A Long Winter's Sleep: What Does Consumer Sleep Technology Data Tell Us?

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Introduction

- Light is the most powerful zeitgeber influencing sleep-wake patterns, and winter's shorter days have profound effects on mood, energy, and metabolic function
- Here, we leverage big data from consumer sleep technology to examine the relationship between objectively measured sleep in winter versus summer months in the United States.

Materials & Methods

Data

- The dataset included 21,101 users residing in the US across 1,255,518 nights (age range: 17-90, mean age: 46.6 ± 16.7 years, 59% female. Objectively measured sleep data were captured using the PSG-validated[1] SleepScore mobile application.
- Data were extracted from 01 January 2019 until 31 August 2022. Seasons were defined according to the Northern Hemisphere's meteorological calendar and included winter (December - February) and summer (June - August)

Analysis

- Descriptive statistics and linear regressions were used for the analysis, controlling for age and gender.

Conclusion

- Bedtime and wake time delays were greater in summer than winter, likely contributing to small improvements to sleep quality, duration, and efficiency in winter compared to summer.
- These findings are generally supported by previous research examining sleep-wake patterns in locations with extreme seasonal differences, such as Northern Norway, where, despite midnight sun and polar nights, researchers have found little variation in sleep-wake timing.

Results

Measure	Value
N	21,101
Female %	59
Age	46.6 +/- (7.7)
Nights recorded	1,255,518
Bed Time	23.33 +/- (1.67)
Wake Time	7.14 +/- (1.73)
Total Sleep Time	357 .21 +/- (78.91)
SleepScore	78.27 +/- (13.51)
Sleep Efficiency	77.2 +/- (10.99)
Sleep Onset Latency	21.58 +/- (22.43)

Table 1. Demographic and average sleep characteristics

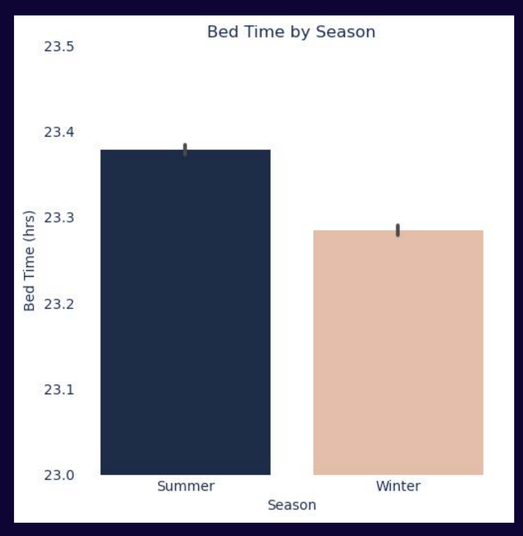

Figure 1. Linear regression showed a shift to earlier bedtimes in winter (β = -0.12, SE = 0.005, p<0.001).

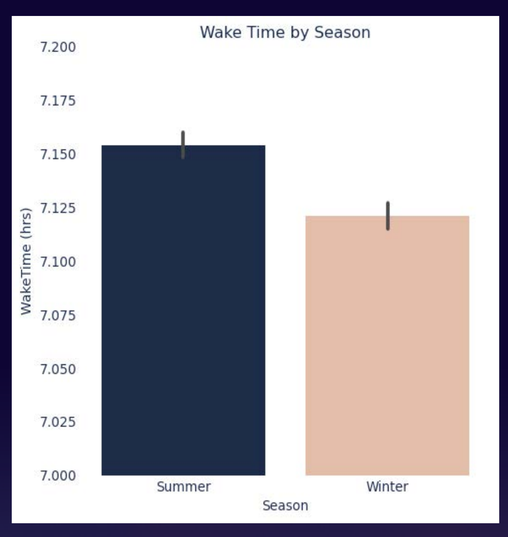

Figure 2. Linear regression showed a shift to earlier waketimes in winter(ß = -0.08, SE = 0.005, p<0.01). The shift in wake times was less than that of Bed Times.

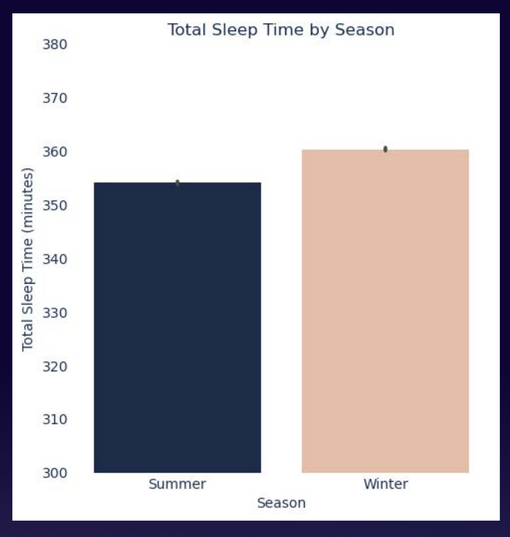

Figure 3. Linear regression showed an increase in Total Sleep Times in winter months(ß = 5.33, SE = 0.23, p<0.001).

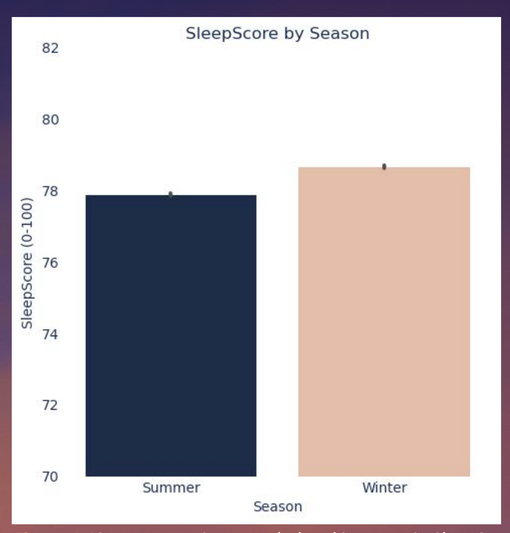

Figure 4. Linear regression revealed and increase in SleepScore during winter months (ß = 0.7 SE = 0.04, p<0.001).

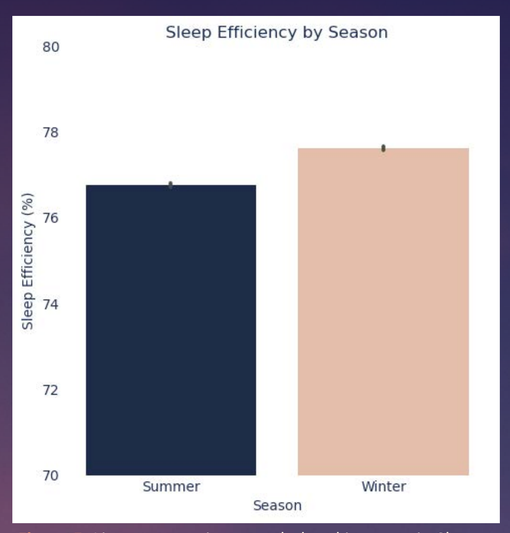

Figure 5. Linear regression revealed and increase in Sleep Efficiency during winter months (ß = 0.86 SE = 0.03, p<0.001).

References

[1] Zaffaroni, A., Coffey, S., Dodd, S., Kilroy, H., Lyon, G., O'Rourke, D., ... & Penzel, T. (2019, July). Sleep staging monitoring based on sonar smartphone technology. In 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 2230-2233). IEEE.