TIMO PARTONEN

SLEEP REGULARITY IS A MAJOR KEY, SOCIAL JETLAG A MINOR, TO MENTAL WELLBEING

KEYWORDS: CIRCADIAN RHYTHM, DIETARY INTAKE, MENTAL HEALTH, PHYSICAL ACTIVITY

Human behaviour is characterized by timing and regularity of activities. On the one hand, chronotype indicates the local clock time which coincides with the midpoint of the longest (usually night-time) sleep period of the day, so that the later it is, the more evening type of person the individual is. On the other hand, diurnal (only seldom nocturnal) preference indicates the most convenient schedule for time usage. Usually, people tend to time their daily activities following local time indicated by clocks. Individuals who prefer being more active in the morning hours lie on the one end of this dimension, whereas on the other end of this dimension are those who prefer being more active in the evening hours.

Thinking beyond the phenotype seen by the naked eye may deepen our understanding of the mechanisms of action which contribute to the diurnal preference or chronotype we have. It might open, if not an avenue, but a view on the actions by which mental health can be promoted. Chronotype is deduced from the timing of the longest sleep period, whereas the diurnal preference estimates the daily rhythm of feeling at one's best from schedules for sleep, dietary intake, physical activity and cognitive exercise. Further, circadian misalignment, also known as social jetlag, is characterized by great differences in bedtimes and wake-up times from weekdays to days off and back again, as the longest sleep period is mistimed relative to the phase of the circadian rhythms. However, chronotype, circadian misalignment and diurnal preference reflect the same physiological basis of human behaviour, that is the intrinsic clock (i.e. the circadian pacemaker) which consists of the suprachiasmatic nucleus in the anterior hypothalamus and generates and maintains the circadian rhythms.

Dysfunction of the intrinsic clock is tightly linked to sleep disturbances as well as depressive episodes. To elucidate the causal contribution of diurnal preference on mood and general wellbeing, a Mendelian randomization study quantified and tested the hypothesis that the more misaligned the physiological circadian rhythms are, relative to the physical light-dark transitions and subsequently the behavioural sleep-wakefulness cycle, the poorer mental health status the individual has (1). A higher genetic liability of earlier diurnal preference (morningness) was associated with lower odds of depressive symptoms. Another Mendelian randomization study corroborated this by showing that earlier diurnal preference (morningness) was associated with lower odds of major depressive disorder (2). Behavioural factors may thus influence the link from the chronotype or diurnal preference to the emergence of sleep disturbances and depressive episodes. Individuals can, however, counteract this with their choices for activities and so shape their schedules. The timing of sleep, dietary intake and physical activity altogether makes a difference here.

SCHEDULES

Within the 24 hours of the day, there is a time window for long enough sleep. When, due to any reason, sleep must be scheduled for during the day due to night shift work, it is never longer than 6 hours in duration on average, and when initiated between 1 p.m. and 7 p.m., it is not longer than 4 hours in duration on average (3). As a positive contrast, it is highly probable that sleep will be 8 hours or longer in duration on average if a person falls asleep within the time window of 9 p.m. to 1 a.m.

One calorie ingested at 8 a.m. is not equal to one calorie ingested at 8 p.m., if judged by its metabolic ramifications. After poor sleep, hunger will be more intensive than usual toward the evening hours, coinciding with a decline in resting energy expenditure and macronutrient metabolism. This may lead to metabolic jetlag and eating late, with less than 25% of calories being consumed before noon, more than 35% after 6

p.m., and the duration for dietary intake exceeding 14 hours from the first to the last bite of the day (4). However, when overweight individuals ate within a self-selected time window of 10 to 12 hours, e.g. from 7 a.m. to 6 p.m., each day for 16 weeks, they reduced body weight, reported being energetic and having improved sleep. These benefits may persist for a year.

Phases of the circadian rhythms are timed by the intrinsic clock, but subject to influence of physical activity. In response to physical exercise of moderate intensity, the circadian rhythms will shift their phase by advances with physical exercise for one hour started at 7 a.m. or from 1 p.m. to 4 p.m., but by delays during the remaining hours of the day (5). The early afternoon hours are recommended for the elderly, less physically active individuals, and those with cardiovascular diseases.

