SUGGESTED READINGS

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ADDITIONAL PATIENT BROCHURES BY SLEEP EXPERTS

- **Dental Appliances**
- **Sleep in Aging**
- **Sleep Bruxism**
- **Drowsy Driving**
- **Insomnia**
- **Human Circadian Rhythms**
- **Strategies for Night Shift Workers**
- **Narcolepsy and Cataplexy**
- **Dreams and Nightmares**
- **Obstructive Sleep Apnea**
- **Patient Guide to Sleep Studies**
- **Positional Therapy for Obstructive Sleep Apnea**
- **Children**
- **Restless Legs Syndrome**
- **Sleep and Post- Traumatic Stress Disorder**
- **Normal Sleep**

"HEALTHY SLEEP FOR HEALTHY CANADIANS"

The Canadian Sleep Society is a national organization committed to improving sleep for all Canadians through: support for research, promotion of high quality clinical care, education of professionals and the public, and advocacy for sleep and sleep disorders medicine.

For more information visit **www.canadiansleepsociety.com** or email **info@css-scs.ca**

Canadian Sleep Society Société Canadienne du Sommeil

DELAYED SLEEP-WAKE PHASE DISORDER (DSWPD)

Delayed sleep-wake phase disorder (DSWPD) is the most frequent intrinsic circadian rhythm disorder and affect about 0.13% - 3.1% of the adult population with an increased prevalence of 7-16% in young adults and adolescents.

DSWPD is characterized by a delay in the main sleep episode and an inability to fall asleep or wake up at the desired times. Patients naturally fall asleep abnormally late around 03:00 to 06:00 and wake up around 10:00 to 15:00. When they sleep at their natural times, sleep quality, sleep stage distribution, and sleep duration are normal.

However, when sleep is planned earlier, at more socially acceptable times (e.g. 23:00), a significant increase in sleep latency and wake time during the first part of the night is observed.

Excessive sleepiness is generally experienced in the morning and difficulties awakening at socially acceptable times are reported. As a result, a significant proportion of DSWPD patients report disrupted work or social functioning. The treatment of choice for DSWPD is exposure to bright light for 1-2 hours in the morning, shielding from light in the evening, and melatonin administration in the early evening.

ADVANCED SLEEP-WAKE PHASE DISORDER (ASWPD)

Advanced sleep-wake phase disorder (ASWPD) is less prevalent than DSWPD with an estimated rate of 1% in middle-aged individuals. It is considered a sleep-wake disorder in old age as sleep tends to stabilize at earlier times-of-day with aging. of evening sleepiness, a need to go to bed early around 18:00 to 21:00, early morning awakenings around 02:00-05:00, and reduced total sleep time.

Engaging in social activities in the evening can be problematic and sleep restriction tends to be worse on weekend days. When patients with ASWPD go to bed earlier, according to their natural sleep tendency, sleep quality and duration are generally normal.

Familial ASWPD, which causes extreme "morning lark" tendencies in whole families, seems to be related to a clock gene mutation, supporting the idea that some sleep disorders have a genetic basis. The treatment of choice for ASWPD is exposure to bright light for 1-2 hours in the evening and shielding from early morning light.

NON-24-HOUR SLEEP-WAKE SYNDROME

Non-24-hour sleep-wake disorder results from a failure of the endogenous circadian system to entrain to the environmental 24-hour day.

Patients with non-24-hour sleep-wake syndrome have sleep onset times that tend to be delayed by 1-2 hours from one day to the next. The condition may go unrecognized for several years. In the disturbed periods, the patient suffers from severe sleep-onset insomnia and difficulty awakening in the morning.

This condition is more common in blind patients, 50% of whom lack photic entrainment the 24-hour day. It is rare in sighted individuals and usually associated with other neurological or psychiatric conditions.

A combined approach with phototherapy in the morning, shielding from light in the evening, and melatonin administration in the evening is suggested to treat this condition.

CONCLUSION

Most behavioural and physiological functions vary across the day. Most of them are generated by an endogenous circadian system and can be entrained by environmental synchronizers such as the light-dark cycle.

A complex interaction between homeostatic and circadian processes modulates the quality and duration of sleep and wake periods. An abrupt change in the timing of sleep relative to the environment can lead to substantial disturbances of sleep and waking like those observed in night shift work, jet lag, DSWPD, ASWPD, and non-24-hour sleep-wake disorder.

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Human Circadian Rhythms

INTRODUCTION

ENTRAINMENT OF HUMAN CIRCADIAN RHYTHMS

CIRCADIAN MODULATION OF SLEEP AND WAKING

CIRCADIAN RHYTHM SLEEP-WAKE DISORDERS

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INTRODUCTION

Circadian rhythms are rhythms that last about 24 hours (from circad about and diem day). They have been observed in a wide variety of physiological and behavioural functions when humans are isolated from the periodic cycling of light and darkness for several weeks indicating these rhythms are endogenous. Indeed, circadian rhythms are under the control of a circadian system which is comprised of a master central clock located in the suprachiasmatic nucleus (SCN) of the anterior hypothalamus and several peripheral clocks located throughout the body and brain.

Endogenous circadian rhythms are self-sustained and generated by a set of clock genes involved in negative and positive regulatory intracellular feedback loops that are observed in individual neurons of the SCN as well as in non-SCN brain and peripheral tissues.

