J. Endocrinol. Invest. 27: 150-157, 2004

Snoring, hypertension and Type 2 diabetes in obesity. Protection by physical activity

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ABSTRACT. Sleep-related breathing disorders are recognized as major health problems in obesity. They are involved in both hypertension and Type 2 diabetes, through mechanisms possibly related to increased sympathetic tone. We studied the association of habitual snoring with diabetes, hypertension, weight cycling and physical activity in a large Italian database of treatment-seeking obese subjects. Clinical and behavioral data were assessed by standardized questionnaires. Consecutive data of 1890 obese patients were analyzed [average body mass index (BMI), 38.2 kg/m^2, median age: 46 yr, 78% females], from 25 obesity Italian centers, with low prevalence of clinical manifestations of cardiovascular disease. Habitual snoring was reported in 56% of the cases, and was associated with day-time sleepiness. The prevalence increased with obesity class and waist circumference, and was positively associated with weight cycling and weight gain since the age of 20, and smoking. Regular physical activity had a protective effect. Snoring was associated with diabetes and hypertension at univariate analysis, but in multivariate analysis an independent effect was only observed for hypertension. After adjustment for age, gender and BMI, physical activity maintained an independent, protective effect on both snoring (odds ratio 0.65, 95% confidence interval 0.49–0.84; *p*=0.001), diabetes (0.50, 0.30–0.86; *p*=0.011) and hypertension (0.71, 0.53–0.95; *p*=0.023). We conclude that in treatment-seeking, obese subjects with low prevalence of cardiovascular disease, snoring independently increases the risk of hypertension, whereas physical activity exerts a protection on both snoring and complications. These data underline the importance of lifestyle interventions to limit the burden of obesity and associated diseases.

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INTRODUCTION

Obesity is a major threat to public health (1), and complicating diseases contribute to morbidity and mortality. Sleep-related breathing disorders (SRBD) are recognized as major health problems in obesity (2). SRBD range from habitual snoring – a disturbing condition without clinical relevance in less severe cases – to sleep apnea syndrome. The majority of patients have excessive daytime sleepiness and tiredness, which may be a problem at work (3) or driving (4), but far more relevant problems may also ensue. The coexistence of cardiovascular and cerebrovascular diseases with sleep-related breathing disorders was long considered the result of shared risk factors, namely ageing, male gender, and obesity (5). In recent years several epidemiologic studies have demonstrated that SRBD are independent risk factors for hypertension (6-8), via increased sympathoadrenal activity. A link between SRBD and Type 2 diabetes was also suggested (9). This association is also biased by the common occurrence of obesity and hypertension in both conditions, as well as by weight cycling, whose role as a confounder on negative health outcomes, particularly cardiovascular mortality, has never been definitely settled (10, 11). However, it was suggested that sleep apnea might

*A complete list of participants to the QUOVADIS study group has been published in ref. (18).

Key-words: Snoring, Diabetes, Non-insulin Dependent, Obesity, Exercise, Weight Gain.

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Accepted October 14, 2003.

also impair insulin levels (12), insulin action and overall glucose regulation (9, 13), leading to diabetes (14). An association was also reported between weight cycling and major illnesses (15), contributing to cardiovascular morbidity and mortality, and a protective role of physical activity was suggested (16).
The majority of studies based the association between SRBD and complications on well-established demonstration of sleep-apnea syndrome, based on whole night polysomnography (6-8, 13). The predictive value of self-reported habitual snoring is also reported, but less clearly established (14, 17).
The QUOVADIS study (QUality of life in Obesity: eVAluation and DIsease Surveillance) is an on-going large, observational trial aimed at measuring the burden of obesity and its complications on health-related quality of life and psychological distress (18); several clinical and laboratory data were collected in consecutive patients attending 25 obesity centers.
The present study specifically aimed at: 1) measuring the prevalence of self-reported habitual snoring in obese patients; 2) assessing the association of hypertension and Type 2 diabetes with clinical data, and specifically with snoring, weight gain and weight cycling.

