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Ayurvedic perspective of Circadian Rhythm

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ABSTRACT

Background: Biological rhythms are the natural cyclical changes in our body, in which researches mainly focuses on circadian rhythms. Body processes vary according to adaptation of solar and lunar related rhythm. Ayurveda explains this on the basis of cyclic rhythm of *Tridoshas*. The *Doshas Kapha, Pitta* and *Vata* maintain the integrity of our body, like *Soma, Surya & Anila* maintaining the integrity of the terrestrial world. **Aims and Objectives:** This review paper aims to understand the concept of circadian rhythm in Ayurvedic view and its application in the prevention and management of disorders. **Materials and Methods:** Literature search were carried out in Classical texts of Ayurveda and Modern system and relevant databases. Total 8969 articles were found, among them 89 relevant articles were taken, of which abstracts and full paper of the most relevant and freely downloadable articles were reviewed. **Results and discussion:** This review clarified that, diet and lifestyle regimens mentioned in Ayurveda aims to maintain the diurnal and seasonal variations of doshas. Deviation in this rhythm lead to many disorders. **Conclusion:** We can maximize our health, mental alertness and immunity by proper alignment of circadian rhythm by following methods like *Dinacharya, Ritucharya*, proper *Ahara* and *Nidra, Ritusodhanas* etc.

Key words: Biological rhythm, Circadian rhythm, Ayurveda, Dinacharya, Ritucharya.

INTRODUCTION

All the physiological processes in our body, as well as disease processes, follow rhythmic variations in response to time and environmental factors. As per *Loka Purusha Samya Siddhanta*^[1] 'Man is a tiny replica of the Universe' and so all the changes in the environment affects human beings, since everything is derived from *Panchamahabhutas*.^[2] In Ayurveda, the cyclical variations are based on the rhythm of *Tridoshas, Agni, Sharira Bala* etc. with respect to age,

time of the day, seasonal changes, food intake etc. Ayurveda has described *Dinacharya, Ritucharya, Sadvritta, Ahara Vidhis* etc. to balance the rhythmic fluctuations of *Doshas* in a normal state. Deviation from this normal rhythm leads to various physical and mental illnesses. Proper alignment of this rhythm is essential for the maintenance of health.

In modern terms, all the physical, mental and behavioral cyclical changes in the functioning of our body are termed as biological rhythms. There are 3 main rhythms based on the length of a single cycle - circadian, infradian and ultradian. Although many biological rhythms have been identified, researches mainly focus on circadian and circannual (seasonal) rhythms. Studies have stated that the same neuroendocrine mechanisms are responsible for circadian and circannual (seasonal) rhythms. Circadian rhythm is a 24-hour cycle responding to light and darkness in the physiological process of living beings eg: sleep wake cycle, temperature regulation etc. Body functions like Sleep-wake cycle, body temperature regulation, activities such as eating and drinking, hormonal and neurotransmitter secretion

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etc. are regulated by Circadian cycle. The circadian cycle is controlled by a part of the hypothalamus called the supra-chiasmatic nucleus (SCN), which is the master center for integrating rhythmic information and establishing sleep patterns. Cyclical fluctuations of melatonin, produced by pineal gland, are also vital for maintaining a normal circadian rhythm.^[3]

AIM AND OBJECTIVES

This review paper aims to understand the concept of circadian rhythm in Ayurvedic and modern view, its physiological and pathological aspects, its role in the prevention and management of such disorders.

MATERIALS AND METHODS

Literature search were carried out in Classical texts of Ayurveda, and Modern system and relevant databases like Google Scholar, PubMed, Ayush portal etc. Search revealed a total of 8969 articles, among them 89 relevant articles were taken, of which abstracts and full paper of some most relevant and freely downloadable articles were reviewed

REVIEW OF LITERATURE

Doshic Rhythms

Physiological variation of *Dosha* according to factors like, age time of day, and time of digestion is shown in table no. 1.

Table 1: Variation of *Doshas* in normal state^[4]

SN	Variables	Vata	Pitta	Kapha
1.	Site	Below <i>Nabhi</i>	Between <i>Nabhi</i> and <i>Hridaya</i> .	Above <i>Hridaya</i> .
2.	Age	<i>Vridhavastha</i>	<i>Youvana</i>	<i>Balyavastha</i>
3.	Day	<i>Aparahna</i>	<i>Madhyahna</i>	<i>Poorvahna</i>
4.	Night	<i>Apararatri</i>	<i>Madhyaratri</i>	<i>Poorva ratri</i>
5.	Stage of digestion	End of digestion	During digestion	Beginning of digestion

Physiological status of *Dosha*, *Agni* and *Sharira bala* according to season is shown in table no. 2.

Table 2: Status of *Dosha*, *Rasa*, *Agni* and *Bala* according to season^[5]

Ritu	Dosha status	Agni Status	Bala
<i>Shishira</i>	<i>Kapha - Chaya</i> <i>Vata - Kopa</i>	<i>Teekshna</i>	<i>Pravara</i>
<i>Vasanta</i>	<i>Kapha - Prakopa</i>	<i>Madhyama</i>	<i>Madhyama</i>
<i>Greeshma</i>	<i>Vata - Chaya</i> <i>Pitta - Prakopa</i> <i>Kapha - Prasama</i>	<i>Manda</i>	<i>Avara</i>
<i>Varsha</i>	<i>Vata - Prakopa</i> <i>Pitha - Chaya</i> <i>Tridoshakopa</i>	<i>Manda</i>	<i>Avara</i>
<i>Sharat</i>	<i>Vata - Prasama</i> <i>Pitta - Prakopa</i>	<i>Madhyama</i>	<i>Madhyama</i>
<i>Hemanta</i>	<i>Vata - Chaya</i> <i>Kapha - Chaya</i> <i>Pitta - Prasama</i>	<i>Teekshna</i>	<i>Pravara</i>

Ritubhavas in a day^[6]

Susrutacharya has mentioned that these *Ritubhavas* can be seen in a day itself and the states of the *Dosha* at that particular time will be in accordance with that *Ritu*. It is shown in table no. 3.

