Association of Obstructive Sleep Apnea and Glucose Metabolism in Subjects With or Without Obesity

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OBJECTIVE—The purpose of this study was to investigate whether the impact of obstructive sleep apnea (OSA) on glucose metabolism was different according to the presence or absence of obesity.

RESEARCH DESIGN AND METHODS—A total of 1,344 subjects >40 years old from the Korean Genome and Epidemiology Study were included. OSA was detected by home portable sleep monitoring. Plasma glucose, HbA_{1c}, and insulin resistance were compared according to OSA and obesity status. The associations between OSA and impaired fasting glucose (IFG), impaired glucose tolerance (IGT), IFG + IGT, and diabetes were evaluated in subjects with and without obesity after adjusting for several confounding variables. The effect of visceral obesity on this association was evaluated in 820 subjects who underwent abdominal computed tomography scanning.

RESULTS—In subjects without obesity, fasting glucose, 2-h glucose after 75-g glucose loading, and HbA_{1c} were higher in those with OSA than in those without after controlling for age, sex, and BMI. In addition, the presence of OSA in nonobese subjects was associated with a higher prevalence of IFG + IGT and diabetes after adjusting for several confounding variables (odds ratio 3.15 [95% CI 1.44–6.90] and 2.24 [1.43–3.50] for IFG + IGT and diabetes, respectively). Further adjustment for visceral fat area did not modify this association. In contrast, in those with obesity, none of the abnormal glucose tolerance categories were associated with OSA.

CONCLUSIONS—The presence of OSA in nonobese individuals is significantly associated with impaired glucose metabolism, which can be responsible for future risk for diabetes and cardiovascular disease.

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Many population- and clinic-based cross-sectional studies have found that obstructive sleep apnea (OSA) is associated with glucose intolerance and insulin resistance (1,2). Furthermore, the Sleep Heart Health Study demonstrated that sleep-disordered breathing was associated not only with diabetes, but also with intermediate hyperglycemia, such as impaired fasting glucose (IFG) and impaired glucose tolerance (IGT), after controlling for age, sex, BMI, and waist circumference (WC) (3). However, the effects of continuous positive airway pressure (CPAP) therapy on glucose metabolism were inconclusive (4–6). These results may be attributable to the differences in populations, variable treatment duration, differences in BMI, discrepant methodologies and cutoffs for OSA, and the presence or absence or excessive daytime sleepiness (EDS). Harsch et al. (5) found that CPAP therapy significantly improved insulin sensitivity after only 2 days of treatment. Of note, the improvement of insulin sensitivity with CPAP therapy was minimal in patients with a BMI >30 kg/m^2, but it was more prominent in less obese individuals, suggesting that the impact of OSA on glucose metabolism may be larger in those without obesity.

Although obesity is a key risk factor for OSA, a substantial proportion of individuals with OSA are not obese, especially those of Asian descent (7–9). In a few studies in nonobese subjects (BMI <25 kg/m^2), OSA was independently associated with insulin resistance, compensatory hyperinsulinemia (10), and metabolic abnormalities (7–10). However, there have been few studies on the difference in metabolic consequences of OSA on the basis of obesity status. In addition, there is a paucity of research that has adequately analyzed the influence of visceral obesity, a cardinal feature of sleep apnea and glucose metabolism.

Therefore, the purpose of the current study was to evaluate whether the association of OSA and impaired glucose regulation (IFG, IGT, IFG + IGT, and diabetes) was different in subjects with or without obesity, even after adjusting for generalized or visceral adiposity. To explain the possible mechanism of this association, insulin resistance and secretion was compared according to obesity and OSA status in a large community-based cohort study in Korea.

RESEARCH DESIGN AND METHODS

—All study subjects were from the ongoing, prospective, population-based Korean Genome and Epidemiology Study (KoGES) cohort. The original study was designed to establish a representative adult cohort in an urban area, the city of Ansan, and to identify the epidemiologic

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