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Frequency of Metabolic Syndrome in Underweight Saudi Adults

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Research Article

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Abstract

Background and Objective: The global prevalence of underweight decreased from 14.6% to 9.7%. There is little information on the frequency of underweight with metabolic syndrome among Saudi adults. Therefore, the aim of this study was to determine the frequency of metabolic syndrome (MetS) in underweight Saudi Adults.

Methods: Out of 5498 participants, we analyzed 184 underweight participants who are equal to or older than 18 years old. All cases were from the population of the primary health at King Fahad Armed Forces Hospital.

Results: Out of 5498 participants analyzed, 184 (2.7%) were underweight. MetsS was present in 13 (7.1%) of underweight cases. There were 50 (27.2%) male and 134 (72.8%) were female. Mean age was 29.7 ± 14.4 (minimum 18 years and maximum 94 years). Mean body mass index (kg/m^2) (BMI) 16.7-1.3, type 2 diabetes (T2DM) and hypertension (HTN) were found in 18 (9.8%) and 9 (4.9%) respectively. Female patients were not significantly higher frequency of MetS compared to males, 10 (76.9)% vs. 3 (23.1%), respectively, p=0.7. Cases with MetS were significantly older, 55.6 ± 19.4 vs. 29.7 ± 14.4 respectively, p<0.0001. BMI was not significantly higher in MetS cases, 16.8-1.4 vs. 16.7-1.3 respectively, p=0.9. Patients with MetS were significantly have higher prevalences T2DM, HTN, low levels of high density lipoprotein (HDL) and high triglyceride. Patients with HbA1c>5.6 or T2DM [OR=4.3; 95% confidence interval (CI), p=0.06, 28.7, (p<0.0001)], elevated plasma TG levels [OR=6.7; 95% CI=3.0, 15.0, p<0.0001], or low levels of HDL [OR=3.1; 95% CI=1.3, 7.4, p<0.0001] were more likely to present. The frequency of MetS was significantly higher in age ≥30 years compared to younger ages, 84.6% vs. 7.7% for the other two age groups respectively, p<0.0001. The mean BMI was not significantly higher in age group 25-29 years, p=0.8. There were upward trend of MetS across each BMI unit with male predominant in BMI 17.0=18.4 kg/m^2.

Conclusion: It can be concluded from our study, the frequency of MetS in underweight Saudi adults is relatively low. Underweight with Mets might be associated with high risk for T2DM and HTN among older adults.

Keywords: Metabolic Syndrome; Underweight; Saudi Arabia

Introduction

The global prevalence of underweight was reported to be 9.7% [1]. A study conducted in seven African countries has shown that the prevalence of being underweight ranged from 12.6% to 31.9%. [4] A study from the United States has shown that the prevalence of underweight children and adolescents in the period of 2007-2010 was 3.5% [2]. Moreover, a study was conducted in Peru in a randomly selected sample of 952 secondary school adolescents showed that the prevalence of underweight was 1.5% [3]. In Russia, the prevalence of underweight adolescents (14-17) was 3.6% [4]. A study from Japan showed the prevalence of underweight was 13.5% in 1976 through the 1980s; however, from 1996 to the 2000s, 23.7% were underweight [5]. In cross-sectional study, found that underweight may be an independent risk factor for cardiovascular disease (CVD) and CVD was more prominent in subjects under age 60 [6].

Metabolic syndrome (MetS) predisposes individuals to increased risk for developing type 2 diabetes (T2DM) and CVD [7]. The prevalence of MetS increased with increasing body mass index (BMI) for both sexes. While only about 6.8% of males and 9.3% of females were underweight and normal weight, they had three or more risk factors for MetS [8]. A study from China showed 4.6% were underweight and 16.4% of them were identified as metabolically abnormal. Metabolic features were comparable between underweight but metabolically abnormal participants and obese participants. Compared with participants with normal weight and normal metabolic features, the underweight but metabolically abnormal participants were more likely to have CVD and albuminuria, with an adjusted odds ratio of 2.33 (95% confidence interval (CI) 1.34-4.05) and 2.56 (95% CI 1.86-3.52), respectively. Among underweight participants, factors associated with metabolic abnormal phenotype included leisure time physical inactivity, mild occupational physical activity, and waist circumference [9]. Some epidemiological data suggest that being underweight as well as being overweight might be associated with the incidence of diabetes in the Japanese population [10-12].

