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Original Study

Sleep Duration and Excessive Daytime Sleepiness Are Associated With Incidence of Disability in Community-Dwelling Older Adults

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A B S T R A C T

Objective: Although sleep disturbances are associated with disability among older adults, no longitudinal study has examined the impact of sleep assessed based on both sleep quality and quantity on incident disability. This study examined whether sleep duration and excessive daytime sleepiness were associated with incidence of disability in community-dwelling older adults.

Methods: A total of 4756 older adults (53.3% women, mean age 71.9 years) met the entry criteria for this study. We measured monthly incident disability, defined as the onset of being certified for personal support or care as required by Japanese public long-term care insurance during the preceding 24 months. Sleep duration, excessive daytime sleepiness (EDS), and demographic factors were assessed at baseline. Cox's proportional hazard regression analysis estimated hazard ratios (HRs) and 95% confidence intervals (CIs) of incidence of disability according to the 3 categories of sleep duration (short: ≤6.0 hours, mid: 6.1 to 8.9 hours, long: ≥9.0 hours), and we used mid duration sleepers as the reference group.

Results: Long sleep duration (HR 1.43, 95% CI 1.04–1.97) and presence of EDS (HR 1.41, 95% CI 1.01–1.98) were associated with higher rates of incident disability. Furthermore, a combination of sleep duration and EDS was associated with a higher rate of incident disability than the mid and no EDS group (HR 2.25, 95% CI 1.36–3.70).

Conclusion: Long sleep duration and EDS affected the incident of disability; thus, older adults with both sleep patterns may require an intervention to alter their sleep habit.

Disability in older adults, which is a growing public health concern, is associated with poorer physical and mental health, greater use of medical care, and a higher rate of institutionalization.[1,2] Identifying risk factors for incident disability is therefore important for the development of preventive strategies.

Sleep disturbances are common among older adults, with more than half of community-dwelling older adults reporting chronic sleep complaints.[3] Sleep complaints have been associated with various adverse health outcomes, including disability in older adults.[4] Previous studies have identified insulin resistance,[5] autonomic nervous system dysregulation,[5,6] metabolic derangement,[7] and inflammation[8] as potential mediators between sleep disturbances and incident disability. Only one longitudinal study has examined the association between sleep complaints and incident disability among older adults.[4] Change in sleep duration with aging is common, and a longitudinal study has revealed that long sleepers tend to have relatively poorer sleep quality.[9] However, the association between sleep duration and incident disability has not yet been fully elucidated.

In contrast, many studies have investigated excessive daytime sleepiness (EDS) in older adults. EDS is one of the most common sleep disturbances, and presents in 15% to 30% of community-dwelling older adults.[10–12] EDS is associated with several adverse health outcomes, including psychiatric disorders,[13] falls,[14] and cognitive deficits.[15,16] Although a few cross-sectional studies have shown an association between disability and sleep complaints, such as difficulty falling asleep or awakening during the night or early morning,[4,17] the impact

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of EDS on the risk of disability is not well understood. Thus, additional evidence is needed to reveal these associations.

No longitudinal study has examined the impact of both sleep quality and quantity on incident disability. In the current study, we examined whether EDS, sleep duration, and their combination affect subsequent incident disability in community-dwelling older adults. We hypothesized that those who have both long sleep durations and EDS would reflect the worsened sleep conditions and show more risk of disability than those with either EDS or long sleep durations only.

Materials and Methods

Setting and Participants

The Obu Study of Health Promotion for the Elderly (OSHPE) is an observational study designed to investigate physical and cognitive function among the elderly population. The study enrolled 5104 community-dwelling older adults. Participants were recruited from Obu, Japan, which is a residential suburb of Nagoya. Inclusion criteria required that participants were aged 65 years or older at examination in 2011 or 2012, lived in Obu, and had not participated in another study in the past. After the baseline assessment, monthly information on participants' health status, including incident disability as assessed by the Japanese public long-term care insurance (LTCI) system, death, or relocation from Obu was obtained from the Obu city office. A total of 348 participants were excluded based on the following criteria: (1) missing values at baseline assessment; (2) a history of Parkinson disease, Alzheimer disease, or depression; (3) severe cognitive impairment as indicated by Mini Mental State Examination (MMSE) scores <18[18]; and (4) already certified by LTCI at any level during the baseline assessment. The final analysis sample consisted of 4755 participants. Informed consent was obtained from all participants before their inclusion in the study, and the Ethics Committee of the National Center for Gerontology and Geriatrics approved the study protocol.

