

Influence of Circadian Rhythm on Human Psychology and Its Management

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ABSTRACT: Circadian rhythms are ubiquitous phenomena that recur daily in a self-sustaining, entrainable, and oscillatory manner, and orchestrate a wide range of molecular, physiological, and behavioural processes. The biological clocks in our body work in perfect harmony with one another and with a central clock that is always linked to the external world, allowing us to live in harmony with it. For the treatment and management of psychological disorders need the knowledge about circadian rhythm to the balance of health/disease at home or in the medical context. The coordination of human activities with their circadian clocks has been significantly affected by modern lifestyles. Anytime the 24h (day-to-night) circadian rhythm is disrupted or disturbed, hence there are corresponding psychological and physiological effects on health. This review article we discuss how the disturbance of these circadian rhythms (day-night cycle) may result in the development of several psychiatric illnesses in humans and offers some preventative approaches. We also summarize the current understanding of circadian rhythms with their influence on physiology and Psychology. By this review, we tried to give informative knowledge about current understanding of circadian rhythms and its influence on physiology, pharmacology, and therapeutic interventions, that will not only use for pharmacy field person but also for society who unaware about day-night cycle.

KEYWORDS: Circadian rhythms; Day night cycle; Disease; Health; Psychology.

I. INTRODUCTION

The name "circadian" derives from two Latin words: *circa* refers to about, and *dies* refers to "day" [1]. The biological/circadian clock, also known as circadian rhythm, is a term used to describe changes in behaviour, physiology, psychology, and molecular structure that occur in cycles of around

24h (one day). It controls the sleep-wake cycle and completes one cycle every 24h. [2]

When we considered the historical point of view of circadian rhythms, was first documented by French astronomer, geophysicist and chronobiologist Jean-Jacques d'Ortous de Mairan. He observed biological timekeeping in 1729 and discovered that the *Mimosa* plant's leaves moved with a 24h periodicity. He was also exposed to these plants to constant darkness and observed and recorded behavior patterns and noted its conclusion. From bacteria to plants to people, living species all demonstrate cycles in their behavior and physiology across timescales as little as seconds (such as heart pace-making cells) and as long as months (such as seasonal oscillators). At the molecular, behavioral, and cellular levels, circadian rhythms are observed as 24h oscillations in biological mechanism. [3] Every research study demonstrated and made evident that human circadian rhythms are significantly influenced by the time of a range of various activities and circadian patterns. Such patterns are: (i) waking up and leaving the bed (ii) exposure to light, especially to light with a "blue" spectral range (which has the most potential to suppress melatonin secretion) (iii) exercising and engaging in some physical activities, with durational effects also; (iv) eating patterns and schedule (v) Social interaction and professional interests (vi) Activity at night (before sleep) and the corresponding timing of sleep onset. [4]

II. DISRUPTION OF THE SYSTEM OF CIRCADIAN RHYTHMS AND HUMAN HEALTH IMPLICATIONS

De-synchronization and disruption of the circadian rhythm occur when internal oscillations are out of phase with the surrounding environment. We refer to this as a circadian disturbance. It results from circadian rhythm loss caused by the dysregulation of clock genes, or by the circadian

misalignment of external and internal clocks. [5] Function is disrupted until the rhythms are realigned when body rhythms collide with those in the environment. Circadian genes are expressed cyclically to regulate circadian rhythms or the body clock, and mutations in these genes can alter or disturb the circadian oscillator. As a result, the disruption of the circadian rhythm is caused by genetic factors (polymorphisms in the core clock genes) and environmental aspects (i.e., artificial night-time light), which raises the risk of developing diverse metabolic syndromes, some chronic and acute illnesses, and disturbances in hormone release. Since melatonin rhythm is influenced by light signals, exposure to light at an inappropriate time prevents melatonin from being produced when it should. Furthermore, it has been shown that low-frequency electromagnetic waves from electrical devices and power lines interfere with the generation and release of melatonin, which affects melatonin cycles and disturbs our circadian rhythms. [6]

