Frequency of underweight in Saudi adults

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 weight Saudi population.

Methods: We analyzed 396 participants who are equal to or older than 20years old with body mass index (BMI) between 18.5 to 24.9kg/m². All cases were from the population of the primary health 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 ≥150mg/dL (≥1.7mmol/L) and reduced HDL as <40mg/dL (<1.03mmol/L) for male and as <50mg/dL (<1.29mmol/L) for female. Abnormal glucose metabolism was considered when HbA1c (≥5.7) or when patients were known to have type 2 diabetes. BMI values classified as normal weight if BMI=18.5 –24.9kg/m². The total number of cohort was separated on basis of age values into five groups: <30years, 30-39years, 40-49years, 50-59years and ≥60years.

Main results: Of the 396 participants analyzed, 158 (39.9%) were male and 238 (60.1%) were female. Age was 51.6±16.3 (minimum 20years 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 were significantly older in MetS patients 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=0.0001). Patients with HbA1c≥5.6 or Type 2 diabetes mellitus were 4-fold to possess MetS [OR=4.9; 95% confidence interval [CI]=3.2, 7.4, (p<0.0001)], or have elevated plasma TG levels (OR=2.6; 95% CI=2.2, 3.1, p<0.0001) and were also more likely to have low levels of HDL (OR=2.4; 95% CI=2.0, 3.0, p<0.0001). 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 OR=2.4; 95% CI=2.0, 3.0, p<0.0001) and were also more likely to have low levels of HDL (OR=2.6; 95% CI=2.2, 3.1, p<0.0001). 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 OR=2.6; 95% CI=2.2, 3.1, p<0.0001)

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.

Keywords: metabolic syndrome, normal body mass index, CI, MetS, HDL.

Introduction

Metabolic syndrome (MetS) is a cluster of metabolic factors. MetS was initially observed in 1923 by Kylin, who described the clustering of hypertension, hyperglycaemia and gout as the syndrome. The first official definition of MetS put forward by a working group of the World Health Organization (WHO) in 1999, a number of different definitions have been proposed. 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). 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 (18.5–24.9kg/m²), similar to disorders which characterized obese individuals. Such patients were described as being a metabolically obese normal weight (MONW) phenotype. In these individuals, an increase in visceral adipose tissue mass, fasting hyperglycemia, lower insulin sensitivity of target tissues, hyperinsulinemia, atherogenic dyslipidemia, high arterial pressure, fatty liver, and greater plasma proinflammatory cytokine concentrations are usually diagnosed.

Due to the lack of 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. In a longitudinal study, identified this syndrome only in 7.1% of those who had BMI <25kg/m². The occurrence of MONW in 20.4% of males and 23.8% of females aged 45–74 was reported. Early identification of individuals at risk is additionally hindered because of the lack of uniform diagnostic criteria of MONW. Therefore, this issue requires further examination. Therefore, the objective of the study was to assess the frequency of MetS in normal-weight Saudis.
Methods

We analyzed 396 participants who are equal to or older than 20 years old with BMI between 18.5 to 24.9 kg/m². All cases were from the population of the primary health 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 IDF criteria that define elevated triglyceride as ≥150mg/dL (≥1.7mmol/L) and reduced HDL as <40mg/dL (<1.03mmol/L) for male and as <50mg/dL (<1.29mmol/L) for female. Abnormal glucose metabolism was considered when HbA1c (≥5.7) or when patients were known to have type 2 diabetes. BMI values classified as normal weight if BMI=18.5–24.9 kg/m². The total number of cohort were separated on basis of age values 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 (X²) test (categorical data comparison) were used between variables to estimate the significance of different between groups for demographic and clinical laboratory. Odds ratio of having MetS was analyzed using Chi square (X²). All statistical analyses were performed using SPSS Version 22.0. The difference between groups was considered significant when P<0.05.

Results

Of the 396 participants analyzed, 158 (39.9%) were male and 238 (60.1%) were female. Age was 51.6 ±16.3 (minimum 20 years and maximum 98 years), Table 1. 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, Table 2. Patients were significantly older in MetS patients (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<0.0001). Patients with MetS were significantly higher HDL and HbA1c≥5.6 or triglyceride (≥1.7mmol/L), Table 2.

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

| Parameters                     | Total   | n (%) |
|--------------------------------|---------|-------|
| n (%)                          | 396     |       |
| Age (years)                    | 51.6 ±16.3 |
| Gender                         |         |
| Male                           | 158 (39.9) |
| Female                         | 238 (60.1) |
| Body mass index (kg/m²)        | 22.8 ±1.6 |
| HbA1c>5.6 or Type 2 diabetes mellitus | 178 (89.9) |
| Triglyceride (≥1.7mmol/l)      | 101 (51.0) |
| High density lipoprotein (<1.29mmol/l) | 127 (64.1) |

