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ORIGINAL ARTICLE

Association between obesity and self-reported sleep duration variability, sleep timing, and age in the Japanese population

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KEYWORDS

Bedtime;
Body mass index;
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Sleep;
Sleep variability

Summary

Objective: The objective of this study was to investigate the association between obesity and sleep habits, including bedtime, wake-up time, and sleep duration variability over a week.

Methods: We analyzed 9289 participants in this study. Following a health examination, each participant self-reported their sleep habits using a standardized 19-item questionnaire. High sleep duration variability was defined as sleep varying ≥ 3 h of the difference between the longest and shortest sleep durations reported over a week-long period. Late bedtime and early wake-up time were defined as 24:00 h or later, and before 6:00 h, respectively. Obesity was defined as a body mass index (BMI) of ≥ 25 kg/m². Subgroup analysis included age (younger group defined as age <65 years vs. elderly group defined as age ≥ 65 years).

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Results: After adjusting for confounding factors and sleep duration, high sleep duration variability [odds ratio (OR), 1.20; $p < 0.005$] was significantly associated with a high OR of obesity. Late bedtime (OR, 1.18; $p < 0.01$) was significantly associated with a high OR of obesity, whereas early wake-up was not. In the subgroup analysis, high sleep duration variability had a significant association with the younger group (OR, 1.25; $p < 0.001$), whereas late bedtime had a significant association with the elderly group (OR, 1.36; $p < 0.005$).

Conclusions: Inappropriate sleep habits, particularly high sleep duration variability in young individuals and late bedtime in the elderly, are associated with a high prevalence of obesity, independently of sleep duration.

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Introduction

Disorders of sleep, an essential component of lifestyle, may be involved in the development of obesity [1]. A large number of studies have investigated the association between mean sleep duration and body mass index (BMI) or the prevalence of obesity [2–4], because the number of sleeping hours represents the most basic element of sleep. However, sleep duration commonly shows daily variations and is usually influenced by the timing of sleep, including bedtime and wake up time. Over recent years, increasing evidence has indicated that both sleep duration variability [5,6] and a mismatch between internal circadian rhythms and behavioural patterns including sleep–wake cycle (i.e., circadian misalignment) [7–10], are associated with impaired cardiometabolic function, which can lead to the development of obesity. Because the sleep–wake cycle during daily life is determined primarily by bedtime and wake up time, the timing of sleep may be associated with the prevalence of obesity. Moreover, high sleep duration variability is usually accompanied with repetitive short sleep and adaptive elongation of sleep on the next day or over the following weekend. Experimental studies have reported that short sleep may have adverse effects, whereas elongated sleep may have beneficial effects on glucose metabolism and appetite [11–14]. Previous observational studies have reported that high variability of sleep is association with an increased risk for obesity in Western populations [15,16]. However, age-related differences are not thoroughly understood, and there is even less evidence in Asian populations, who have different thresholds for obesity than Western populations [17]. Numerous

studies have reported a significant association of sleep timing with obesity in children or younger people [18,19]; however, there is a lack of evidence for the potential effects of sleep timing on obesity in elderly people. Thus, the objective of this study was to describe the association of sleep variability, sleep timing and obesity in younger and elderly populations.

This study investigated whether self-reported sleep duration variability over a week and sleep timing including bedtime and wake-up time were associated with obesity independently of sleep duration in a large-scale Japanese population who had no shift work, considering age-related differences. We excluded participants who were receiving treatment for cancer or had a past history of cardiovascular diseases, psychiatric disorders (excluding insomnia), or neurological diseases based on medical history and medication records because these comorbidities can strongly influence sleep habits [20].

Methods

Study participants and design

In November 2014, we commenced the Hiroshima Sleep and Healthcare study (HIRSH study) [21,22], an observational study that addressed the association of sleep habits with lifestyle-related diseases. Potential participants were recruited after undergoing health examinations at the Health Management and Promotion Center of the Hiroshima Atomic Bomb Casualty Council or cooperating facil-

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