III. MECHANISM OF CIRCADIAN RHYTHM

The circadian clock is composed of two parts: The first is the central clock, which is found in the hypothalamic SCN (suprachiasmatic nucleus). The SCN functions as the brain's primary pacemaker, directing the circadian rhythm that is influenced by light signals, and the peripheral clocks found in different body tissues. In each of their distinct tissues, the peripheral clocks serve a vital, significant, and special role that regulates the circadian expression (cycles) [7]

The suprachiasmatic nucleus coordinates the timed rhythms in other parts of the brain and across the body where the rhythms in the brain are included in the production of hormones and peptides. The circadian rhythms in the body and the brain may be affected by environmental variables including stress and food. [8] The way the circadian system performs its functions must be taken into account in connection to three different levels of informational and operational organization. The first is the process by which the external environment conveys (or "Inputs") significant details to the internal "master" clock, which is housed in the SCN of the brain, relating to the separation of the night from day. The second category of brain components is called "Intrinsic," and it consists of the master clock and its associated regulatory mechanisms (ex, the melatonin secretion from the pineal gland). These affect the onset of sleep, the structure of

sleep, the sleep-wake cycle, and other behavioral changes that are influenced by the CNS. The third is the coordination of all other metabolic, hormonal, thermoregulatory, autonomic nervous, physiological and immunological processes by the circadian system or cycle to maximize the connections between behavior patterns and vital functions of the body. [9]

IV. MELATONIN AND COMMUNICATION THROUGH PINEAL GLAND:

From the outlook of the circadian system, the pineal gland, which regulates the daily melatonin release pattern, is one of the main outputs of the suprachiasmatic nucleus. Melatonin release is strongly inhibited during daylight hours by light exposure, which is detected by the eye and signalled by the suprachiasmatic nucleus. Two to three hours before the start of routine sleep, melatonin release increases quickly in response. (Typically mid-evening) Melatonin, in particular, helps to promote appropriate sleep pattern and coordinates behavioural as well as physiological elements of sleep. Melatonin then blocks the circadian signal to increase wakefulness by feeding back straight into the suprachiasmatic nucleus. Additionally, it competes with the behavioural and serotonergic stimulating effects of the sleep phase. Melatonin then inhibits the circadian signal for increasing wakefulness by feeding back directly into the SCN. Additionally, it competes with the serotonergic inputs to the SCN's activating actions. Thus, endogenous melatonin contributes significantly to the maintenance of the body's daily cycles. The connections between melatonin and clock genes seem to affect some of these chronobiotic effects. [10]

V. SLEEP/WAKE CYCLE AFFECTS HUMAN BEHAVIOUR AND PSYCHOLOGY:

The most important external factor that affects sleep is light. The majority of people are aware that it's simpler to fall asleep when it's dark outside, but there is more to the connection between sleep and light. The body's biological clock regulates when to sleep and when to be awake and light plays a key part in controlling the circadian rhythm. Melatonin is a crucial hormone that aids in the promotion of sleep, and light has a significant impact on its synthesis. While research suggests that human biology evolved to sleep following the daily cycles of sunlight and darkness, the availability of

power ensures that there is always light. The artificial light that illuminates houses and the night sky, whether it comes from streetlights, workplace lighting, or mobile phones, is a constant in modern life. The sleep/wake cycle sometimes referred to as circadian rhythm, is the pattern of day and nighttime alertness and drowsiness at regular intervals. SCN are sensitive to light, as we already mentioned. The eyes will notice the body's fatigue when it is dark at night by sending a signal to the thalamus. Thus, the SCN instructs the body to produce the hormone melatonin, which causes the body to become fatigued. Having a regular or precise time sleep pattern allows CR to perform at its finest. The interruption of the CR's normal rhythm may cause emotional disturbances, cognitive deficiencies, and even metabolic stress. As all hormones associated with functions are coupled or interconnected with SCN, this results in such psychiatric disorders. [11] According to research studies, Major Depressive Disorder (MDD) individuals have problems falling asleep and staying asleep 90% of the time, which alters their sleep patterns. Likewise, disruption and inconsistency of the sleep/wake cycle are the causes of manic episodes in people with bipolar disorder. According to these results, one of the major treatments in the process of helping people with mood problems is making sure they get steady, sufficient sleep. [12]

