

Circadian Rhythm Sleep Disorder among Nurses in Emergency Department: A Systematic Review

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ABSTRACT

Background: Circadian Rhythm Sleep Disorders (CRSD) is a sleep pattern disorder that can be caused by a shift work system, especially the night shift. This disorder can cause various cardiovascular diseases, psychological, decreased concentration, even Alzheimer's. Some professions that demand high precision such as nurses who work with night shifts in the Emergency Room are very vulnerable to CRSD and if not handled, it can lead to work negligence. The purpose of this review is to review CRSD due to work shifts, possible risks to the ED nurse and how to overcome them.

Subjects and Method: This article uses CRSD-related reviews published from 2000-2018 from various databases: PubMed, PMC Central and Elsevier open-access. The search was conducted on 1-14 July 2018 with keywords: "Circadian Rhythm Sleep Disorders", "treatment AND CRSD", "the effect of CRSD", "CRSD AND nursing, and" CRSD in night workers".

Results: Based on the 20 articles reviewed, CRSD is a sleep pattern disorder that can be caused by endogenous factors and exogenous factors. One exogenous factor is a disturbance due to working time with the shift work disorders (SWD) system. There are several ways to overcome CRSD due to working hours, including: taking a nap before work, modifying the environment by avoiding light if going to sleep, but approaching light if you have to wake up, resetting your sleep schedule, and giving melatonin.

Conclusions: CRSD due to work disorders is called SWD which can be overcome by rearranging sleep, modifying the environment to fit the circadian rhythm, and consuming melatonin if needed.

Keywords: Circadian rhythm sleep disorders, shift work disorders, nurses

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BACKGROUND

Circadian rhythms are psychological and biological cycles that show endogenous oscillation every 24 hours. This rhythm regulates various biological processes including sleep cycles in humans called "biological clocks" (Golombek and Rosenstein, 2010).

Circadian Rhythm Sleep Disorders (CRSD) is a sleep pattern disorder caused by changes in biological hours in humans. CRSD is a circadian rhythm disorder that occurs most often in adolescents and adults

with a prevalence of 7% to 16% (Wichniak et al., 2017).

CRSD can cause various diseases such as cardiac arrhythmias, ischemic strokes, epilepsy, dementia and even Alzheimer's disease. (Brzecka et al., 2018; Smolensky et al., 2015).

CRSD disorders have also been reported to reduce concentration, increase the risk of neglect, insomnia, and other psychological disorders (Zee et al., 2013).

Nurse work in emergency department (ED) is a job that requires high concentra-

tion, but the shift work system makes nurses very vulnerable to CRSD. This is very dangerous for the patient safety, so it needs a clearer understanding of CRSD and how to overcome it.

The purpose of this study is to review Circadian Rhythm Sleep Disorders due to work shifts and possible risks to the ED nurse and how to overcome the disorder.

SUBJECTS AND METHOD

This article was a systematic review conducted by reviewing topics related to CRSD published since 2000-2018 from various databases including: PubMed, PMC Central and Elsevier open-access.

The study was conducted from July 1 to 14, 2018 using the following keywords: "Circadian Rhythm Sleep Disorders", "treatment AND CRSD", "the effect of CRSD", "CRSD AND nursing, and" CRSD in night workers".

The criteria for the article under study are: direct research conducted on adults and workers who have night shifts, systematic reviews, international reviews and guidelines. After the search process, 20 articles will be reviewed.

RESULTS

1. Biological Clock and Circadian Rhythm

Humans will adapt to day and night, dark and light because, temperature, light, and environmental changes will affect the body's metabolic system (Shea, 2011).

The adaptation process is done by resting, sleeping, and awakening. These three processes are regulated by an endogenous mechanism that lasts for 24 hours and continues to repeat so-called "Circadian rhythms". The center of circadian rhythm regulation is located in the central nervous system in the supra-chiasmatic nucleus (SCN) called the main

clock, but the whole process can occur in the liver, adipose tissue, and the digestive tract called peripheral clocks (Wichniak et al., 2017).

2. The circadian rhythm mechanism is based on the light response

Circadian rhythms are very dependent on light. This process begins when many retinal ganglion cells contain melanopsin as the main receptor for light giving photic information directly to the SCN (retino-hypothalamic) and indirectly (retinogeniculate) (Burman, 2017). This response is used by SCN to regulate circadian rhythms which ultimately regulate the function of heart rhythm, autonomic function, endocrine system, and metabolism. It is in situations where light (exposure duration and spectrum length) is inadequate, rhythm signals for resting and even sleeping (Smith and Eastman, 2009).