OUTCOMES

The timing of the longest sleep period of the day impacts health status (6). The more of an evening type a person is at baseline, the more often there will be sedentary lifestyle, unhealthy dietary intake, longer screen time, alcohol use disorders, cannabis use disorders, insomnia, anxiety disorders, depressive disorders, cardiovascular diseases and premature deaths during the follow-up. Usage of the summertime arrangements, as governed by Directive 2000/84/EC, will trigger the shift toward more evening-oriented activities each year for seven months and thereby gradually make them the most common.

The circadian misalignment across days of the week impacts health status (7). The greater social jetlag a person has, the more often there will weight gain and adverse changes in levels of blood glucose and lipids during the follow-up. There are, however, effective countermeasures which deliver benefits within three weeks if the timing of night sleep, dietary intake and physical activity are in sync and aligned logically with the hands of the intrinsic clock (8). In a nutshell, these countermeasures are listed in *Table 1*. The benefits from them include reduced sleepiness in the morning, reduced stress, elevated mood, and improved cognitive and physical performance.

Table 1. Instructions for countermeasures against circadian misalignment.

Intervention	Instructions given
Wake-up time	Try and wake up 2-3 hours before the habitual wake-up time.
	Maximize daylight exposure during the mornings. If there is not enough daylight, use artificial bright light exposure.
Bedtime	Try and go to sleep 2-3 hours before the habitual bedtime.
	Minimize light exposure during the evenings.
	Do not take a mobile phone in the bedroom.
Sleep regularity	Try and keep the wake-up and bedtimes as fixed as possible between weekdays and days off.
Dietary intake	Keep a regular schedule for daily meals.
	Have breakfast as soon after wake-up as possible.
	Eat lunch at the same time every day.
	Do not have dinner after 7 p.m.
Caffeine	Do not drink any caffeine after 3 p.m.
Physical activity	If you do exercise, exercise in the morning or early afternoon.
Naps	Do not nap. If you take a nap, do not nap after 4 p.m. nor longer than for 20 minutes.

The regularity of the longest sleep period of the day impacts health status (9). The more regular sleep-wake cycle a person has at baseline, the less often there will be relapses in heavy alcohol use, insomnia, depressive symptoms, metabolic syndrome, cardiovascular diseases, sleep apnoea and premature death during the follow-up. Further, the more regular sleep-wake cycle a person has at baseline, the more often the person will have a physically active lifestyle during the follow-up. Recent evidence demonstrates that sleep regularity is an even stronger predictor of mortality risk than average sleep duration.

PROJECTIONS

There are two main drivers for sleep habits in transition among people living in Finland. Both bear health hazards and thereby have key importance in terms of not only mental health but also public health at large. We can change the first one, but it needs that we reschedule our 24/7 society, whereas the second one changes us so we can only adapt.

One of the drivers is the evening-oriented preference for daily activities, or the late chronotype. Earlier, until the 2010's, there were more morning-oriented than evening-oriented individuals among adults living in Finland, as of the 17,386 study participants, 21.3% assessed themselves as definite morning persons and 15.2% as definite evening persons during the period of 2007 to 2017 (10). However, these proportions have been turned upside down during the 2020's (11). Having seen this trajectory from the 1980's onward, it is of no surprise if those health hazards which have been associated with the behavioural trait toward eveningness would become more common among adults currently living in Finland.

Another of the drivers is the ongoing climate change. It will slowly influence mental health (12). The current scenario for Finland tells us that days will become warmer and sunnier in summer as well as warmer and darker in winter (13). At the population level, on the one hand, positive impacts include increases in the level of physical activity with rising temperatures, but higher temperature in summer and darkness and greater precipitation in winter may however rule each other out (14). On the other hand, negative impacts are forecast for nutrition and sleep at a population level, where there might be decreases in consumption of fruits and vegetables, as well as already seen increases in sleep disturbances and depressive symptoms (15). It may mean that their health-related hazards will become more common than they currently are in a population. All this will also most probably challenge schedules for the daily activities that we and the generations after us follow.

