on the Obesity Clinic's registry, there were 146 patients who attended the clinic from January 1, 2005 to December 31, 2005. However, only 114 (78.1%) patients were eligible for the study, based on the inclusion and

**Table III. Physical and metabolic characteristics of the study population by gender.**

| Variable | Male patients (n = 31) | Female patients (n = 71) | Both genders (n = 102) |
|---|---|---|---|
| Height* (cm) | 168.0 ± 10.5 | 155.8 ± 6.8 | 159.5 ± 9.8 |
| Weight† (kg) | 108.0 (36.0) | 89.0 (21.0) | 92.5 (21.4) |
| Body mass index† (kg/m$^2$) | 37.5 (8.4) | 37.2 (6.4) | 36.4 (7.2) |
| Systolic blood pressure† (mmHg) | 120 (10) | 120 (16) | 120 (15) |
| Diastolic blood pressure* (mmHg) | 80 ± 10 | 79 ± 8 | 80 ± 9 |
| Fasting blood glucose† (mmol/L) | 4.8 (0.8) | 4.5 (1.0) | 4.5 (1.0) |
| Total cholesterol* (mmol/L) | 5.5 ± 0.7 | 5.6 ± 0.9 | 5.5 ± 0.8 |
| Low-density lipoprotein cholesterol* (mmol/L) | 3.5 ± 0.6 | 3.5 ± 0.9 | 3.5 ± 0.8 |
| High-density lipoprotein cholesterol* (mmol/L) | 1.2 ± 0.3 | 1.3 ± 0.3 | 1.3 ± 0.3 |
| Triglycerides* (mmol/L) | 1.7 ± 0.7 | 1.6 ± 0.8 | 1.6 ± 0.7 |

* Data is expressed as mean ± standard deviation.
† Data is expressed as median (interquartile range).

**Table IV. Associated factors of the metabolic syndrome using simple binary logistic regression (n = 102).**

| Variables | Crude odds ratio | 95% confidence interval | Wald statistic | Degrees of freedom* | p-value* |
|---|---|---|---|---|---|
| Age | 1.05 | 1.01–1.09 | 7.52 | 1 | 0.007 |
| Gender | | | | | |
| Female | 1.00 | | | | |
| Male | 0.60 | 0.25–1.50 | 1.16 | 1 | 0.287 |
| Ethnicity | | | | | |
| Malay | 1.00 | | | | |
| Others | 1.54 | 0.36–6.54 | 0.343 | 1 | 0.558 |
| Obesity class | | | | | |
| Class I | 1.00 | | 0.57 | 2 | 0.751 |
| Class II | 1.43 | 0.56–3.61 | 0.57 | 1 | 0.451 |
| Class III | 1.23 | 0.45–3.37 | 0.16 | 1 | 0.690 |

* Wald statistic
Obesity class 1: BMI 30.0–34.9; class 2: BMI 35.0–39.9; class 3: BMI ≥ 40.0

exclusion criteria. Of these, 102 (69.9%) patients had complete data and comprised the study population. The mean (SD) age was 39.5 (12.7) years, with an age range of 19–76 years. The demographics of the study population are shown in Table II, and their physical and metabolic characteristics are shown in Table III. The overall prevalence of the metabolic syndrome was 40.2%, with a prevalence of 32.3% in males and 43.7% in females. However, there was no significant difference in the prevalence between males and females. The prevalence was noted to increase with increased BMI class; from class 1 (35.9%) to class 2 (44.4%) but was slightly lower in obesity class 3 (40.7%).

The lowest prevalence of comorbidity was raised fasting blood glucose (17%) followed by high triglyceride (36%), reduced HDL (40%) and raised blood pressure (42%). About 40% of the subjects had two or more metabolic comorbidities, and a quarter of the obese patients had no other comorbidity (Fig. 1). Table IV shows the results of simple binary logistic regression analysis for potential associated factors of the metabolic syndrome. The significant unadjusted risk factor was age, which was also the only independent variable that was statistically significant in the multivariate analysis using multiple binary logistic regression.

## DISCUSSION

This study analysed the prevalence of the metabolic syndrome in obese patients who attended the Obesity Clinic, using the recently-introduced definition of the metabolic syndrome by the IDF. There are few comparable studies of the metabolic syndrome in this specific group, and the results of this study provide valuable information on the metabolic syndrome in obese adults. The overall prevalence of the metabolic syndrome among obese patients in the present study, at 40.2%, is considerably lower than that in other comparable studies in obese patients conducted in Italy (53%) and Taiwan (50.7%).[5,7] The differences in prevalence might be due to the different definition used for the criteria of the metabolic syndrome in the different study populations. The studies in Italy and in Taiwan used the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP) III definition.[5,7] While the NCEP ATP III criteria for hypertriglyceridaemia,

