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All That Glitters Is Not Gold: The Same Sleep Time, but Different Diabetogenic Outcomes

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Every day, we sleep. The sleep-wake cycle is a key structure of biological clocks (called circadian rhythms), which control many aspects of physiological function on a 24-hour cycle [1]. Sleep plays a crucial role in maintaining an individual's overall health and well-being. During sleep, the body undergoes various biological processes, such as physical recovery, damage repair, consolidation of memories, and restoration of the immune system. Adequate sleep reduces inflammation and oxidative stress. After waking up, we can ingest, digest, absorb, and utilize nutrients, combined with the activation of the sympathetic nervous system and an increased metabolic rate. These changes in circadian rhythm and the metabolic balance are intimately intertwined [2].

The amount of time people spend sleeping in modern civilization has, however, progressively decreased after the development of electricity and artificial lights [3]. Trends in sleep duration have also been studied in Korean adults: according to the Korea National Health and Nutrition Examination Survey (KNHANES), sleep duration has significantly decreased in young and middle-aged Korean adults from 2007 to 2015 [4]. Numerous studies have found evidence that changes in sleep patterns may be a reason for the rise in metabolic disorders throughout the same time period [1]. A monumental systematic review and meta-analysis of prospective cohort studies [5] analyzed the relationship between sleep disturbances (in quantity and quality) and the development of type 2 diabetes mellitus (T2DM). The relative risk of T2DM was 1.28 (95% confidence interval [CI], 1.03 to 1.60) for a short duration of sleep (≤5 to 6 hours/night) and 1.48 (95% CI, 1.13 to 1.96) for a long duration of sleep (>8 to 9 hours/night). Experimental studies in healthy human subjects involving sleep restriction have also shown that sleep disruptions, including sleep restriction and fragmentation, decrease insulin sensitivity [6], which is a risk factor for diabetes. Even after the onset of diabetes, patients with diabetes who slept around 7 hours each night had the lowest hemoglobin A1c levels [7,8].

However, the U-shaped correlation between sleep quantity and the risk of T2DM has been derived from studies that mainly focused on Western populations. Considering that the effect of sleep insufficiency on T2DM risk can vary among ethnicities, this issue needs to be evaluated more in Asian populations. However, previous Asian studies were based on a relatively short follow-up period and a small number of subjects. In the current issue of *Endocrinology and Metabolism*, Lee et al. [9] published a study investigating the effect of sleep duration on the risk of T2DM incidence according to sex, age, and body mass index (BMI). Unlike previous Asian studies, this report utilized a prospective Korean cohort with a much longer follow-

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up period (16 years) and included all biomedical diagnostic criteria for diabetes. The authors confirmed sleep deprivation (≤5 hours/night) as a risk factor for T2DM. Interestingly, in a subgroup analysis, this risk was confined to male, younger (<60 years), or the non-obese (BMI <25 kg/m^2) population. Although this paper did not provide direct clues why these subgroups are more vulnerable, preventing sleep deprivation can be a simple starting point for preventing diabetes in non-obese individuals, who may be relatively unlikely to pay attention to diabetes risk.

Moreover, the authors made an intriguing claim that prolonged sleep duration (>7 hours/night) raised T2DM risk in obese people. Although this result was not replicated in the sensitivity analysis using persistent habitual sleep length, and the study design was suboptimal for determining causality, the authors offered several possible explanations. One that stands out is that excessive sleep time may be linked to a number of harmful conditions that were omitted from the covariates of this study. This explanation implies that in the clinical setting, it may be insufficient to simply check whether an obese person without diabetes is sleeping enough. Instead, it seems crucial to ask about sleep quality and check for any pathological conditions related to poor sleep quality.

This study is interesting and meaningful, but some questions remain. In this study, the mean sleep duration of all participants included was not disclosed, but according to another recent study, the average self-reported sleep duration in Korea was 6.76 hours per day as of 2013 to 2015 [4]. How would modifying the reference interval according to that sleep duration (for example, 5.5 to 7.5 hours/night, closer to 6.76) change the results of the analysis? In the Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society, adults are recommended to sleep >7 hours/night to promote optimal health [10]. However, more regional and population-specific studies are required to determine the association between sleep duration and diabetes since the average sleep time and circadian patterns are influenced by the latitude and environment of each country [11]. Secondly, as the authors already mentioned, sleep habits (sleep duration, sleep apnea, and the presence of snoring) were assessed by questionnaires in this study. However, sleep habits can now be assessed in a more objective and quantitative manner by using wearable devices (e.g., actigraphy), even in cohort studies [12]. Future advances are anticipated with the aid of these technologies, not only in the field of customized healthcare but also in the study of sleep disorders and metabolic disorders in the general population. Finally, given that the menstrual cycle and menopause can affect sleep [13], a subgroup analysis according to menopausal status might be helpful to delineate correlations that would otherwise be hidden.

In conclusion, this study implies that the same sleep duration does not always produce the same metabolic results for everyone. In this era of personalized healthcare, further discussions on sleep management tailored to individual characteristics need to be made on the basis of well-structured diverse studies.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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