Determination of the beginning and end of circadian rhythms is strongly influenced by light and melatonin excretion. During the night the pineal gland secretes melatonin 2-3 hours before one's regular sleep and will continue to decline until it reaches its lowest point at night and the next circadian rhythm begins, melatonin levels can be measured through plasma, urine and saliva (Bencloucif et al., 2008).

3. The mechanism of circadian rhythms is based on genetic regulation

Some gene experiments modulated by melatonin have been reported to affect circadian rhythms as Per 1 (homologous period 1), Per2 (homologous period 2), BMal1, and two cryptochrome (Cry) homologous genes (cryptochrome 1 gene, Cry1, and cryptochrome 2 genes, Cry2) (Takahashi et al., 2008).

These genes and their products interact to form the translation of the basic molecular feedback transcription of the

circadian rhythm. During the day, the BMal1 gem interacts with the Cry gene to produce maximizing this transcription. Protein Per and Cry translate the results to the SCN nucleus and inhibit CLOCKY-BMAL1 transcription (Phyllis et al., 2013).

During the end of the night, the Per-Cry gene regulates the cycle for the next

circadian stage to begin. An estimated 10% of all genes in the body's expression process depend on the circadian rhythm gene (gem of the body clock), but the peripheral network has its own settings that are synchronized by the SCN direct message (Ko et al., 2006).

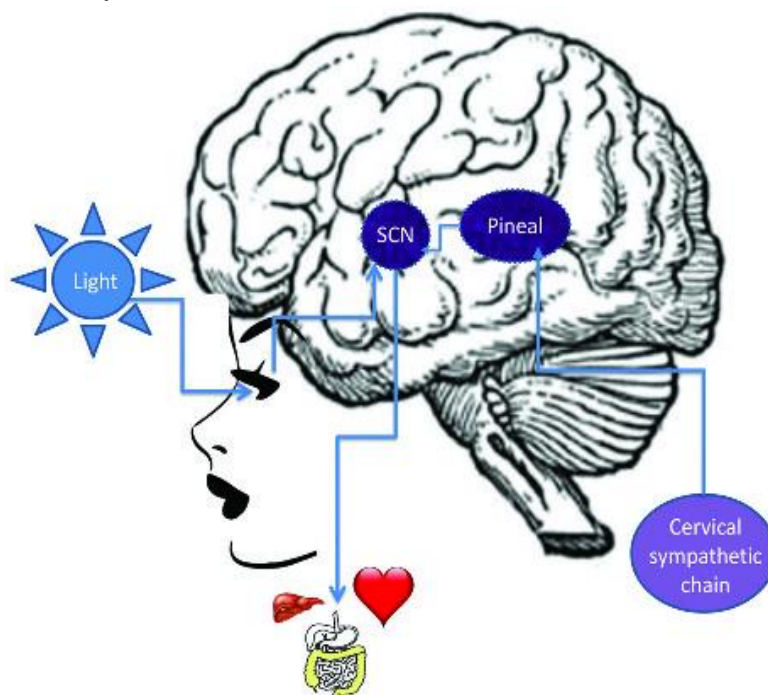


Figure 1. The mechanism of light in the regulation of circadian rhythms
Sumber: Pavlova, 2017.

4. Circadian Rhythm Sleep Disorders (CRSD)

Based on International Classification of Sleep Disorders (ICSD), CRSWD diagnosis can be confirmed if there were three criteria as follows:

(1) Further sleep-wake rhythm disturbances which often called circadian rhythm sleep-wake disorders (CRSWD) occurred at least 1 month (chronic) due to changes in the endogenous circadian time system or misalignment between endogenous circadian rhythms and sleep-wake schedules needed by the physical, social environment, and an individual's employment.

(2) This circadian rhythm disturbance could lead to insomnia at night, excessive sleepiness in the morning or during the day or both.

(3) Sleep and wake disorders caused significant clinical, physical, social, occupational, educational, or other important mental disorders.

However, the classifications of sleep-wake circadian rhythms (CRSWD) based on endogenous factors were delayed sleep-wake phase disorder (DSWPD), advanced sleep-wake phase disorder (ASWPD), non-24-hour sleep-wake rhythm disorder (N24SWRD), and irregular sleep-wake rhythm disorder (ISWRD). This endoge-

nous disorder was caused by homeostatic changes in the body, changes in digestive functions such as changes in meal times, quantity of food, and composition. In addition, the interference could also be caused by exogenous factors, among others: Shift work disorder (SWD) caused by changes in sleep time due to work or school schedules that require staying awake at night or during regular rest periods, and jet lag disorder which was a disorder caused by significant time differences such as travel across the countries or continents (Wichniak *et al.*, 2017).

