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Original Article

The association between sleep duration and dry eye syndrome among Korean adults

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ABSTRACT

Objective: The aim of the present study was to investigate the association between sleep duration and dry eye syndrome (DES) symptoms.
Methods: We investigated 15,878 subjects (male = 6684; female = 9194) aged 20 years and older who underwent physical examinations and completed a self-report questionnaire and other anthropometric variables from the fifth Korean National Health and Nutrition Examination Survey (KNHANES) 2010–2012. Odds ratios (OR) and 95% confidence intervals (95% CI) for DES according to sleep duration were calculated using multiple logistic regression models.
Results: Compared to that in an optimal sleep group (6–8 h/day), OR (95% CI) DES prevalence after adjusting for age, gender, sociodemographic factors (educational level, occupation, household income, and residence), and health behaviors (smoking habit, alcohol consumption, and level of exercise) was 1.20 (1.05–1.36) for a mild short sleep group (5 h/day) and 1.29 (1.08–1.55) for a severe short sleep group (≤4 h/day).
Conclusion: Our results revealed that DES increased at shorter sleep durations.

1. Introduction

Sleep duration is increasingly being considered as an important factor for quality of life and is associated with both physical and mental health outcomes. Several studies have revealed a U-shaped relationship between sleep duration and risk of chronic diseases [1] (coronary heart disease, stroke, diabetes mellitus), cancer [2,3], all-cause mortality [4], and visual impairment [5]. However, far too little attention has been paid to the relationship between sleep duration and eye problems, especially dry eye syndrome (DES).

DES is an ocular surface disease resulting from tear deficiency or excessive evaporation that causes symptoms of grittiness, eye discomfort, and visual disturbance [6,7]. DES is recognized as a serious public health concern worldwide and the main reason for visits to eye clinics. The prevalence of DES ranges from 7.9% to 28.7% [8–11], and a South Korean survey reported it as 17.7% [12]. The impact of DES can deteriorate quality of life. It has been shown that DES can lead to difficulties in performing activities of daily living such as reading, professional work, and driving [13]. DES has placed a considerable burden on the economic vitality of the individual and the society as a whole. Previous studies have reported that management of DES costs about $783 US dollars (range $757–$809) per patient annually in the United States [14] and $530 US dollars (range, $146–$914) in Asia [15]. Loss of productivity among DES patients creates an overall annual cost of $55.4 billion in the United States [14].

Risk factors influencing DES have been reported in several surveys. Widely accepted risk factors for DES are gender, age, smoking, wearing contact lenses, and systemic disease [8–11]. With respect to sleep duration, a small group study revealed that sleep deprivation could cause reduced tear secretion, leading to the development of DES [16]. However, until recently, there have been few reliable population-based studies examining the association between sleep deprivation and DES symptoms.

According to a previous study, respondents with shorter sleep durations had more DES symptoms than those with normal sleep durations [17]. However, this survey focused only on the associations between eye surgery and DES risk. Thus, sleep duration assessed in the aforementioned study focused only on one covariate.

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Therefore, a complete comprehensive relationship between sleep duration and DES risk is yet to be addressed.

The aim of the present study was to assess the association between sleep duration and DES symptoms among adults aged 20 years or older in a population-based study from the fifth Korean National Health and Nutrition Examination Survey (KNHANES). We presumed that individuals with short and long sleep durations would be at increased risk for DES. In addition, we examined whether those relationships would be affected by age, gender, sociodemographic factors (educational level, occupation, household income, and residence), and health behaviors (smoking habit, alcohol consumption, and level of exercise).

2. Methods

2.1. Study population and data collection

This study was based on data from KNHANES V (2010–2012), a cross-sectional, nationally representative, population-based survey regarding health and nutritional status of Korean residents established by the Korea Centers for Disease Control and Prevention (KCDC) [18]. Subjects were chosen using systematic sampling with multistage clusters based on age group, geographical area, and gender recorded in household registries. Trained interviewers conducted surveys and administered questionnaires regarding socioeconomic characteristics, health-related behavior, and medical history. Examiners also carried out physical examinations, which included ophthalmologic assessments either at the subject's home or at a mobile examination center. At first, 25,534 individuals participated in the KNHANES V. We selected 15,878 subjects (6684 men and 9194 women) aged 20 years or older with no missing data on the physical examination, questionnaires, and other anthropometric variables.