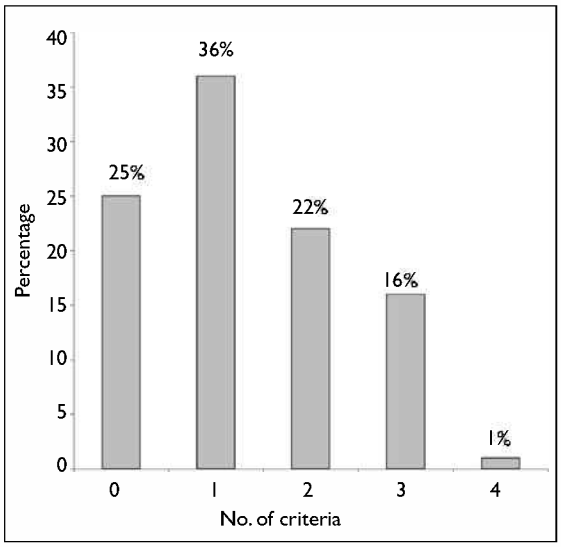


**Fig. 1** Bar chart shows the distribution of patients with metabolic comorbidity criteria using the International Diabetes Federation definition.[6]

reduced HDL, increased fasting plasma glucose and raised blood pressure are similar to the IDF criteria, central obesity is not a mandatory criteria, unlike that proposed by the IDF. This might give rise to a higher prevalence of overall metabolic syndrome in the studies using the NCEP ATP III definition. Another possible explanation could be that our study population was younger than the two comparable studies noted above. The prevalence of obesity has been shown to be higher with increasing age.[4] Also, as the waist circumference of the subjects were not measured in our study, there could be subjects whose BMI was < 30 kg/m$^2$, but who met the waist circumference criterion for the metabolic syndrome, and this would give rise to an underestimate of the proportion of patients with the syndrome. In a study of 60 obese male patients attending a metabolic clinic in Russia, the prevalence of the metabolic syndrome using the IDF criteria was 45.0%,[8] which was also slightly higher than the results in our males (32.3%). This could also be attributable to racial differences, as the majority of our patients were Malays.

In our study, the percentage of the metabolic syndrome in females at 43.7% was greater than that in males at 32.3%. This finding of a higher percentage of the metabolic syndrome in females is consistent with other studies. Marchesini et al reported a prevalence of 56.7% in females, compared to 51.9% in males.[5] Similarly, Lee et al found a higher prevalence in their female subjects at 31.9%, compared with 20.5% in males, but found that males were significantly associated with an increased risk of having the metabolic syndrome.[7] However, the present study and the study conducted by Marchesini et al[5] did not find a similar association. Population-based studies have also shown that the prevalence of the metabolic syndrome using the IDF criteria tended to be higher in females. In a study of 4,452 Korean adults, the prevalence of the metabolic syndrome was 16.5% in males and 28.8% in females; in another study of 1,513 adults in Hong Kong, the prevalence was 7.3% in males and 8.8% in females.[9,10]

The prevalence of the metabolic syndrome was noted to increase from obesity class 1 to 2, though the prevalence in obesity class 3 was slightly lower. The study by Marchesini et al showed that the prevalence of the metabolic syndrome in their obese subjects increased with rising obesity class and found that the metabolic syndrome was significantly associated with BMI.[5] The OR was 1.37 with 95% CI of 1.32–1.56. However, the metabolic syndrome was not significantly associated with BMI class in this study. A similar finding was reported by Lee et al, who conducted a retrospective study involving 534 obese patients referred to a surgical centre for weight reduction surgery.[7] This negative finding initiated an interesting postulation that perhaps the severity of obesity does not influence the risk of having the metabolic syndrome. Once obesity sets in, the probability of having the metabolic syndrome may be higher than for non-obese people. It might suggest that increasing severity class or increasing BMI in an obese person does not differ in terms of their body mechanism or pathophysiology to develop the metabolic syndrome. However, further assessment should be done to confirm the postulation generated from our finding.

The prevalence of individual metabolic comorbidities of the metabolic syndrome in our study population according to the IDF definition was high. Hypertension was the most common finding (42%) in our study. This was followed by the prevalence of reduced HDL (40%) and raised triglyceride (36%) levels. Raised fasting blood glucose or previously-diagnosed diabetes mellitus was found in 17% of our study population. Similar findings were observed in the study by Marchesini et al in Italy, where elevated blood pressure or previously-diagnosed hypertension has a high prevalence in obese persons, and in Marchesini et al's study, the prevalence of raised blood pressure in their obese subjects was very high at 48.7%.[5] Insulin resistance is the common proposed mechanism linking obesity and hypertension.[11] An analysis of the 1998 Singapore National Health Survey found that the hypertension factor was positively loaded for obesity.[12] This finding was in keeping with the existing knowledge that obesity is clearly linked to essential hypertension.

In the Framingham study, it was estimated that 78% of essential hypertension in men and 65% in women could be attributed to obesity. Our study also interestingly identified a group of obese persons without metabolic involvement

(isolated obesity). About 25% of our study population had isolated obesity, which is higher compared to the 12.8% observed by Marchesini et al.[5] A probable explanation for the high prevalence of isolated obesity in our study is the younger age of the study population. The mean age of our subjects was 39.5 years, compared to 45 years in the compared study. They also found that isolated obesity was significantly associated with younger age. The mean age of our patients with isolated obesity was 39.0 years, while those with metabolic syndrome was 44.8 years ($p < 0.001$). Another related study, which was conducted in the United Kingdom and involved obese children and adolescents, revealed very high isolated obesity at 31%.[13] Age was the only significant associated factor found to influence the odds of having the metabolic syndrome in this study. This finding was consistent with other comparable studies.[5,7] Marchesini et al reported that the odds of having the metabolic syndrome increased by 1.43 (95% CI 1.32–1.56) for every ten-year age increment.[5]

In conclusion, the prevalence of the metabolic syndrome among obese patients using the IDF definition was high, but lower as compared with other similar studies of obese persons. The prevalence of the metabolic syndrome in obese patients was higher in females and significantly increased with age. Hypertension was the most common metabolic comorbidity found in obese patients followed by reduced HDL, high triglyceride and high fasting blood glucose.

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