In a paper that was published in the journal *Translational Psychiatry*, the group claims that circadian rhythm disruption (CRD) is a psychopathology factor that is present in a variety of mental health disorders (psychiatric) and that learning more about the molecular mechanisms underlying the sleep/wake cycle (CR) could lead to the development of novel patient therapies, treatments, and management strategies.

The neurophysiology of wakefulness and sleep is controlled by how the arousal-promoting systems in the brain are affected by the sleep-promoting neurons in the anterior hypothalamus and the sleep-inhibiting neurons in the posterior and lateral hypothalamus. Excitatory neurotransmitters like serotonin, noradrenaline, acetylcholine, and histamine are produced during the waking state in the midbrain, basal forebrain, and brainstem regions. The release of inhibitory neurotransmitters like GABA from the VLPO (ventrolateral preoptic nucleus) is reduced. [13]

VI. CIRCADIAN RHYTHM ON MOOD AND PSYCHOLOGICAL DISORDER:

Disturbance of circadian rhythm because of abnormal sleep/wake cycle consists of psychological illness such as change in behavior pattern, and disturbance of mood that produces psychological disease. Some major psychiatric diseases are described below which cause the concept of the circadian rhythm.

1. Circadian rhythm associated with bipolar disorder and mood:

The major symptoms of bipolar disorder include variations in mood, vitality, performance, and capacity to carry out a variety of activities. In today's research papers, the link between the disturbance of the circadian rhythm and bipolar disorder (BD) is also well established. [14] Positive affect and negative impact are two categories for the emotional state of feeling known as mood. Sleep disturbance disrupts circadian physiology, which in turn worsens the atypical pattern of neurotransmitter releases. The mood is simultaneously correlated with the neurotransmitters the limbic system of the brain secretes. [15]

2. Circadian rhythm associated with depression:

According to research, circadian rhythm disruption may induce depression in two ways: first, it can produce neurobiological dysfunction because of the circadian system's instability, and second, it can make depression worse by interfering with the body's regular sleep-wake cycle. [16] Insomnia is a significant symptom of MDD and is caused by circadian rhythm disruption. Because insomnia is a risk factor for escalating stress and is reported by between 80% and 90% of people who are depressed, according to a study.¹⁷ Recent studies and investigations have shown an association between the severity of severe depressive signs in people with the misalignment of circadian rhythms. [18]

3. Circadian rhythm associated with Schizophrenia:

Since circadian disruption has been shown to enhance negative mood, irritability, and emotional instability in healthy adults, schizophrenia may also be vulnerable to SCRD. [19] Schizophrenia is a serious mental disorder that is marked by irrational or contradictory thinking, odd behavior, and weird speech. It may also cause hallucinations and delusions. Additionally linked to the interruption of Circadian rhythm is schizophrenia. As high as 80% of schizophrenia patients were shown to have SCRD (sleep and circadian rhythm disruption), which has been described as a defining feature of the condition.[20] According to recent research, the majority of sleep

disruptions in schizophrenia patients seem to be due to irregularities in the circadian system, as shown by the misalignment of the sleep-wake cycle and the endogenous circadian cycle.[21]

4. Circadian rhythm associated with cognitive activities:

This skill is necessary for carrying out cognitive tasks including keeping focus, adhering to instructions, developing performance, carrying out multi-step procedures, complex reasoning, and multitasking. Several scientists and psychologists concur that variations in working memory capacity may account for more than half of the variation in general intelligence among people. In reality, it gives us mental space where we may store knowledge while still occupying our minds with other things. Persons with attention issues, concentration issues, learning challenges, stroke patients, and people who have had traumatic brain injuries may have WM deficiencies.[22]

