Original Article

The Prevalence of Metabolic Syndrome in First Degree Relatives of Patients with Obstructive Sleep Apnea Syndrome: A Case–Control Study

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Abstract

Background: There was the association between the metabolic syndrome (MS) and obstructive sleep apnea (OSA). Also, the genetic factors have been implicated in the OSA. Our aim was to compare the frequency of MS in first-degree relatives (FDRs) of OSA patients with healthy controls. **Methods: 39** FDR (parents, siblings, and children) of patients diagnosed with OSA at Bamdad Respiratory and Research Center as cases and age- and sex-matched healthy controls were included in the current case–control pilot study. The sampling method was convenience sampling based on having inclusion criteria and consent to participate in the study. Demographic characteristics and essential criteria for diagnosing MS included blood pressure, anthropometric [weight (kg), height (cm), waist circumference (cm) and body mass index (BMI) (kg/m^2)], and biochemical indices (lipid profile and blood glucose) were assessed based on standard protocols. **Results:** In the comparison of the demographic and clinical characteristics of two39 cases and control groups, weight and diastolic blood pressure were significantly higher in case group than controls ($P < 0.05$). Case and control groups were not significantly different in the frequency of MS ($P > 0.05$). Although, the frequency of hypertension as an important cardiovascular risk factor was higher in cases than controls ($P < 0.05$). **Conclusions:** The present study demonstrates that the frequency of MS is not significantly different between FDRs of OSA patients and controls. However, further large-scale studies are warranted to detect the frequency of MS in people with hereditary background for OSA compared to general population.

Keywords: *Abdominal hypertension, metabolic syndrome, obesity, obstructive, sleep apnea, waist circumference*

Introduction

Obstructive sleep apnea (OSA) syndrome is a prevalent sleep disorder characterized with repeated episodes of partial and complete upper airway obstruction occurring during sleep.[1] The prevalence of OSA among adults in the general population has been estimated to be between 9% and 38%.[2] It has been reported that the prevalence of OSA in Iranian population is lower than Western population.[3] Although, it has been supposed that the prevalence of OSA will increase over time all around the world with the increasing epidemic of obesity as one of the most important risk factors for the disease.[4] The patients with OSA often exhibit a number of adverse health outcomes comprising decreased quality of life, psychological, cardiovascular, and metabolic disorders leading to its increased morbidity and mortality.[5-8] In recent years, there has been an increasing interest in investigating the association between OSA and metabolic syndrome. Metabolic syndrome refers to a cluster of metabolic risk factors for diabetes and cardiovascular diseases including, central obesity, hypertension, hyperglycemia, and dyslipidemia.[9] It has been reported that the prevalence of metabolic syndrome in OSA patients is higher than general population.[10] Surprisingly, OSA and metabolic syndrome share common risk factors, such as obesity, middle age, genetics, and lifestyle behaviors.[11] Recent studies have indicated a robust independent association between OSA and various features of metabolic syndrome comprising hypertension, dyslipidemia, and impaired glucose tolerance, although, mechanisms underlying the association have not been fully understood.[12-14]

It has been reported that people with a family history of OSA is at a greater

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risk for the disease compared to the general population, showing that genetic factors play an important role in the pathogenesis of OSA.[15,16] Additionally, the genetics is reported an important factor in OSA.[17] Therefore, finding more than usual risk of OSA patients' family members to metabolic syndrome with extensive adverse effects could be helpful in early screening and preventive measures in this population. This strategy would have the health and economic benefits. Therefore, the aim of the current study was to compare the prevalence of metabolic syndrome in first-degree relatives (FDRs) of OSA patients with the general population.

Methods

Study design and participants

This pilot case-control study was carried out from the 1st of September 2018 to the 1st of November 2019 at Bamdad respiratory and sleep research center (BRSRC), Isfahan, Iran. FDRs included the parents, siblings, and children of OSA patients diagnosed by attended overnight standard polysomnography at BRSRC were invited to participate in the study. Totally, 39 individuals aged 18 years or older included in the study. The sampling was performed with convenient sampling. Healthy controls, matched for age and sex, were recruited from patients of orthopedics, surgery, and gynecologic clinics. Study protocol was approved by the ethics committee of Isfahan University of Medical Sciences (Research project number: IR.MUI.MED.REC.1397.243) and written informed consent was provided by all participants before taking part in the study.