When free to run without the influence of environmental synchronizers, endogenous circadian rhythms adopt a period that is close, but slightly different than 24 hours. In real life, an individual is exposed to his terrestrial environment and adopts a rhythm of 24 hours. This is achieved by a process called circadian entrainment by which environmental synchronizers adjust the individual's circadian system to his environment.

ENTRAINMENT OF HUMAN CIRCADIAN RHYTHMS

The light-dark cycle is the most powerful environmental synchronizer for most animals including humans. Photic cues perceived by retinal ganglion cells containing melanopsin is transmitted to the SCN via the retino-hypothalamic tract, a direct monosynaptic tract.

Exposure to light can shift rhythms of the central clock towards other internal time zones (called circadian phases). The pattern of light exposure can be planned to rapidly reset the timing of the circadian system according to a phase response.

Exposure to light in the late evening/early night will delay rhythms to later times (akin to a westward travel) whereas light exposure in the late night/early morning will advance rhythms to earlier times (akin to an eastward travel). Light intensity, its spectral composition, and prior exposure to light, influence the resetting response of the circadian system. The central circadian clock is sensitive to low indoor room light and integrates light information in such a way that its effect can be sustained even when light is intermittently interrupted by darkness. Light in the blue visible range of 440-480 nm induces larger phase shifts than white light, although a switch of sensitivity towards light in the green visible range of 555 nm occurs at lower irradiances. Melatonin has also been shown to reset human circadian rhythms.

Administration of melatonin in the evening and morning can advance and delay the endogenous circadian rhythms, respectively. Other non-photic synchronizers such as exercise, meal and nap timing could entrain the circadian system, although these effects require further studies.

The mechanisms involved in the resetting of peripheral clocks is a matter of research. The timing of light/dark exposure, meals, and glucocorticoids has been shown to reset peripheral clocks.

CIRCADIAN MODULATION OF SLEEP AND WAKING

Two processes interact to module the duration and quality of sleep and waking. One of these processes is called the **homeostatic process** and is a measure of sleep pressure that accumulates during wake periods and dissipates during sleep periods.

Dissipation of sleep pressure during the night is more concentrated during the first hours of sleep and is mainly quantified by the amount of slow wave sleep (SWS) and slow wave activity (SWA).

The second process is called the **circadian process** and is controlled by the endogenous circadian system. It modulates the strength of sleep propensity and varies as a function of time-of-day. Peak time of sleep propensity occurs near the nadir of core body temperature cycle, at the end of the night.

An interaction between homeostatic and circadian processes explains the drop in vigilance levels around 4:00-6:00 and 13:00-15:00 for an individual who normally sleeps from midnight to 8:00.

CIRCADIAN RHYTHMS SLEEP-WAKE DISORDERS

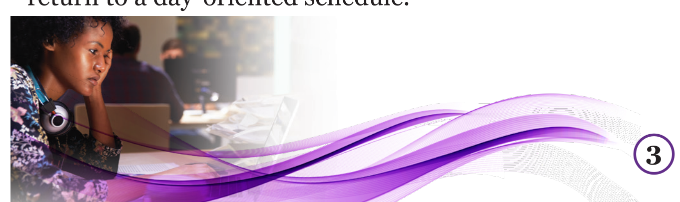
Circadian rhythm sleep-wake disorders form a distinct subgroup of sleep disorders, caused by misalignment between the patient's natural sleep requirements and that dictated by his professional or social life.

NIGHT SHIFT WORK

When an individual works at night, a mismatch occurs between their endogenous circadian rhythms and a typical sleep/wake schedule. This leads to sleep and wake disturbances with day sleep that is often only 5-7 hours long.

Complaints of insomnia symptoms are more common among night than day workers. A variety of countermeasures have been proposed to improve night shift workers circadian adaptation to their schedule including exposure to artificial bright or blue light, goggle use, and melatonin administration.

These approaches could improve alertness, performance, and/or sleep of night shift workers but have limitations and the disadvantage of disturbing circadian adaptation during rest days, as most workers return to a day-oriented schedule.



The long-term safety of artificial light exposure must be better documented. Exogenous melatonin is known to have sleep-promoting and circadian phase shifting effects. A few prior studies suggest the use of melatonin tablets or melatoninergic receptor agonists can be beneficial for shift workers, although further large scale experimental testing is needed to support their clinical efficacy.

Finally, interventions designed to correct the circadian misalignment might not be advisable or practical in all types of shift work rosters. The strategic planning of naps is considered efficient and safe in sustained operations, and should also be considered.

JET LAG

Rapid travel across more than 2 time zones induces an abrupt desynchrony between circadian clocks and the new sleep schedule at destination.

About two thirds of transmeridian travelers present acute symptoms of sleep disturbances, fatigue, impaired alertness, gastrointestinal malaises, headaches, and irritability. While this is simply an annoyance for most passengers, jet lag is a serious safety issue in the aviation industry.

The severity and duration of the symptoms depends on the direction of the flight as well as the number of time zones crossed. Eastward flights of approximately 6-hour time zones changes are associated with difficulty falling asleep, sleep disturbances in the first half of the night, difficulty awakening, and fatigue in the morning/early afternoon. In comparison, westward flights across similar distances lead to poor sleep quality in the later half of the night, early morning awakening, and fatigue in the evening/late afternoon. Sleep disruption will be more severe on the second day after arrival whereas sleep is often increased on the date of arrival due to recovery from the acute sleep debt. Substantial individual variability exists in tolerance to jet lag and can be affected by age, sleeping behaviour, and exposure to light and darkness.