

Development of a mobile application (App) to delineate “digital chronotype” and the effects of delayed chronotype by bedtime smartphone use

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Objective: The widespread use and deep reach of smartphones motivate the use of mobile applications to continuously monitor the relationship between circadian system, individual sleep patterns, and environmental effects.

Methods: We selected sixty-one healthy adult participants (47 men, mean age: 26.7±9.4) with 14-day data from the “Know Addiction” database. We developed an algorithm to identify the “sleep time” based on the smartphone behaviors. The total daily smartphone use duration and the last three pre-sleep episodes were identified respectively. We applied product method for mediation analysis to investigate the mechanism of total daily smartphone use on sleep through pre-sleep use.

Results: Both total daily duration (5.73±3.42 hours) and the last three pre-sleep episodes duration (PS1~3: 49.1±58.2 minutes) of smartphone use significantly delayed sleep onset, midpoint of sleep and reduced total sleep time. One hour of increased smartphone use daily, delays the circadian rhythm (midpoint of sleep) by 3.5 minutes, and reduced 5.5 minutes of total sleep time (TST). One hour of increased pre-sleep smartphone use delayed circadian rhythm by 1.7 minutes, and reduced 39 second of TST. The mediation effects of PS1~3 also significantly impacted on these three sleep indicators. PS1~3 accounted for 14.3% of total daily duration, but the proportion mediated of delayed circadian rhythm amplified to 44.0%.

Conclusion: We presented “digital chronotype” with an automatic system that can collect high temporal resolution data from naturalistic settings with high ecological validity. Smartphone screen time, mainly mediated by pre-sleep use, delayed the circadian rhythm and reduced the total sleep time.

中文題目：開發全自動化計算睡眠作息的手機程式：探討睡前使用手機對睡眠造成的影響

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