Thus, CRSD was very likely to occur to nurses who would always get a night shift and must be awake all night.

In addition, CRSD could also be determined by measuring melatonin levels. In sufficient conditions of the light, the melatonin was secreted at 9:00 and 10:00 pm with the maximum level in the adult plasma by 60-70pg/ml (reached at 2.00 and 4.00 am. Melatonin secretion substantially decreased at 7.00 and 9.00 am (Zawilska *et al.*, 2009).

DISCUSSIONS

1. The Risk of CRSD and its Potensial Relationship with EI Nurse Negligence

Untreated CRSD could lead to a variety of physical, psychological, and behavioral disorders (Phyllis *et.al*, 2013). Physical disorders that could occur include: rheumatoid arthritis, asthma, coronary heart disease, cardiac arrhythmias, hemorrhagic and ischemic strokes, epilepsy, headaches, gastric and duodenal ulcers, gastroesophageal reflux, and biliary colic (Silvertsen *et al.*, 2017).

Previous research has reported that sleep disorders could be one of the symptoms and risk factors for Alzheimer's disease, insomnia, menstrual disorders in

women, and dementia (Brzecka *et al.*, 2018).

Emergency Installation (EI) was the patients' main access to the first treatment with various levels of emergency cases in the hospital (Emergency department, 2018). The EI was a room with overcrowded conditions, according to The College of Emergency Medicine (2012), this was affected by a variety of factors including the large number of health personnel from various multi-disciplines, variations in levels of gravity, high demands of the community, work stress, high workload, and the level of patients' dependence in nursing care.

If the condition was occurred for a long time, the nurse would get tired easily, depressed, and cannot handling the patient properly (Cole, 2011). According to Afleck *et al.* (2013), this over-crowded situation was one of the factors that worsened the quality of treatment given by the nurses to patients in the EI. This condition would adversely affect patients' safety, comfort, and satisfaction.

Nurses who used their night time to work and sleep at day time were more likely to experience CRSD and it can caused health problems such as increasing the risk of heart disease, gastrointestinal disorders, and chronic fatigue. This chronic fatigue was a severe fatigue in the body that would affect other diseases, reduced appetite, and also can reduce the nurses' motivation (Carole *et al.*, 2008).

Previous study has reported that women were more likely to experience CRSD than men, with a ratio of 5.7 times for women and 3.7 times for men (McNeely *et al.*, 2014).

2. CRSD Diagnosis due to Exogenous Work Shift Factor

Of the various types of CRSD caused by exogenous factors, night shift work was the

most common reason stated by the subjects. Almost 20% of professional workers experienced irregular night shifts and around 10-40% experienced shift work disorders (Becker *et al.*, 2015).

This diagnosis was confirmed if all these following criteria were found:

- (1) Insomnia and/or excessive sleepiness along with a reduction in sleep time due to working with the shift system.
- (2) Symptoms which continued to occur for at least three months with the work shift system.
- (3) Sleep log and monitoring of actigraphy (if possible along with a measured light exposure test) of at least 14 days of working and holidays indicated sleep disorder.

Biological assessment such as: dim light melatonin onset (DLMO) was found in low levels of 6-sulfatoxymelatonin in urine (Morgenthaler *et al.*, 2007).

3. CRSD Management Guidelines due to Work Shifts

Several steps and principles for CRSD handling due to work shifts according to Morgenthaler *et al.*, (2007), among others:

- (1) Sleeping for about 30 minutes before going to work after 6-7 hours of long sleep can be useful to reduce the risk of accidents at work, and significantly improved physical and psychological performance.
- (2) Looking for a bright location in working time, because light could give a response to the SCN to keep people awake.
- (3) After finishing the work at night, go home and darken or dim the lights to help people to sleep quickly, it would be better to wear dark glasses during the trip home in order to avoid adequate sunlight.

- (4) The enhancement of sleep quality could also be done by giving a low dose of 0.5-3 mg of melatonin per day.
- (5) Resetting the sleep schedule, for example, if the work was started before 10 pm (for 8-hour shift) then people need to sleep at 7 am - 8 pm or 2 pm - 9 pm, then wake up and try to get a short sleep (30 minutes before work).
- (6) If it was required to take a higher dose of melatonin, which was 3-5 mg, it must be given 3 hours before the scheduled bedtime. During this particular time, bright light must be avoided.

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