MATERIALS AND METHODS

Patients

We report data on 1890 obese patients (Table 1), enrolled by 25 Italian centers in the observational QUOVADIS study, providing a complete picture of obese patients seeking treatment at Italian obesity centers. The protocol of the study and the main features of patients have been previously reported (18). All treatment-seeking obese subjects were eligible for the study, provided they were not on active treatment for obesity at the time of enrolment, were in the age range between 20 and 65 yr, agreed to fill a package of self-administered questionnaires, and signed an informed consent to participate.
Recorded clinical data also included cigarette smoking, an evaluation of self-reported structured physical activity, a previous diagnosis of hypertension (or treatment with arterial pressure lowering drugs) and clinically detected coronary heart and peripheral vascular disease. Patients were not systematically screened for coronary heart disease (CHD) by electrocardiogram or Doppler ultrasounds.
Snoring was specifically investigated by systematically asking patients about previous reports by relatives of their sleeping pattern, occasional or habitual snoring, and age since first report, using standardized questions. Although a few patients reported symptoms suggestive of obstructive sleep apnea syndrome, this diagnosis was not systematically investigated. Referred data on habitual snoring were compared with the response to a specific item of the obesity-related well-being (ORWELL-97) self-administered questionnaire (19), enquiring about daytime sleepiness and its influence on daily activities. The questions "Do you ever feel sleepy?" and "Does sleepiness interfere with your daily activities?" were considered. However, in statistical analysis, snoring was considered on the sole basis of self-reported assessment, independently of daytime sleepiness.
Finally, the weight history was checked by the assessment of body weight at the age of 20 yr and the number of times patients had lost weight as an effect of dietary programs. For this purpose, a grid was included in the Case Report Form and patients were systematically interviewed as to the number of times they had lost more than 30 kg, 20 to 30 kg, 10 to 20 kg, 5 to 10 kg or less than 5 kg because of programmed dietary restriction. The values were used to compute the total number of dieting programs and total cumulative weight loss. The sum of total weight loss and the difference

Table 1 - *Characteristics of the 1890 patients under study (prevalent and 95% confidence interval or median and range).*

Male gender (%)	22.1 (20.2 – 24.0)
Age (yr) (median and range)	46 (20 – 65)
Waist circumference >102 cm (M) or >88 cm (F)	94.6 (93.4 – 95.5)
Body Mass Index (kg/m^2) (median and range)	38.2 (30.0 – 82.2)
Obesity class I (30 to 34.9 kg/m^2) (%)	38.4 (36.2 – 40.5)
Obesity class II (35 to 39.9 kg/m^2) (%)	28.3 (26.3 – 30.3)
Obesity class III (>40 kg/m^2) (%)	33.4 (31.2 – 35.5)
Weight (kg) (median and range)	98 (66 – 200)
Weight at the age of 20 yr (kg) (median and range)	65 (39 – 150)
Previous attempts to lose weight (%)	81.7 (79.9 – 83.4)
No. of attempts (median and range)	3 (0 – over 20)
Age at first attempt (median and range)	26 (<10 – 63)
Structured physical activity (%)	15.8 (14.2 – 17.5)
H of physical activity/week (median and range)	2 (1 – over 15)
Active smokers (%)	22.6 (20.8 – 24.5)
Previous smokers (%)	22.4 (20.5 – 24.3)
Snoring (%)	56.1 (53.8 – 58.3)
Snoring by over 5 yr (%)	33.6 (31.5 – 35.7)
Daytime sleepiness (%)	42.6 (40.4 – 44.8)
Family history of coronary disease (%)°	2.6 (1.9 – 3.4)
Family history of diabetes (%)#	43.6 (41.4 – 45.9)
Total with diabetes (%)	12.8 (11.3 – 14.4)
Previously diagnosed diabetes (%)	9.3 (8.0 – 10.6)
Newly detected diabetes (BG Γ126 mg/dl) (%)	2.7 (2.1 – 3.6)
Newly detected diabetes (120-min BG Γ200 mg/dl) (no.=834) (%)	2.0 (1.2 – 3.2)
Total with hypertension (%)	62.3 (60.1 – 64.5)
Previously diagnosed hypertension (%)	36.5 (34.3 – 38.6)
Newly detected hypertension (Γ140/90 mmHg) (%)	26.7 (24.7 – 28.7)
Total with hyperlipidemia (%)	65.9 (63.7 – 68.0)
Previously diagnosed hyperlipidemia (%)	22.7 (20.8 – 24.6)
Newly detected hyperlipidemia (%)*	44.4 (42.1 – 46.7)
Coronary heart disease (%)	2.6 (1.9 – 3.4)
Peripheral vascular disease (%)	0.8 (0.5 – 1.3)

*: LDL-cholesterol Γ130 mg/dl and/or triglycerides Γ150 mg/dl, or statins/fibrates use; °: First degree relatives (males, age <55 yr; females, <65 yr); #: First and second degree relatives.