Anthropometric and blood pressure measurements

All anthropometric assessments were done by a trained staff based on standard protocols. The height of each participant was determined using a wall stadiometer to the nearest 0.1 cm in bare feet. The body weight was measured in light clothing to the nearest 0.1 kg using a calibrated digital scale. The body mass index was calculated as the weight (kg) divided by the square of height (m). A measuring tape was used to measure waist circumference (WC) (cm) in standing position midway between the lowest rib and the iliac crest. Blood pressure was measured twice with a 5-min interval using a mercury sphygmomanometer after a 10-min rest period. The average of the two measurements was used for analyses.

Biochemical variables

All study participants were refereed to medical laboratory of Khorshid hospital, affiliated to Isfahan University of Medical Sciences, Isfahan, Iran, to assess biochemical variables. Five milliliters of fasting blood sample were collected by laboratory technologists; the serum was separated and stored in -70°C for further analyses. Fasting blood sugar (FBS), total cholesterol, triglyceride, LDL-, and HDL cholesterol were determined using commercial kits (Pars Azmoon, Iran).

Metabolic syndrome definition

The diagnosis of metabolic syndrome was done by the presence of three or more of the following factors: (1) central obesity which is defined as WC ≥90 cm for males and ≥85 for females, (2) TG levels ≥150 mg/dL, (3) HDL-cholesterol levels <40 mg/dL for males and <50 mg/dL for females, (4) systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg or receiving treatment for diagnosed hypertension, and (5) FBS ≥100 mg/dL or receiving previous treatment for diagnosed type 2 diabetes.[18]

Statistical analysis

In the present study, quantitative and categorical data were presented as mean (SD) and frequency (percentage), respectively. Continuous normal variables were compared between groups by using independent samples *t*-test, whereas Chi-square or Fisher exact tests were used for categorical data. Data analyses were performed using Statistical Package for Social Sciences version 16 (SPSS Inc., Chicago, IL, U.S.A.). A P value of 0.05 was considered as significant.

Results

Table 1 summarizes basic characteristics of the study participants. The mean age of cases and controls was 41.05 ± 10.83 and 42.54 ± 13.16 years, respectively ($P > 0.05$). There were 38.5% of males in the case group versus 43.6% in the control group. There was not any significant difference between case and control subjects in terms of smoking, biochemical factors, body mass index and WC ($P > 0.05$). However, weight was significantly higher in cases compared to controls ($P < 0.05$).

The comparison of cardio-metabolic risk factors between case and controls is shown in Table 2. There was not any significant difference in the frequency of metabolic syndrome as a whole and its components except for hypertension between case and control groups ($P > 0.05$). Our findings showed that the frequency of hypertension was significantly higher in case group compared to controls [Figure 1a and b].

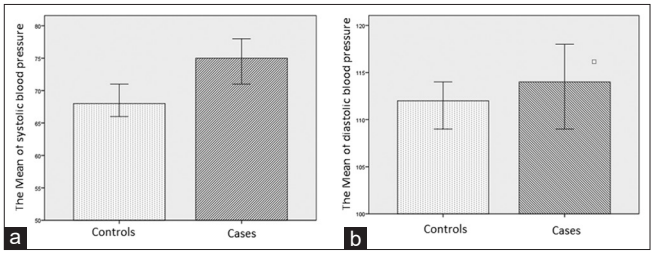

Figure 1: Comparing the mean of systolic (a) and diastolic (b) blood pressure between cases. Values in table are presented and control groups

Table 1: Comparison of general characteristics between case (first degree relatives of OSA patients) and control groups

Variable	Case (*n*=39)	Control (*n*=39)	*P*
Age (years)	41.05±10.83	42.54±13.16	0.6
Sex			
Male	38.5	43.6	0.41
Female	61.5	56.4	
Current smoking (yes)	17.3	7.1	0.07
Weight (kg)	76.59±14.96	70.64±11.48	0.05
Waist circumference (cm)	90.75±21.24	91.36±15.32	0.86
Fasting blood sugar (mg/dL)	93.64±15.35	100.54±27.64	0.17
Total cholesterol (mg/dL)	190.69±34.43	189.05±34.83	0.83
Triglyceride (mg/dL)	134.62±63.63	131.54±42.65	0.80
LDL- cholesterol (mg/dL)	115.15±25.82	114.38±29.72	0.90
HDL- cholesterol (mg/dL)	49.18±10.51	48.21±8.21	0.65
Diastolic blood pressure (mmHg)	75.13±11.56	68.97±7.18	0.006
Systolic blood pressure (mmHg)	114.23±13.05	112.05±8.94	0.39
Body mass index (kg/m^2)	28.15±4.71	27.58±4.83	0.60