2.2. Main variables

DES was diagnosed using a self-report questionnaire assessing DES symptoms. Asking about associated DES symptoms is among the most reliable diagnostic methods [6,19], especially since there is no absolute clinical diagnostic test for determining individuals with DES.

To assess DES symptom prevalence, subjects were asked the following question: "Until now, have you ever had symptoms of DES before: for example, a sense of irritation or dryness of the eye?" Possible answers were "yes" or "no."

Sleep duration was assessed with the following question: "How many hours of sleep, per day on average, do you get?" Answers were based on a numerical value. The international classification of sleep disorders notes that a "short sleeper" is an individual who sleeps less than five hours, and a "long sleeper" is one who sleeps more than nine hours [20]. We classified sleep duration into five categories: severe short sleep duration (≤4 hours), mild short sleep duration (five hours), optimal sleep duration (six to eight hours), mild long sleep duration (nine hours), and severe long sleep duration (≥10 hours).

Next, we defined sociodemographic variables (educational level, occupation, household income, and residence). Level of education was defined as follows: less than elementary school, middle school, high school, and more than university. Occupation was categorized as manual, nonmanual, and unemployed [21]. Participants considered to be manual workers included artisans, plant and machine operators, assemblers, elementary workers, clerks, sales and customer service workers, agriculture, fishery, and forestry workers. Participants designated as nonmanual workers included technicians and associated professionals, legislators, senior officials, managers, and other professionals. Household income level was calculated using standardized methods of classification based on gender and age group compared to standard income levels in Korea. Adjusted income numbers based on household size were used to categorize income in quartiles. Residence was classified as rural or urban based on Korean administrative units.

A self-administered questionnaire was used to investigate health behavior factors such as history of smoking, alcohol consumption, and level of exercise. Smoking habitation was divided into two groups: smoker and nonsmoker. A smoker was defined as having smoked more than 100 cigarettes, whereas a nonsmoker was defined as having smoked fewer than 100 cigarettes in their lifetime. The smoker category was separated into two groups according to quantity and duration of smoking history as pack-years. Alcohol consumption of at least seven glasses of alcohol two or more times per week for males and more than five glasses for females was considered as "heavy" alcohol consumption. "Moderate" alcohol consumption was drinking in the range between "none" and "heavy." Level of exercise was categorized from "none" to "low" to "high." "High" level of exercise meant at least 20 minutes of activity causing shortness of breath more than three days per week.

2.3. Statistical analysis

Data were analyzed using SAS version 9.3 (SAS Institute, Cary, NC, USA). The χ^2 test with weighted values were used to compare differences between baseline characteristics related to DES symptoms. Weighted percentages and 95% confidence intervals (CI) were calculated using the sampling clustering weight.

We also calculated odds ratios (OR) and 95% CI using three different logistic regression models to estimate the association between sleep duration and DES. A final logistic regression model was adjusted for age, gender, sociodemographic factors (education level, occupation, household income, and residence), and health behaviors (smoking habit, alcohol consumption, and exercise level). p Values of less than 0.05 for two-tailed tests were considered to be statistically significant.

2.4. Ethics statement

Written informed consent confirming voluntary participation was provided by the study participants. The identifying records of all participants were completely anonymized before the current analysis. The Institutional Review Board (IRB) of the Korea Centers for Disease Control and Prevention (KCDC) (IRB 2010-02CON-21-C; 2011-02CON-06-C; 2012-01EXP-01-2C) approved this protocol.

3. Results

There were 15,878 respondents in our study, comprising 6684 (49.08%) males and 9194 (50.92%) females (Table 1). A total of 3888 (14.35%) subjects were aged 65 years and older. Subjects based on sleep duration are as follows: severe short duration (≤4 hours) = 754 (3.86%), mild short duration (five hours) = 1768 (9.98%), mild long duration (nine hours) = 663 (4.05%), and severe long duration (≥10 hours) = 522 (3.44%).

The weighted prevalence of DES symptoms according subject characteristics is listed in Table 2. The prevalence of DES was 16.16% and was higher among women compared to men (11.54% vs. 22.43%; $p < 0.001$). Statistically higher DES prevalence emerged between the ages of 35 and 50 years, among rural residents, those who were unemployed, those who never smoked, and those with moderate alcohol consumption. Individuals with longer sleep duration tended to be less likely to have DES, based on comparisons from mild severe (nine hours) to severe (≥10 hours) durations. In contrast, sleepers with short duration tended to have a higher DES prevalence when