
Evening owls have increased odds for both psychiatric and somatic illnesses

Ilona Merikanto, Timo Partonen

Abstract

Based on the timing of their daily activities, humans can be classified into earlier-timed Morning chronotypes ("morning larks"), later-timed Evening chronotypes ("evening owls"), or between-timed Intermediate chronotypes. In adults, the genetic effect accounts for 50% of the inter-individual variance in chronotype. Evening owls in particular have an elevated risk of health hazards, while morning larks appear to be protected from these health-related problems.

Introduction

Individual variation occurs in the circadian timing of physiological functions and daily activities. Based on the peak times of physiological functions, such as blood pressure, hormone secretion, core body temperature as well as sleep onset and awakening, humans can be classified into three chronotypes: earlier-timed Morning-types ("morning larks"), later-timed Evening-types ("evening owls"), or between-timed Intermediate-types (1-3).

Genetic effects account for one-half of the inter-individual variance in chronotype in adults. In a Finnish twin cohort study, the estimate for the overall genetic effect (broad sense heritability) was 50% (95% confidence interval of 46% to 53%) composed of 12% (0 to 24%) for additive genetic factors and 38% (25% to 51%) for genetic factors due to dominance, thus leaving 51% for environmental factors (4). In a study of Dutch twin families, the total heritability (the sum of additive and non-additive genetic influences) for chronotype was 44% for the younger generation and 47% for the older generation (5).

Individual chronotype does not change to a marked extent once a person has reached adulthood, even though a slight shift towards morningness appears common during aging (6). However, a study to measure the stability of chronotype yielded that 63% of the respondents reported the same chronotype (kappa value of 0.47) five years later (4). It is of note here that 68% of the morning larks did report the same chronotype, but only 44% of the evening owls. An explanation might be that evening owls die younger, or alternatively switch their chronotype (6). Besides age, gender also seems to influence on the diurnal preference. For instance, in the Finnish adult population eveningness is more common among women than among men (7).

In epidemiological studies chronotype is often determined based on questionnaires. The original Morningness-Eveningness questionnaire, MEQ, by Horne and Östberg dates back to 1976 and consists of 19 items (1). In addition to this one, there are many other self-report questionnaires for the assessment of chronotype, such as the Diurnal Type Scale, DTS (8), and the Munich ChronoType Questionnaire, MCTQ (9). Of these two, the former was developed for shift work studies whereas the latter collects some additional detailed information on the sleep-wake behaviour under natural conditions (10).

Epidemiological studies have revealed that chronotype greatly influences on the susceptibility to health hazards of a wide range. Evening-type in specific has been associated with a lot of health hazards, while the circadian preference towards morningness seems to protect individuals from these health-related problems (7, 11-22; for the relevant Finnish population-based data, see Table 1).

Chronotype and life habits

Considering life habits, Evening-types are more prone to use alcohol and smoke than other chronotypes (11, 14-16, 20). Diurnal preference towards eveningness is also associated with greater usage of cannabis and ecstasy as compared to other chronotypes (23). Furthermore, Evening-types not only tend to have less healthy dietary intake but also are more emotionally-driven eaters as compared to Morning-types (17, 21).

It is possible that these unhealthy habits are more common among Evening-types due to higher susceptibility of Evening-types to sleep problems and depression and thus are used as self-medication, but this also increases the severity of these health issues.

Table 1. Diseases and symptoms associated with eveningness based on the National FINRISK Study 2007 Survey data (7, 16-19, 21-22).

Disease or symptom
Insufficient sleep
Insomnia
Nightmares
Medication for sleep problems
Depressive symptoms
A diagnosis or treatment for depression
Antidepressant medication
Hypertension
Type 2 diabetes
Bronchial asthma
Wheezy breathing with dyspnoea and without respiratory infection
Awoken with heavy breath and shortness of breath
Hay fever or allergic respiratory symptoms
Medication for asthma

Chronotype and sleep

Long sleep duration (over 9 hours per night) is associated with diurnal preference towards eveningness (7). Studies have suggested that Evening-types sleep less during working days as compared to other chronotypes (9, 24-26) due to reluctance of Evening-types to advance their bedtimes in order to have sufficient amount of sleep to feel rested (27). This can result to accumulation of sleep deprivation, which is then compensated by sleeping longer during the weekends. It is thus not surprising that Evening-types feel more than other chronotypes that their sleep is insufficient (7). It is also possible that Evening-types have longer circadian periods than others (3, 28).

If this were to hold, it would explain the higher prevalence of eveningness among long sleepers and why Evening-types feel unrested even after 7 to 8 hours of sleep, even though their wake up time would be later than Morning-types. Furthermore, Evening-types complain of more insomnia symptoms than other chronotypes (7, 12). They also report more nightmares and use more sleep medication than other chronotypes (7).

It is possible that Evening-types are more prone to wider circadian misalignment of biological rhythms due to their innate need to sleep more than other chronotypes, which predisposes them to accumulation of sleep deprivation during working days.

