Brief report

The association of sleep duration and type 2 diabetes in Korean male adults with abdominal obesity: The Korean National Health and Nutrition Examination Survey 2005

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1. Introduction

Diabetes mellitus is a major concern in Korea as well as worldwide. In Korea, the prevalence of diabetes was estimated to be 5.9% in 2003 and is expected to reach 10.9% by 2030 [1]. Sleep duration has recently been recognized as a novel risk factor for type 2 diabetes. Short or long sleep duration was associated with type 2 diabetes [2-5]. Obesity, in particular abdominal obesity, is also very strongly related to the development of type 2 diabetes [6]. In this regard, diabetes with and without abdominal obesity might have different characteristics, and abdominal obesity could influence the association of sleep duration and diabetes. In the present study, we investigated the association among sleep duration, abdominal obesity, and the prevalence of type 2 diabetes in Korean male adults.

A B S T R A C T

We used data of 1652 male adults aged 20-60 years from KNHANES III. Short sleep duration was significantly associated with an increased prevalence of type 2 diabetes in Korean male adults without abdominal obesity (OR in sleep duration of ≤5 compared to 7 h/day: 2.40 [95% CI, 1.18-4.91]).

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2. Methods

The Third Korean National Health and Nutrition Examination Survey (KNHANES III) was conducted by the Korean Ministry of Health and Welfare in 2005. We included male adults aged 20–60 years (n = 2342) because of more consistent previous reports among male adults [3–5] and physiologic and pathologic changes of sleep with aging [7]. After excluding those with missing values, we obtained a final sample of 1652.

Sleep duration was self-reported and divided into five categories: ≤5, 6, 7, 8, and ≥9 h/day. Diabetes was defined as a previous diagnosis, use of medication, or a fasting glucose ≥7.0 mmol/l. Diabetes was considered type 2 unless diagnosis was made ≤20 years old and insulin was used. A BMI ≥25 kg/m² and a waist circumference ≥90 cm was considered as general and abdominal obesity, respectively, according to the definition of obesity for Asians by the Western Pacific Regional Office of the World Health Organization [9]. Hypertension was defined as a previous diagnosis, use of medication, or a systolic/diastolic blood pressure ≥140/90 mmHg. High triglyceride was defined as ≥2.26 mmol/l. A high density lipoprotein cholesterol (HDL-C) <1.00 mmol/l was considered low. High cholesterol was defined as a previous diagnosis, use of medication, or a total cholesterol ≥6.20 mmol/l [10].

Logistic regression was used to calculate odds ratios (OR) for diabetes after adjustment of age, smoking, drinking, exercise, education, household income, residential area, hypertension, general obesity, abdominal obesity (in all subjects), high triglyceride, low HDL-C, and high cholesterol.

Because the mean sleep duration (±SD) was 6.9 (±1.2) h/day, 7 h/day was used as the reference. All analyses were performed using SPSS (version 11; SPSS Inc., Chicago, IL). P < 0.05 was considered statistically significant.

3. Results

Among 1652 male adults aged 20–60 years, 147 (8.9%) had diabetes and 411 (24.9%) had abdominal obesity. Mean sleep duration was 6.9 ± 1.2 h. The prevalence of diabetes was 7.3% and 13.6% among those without and with abdominal obesity. The prevalence of diabetes according to sleep duration (≤5, 6, 7, 8, ≥9) is listed in Table 1. In subjects without abdominal obesity, those with short sleep duration (≤5 h) had an increased OR for diabetes (2.40 [95% CI, 1.18–4.91]) compared to those with sleep duration of 7 h. There was no significant increase in OR for diabetes in subjects with abdominal obesity with a short (≤5 h) or long (≥9 h) sleep duration.

4. Discussion

The present study showed an association between sleep duration and type 2 diabetes in Korean male adults aged 20–60 years. Short sleep duration was significantly associated with an increased prevalence of diabetes among men without abdominal obesity. This is the first study that has shown this association in an Asian population, and the first that has examined the role of abdominal obesity.