However, little attention has been paid to nearly equally frequent problem of underweight in adults. Moreover, in many studies overweight individuals were compared to those with normal weight, while potential differences between normal weight and underweight subjects were not taken into consideration. Underweight in turn is associated with increased mortality of adults and elderly people when compared to normal weight or overweight individuals [13]. There is little information on the frequency of metabolic syndrome in underweight among adult Saudis. Therefore, the aim of this study was to determine the frequency of metabolic syndrome in underweight Saudi adults.

Methods

Out of 5498 participants, we analyzed 184 underweight participants who are equal to or older than 18 years old. 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). Hypertension (HTN) was defined when the systolic blood pressure was ≥130 mm Hg and/or diastolic blood pressure was ≥85 mm Hg in addition to receiving any medication for hypertension [14]. BMI values classified as underweight if (body mass index) BMI < 18.5 kg/m2 [15]. Metabolic risk factors were defined using the 2006 IDF criteria that define elevated triglyceride as ≥150 mg/dL (≥1.7 mmol/L) and reduced high density lipoprotein cholesterol (HDL-cholesterol) as <50 mg/dL (<1.29 mmol/L) for female [16]. Abnormal glucose metabolism was considered when HbA1c (≥5.7). Participants were defined as having T2DM according to self-report, clinical reports, use of antidiabetic agents and HbA1c (≥6.5) [17]. A combination of two or more of these risk factors was used to define MetS [16]. The total number of cohort were separated on basis of age values into three groups: <25 years, 25-29 years and ≥30 years.

Statistical Analysis

Unpaired t-test analysis and Chi square (X^2) test (categorical data comparison) were used between variables to estimate the significance of different between groups for demographic and clinical laboratory. All statistical analyses were performed using SPSS Version 23.0. The difference between groups was considered significant when P<0.05.

Results

Out of 5498 participants analyzed, 184 (2.7%) were underweight. MetsS was present in 13 (7.1%) of underweight cases. There were 50 (27.2%) male and 134 (72.8%) were female. Mean age was 29.7 ± 14.4 (minimum 18 years and maximum 94 years), (table 1). Mean BMI 16.7-1.3, T2DM and HTN were found in 18 (9.8%) and 9 (4.9%) respectively. Table 2 showed basic characteristics and comparison of different variables according the presence or absence of MetS for the population under study. Female patients showed not significantly higher frequency of MetS compared to males, 10 (76.9)% vs. 3 (23.1%), respectively, p=0.7. Cases with MetS were significantly older, 55.6 ± 19.4 vs. 29.7 ± 14.4 respectively, p<0.0001. BMI was not significantly higher in MetS cases, 16.8-1.4 vs. 16.7-1.3 respectively, p=0.9. Patients with MetS were significantly have higher prevalences of T2DM, HTN, low HDL and high triglyceride (table 2). Patients with HbA1c>5.6 or T2DM [OR=4.3; 95% confidence interval (CI), p=0.06, 28.7, (p<0.0001)], elevated plasma TG levels [OR=6.7; 95% CI=3.0, 15.0, p<0.0001], or low levels of HDL [OR=3.1; 95% CI=1.3, 7.4, p<0.0001] were more likely to present.

Parameters		Total	Metabolic syndrome		P value
			Present	Absent	
n (%)		184	13 (7.1)	171 (92.9)	
Gender	Male	50 (27.2)	3 (23.1)	47 (27.5)	0.7
	Female	134 (72.8)	10 (76.9)	124 (72.5)	
Age (years)		29.7 ± 14.4	55.6 ± 19.4	29.7 ± 14.4	<0.0001
Body mass index (kg/m^2)		16.7-1.3	16.8-1.4	16.7-1.3	0.9
Type 2 diabetes mellitus		18 (9.8)	10 (76.9)	8 (4.7)	<0.0001
Hypertension		9 (4.9)	8 (61.5)	1 (0.6)	<0.0001
HbA1c>5.6 or Type 2 diabetes mellitus		19 (67.9)	9 (90.0)	10 (55.6)	0.06
Triglyceride (≥1.7 mmol/l)		7 (13.0)	6 (50.0)	1 (2.4)	<0.0001
High density lipoprotein (<1.29 mmol/l)		10 (31.3)	7 (58.3)	3 (15.0)	0.01

Table 1: Basic characteristics of the underweight population under study in patients with and without the metabolic syndrome [means ± SD or number (%)].

