Abstract: Working against the natural endogenous rhythm of the body, disrupts normal sleep and affects the well-being of the individual. The study looks upon the various health consequences that arise in people engaged in shift work. A literature search of original and major review articles as well as books related to shift work were performed. Studies revealed that the misalignment between the endogenous circadian rhythm and the external 24 hr environment gives rise to several physical, psychological, physiological, personal and social disturbances among shift workers. With the increasing number of shift workers around the globe, every year, their health issues need to be addressed. Feasible recommendations from previous studies were compiled and reported.

Keywords: workers, sleep, shift work, melatonin, cancer

Reemy Sara Mathai
Department of Zoology
University of Kerala
Kariavattom
Trivandrum

Mili Mohanan
Department of Zoology
University of Kerala
Kariavattom
Trivandrum

Arun Raveendran
Department of Zoology
University of Kerala
Kariavattom
Trivandrum

Mathew M. Oommen
Department of Zoology
University of Kerala
Kariavattom
Trivandrum
1. Introduction:

Restorative sleep is an important determinant of an individual’s overall health. There exists a sleep/wake cycle which is in rhythm with the light/dark cycle of environment. The hypothalamic supra-chiasmatic nuclei (SCN) has the prime control over the endogenous sleep/wake cycle, promoting wakefulness at specific times of the day. The wake promoting role of the SCN works in opposition to the homeostatic sleep drive and the strength of the drive depend on the extent of the prior wakefulness. Therefore as the day proceeds, the homeostatic sleep drive increases in strength. This propensity to fall asleep during the day is opposed by the circadian drive for wakefulness, which is mediated by the SCN. As the wakefulness drive of the SCN recedes at night, a time when the homeostatic drive is at its maximum, the sleep drive predominates and sleep is initiated. Other key components of the circadian process are the pineal gland, which releases melatonin- partly in response to SCN signaling and partly in response to the onset of darkness- to promote sleep during the individual’s normal period of darkness.

Figure 1: Sleep drive verses wakefulness drive
2. Shift Work And Circadian Misalignment:

The increasing pressure of industries to remain productive without time constraints, forced laborers to work round the clock. Workers shifted their work and sleep between evening, night and morning schedules as per their job requisites. Today, more than 16% of salary workers are shift workers.

This misalignment between the endogenous circadian rhythm and external 24 hr environment forms the basis for health problems associated with shift-work. This has become the rising concern of the day. Individuals working at night hours, is doing so when his/her circadian rhythm is promoting sleep and sleeps when the circadian rhythm is promoting wakefulness.

The inability to align the endogenous circadian rhythm with sleep/wake schedule required of the occupation can result in insomnia, disturbed and non-restorative sleep and fatigue as shift workers continually attempt to sleep when the circadian propensity for sleeping is low. This can eventually lead to sleep deprivation if day-time sleep is fragmented. The homeostatic drive, which is responsible for the increased tendency to fall asleep, the longer an individual is awake, increases as a consequence of the lack of sleep achieved earlier in the day-time. This makes a person feel more tired and drowsy over the course of the night, with the greatest sleepiness occurring in the early morning hours. Symptoms of excessive sleepiness and insomnia can persist as long as the shift work and the abnormal sleep-wake pattern persist.

![Figure 2. Disease Set-In, A Schematic Representation](image-url)
3. Health And Social Impacts:

During the period of time adaptation, this external and internal desynchronization of the human organism leads to a functional disturbance of its time organization (dyschronism). As insomnia and sleepiness aggravates, psychiatric conditions like anxiety and depression may set in. The primary consequences of the resulting sleep deprivation are incremental decrease in individual’s alertness, cognition and reaction time. As sleep deprived people continue to perform their routine work tasks while fighting the biologic drive for sleep, they may fail to recognize the warning signs of fatigue, which can have grave consequences. These brief sleep intrusions substantially impair psychomotor performance and manual dexterity. The transient loss in motor and cognitive performance depends upon the extent of shifts. The synergistic effects of all these hampers the socio-temporal patterns of the individual, elevates stressfulness and thereby increases both risk and incidence of errors, injuries and accidents. As individuals attempt to self-treat the stress of sleep disturbances, shift workers may develop maladaptive behaviors, such as drug and alcohol dependency, to counter the effects of sleep deprivation.