Even though people with Delayed SWPD (Sleep-Wake Phase Disorder) performed worse on cognitive tests than excellent sleepers, Richardson et al. (2018) found no correlation between working memory impairment in youths with Delayed SWPD and good sleepers. Despite this, individuals with delayed SWPD did generally perform worse than those who had a satisfactory night's sleep in terms of thinking, organization, focus, and daily functioning. [23]

5. Circadian rhythm associated with sleeping problems:

A circadian rhythm sleep disorder, as described by the International Classification of Sleep Disorders, is a recurrent or persistent pattern of sleep disturbance that is mainly caused by "alterations of the circadian timing system." The inability to fall asleep without frequent delays is a symptom of delayed sleep phase disorder. This delay often occurs more than two hours beyond the time that is preferred or considered to be socially acceptable for going to bed. Patients with delayed sleep phase disorder are categorized as "evening types." Difficulty falling asleep before 2-6a.m. and a preference for waking periods between 10 and 1 p.m. are clinical symptoms of DSPD [24]

When compared to desirable or socially acceptable standards, people with ASPD (Advanced Sleep Phase Disorder) often sleep and wake up several hours early. The sleep cycle is often stable. When they arise between two and five in the morning, patients with ASPD often go to sleep between six and nine in the evening. The term

"larks" or "morning types" is occasionally used to describe people with ASPD [25]

6. Jet lag Results from rapid time zone switching, which temporarily changes the external environment with the timing of the internal circadian cycle. Jet lag symptoms include exhaustion during the day, sleepiness at night, mood swings, insomnia, and difficulty in concentration, overall malaise, and gastrointestinal issues. Once the traveler has adapted to the new time zone, symptoms often go away in a few days. The travel direction, the time zones, and a person's vulnerability to jet lag are the three main variables that affect how severe it will be. Travelling eastward often requires more adjustment than travelling westward. Because the circadian sleep pattern lasts for more than 24h, moving eastward necessitates a sleep phase advance, which is more challenging than a sleep delay. [26]

7. The term "shift work" refers to irregular and flexible work patterns. These may vary from occasional night shift employment or on-call jobs to regular night shift work. Schedules that demand nocturnal sleepers to arise in the early morning are also mentioned. Although shift workers often complain about sleep issues, not all of them have symptoms that are severe enough to affect their ability to function at work and in their social lives. People react differently to shift work depending on their age, employment schedule, personal and family commitments, ability to plan, and preferred waking hours. [27] Sleep problems are quite prevalent in young individuals who have been diagnosed with neurological (psychological) illnesses, as was mentioned. Since many elements of mood and cognition are strongly influenced by circadian rhythms, some of these sleep disorders may be caused by variations in circadian rhythm, which may also be important in and of themselves. According to the findings of the Hthatence research, chrono type is linked to characteristics and actions that may be significant for psychopathologies, such as higher aggression, emotional vulnerabilities, risky actions, and antisocial conduct. [28]

VII. TREATMENT OF CIRCADIAN RHYTHM PSYCHIATRIC DISORDER:

All psychiatric disease is greatly associated with sleep and wake pattern (circadian rhythm). Hence for the management of psychiatric disorders adjustment of sleep patterns is an important consideration.