Parameters	Odd Ratio	P value
HbA1c>5.6 or Type 2 diabetes mellitus	4.3 (0.6-28.7)	0.06
Triglyceride (≥1.7 mmol/l)	6.7 (3.0-15.0)	<0.0001
High density lipoprotein (<1.29 mmol/l)	3.1 (1.3-7.4)	0.01

Table 2: The odd ratio for underweight patients with metabolic syndrome in correlation to HbA1c>5.6 or Type 2 diabetes mellitus, Triglyceride (≥1.7 mmol/l) and High density lipoprotein (<1.29 mmol/l).

Figure 1 showed the frequency of underweight cases across different age groups and mean BMI in relation to gender. The frequency of MetS was significantly higher in the age ≥30 years compared to younger ages, 84.6% vs.

7.7% for the other two age groups, p<0.0001, figure 1 A. The mean BMI was not significantly higher in age group 25-29 years, p=0.8, figure 1 B. Figure 2 showed the frequency of metabolic syndrome of underweight cases across BMI groups and in relation to gender. There were upward trend of MetS across each BMI unit with male predominant for BMI 17.0=18.4 kg/m^2, figure 1 A and B.

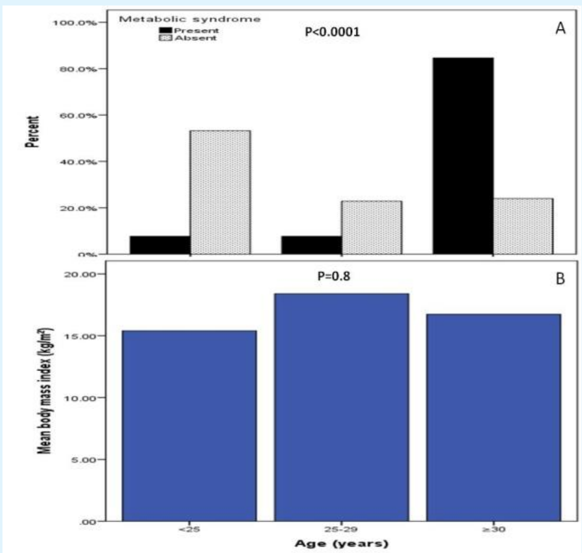

Figure 1: Frequency of underweight cases across different age groups (A) and Mean body mass index (kg/m2) in relation to gender (B).

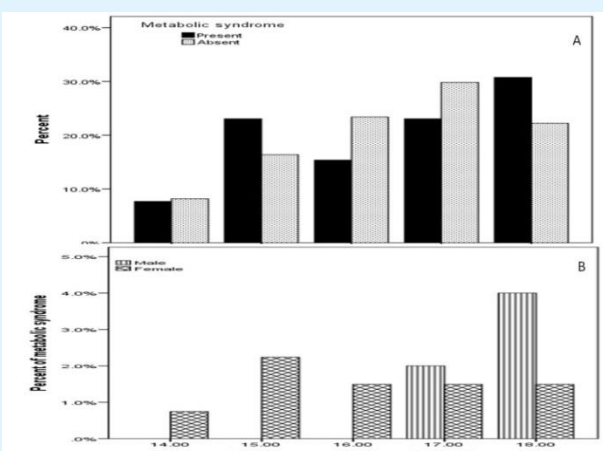

Figure 2: Frequency of metabolic syndrome of underweight cases across body mass index (kg/m2) groups (A) and in relation to gender (B).

Discussion

We found the frequency of underweight in our representative population using BMI criteria was 2.7%. Lower than other developing countries and slightly higher than developed countries. The underweight prevalence, worldwide, was projected to decline from 26.5% in 1990 to 17.6% in 2015. In developed countries, the prevalence was estimated to decrease from 1.6% to 0.9% while in developing regions, the prevalence was forecasted to decline from 30.2% to 19.3% [18]. Moreover, our study showed the mean age of underweight was 29.7 ± 14.4 years. Reasons for the high prevalence of underweight during early adulthood may be related to food insecurity and fear of being fat [19]. Some studies report an increase of an underweight body ideal and in eating disorders in Southeast Asia [20].

