SLEEP, 2024, 47, 1–3
https://doi.org/10.1093/sleep/zsae159
Advance access publication 12 July 2024
Editorial

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Decoding the weekend sleep dilemma: the health impacts of catching up on sleep

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Getting *sufficient* and *regular* sleep is ideal, yet this is rarely achieved in today's modern life. According to a 2020 national survey of over 390 000 Americans, approximately one-third of adults sleep <7 hours per night [1]. Individuals deprived of sleep on weekdays–workdays are faced with a dilemma on the weekends–non-workdays: should they catch up on sleep (i.e. prioritize sleep duration) or continue to maintain the same sleep schedule during the workdays (i.e. prioritize sleep regularity)?

The National Sleep Foundation's recent consensus statement recommends up to 1–2 hours of weekend catch-up sleep and/or naps to help offset potential sleep debt accumulated during the weekdays [2]. This guideline considers both the positive effects of additional sleep and the negative impacts of irregular sleep and/or rhythm patterns in young [3–5] and older adults [6, 7]. However, an optimal solution for the dilemma is still lacking, calling for a direct comparison of the benefits and costs of weekend catch-up sleep.

In the current issue of *SLEEP*, a new study by Chaput et al. [8] offers insights into this research question in the context of cardiovascular health and mortality. Strengths of this study include the use of objectively measured sleep and a longitudinal study design. They analyzed actigraphy data from 73 513 UK Biobank participants and defined weekend catch-up sleep as the amount of additional sleep on weekends compared to weekdays. The outcome measures were all-cause mortality and cardiovascular disease (CVD) incidence over a follow-up period of 8 years (SD = 0.9 years). They found that weekend catch-up sleep was not associated with all-cause mortality or CVD incidence, after adjusting for demographics, physical activity, diet, alcohol consumption, smoking, medical history, shiftwork history, and chronotype.

These results are intriguing when compared with previous cross-sectional studies that consistently reported potential benefits of weekend catch-up sleep, showing its associations with better mental and physical health outcomes, such as lower incidence of depression [9, 10], lower body mass index [11], reduced metabolic syndrome [12], and decreased systemic inflammation [13]. A possible explanation for the findings from Chaput et al.'s study is that the benefits of catch-up sleep were counterbalanced by the costs of increased sleep irregularity across weekdays and weekends. However, sleep regularity was not measured in this study, making it difficult to directly address this possibility. Weekdays–weekends sleep regularity, nevertheless, should be given attention in future research on catch-up/recovery sleep.

While Chaput et al. [8] found a lack of overall beneficial or detrimental health effects of weekend catch-up sleep, further investigations into the effect modifiers are also warranted. Whether or not sleep debt occurred during weekdays may be one of these factors. The impact of weekend catch-up sleep may also vary based on the amount of sleep recuperated. These possibilities are supported by studies observing the interaction effects of weekend catch-up sleep and weekday sleep durations on CVD and other health outcomes [13]. For example, Zhu et al. analyzed cross-sectional data from 3400 adults in the United States and found that weekend catch-up sleep was associated with a lower prevalence of CVD, but only among those who slept <6 hours during weekdays [14]. However, this finding was not replicated in Chaput et al.'s study, where sensitivity analyses of weekday short sleepers (<6 hours/day) revealed no overall benefits or costs at any amount of recuperated sleep on weekends (0–1, 1–2, or >2 hours) on all-cause mortality or CVD [8]. In a previous study, sleep duration of ≤5 hours was related to all-cause mortality in the same actigraphy subpopulation of the UK Biobank [15]. This implies that Chaput et al.'s study may benefit from establishing the relationship between device-measured sleep duration and mortality or CVD prior to their investigation on weekday–weekend sleep duration differences. Such a practice may help identify an appropriate cutoff value for their sensitivity analysis strategy.

Additional factors that might modify the effects of catch-up sleep, such as sleep disorders, habitual sleep quality, and sleep regularity, should be investigated in future research. For example, could the associations between weekend catch-up sleep and health outcomes differ among individuals at varied risk levels? Concerns have been raised about the representativeness of the UK Biobank

due to a "healthy volunteer" selection bias [16]. Moreover, Chaput et al. did not undertake additional stratified analyses based on potential risk factors, such as age, biological sex, and status/history of shift work. This limitation may hinder the interpretation and generalizability of the results to populations with greater risk. Another limitation concerns the composition of the control group. In their main analysis, the control group included individuals who slept more than an hour longer on weekdays compared to weekends. This raises concerns about potential confounding effects related to weekend sleep debt. This limitation was partially addressed by their sensitivity analysis, in which Chaput et al. refined the control group to include only participants who slept no more than 30 minutes longer on weekdays than on weekends. They found that weekend catch-up sleep between 0 and 2 hours was not associated with mortality, whereas catch-up sleep ≥2 hours was associated with increased all-cause mortality [8]. These results further imply a dose–response relationship between catch-up sleep amount and health outcomes [9, 13].

Besides the amount of catch-up sleep, timing could also be considered. Though the eFigure 1 in Chaput et al.'s article illustrates the distribution of sleep onset and offset times, it would be more informative to generate these depictions separately for weekdays and weekends. Additionally, it would be more beneficial to focus on the differences in sleep onset–offset times between weekdays and weekends for individual participants. The rationale is that catch-up sleep during weekends that falls outside an individual's habitual sleep window may differ from that within the habitual sleep window in the context of sleep regularity, circadian rhythm, and health benefits. Additionally, different approaches to catching up on sleep, such as going to bed earlier, waking up later, or napping during the day, might have different circadian and health implications. For instance, delaying wake-up time can reduce the duration of morning light exposure, delay the circadian phase [17], and increase the likelihood of skipping breakfast [18], all associated with negative health outcomes. Napping is associated with adverse health outcomes, particularly in older adults [19]. In addition, our recent study indicates that naps at different times of day are differentially related to neurocognitive health [20].

Overall, the null results from Chaput et al. could suggest that catch-up sleep offers no benefits. As the first study with a large cohort sample size, objectively measured sleep, and longitudinal assessment of outcomes, this work prompts further exploration into the tradeoff between benefits and costs of weekend catch-up sleep, especially in terms of optimal duration and timing of catch-up sleep that best promotes health. Nevertheless, these findings still warrant independent external replications. Implementing and interpreting the current sleep scoring based on actigraphy also requires extreme caution [21]. Ideally, future research should utilize more accurate sleep assessments, such as polysomnography. Individual differences in demographics, sleep history, and lifestyles should be considered to inform personalized approaches to catch-up sleep. Moving forward, experimental studies could help establish the causal effects for individuals with different demographic and health backgrounds, informing more precise and practical sleep guidelines for the public.

Funding

This work is supported by a start-up fund from the Department of Anesthesia, Critical Care, and Pain Medicine at Massachusetts General Hospital (to PL). Additionally, CG is supported by the Alzheimer's Association (AARFD-22-928372), LG is supported by the Alzheimer's Association (AACSF-23-1148490), the National Institute on Aging (R03AG087439), and Patient-Centered Outcomes Research Institute (DE-2023C1-31327), KH is supported by the National Institute on Aging (R01AG083799).

Disclosure Statements

Financial disclosure: Dr. Li has received a monetary gift to support research from iFutureLab. The other authors have indicated no financial conflicts of interest. *Nonfinancial disclosure:* None.

Data Availability

Data sharing is not applicable to this editorial as no new data were created or analyzed.

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