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

| Parameters                              | Metabolic syndrome | P value |
|-----------------------------------------|--------------------|---------|
|                                       | Yes                | No      |
| n (%)                                   | 328 (30.9)         | 732 (69.1) |
| Age (years)                             | 58.1±14.0          | 44.9±15.6 |
| Gender                                  |                     |
| Male                                    | 89 (44.9)          | 69 (34.8) |
| Female                                  | 109 (55.1)         | 129 (65.2) |
| Body mass index (kg/m²)                 | 22.9±1.5           | 22.6±1.7 |
| HbA1c>5.6 or Type 2 diabetes mellitus   | 178 (89.9)         | 78 (39.4) |
| Triglyceride (≥1.7mmol/l)               | 101 (51.0)         | 11 (5.6)  |
| High density lipoprotein (<1.29mmol/l)  | 127 (64.1)         | 41 (20.7) |

Table 3 shows patients HbA1c≥5.6 or Type 2 diabetes mellitus with were 4-fold to possess MetS [OR=4.9; 95% confidence interval [CI]=3.2, 7.4, (p<0.0001)], or have elevated plasma TG levels (OR=2.6; 95% CI=2.2, 3.1, p<0.0001) and were also more likely to have low levels of HDL (OR=2.4; 95% CI=2.0, 3.0, p<0.0001).

The frequency of MetS is consistently increasing with increasing age until the sixth decade, Figure 1A. MetS is more frequent in male at the age group (≥60 years), Figure 1B. The frequency of MetS is consistently increasing with increasing BMI, Figure 2A with male predominant, Figure 2B. The mean of BMI among MetS is not statistically significant positively correlated with increasing with advanced age (r= 0.1, p=0.4).
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≥60. According to the result of studies conducted in the USA, the
frequency of occurrence of MetS increases together with age, from 6.7% in the age
group 20–29 to 43.5% in the age group 60–69, and 42% in the group of
individuals aged 70 and over.16

In the early eighties, a specific type of obesity defined as
metabolically obese normal weight subjects (MONW) was described.17
These individuals were characterized by normal body weight and BMI, but presented
hyperinsulinemia, insulin resistance, and increased type 2 diabetes, hypertriglyceridemia and cardiovascular diseases
predisposition.18,19 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.18 In another study carried out in Switzerland,
which included only females of Caucasian origin aged 35–75 years,
women with MONW had a higher cardiometabolic risk and higher
prevalences of low HDL-cholesterol, high waist circumference,
high triglycerides and hyperglycaemia but a similar prevalence of
hypertension compared to lean women.20

In this report, we advance the notion that MONW individuals are
those with a normal BMI who fulfil the criteria for the MetS as
defined by the ATP III guidelines. We observed that men and women in
the normal BMI range are more likely to have the MetS compared
with those with BMI 18.5–20.9kg/m². 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 not only support this view, but also
depict an even more apparent age and gender associated pattern of
abdominal fat accumulation. This phenomenon is consistent with
previous study.21,22 Individual risk factors of may differ between males
datafemales and, therefore, contribute to gender-related differences
in the risk of metabolic complications, such as insulin resistance.23
Despite the fact that the total frequency of occurrence of MONW was
noted in both genders, an increased risk of this syndrome was noted
among females with considerably lower BMI values. Several studies
showed higher body fat (especially visceral depot) and low lean mass
in the metabolically obese normal-weight individuals.23,24

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<25kg/m²), the features of the MetS
remained very common with over half exhibiting at least one 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
this populations.25

This underpins the importance of estimating the country-specific
prevalence of MetS. One reason for this finding is that the population of
Saudi Arabia is changing from its traditional lifestyle to westernised
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
Our results should be interpreted in light of the study’s limitations.

Discussion
We found that MetS was present in 50.0% of the total number
of participants, 89 cases (44.9%) of males; 109 cases (55.1%) of
females. This percentage should be considered as relatively high,
considering the accepted definition of the syndrome, i.e. BMI<25.0
kg/m², but not <26–27kg/m² as adopted by many other researchers.10
In previous studies, MetS – defined according to the IDF–was
diagnosed in 12.3%, 30.75% of males and 26.8% of females.
However, these studies concerned a much younger population,
starting from the age of 20 years.14,15 Such a high percentage of
individuals with MetS reported in our study resulted mostly from the
sample selection. It was an open research; therefore, 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 those
aged ≥60years. We found the occurrence of MetS increases together
with 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 increases together with age, from 6.7% in the age
group 20–29 to 43.5% in the age group 60–69, and 42% in the group of
individuals aged 70 and over.16

![Figure 1](image1.png)
Figure 1 (A) Percentages of metabolic syndrome across different age groups
and (B) in relation to gender.

![Figure 2](image2.png)
Figure 2 (A) Percentages of metabolic syndrome across different body mass
index groups and (B) in relation to gender.

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First, most of the patients enrolled were already on treatment for diabetes and hypertriglyceridemia, which imposed some limitations on the study. We tried to overcome this by obtaining the necessary sample size and by using data documented before treatment. Finally, as this was a hospital-based, 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. Another limitation of the present study was having considered only overall normal weight (assessed by BMI) and not abdominal obesity (measured by waist circumference), 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.

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Conflict of interest

Authors declare that there is no conflict of interest.

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