Chronotype and depression

Eveningness has been associated with higher risk for depressive symptoms as well as major depression than other chronotypes in both smaller sample sizes (29-40) as well as in a bigger nationwide sample size (18). Evening-types also use more antidepressant medication than other chronotypes (18).

One study reported that Evening-types are more prone to attempt violent suicides than other chronotypes (40). It is possible that sleep problems, which are common among Evening-types, also relate to heightened risk for depression in Evening-types as compared to other chronotypes as sleep problems and depressive symptoms often appear together (41-43).

Evening-type is also associated with lower blood pressure and higher resting heart rate as compared to other chronotypes, and these are emphasized with higher weight and greater waist circumference the more depressed the Evening-type person was (18). Tendency to depression can thus increase the risk for other diseases among Evening-types. For instance, high resting heart rate in depressed patients has been reported to increase the risk for mortality (44-45).

Chronotype and cardiovascular diseases and type 2 diabetes

Considering other health hazards present in Evening-types, it is not surprising that eveningness is also associated with heightened risk for hypertension and type 2 diabetes. In this same study, Evening-types also had lower levels of LDL cholesterol as well as lower total cholesterol levels after fasting as compared to other chronotypes (19). Lower fasting cholesterol levels might be related to disturbances in the glucose metabolism and thus contribute to the higher risk for type 2 diabetes in Evening-types (46).

Similarly, greater waist circumference and body weight in Evening-types predispose to cardiovascular diseases and type 2 diabetes (19). Sleep deprivation and tendency to sleep long, which are related to eveningness, as well as long-term misalignment of circadian rhythms all disrupt hormonal regulation of appetite and glucose and lipid metabolism (47-51).

Sleep characteristics related to eveningness and potentially a wider misalignment of circadian rhythms could thus predispose to metabolic disorders in Evening-types. In addition, unhealthy life habits associated with diurnal preference towards eveningness could heighten this risk.

Chronotype and respiratory disorders

Eveningness has also been associated with increased risk for respiratory symptoms and syndromes as well as bronchial asthma. As compared to other chronotypes, Evening-types have more wheezy breathing with dyspnoea without respiratory infection, awake more often having difficulties to breathe or awake in coughing and have more allergic respiratory symptoms. Evening-types also report more hay fever than other chronotypes. Furthermore, eveningness is associated with higher risk to bronchial asthma. It is thus not surprising that Evening-types also use more medication for asthma than other chronotypes (22).

Awakening with difficulties to breath and coughing indicate nocturnal worsening of asthma symptoms, which has been reported more frequently among Evening-types (52). It has been suggested that the nocturnal worsening of asthma symptoms are related to

abnormal increases in airway inflammatory cells, which leads to airway over-reactivity at night (22, 53). Success of chronotherapy in treating nocturnal asthma supports this view (54-56). Moreover, circadian misalignment has been linked to both the onset as well as worsening of inflammatory disorders (57). If Evening-types are more likely to experience circadian misalignment of biological rhythms, this could also predispose them to, with a higher likelihood than other chronotypes, respiratory disorders and bronchial asthma as circadian disruption is often linked to the onset or worsening of inflammatory disorders (57).

Higher tendency to smoke among Evening-types is also a risk factor for respiratory disorders, but the heightened association between Evening-type and respiratory symptoms and bronchial asthma were significant even though smoking was accounted for in the Finnish population-based health examination study by Merikanto and her co-workers (22). This indicates that unhealthy life habits among Evening-types do not alone explain risk for these disorders, but there is a more complex pathway behind the association between chronotype and the risk for respiratory disorders and bronchial asthma.

Implications

Especially those Evening-types, who are forced to follow a schedule that is more preferable for and favours Morning-types, are likely to have a higher risk for circadian disruption of rhythms and thereby might be predisposed to health problems (58). Assessment of the individual chronotype could thus be beneficial in order to adjust schedules and life habits to minimize the risk for illnesses.

Adjustment of sleep habits according to the individual's innate chronotype might be difficult in a society which promotes morningness. Yet, avoiding life habits that are unhealthy (such as alcohol misuse, smoking, overeating or physical inactivity) would be beneficial to everyone but especially to Evening-types.

Accumulation of sleep deprivation during working days may also be prevented by taking short naps (10 to 20 minutes). If so, the naps should be timed to occur between noon and the early afternoon, in order to prevent further misalignment of the sleep-wakefulness rhythm.

Conclusion

All in all eveningness is associated with multiple health hazards, while the diurnal tendency towards morningness seems to protect from these health issues. It seems that sleep characteristics related to eveningness in particular increase the risk of metabolic and respiratory disorders, and also that of a wider circadian disruption. It has been hypothesized that this kind of circadian misalignment of biological rhythms might relate to a worsening of symptoms and the onset of diseases among Evening-types.

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Ilona Merikanto, MSc,
National Institute for Health and Welfare (THL),
Department of Mental Health and Substance Abuse Services,
Helsinki, Finland
Department of Biosciences, University of Helsinki, Helsinki, Finland

Timo Partonen, MD, research professor,
National Institute for Health and Welfare (THL),
Department of Mental Health and Substance Abuse Services,
Helsinki, Finland

Correspondence:
ilona.merikanto@helsinki.fi