Seasonality of Human Sleep: PSG in Urban Neuropsychiatric Patients

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Background: Photoperiodic responsiveness in humans has been shown in controlled, experimental studies, but effects were much less pronounced or not demonstrable under habitual, urban light conditions. Seasonal changes in human sleep are thought to be suppressed by abundant artificial light sources. Recently, we reported significant variations in human sleep architecture over one year. The present study aimed to replicate these results and to explore possible underlying mechanisms.
Methods: PSG data were obtained from 372 neuro/psychiatric patients [49±17yrs, 54% female, without psychotropic medication] visiting our sleep-laboratory November-2017 till Feburary-2020. Scheduling of the patients' sleep was adjusted to their usual routine, including timing, but alarm clocks were not allowed. For analysis, linear mixed-effect model was applied. For visualization, a 90-day moving-average was used. Same-day outside mean temperature, sunlight duration, and photoperiod were correlated with raw sleep parameters.
Results: Significant results for effect-of-month: TST (Total Sleep Time, $F_{11,360}$=2.54,p=.004), REM-sleep ($F_{11,360}$=2.94,p=.001), SWS (Slow Wave Sleep, $F_{11,360}$=3.10,p=.001). Post-hoc showed strong significant differences: TST ~50min (t_{71}=3.46,p<.001,d=0.81) and REM-sleep ~25min (t_{71}=3.63,p<.001,d=0.85) higher in December than June; SWS ~32min (t_{63}=4.00,p<.001,d=1.04) lower in September than February. Moving-averages showed maximum peak/nadir differences (Δ): $\Delta TST_{2018/2019}$=61/63min; $\Delta REM_{2018/2019}$=25/25min; $\Delta SWS_{2018/2019}$=24/30min. Similar TST and REM-sleep patterns between years: parallel decline starting mid-April-2018 and mid-February-2019 reached nadirs around late-August-2018 and early-June-2019. SWS courses were strikingly similar between years, continuously decreasing from mid-March till late-September, afterward rising again. Significant correlations between sleep parameters and outside factors were negative (TST/Temperature:rs_{370}=-0.19,p<.001; REM/Temperature:rs_{370}=-0.18,p<.001; SWS/Temperature:rs_{370}=-0.16,p=.001; TST/Photoperiod:rs_{370}=-0.20,p<.001; REM/Photoperiod:rs_{370}=-0.22,p<.001; TST/Sunshine:rs_{370}=-0.13,p=.005).
Conclusions: Previously reported patterns of prolonged TST/REM-sleep in winter and shorter SWS in autumn were replicated by the present data. Recommendations could be made for sleep-disturbed patients to consider seasonal adjustments to sleep habits. Findings still need to be confirmed in a healthy population. Nevertheless, the magnitude of variation in sleep architecture throughout the years, even in an urban population, is impressive. Observed variation between years might be explained by weather factors. TST/REM-sleep shift between years mirrors mean temperatures <0°C being recorded in Berlin until mid-March in 2018 and early-February in 2019. SWS might be independent of weather factors but switches between incline and decline coincide with photoperiod length passing a 12h threshold.