Jet Lag and Shift Work

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KEYWORDS

• Jet lag • Shift work disorder • Melatonin • Circadian rhythm • Sleep schedule • Phase shift

KEY POINTS

- Jet lag disorder and shift work disorder result from extrinsic work and travel obligations in conflict with the intrinsic circadian rhythm.
- Poor seasonal or ambient light can prolong the time to adapt to either transmeridian travel or shift work.
- Symptoms of extrinsic circadian disorders are similar to those of other sleep disorders; namely sleepiness, fatigue, poor or irritable moods, or cognitive inefficiency.
- Misalignment and the secondary effects are usually temporary and reversed over a period of days to weeks, given sufficient opportunity to recuperate and reentrain.

INTRODUCTION

The circadian rhythm orchestrates the rest/activity cycle with influences directly affecting cells throughout the brain and body. Although innate and coded within human DNA, this cycle usually does not run freely; it is modified by the circadian pacemaker interaction with circadian clock mechanisms. The pacemaker activity is a function of cells in the suprachiasmatic nucleus (SCN), within the hypothalamus. Cells throughout the brain and body have receptors modulating circadian molecular function and in turn affecting cellular activity and metabolism.[1] These rhythms can be regulated by zeitgebers, which are stimuli such as light, activity, or other sources of feedback to the circadian system.

Common zeitgebers include exercise, sleep, and food, but light provides the most potent feedback. The common pathogenesis underlying the extrinsic circadian rhythm disorders is a temporary misalignment between the circadian rhythm and the local time, often exacerbated by inappropriately timed light and activity patterns. The pacemaker activity of the SCN is normally synchronized to the light/dark cycle. The circadian phase can alternatively be ahead of the local light/dark cycle, termed advanced, or behind the local day/night cycle, termed delayed.

Light mediates circadian pacemaker activity by acting on intrinsically photosensitive retinal ganglion cells. Light exposure can appropriately induce phase shifts to adjust the circadian rhythm to local time or new social obligations but can also create disorder in the circadian cycle, with consequent effects on physiology and neurocognitive performance. The population worldwide is aging so it is noteworthy that the ability to tolerate circadian phase misalignment diminishes with increasing age.[2]

The entrained circadian rhythm is vital to physical activity and metabolic, gastrointestinal, and central nervous system homeostasis, with

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abnormalities associated with even short-term circadian malalignment. Examples of the adverse effect of extrinsic circadian alignment on these systems in recent studies include the control of blood sugar, consequent pancreatic insulin production, blood pressure, intimal blood vessel thickness, immune function, and psychological mood and cognitive function.[3,4]

Ambient light levels contribute to the cause of circadian misalignment in shift work and jet lag, and this can also be seen seasonally, in winter months, when lower ambient light exposure is frequently associated with higher population suicide rates and seasonally acquired depression, because a healthy balanced circadian rhythm is essential to normal function on multiple levels ranging from cellular function to gross neurocognitive function.

Poor seasonal or ambient light can prolong the time to adapt to either transmeridian travel or shift work. Symptoms of extrinsic circadian disorders are similar to those of other sleep disorders, namely sleepiness, fatigue, poor or irritable moods, or cognitive inefficiency. Misalignment and the secondary effects are usually temporary and reversed over a period of days to weeks, given sufficient opportunity to recuperate and reentrain. Jet lag and shift work are common acquired circadian rhythm abnormalities resulting from behaving independently from the endogenous circadian rhythm.

JET LAG

In 2013, 29.0 million US travelers visited overseas markets, an increase of 2% from 2012.[5] Most of these trips crossed more than 3 time zones. Many travelers experience the effects of jet lag induced by the mismatch in circadian phase and activity level as they move through time zones at a rate too rapid for normal adaptation to occur. Jet lag arises when the slow innate adaptation present for changes in seasonal ambient light is not immediately able to keep up with rapid circadian phase shifts across different time zones.

The greater the number of time zones crossed, the greater the risk of developing symptoms such as hypersomnia during the period of desired wakefulness or wakefulness and insomnia during the period of desired sleep. Additional fatigue associated with air travel can arise from abrupt change of sleep patterns to reach the airport, change to mealtimes, the stress of travel, and dehydration or low oxygen tension, which can arise during flights. These adverse symptomatic effects are often in addition to baseline sleep deprivation.

In 2010, it was estimated that 30% of the US population had 6 hours sleep or less.[6] Geographic location, distance traveled, duration of time spent in travel, and social obligations at the destination affect the adjustment to local time as ambient light conditions vary. The timing of social obligations at the destination may exacerbate or alleviate the change in time zones. For example, a morning-type retiree traveling 6 hours ahead from Miami, Florida, to Barcelona, Spain, might have little to no change in dinner time and bedtime at the destination relative to the origin. In contrast, traveling just half this distance 3 hours ahead from San Francisco to New York for a 7 AM business meeting could have a large effect on wake time, breakfast time, and morning alertness relative to behavior at origin.

Because most people have an evening tendency, or more easily delayed circadian rhythm, people taking flights in an easterly (earlier) direction are more prone to circadian rhythm symptoms than those traveling in a westerly (later) direction. It has long been recognized that in populations of people this adaptation to jet lag is more rapid when traveling westward, although genetic variability may be a significant factor in interindividual variability, with morning types adapting more readily to eastward travel and evening types adapting more readily to westward travel.[6]

Diagnosis of Jet Lag Disorder

The evaluation for jet lag disorder may be summarized as follows:

1. Diagnosis is made by history.
2. Tests to confirm the diagnosis of jet lag are unnecessary.
3. Tests to identify comorbid sleep disorders may be necessary.
4. Sleep logs or actigraphy can help detect insufficient sleep syndrome.
5. Polysomnography or home apnea testing should be considered if pertinent apnea symptoms are present and sleep complaints persist despite an adequate period within the same time zone.
6. Multiple sleep latency test (MSLT) may be appropriate if hypersomnia and ancillary symptoms of narcolepsy are present, although MSLT should be avoided if there has been recent transmeridian travel because of risk of false-positives from disordered circadian rhythm.

International Classification of Sleep Disorders (ICSD)-3 Diagnostic Criteria for Jet Lag Disorder are shown in **Box 1**.