The association of short sleep duration and diabetes has been recently reported in several studies, more consistently among male adults. Short sleep duration was related to diabetes in the Massachusetts Male Aging Study [3] and in both men and women in the cross-sectional analysis of the Sleep Heart Health Study [11]. However, in a Swedish study, increased incidence of diabetes related to short sleep duration was found in men but not in women. This association was not found in female adults in the Nurse Health Study [5] and in the KNHANES III (data not shown), either. Long sleep duration has also been associated with diabetes [2,3,5,11], but this association is thought to be mediated by confounding factors [2,3,5].

Explanation for this association and the role of abdominal obesity is not clear. Acute sleep deprivation is accompanied by impaired insulin secretion and sensitivity [12]. Insulin secretion and sensitivity are also affected by obesity. Obese diabetics (BMI ≥ 25) had both insulin resistance and insulin secretory dysfunction, whereas non-obese diabetics had only insulin secretory dysfunction [13]. In addition, an Asian diabetic population tends to be less obese and more likely to have insulin secretory dysfunction [14–18]. Since abdominal obesity is more relevant than general obesity in the development of diabetes [6], more obvious pathogenic heterogeneity may exist based on abdominal obesity. Therefore, without abdominal obesity, short sleep duration may contribute to the development of diabetes through insulin secretory dysfunction. But once abdominal obesity is present, short sleep

| Table 1 – The prevalence and odds ratios for type 2 diabetes across sleep duration by abdominal obesity. |
|---|---|---|---|
| Sleep durationa | All subjects (n = 1652) | No abdominal obesity (n = 1241) | Abdominal obesity (n = 411) |
| | %b (DM/n°) | OR° (95% CI) | %b (DM/n°) | OR° (95% CI) | %b (DM/n°) | OR° (95% CI) |
| ≤5 | 14.1 (26/185) | 1.69 (0.96–2.98) | 14.2 (18/127) | 2.40 (1.18–4.91) | 13.8 (8/58) | 1.04 (0.38–2.87) |
| 6 | 7.4 (34/459) | 1.01 (0.61–1.67) | 5.5 (19/344) | 0.96 (0.49–1.87) | 13.0 (15/115) | 1.06 (0.47–2.39) |
| 7 | 7.8 (41/525) | 1 | 5.8 (23/399) | 1 | 14.3 (18/126) | 1 |
| 8 | 8.8 (34/386) | 1.10 (0.66–1.84) | 7.7 (23/300) | 1.31 (0.68–2.50) | 12.8 (11/86) | 0.81 (0.33–2.00) |
| ≥9 | 12.4 (12/97) | 1.26 (0.60–2.66) | 11.3 (8/71) | 1.60 (0.63–4.06) | 15.4 (4/26) | 1.11 (0.31–3.98) |

a Sleep duration in hours per day.

b Prevalence of type 2 diabetes in each sleep duration category. P-value for all subjects, no abdominal obesity, and abdominal obesity was 0.049, 0.009, and 0.995 respectively.

c The number of type 2 diabetes patients/the number of subjects in each sleep duration category.

° Odds ratio for type 2 diabetes adjusted with age, smoking, drinking, exercise, education, income, and residential area, hypertension, general obesity, abdominal obesity (in all subjects), high TG, low HDL-C, and high cholesterol.
duration may not result in a further increase of insulin resistance.

There are several limitations to this study. First, we did not include obstructive sleep apnea (OSA). However, OSA was not correlated with sleep duration, and the effect of short or long sleep duration was observed regardless of OSA symptoms [11]. Second, this study was cross-sectional. Third, sleep duration was self-reported; however, it was strongly correlated with instrumental measurements [19]. Prospective studies are warranted to elucidate the causal relationships between sleep duration and diabetes based on abdominal obesity.

Conflict of interest
The authors declare that they have no conflict of interest.

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REFERENCES