The disruption to the familial, social and personal life represents a major area of concern for shift workers. They exhibit higher rates of absenteeism from work, moodiness, forgetfulness, decreased concentration, reduced work satisfaction and irritability compared to other workers. They also experience social isolation and decreased overall well-being. Higher divorce rates account for the marital disconnect, lower morale and other behavioral problems.

Working against the endogenous clocks disrupt the natural sleep/wakefulness cycles, expose the organism to light at atypical biological times and result in irregular eating patterns and alter the usual social and family routine. In acute as well as long term studies, unfavorable alterations have been reported in lipid and carbohydrate metabolism, in insulin resistance, growth hormone and corticosteroid secretion patterns and/or blood concentration. On an epidemiological basis, hypertension, left ventricular hypertrophy, obesity and high triglyceride levels have found to be more prevalent among shift workers. Studies reveal that shift workers suffer more from colds and flu, impaired glucose metabolism and more gastrointestinal problems such as indigestion, ulcers, diarrhea and constipation and have a 40% additional risk for cardiovascular diseases than day workers.

Working at odd hours is never recommended for pregnant women as in addition to the health issues it poses on the mother; it affects the baby’s health too. Montreal survey revealed the
association between shift work and low birth weight. Significant relationship between shift work, preterm birth, and increased risk of spontaneous abortions was brought to light through several studies. Reasons for these effects include increased stress, poor diet, increased smoking and caffeine consumption.

4. Cancer Risk:

A circadian phase shift exerts its effect upon molecular, cell and tissue physiology and occurs over an extended period during which the time sequence of the biologic rhythms of many variables is different from that found in day-night adapted individuals, ie, the circadian time organization which is thought to be linked to optimal function. Involvement of the genetic circadian oscillator system with oncogenesis has been demonstrated in animal experiments. Alterations in the rhythmicity of circadian period gene per 2 have been shown to be related to the development of neoplasia. The mortality study by Taylor and Pocock reported a significant increased incidence of neoplasms in shift workers compared with the general population. Recently an increase in incidence in breast cancer and colorectal cancer has been reported after prolonged exposure to shift work in women. The possible explanation is the suppression of the nocturnal melatonin secretion, an oncostatic agent which counteracts tissue proliferation in both breast and colonic tissues, due to light exposure during night time work.

5. Recommendations:

Since shift work has become an unavoidable attribute of the global industry today, and with its minor health effects to the life threatening impacts on subjects, we need to focus on the measures that need to be undertaken, without compromising on the health of the workers. The first in the checklist would be to devise sleep-friendly shifts. Quick shift changes should be avoided and made sure that shifts rotate forward. Regularity of shifts has been shown to avoid dyschronism and related health effects. It is advisable to take short power naps during breaks to refresh one’s self and to get rid of the drowsiness during night work.

Crowley et al recommended the combination of intermittent bright light during the night shift, dark sunglasses (as dark as possible) during the commute home and a regular early day time dark/sleep period if complete circadian adaptation to night shift is to be achieved.
Timing of food uptake will be supportive when a circadian phase adaptation should be attempted and appropriate timing at the main meals may improve shift work tolerance.

Though benzodiazepines induce sleep and xanthene drugs like caffeine delay sleep onset, regular usage are not recommended due to the possible side effects such as headache, drowsiness, dizziness, tremor, anxiety and mood disturbances. Combined use of appropriately timed bright light and close to physiological doses (0.5-1mg) of melatonin is likely to support phase adaptation and may be helpful in the treatment of shift work. Melatonin, a mild hypnotic, when given in suprapharmacologic doses of 3-10mg, can induce sleep without any significant side effects and post hypnotic performance deficits.

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