Values in table are mean±SD for continuous variables and percentage for categorical variables, *P* values were obtained from analysis of variance (ANOVA) for continuous variables and Chi-square test for categorical ones

Table 2: Comparing the prevalence of cardio-metabolic risk factors between case (first degree relatives of OSA patients) and control groups

Disorder	Case (*n*=39)	Control (*n*=39)	*P*
Central obesity, *n* (%)	15 (38.5)	12 (30.8)	0.16
Diabetes, *n* (%)	1 (2.6)	4 (10.3)	0.18
Hypertension, *n* (%)	20 (51.3)	9 (23.1)	0.009
Hypertriglyceridemia, *n* (%)	24 (61.5)	29 (74.4)	0.23
Metabolic syndrome, *n* (%)	8 (20.5)	13 (33.3)	0.31

P-values were obtained from Chi-square test

Discussion

Metabolic syndrome is known as a cluster of metabolic conditions that increase the risk of cardiovascular diseases and type 2 diabetes.[19,20] It seems that the prevalence of metabolic syndrome will increase in developing countries like Iran considering lifestyle changes, such as physical inactivity and unhealthy eating behaviors, due to urbanization. During recent years a growing number of studies have been investigated the association between metabolic syndrome and OSA. It has been reported that the prevalence of OSA is about 60% in metabolic syndrome patients.[21] We supposed that the frequency of metabolic syndrome in FDRs of OSA patients is different from the general population considering the strong association between OSA and metabolic syndrome on one hand and the high heritability of OSA on the other hand.

Based on our findings, only the prevalence of hypertension was significantly higher in case group compared to controls. There was not any significant difference in the frequency of metabolic syndrome as a whole and other components included diabetes, hypertriglyceridemia, and central obesity. These findings may emphasize the importance of environmental and lifestyle factors over genetic factors. A number of studies have indicated that the prevalence of hypertension is higher in OSA patients. Some variables including gender, age, and obesity are known as risk factors of hypertension in OSA patients.[22-24] The higher prevalence of hypertension in case group, not only could be related to the genetic factors, but also could be affected by environmental factors, such as smoking, physical activity, and diet in their families. This can be good news about capability and success of the measures such as changes in physical activity and diet in the prevention of cardiovascular complication of metabolic syndrome.

To the best of our knowledge, this was the first study in Iranian population that compared the prevalence of metabolic syndrome and its components between FDRs of OSA patients and general population. Although, further studies are warranted to explore underlying factors behind the higher prevalence of hypertension in FDRs of OSA patients.

Previous studies have reported that there is an association between OSA and increased risk of metabolic syndrome as a main cardiovascular risk factor in these patients.[25,26] Additionally, based on previous studies, the risk of OSA in family members of OSA patients is high because of craniopharyngeal morphology.[27] Although, we could not find any association between the risk of metabolic syndrome in FDRs of OSA patients. The finding suggests that maybe genetic background do not increase the risk of OSA-related chronic diseases such as metabolic syndrome. Additionally, it is possible that the findings be associated to the limitations of the current study. The most important limitation of the present study was a relatively small sample size. It is possible that nonsignificant difference in the frequency distribution of metabolic syndrome between case and control groups be due to the lack power.

Additionally, we did not assess all potential confounding variables like socio-economic and lifestyle variables. Despite these limitations, our study provides new insight for designing future studies for chronic diseases screening among people who are susceptible to OSA as well as doing suitable interventions for prevention and treating them. In conclusion, the results of the current case–control study showed that there was not any significant difference between FDRs of OSA patients and healthy individuals in terms of metabolic syndrome. However, further large-scale studies are warranted to detect the frequency of metabolic syndrome in people with hereditary background for OSA and comparing it with the general population.

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Conflicts of interest

There are no conflicts of interest.

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