Author

Timo Partonen, MD, PhD
Research Professor, Finnish Institute for Health and Welfare (THL), Department of Healthcare and Social Welfare, Mannerheimintie 166, 00300 Helsinki, Finland.

Correspondence

E-mail: timo.partonen@thl.fi

References:

1. O'Loughlin J, Casanova F, Jones SE, Hagenaars SP, Beaumont RN, Freathy RM, Watkins ER, Vetter C, Rutter MK, Cain SW, Phillips AJK, Windred DP, Wood AR, Weedon MN, Tyrrell J. Using Mendelian Randomisation methods to understand whether diurnal preference is causally related to mental health. Mol Psychiatry 2021;26:6305-16.

2. Daghlas I, Lane JM, Saxena R, Vetter C. Genetically proxied diurnal preference, sleep timing, and risk of major depressive disorder. JAMA Psychiatry 2021;78:903-10.

3. Smolensky MH, Sackett-Lundeen LL, Portaluppi F. Nocturnal light pollution and underexposure to daytime sunlight: complementary mechanisms of circadian disruption and related diseases. Chronobiol Int 2015;32:1029-48.

4. Gill S, Panda S. A smartphone app reveals erratic diurnal eating patterns in humans that can be modulated for health benefits. Cell Metab 2015;22:789-98.

5. Youngstedt SD, Elliott JA, Kripke DF. Human circadian phase-response curves for exercise. J Physiol 2019;597:2253-68.

6. Didikoglu A, Maharani A, Payton A, Pendleton N, Canal MM. Longitudinal change of sleep timing: association between chronotype and longevity in older adults. Chronobiol Int 2019;36:1285-300.

7. Bouman EJ, Beulens JWJ, Groeneveld L, de Kruijk RS, Schoonmade LJ, Remmelzwaal S, Elders PJM, Rutters F. The association between social jetlag and parameters of metabolic syndrome and type 2 diabetes: a systematic review and meta-analysis. J Sleep Res 2023;32:e13770.

8. Facer-Childs ER, Middleton B, Skene DJ, Bagshaw AP. Resetting the late timing of 'night owls' has a positive impact on mental health and performance. Sleep Med 2019;60:236-47.

9. Windred DP, Burns AC, Lane JM, Saxena R, Rutter MK, Cain SW, Phillips AJK. Sleep regularity is a stronger predictor of mortality risk than sleep duration: a prospective cohort study. Sleep 2024;47:zsad253.

10. Partonen T. Seasonal variation in mood and behavior as well as diurnal preference in the Finnish adult population. Psychiatria Fennica 2021;52:14-21.

11. Merikanto I, Partonen T. Uni ja nukkuminen. Terve Suomi -tutkimuksen 2022–2023 ilmiöraportti. Helsinki: Terveyden ja hyvinvoinnin laitos 2023. https://www.thl.fi/tervesuomi_verkkoraportit/ilmioraportit_2023/uni_ja_nukkuminen.html

12. Burrows K, Denckla CA, Hahn J, Schiff JE, Okuzono SS, Randriamady H, Mita C, Kubzansky LD, Koenen KC, Lowe SR. A systematic review of the effects of chronic, slow-onset climate change on mental health. Nat Mental Health 2024;2:228-43.

13. Ruosteenoja K, Jylhä K. Projected climate change in Finland during the 21st century calculated from CMIP6 model simulations. Geophysica 2021;56:39-69.

14. Wennman H, Partonen T. Impacts of temperature and solar radiation changes in northern Europe on key population health behaviors: a scoping review of reviews. Scand J Public Health 2025;53:184-94.

15. Raza A, Partonen T, Magnusson Hanson L, Asp M, Engström EP, Westerlund H, Halonen JI. Daylight during winters and symptoms of depression and sleep problems: a within-individual analysis. Environ Int 2024;183:108413.