In the current study, the frequency of MetS was present in 7.1% out of 184 underweight cases. Underweight females with MetS in the study group was not significantly higher than males, 76.9% vs. 23.1% respectively, p=0.7. The results also showed that Mets was present in 7.7% of the study subjects aged <25 years and 25-29 years, while in age group ≥30 years was 84.6%, p<0.0001. In addition, the mean BMI was not significantly higher in age groups 25-29 years compared to subjects aged <25 years and ≥30 years. Moreover, There were upward trend of MetS across each BMI unit with male predominant for BMI 17.0=18.4 kg/m^2. The largest Polish epidemiological study evaluating the health status of Poles is the WOBASZ study (Multi-center National Population Health Examination Survey), whose first edition was conducted in 2003–2005, and the second in 2013–2014. WOBASZ studies showed subjects with underweight with MetS occurred in women of childbearing age in about 4% [21,22].

We showed that HbA1c>5.6 or T2DM was present no significantly in 90% of underweight with MetS, p=0.06. Mechanisms behind the association between underweight and T2DM among older adults are uncertain. Insulin secretion declines in older adults and lean diabetic older adults exhibit a profound impairment in glucose induced insulin release while obese diabetic older adults do not [23,24]. Several experimental studies using rats showed that protein-calorie malnutrition and magnesium deficiency cause low insulin secretion and a low pancreatic insulin store [25]. In humans, a study of 556 older adult subjects reported that a poor nutritional status was associated with the prevalence of T2DM; mean serum albumin levels were lower among diabetic than nondiabetic subjects [26]. Furthermore, low dietary magnesium was associated with risk of T2DM [27].

We found HTN was present significantly in 61.5% of underweight with MetS, p<0.0001. To date, most of the studies that have linked body weight with blood pressure have been conducted on middle-aged subjects because age is positively related with blood pressure, and the occurrence of HTN has been observed to increase markedly from approximately 40 years of age [28,29]. On the other hand, there are few such reports conducted on young adults [28]. Okasha, et al. [30] reported that BMI and body weight were positively associated with blood pressure in both males and females. Hirose, et al. [31] reported the presence of close positive correlations between changes in body weight and changes in blood pressure in 4976 university students during a 3-year follow-up period. Moreover, in a large nation-wide survey of health states on 323,517 university students in Japan, Kitamura et al. reported that BMI was positively correlated with systolic and diastolic blood pressure [32]. In an earlier study on 3686 university students, they also found that changes in body weight were positively correlated with changes in blood pressure [33]. The studies examining the association between HTN and body weight have been conducted on various age groups, especially middle-aged individuals, and have shown that BMI are positively associated with the risk for hypertension. However, most of these studies were cross-sectional. Among the few longitudinal studies, Huang et al. reported that weight gain dramatically increased the risk for HTN in study of 82,473 female registered nurses who were 30–55 years of age at study entry [34]. Field, et al. [35] described that for each 10 lb (4.5 kg) gain in weight, the risk of hypertension increased 30% in 46,224 females (the mean age of 39 years) who were participants in the Nurses' Health Study II. However, these studies were conducted in middle-aged individuals, and there are few longitudinal studies in young adults. 9.5% females were found to be underweight in a study done by Atanasova V, et al. in foreign medical students [36]. On the other hand, Salve SB, et al. in their study found that 29.52% males and 31.73% females had less than normal BMI [37].

For prevention of underweight with MetS patients, it is important to investigate risk factors, especially lifestyles, because these can be modified. Lifestyle factors are associated with BMI; for instance, physical activity and eating behaviors were reported to be associated with BMI [38]. Therefore, it is necessary to consider both physical activity and eating behaviors when examining lifestyle factors associated with underweight. Although the relationship between physical activity and underweight among adolescents has been investigated, eating behaviors such as eating speed, snacking, and breakfast were not considered in these studies. Under nutrition in adulthood can lead to increased morbidity and mortality and other adverse outcomes [39].

Strengths and Limitations

Our results should be interpreted in light of the study's limitations. The first limitation is the small number of subjects which might not allowed us to explore trends within detailed clusters of sex, BMI and age. Most of the patients enrolled were already on treatment for HTN and T2DM which imposed some limitations on the study. We tried to overcome these by obtaining the necessary sample size and by using data documented before treatment. Another limitation of the present study was having considered only overall obesity (assessed by BMI) and not abdominal obesity (measured by waist circumference), which is known to bear a close relationship with the target diseases. 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.

Conclusion

It can be concluded from this study that the frequency of MetS IN underweight Saudi adults is relatively low. Mets with Underweight might be associated with risk for T2DM and HTN among older adults.

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