Measures

Certification of need for care in the LTCI system

The nationally uniform criteria for long-term care need certification was objectively established by the Japanese government, and certification of need with respect to levels of care for older adults is determined based on evaluation results by the Certification Committee for Long-Term Care Need in municipalities in accordance with these basic guidelines. The process of eligibility for certification of need for care in the LTCI system is as follows: (1) an elderly person or caregiver contacts the municipal government to request official certification of the care needs of the applicant; (2) a trained local government official then visits the home to evaluate nursing care needs based on current physical and mental status; (3) after completion of the assessment, the results are entered into a computer to calculate the standardized scores on physical and mental status, estimate the time required for the care of the individual (grooming, bathing, eating, toileting, transferring, assistance with instrumental activities of daily living [IADLs], behavioral problems, and rehabilitation and medical services), and assign a care-need level based on the total estimated care time; (4) the care needs certification board reviews the data, which include a report from the primary physician of the applicant; and (5) finally, the applicant is assigned to the level of care required (certified support-level ranging from 1–2 or care-level ranging from 1–5). Every 6 months, the eligibility of the individual receiving care via the LTCI system is reevaluated. In the present study, incident disability was defined as the onset of certification at support-level 1–2 or care-level 1–5.

Assessment of sleep habits

At baseline assessment, participants were asked about usual sleep and wake times, and the answers were used to calculate sleep durations. EDS was assessed using the question "How often do you have daytime sleepiness requiring a nap?" with the following options: "almost always," "sometimes," and "rarely or never." EDS was deemed to be present when it was reported to occur "almost always."

Other measurements

Sociodemographic variables including sex, age, and education level (years) were collected along with medical history, weight (kg), and height (m). Body mass index (BMI) was derived as weight in kilograms divided by the square of height in meters. Participants were asked about medical diagnoses and medications via face-to-face interviews. Depressive symptoms were measured with the Geriatric Depression Scale[19] (range 0–15), with higher scores indicating more depressive symptoms. The Geriatric Depression Scale includes 15 items, and participants whose total score was ≥ 6 were defined as having depressive symptoms. Global cognitive function was measured using the MMSE. Physical activity was assessed by the total amount of time spent walking on an average day. For smoking and alcohol drinking status, participants were categorized as current, past, or never smokers or alcohol drinkers, respectively.

Statistical Analysis

All analyses were performed using SPSS 21.0 J for Windows (SPSS Japan Inc., Tokyo, Japan). Participants were divided into 3 groups according to sleep duration (short: $\leq$6.0 hours, mid: 6.1 to 8.9 hours, long: $\geq$9.0 hours)[20–22] and categorized with respect to presence or absence of EDS. Furthermore, we also divided participants according to the combination of sleep duration and EDS as follows: (1) short sleep duration and absence of EDS (short and no EDS); (2) short sleep duration and presence of EDS (short and EDS); (3) mid sleep duration and absence of EDS (mid and no EDS, control); (4) mid sleep duration and presence of EDS (mid and EDS); (5) long sleep duration and absence of EDS (long and no EDS); and (6) long sleep duration and presence of EDS (long and EDS). Continuous data are presented as means $\pm$ SDs. Characteristics were summarized as means $\pm$ SDs for continuous variables and as counts and percentages for categorical variables. Comparisons were performed using analysis of variance and Pearson χ^2 test for categorical data. Kaplan-Meier survival analysis for the incidence of disability was performed to compare sleep duration or presence of EDS. Furthermore, univariate and multivariate Cox proportional hazard regression models were conducted to assess hazard ratios (HR) with 95% confidence intervals (CI) for the risk of incident disability. In multivariate analysis, potential confounders included age, sex, BMI, education level, number of medications, MMSE score, chronic disease, depressive symptoms, smoking habits, alcohol consumption, and physical activity. The significance level was set at $P < .05$ for all tests.

Results

The number (%) of participants in each age range exhibiting short sleep duration was as follows: 65–69 years: 232 (12.1%), 70–74 years: 156 (10.5%), 75–79 years: 79 (5.1%), 80–84 years: 19 (5.1%), 85 years or older: 4 (3.0%), total: 490 (10.3%). The number (%) of participants in each age range exhibiting long sleep duration was as follows: 65–69 years: 212 (11.1%), 70–74 years: 252 (17.0%), 75–79 years: 206 (24.1%), 80–84 years: 128 (34.0%), 85 years or older: 55 (41.7%), total: 853 (17.9%). Further, the prevalence of EDS tended to increase with participant age: 65–69 years: 218 (11.4%), 70–74 years: 205 (13.9%), 75–79 years: 167 (19.6%), 80–84 years: 66 (17.6%), 85 years or older: 33 (25.0%), total: 689 (14.5%) (P for trend $< .01$). Descriptions of the