1. Chronotherapy:

Depending on the kind and severity of the problem, this therapeutic method gradually increases or delays sleep duration (3h every two days). Since it can take weeks to effectively change the sleep-wake cycle, this type of therapy necessitates a strong commitment from both you and your partner. [29] You must adhere to this regular sleep-wake pattern after the ideal schedule has been reached. Chronotherapeutic refers to non-pharmaceutical therapies intended to limit exposure to environmental signals from the outside world that affects biological rhythms. Interventions in chronotherapy are based on circadian rhythms, which control a number of biological processes on a cycle of almost 24h. The functioning of biochemical and physiological systems, including the activity of the emotional state and the sleep-wake cycle, are altered by circadian rhythms, which also cause biological cycles. These rhythms control and coordinate neurotransmitters, body temperature, hormone release, and daily stability under predetermined patterns. The SCN, often called as the circadian pacemaker, may contain significant levels of melatonin and serotonin receptors. Chronotherapy tries to resynchronize circadian cycles to balance these neurotransmitter systems. Indeed, studies have shown that this kind of treatment has a beneficial effect on depression symptoms. [30, 31]

2. Bright light therapy:

In studies on circadian rhythms, it was shown that melatonin production in humans may be inhibited by strong light because photoperiod was coded by the biological clock into the nocturnal melatonin secretion duration signal. Many mental sleep disorders may benefit from melatonin's modest soporific properties. The use of bright light treatment may either promote or inhibit sleep. This therapy must be administered at the right time, and a sleep specialist's advice is necessary. Bright light treatment always works by resetting the circadian clock to better align with the earth's cycle of dark and light. This treatment requires exposure to high-intensity light, which must be used between one and two hours every day. It is based on sleeping habits. If you have a problem with a delayed sleep condition, strong light exposure in the early hours of the day may be helpful. By decreasing interior lighting and avoid brightness of cellphone, TV, and computer displays in the evening and at night, we should likewise reduce our light exposure. If you have a severe sleep problem, bright light exposure in the evening might be good. Manage your light

exposure. The biggest environmental indication for resetting your sleep-wake cycle is light. You might require more natural light throughout the day and less nighttime artificial light from TV screens and other electronics. Melatonin levels may be lowered by artificial light, which makes it more difficult to fall asleep. You may reduce the brightness of your electronic gadgets by using smart phone applications, light-blocking glasses, or screen filters. Before going to bed, dim illumination may also help lessen symptoms of circadian rhythm disorder. When you are outdoors during the day, wearing light-blocking glasses may be helpful for shift workers. There is growing fact that morning BLT is safe as well as effective for treating depression in BD, and that it is a viable option for both psychopharmacology and psychotherapy to treat adults with depression. Research on phototherapy for bipolar illness has shown that the disease is treatable with this therapy. [32, 33]

3. Lifestyle, and behavior therapy:

As mental illnesses have a larger role in overall health, both the number and kinds of lifestyle disorders are growing. [34] this strategy aims to promote improvements in sleep quality and the formation of healthy sleeping patterns. Maintaining regular sleep-wake times primarily entails avoiding daytime sleep (with the exception of shift workers), maintaining an exercise routine (avoiding high-intensity exercise within 1h of bedtime), and abstaining from alcohol, nicotine, caffeine, and stimulating activities few hours before bed. Maintain a regular and timed meal plan while taking into account the precise interval, which has regular shift workers or sleeps at random times of the day or night. Try to find a cool, peaceful area to sleep in, and adopt a stress-free nighttime routine. These are some habits you may adopt regularly to sleep better and fall asleep more quickly. Circadian rhythms are affected by a wide range of variables, including lifestyle choices, biological molecules, and geological occurrences. [35]

VIII. CONCLUSION

For healthy lifestyle and wellbeing of human being circadian rhythm is essential to keep it well-entrained with environmental signals such as natural light and social cues. Psychological changes can be observed from and markers which are, major depressive disorder (MDD), bipolar disorder (BD), anxiety and behavioral alterations is because of The de-synchronization or disturbance of the circadian rhythm(sleep/wake cycle) . Thus, when the natural

circadian rhythm is disrupted due to work adjustment and alteration of the in activity, it can seriously impact circadian timing systems resulting sleep disruption that can cause physiological and psychological stress. Hence it's important to know and aware about circadian system (internal or external clock) of our body to live with good mental and well body condition.

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