Table 3: *Ritubhavas* in a day

Dina	Ritu	Doshaavasta
<i>Poorvahna</i>	<i>Vasantha</i>	<i>Kaphaprakopa</i>
<i>Madhyahna</i>	<i>Greeshma</i>	<i>Pitta Chaya</i>
<i>Aparahna</i>	<i>Pravrit</i>	<i>Vataprakopa</i>
<i>Pradosha</i>	<i>Varsha</i>	<i>Pitta Chaya</i>
<i>Madhyaratri</i>	<i>Sharath</i>	<i>Pitta Prakopa</i>
<i>Pratyusha</i>	<i>Hemanta</i>	<i>Pitta Samana</i>

Factors influencing Circadian Rhythm

Dinacharya, *Ritucharya*, *Sadvritta*, rules for *Ahara* and *Nidra* etc mentioned in Ayurvedic classics aim to maintain normalcy of *Doshic* rhythms.

Dinacharya^[7]

Nature moves in cycles day to night and winter to spring. The movement of Sun is responsible for this diurnal and seasonal variations. As the human beings are a miniature forms of Universe, they should follow these changes by adjusting their routines to keep themselves healthy. *Dinacharya* includes all the daily activities starting from waking up at *Brahmamuhurtha* to sleep, to keep a balance of daily rhythm of *Doshas* and thereby regularizes a person's biological clock, aids digestion, absorption and assimilation, and generates self-esteem, discipline, peace, happiness, and longevity.

Ritucharya^[8]

The seasonal changes are very evident in the environment which affects rhythm of tridosha also, and it is manifested as *Sanchaya* (Stage of Accumulation), *Prakopa* (Stage of Aggravation) and *Prasama* (Stage of suppression of vitiated *Doshas*): This can lead to an internal imbalance, which in turn leads to various physical and mental disorders. *Ritucharya* (seasonal regimen) are various rules regarding diet and lifestyle to acclimatize the changes happening in nature as per different seasons, without altering the body homeostasis. Researches proved that, failure of the circadian cycles to properly adapt to the change in the length of the day as the seasons progress, results in mood disorders SAD (Seasonal Affective Disorders).

Sadvritta^[9]

The word *Sadvritta* means good behavior or habits which help in maintaining a healthy body, mind, sensory perceptions and soul. By following these codes of conducts, social, emotional, psychological, personal, spiritual and ethical aspects of life can be maintained. For an illustration, a) *Vyavaharika Sadvritta* includes, speaking truth always, not getting addicted to sensory pleasures, etc. b) *Samajika*

Sadvritta includes Speaking softly, Speaking politely with teachers, elderly, intelligent people, etc. c) *Manasika Sadvritta* - understand the real divine, One should not live under continued grief, One should always be confident etc. d) *Dharmika Sadvritta* includes, worshiping gods, cows, Brahmins, elderly people and teachers, honouring fire, etc. e) *Sharirika Sadvritta* includes Application of oil to head, ear, nose and feet, Cutting nails and hair thrice a fortnight etc. In *Charaka Samhita Chikitsasthana Rasayanadhyaya*, *Aachara Rasayana* has been explained which includes the mental hygiene to be followed to lead an ideal ethical way of living. It includes truth, nonviolence, personal and public cleanliness, mental and personal hygiene, devotion, compassion, and a yogic lifestyle.^[10]

Ahara and Nidra

Ahara, *Nidra* and *Brahmacharya* are the *Thrayopasthambas*. Among these *Ahara* is the essential factor responsible for strength, complexion, growth and full span of life. *Ahara* means a balanced diet. One should consume food according to the *Ahara niyamas* mentioned in our classics for the proper digestion and good health. The factors which should be considered while taking *Ahara* include *Matra*, *Desa*, *Kala* (includes both *Nityaga* and *Avasthika*), status of *Agni* etc to maintain a normal rhythm.^[11] *Acharya Charaka* has said that *Ahara* is the root cause of health and diseases.^[12]

For the maintenance of health, sleep also has equal importance as that of diet. Even though a daily routine process, by following *Nidra* in a proper way, the well-functioning of both *Shareera* and *Manas* can be maintained. Proper and improper sleep is necessary for Happiness, misery, nourishment, emaciation, strength, weakness, virility, sterility, knowledge, ignorance, life and death. In Ayurvedic classics 7 types of *Nidra* are mentioned, and among them *Ratriswabhavaprabhava Nidra* is the natural phenomenon which brings health if followed adequately and properly.^[13] Sleep-wake cycle is one of the most important and well-known circadian rhythms. In terms of modern physiology, sleep

maintains metabolic caloric balance, thermal equilibrium, immune competence, learning and memory consolidation. Healthy body requires proper hours and good quality sleep. Poor quality sleep is a major factor causing progression of various diseases, including lifestyle disorders.^[14]

Derangement in Circadian Rhythm

The factors leading to derangement in circadian rhythm include *Vega Dharana* and *Udeerana*, malfunctioning of *Agni*, and improper *Ahara* and *Nidra* etc.

Vegas are of two types. 1. *Adharaneeya Vegas* - Those urges which should not be suppressed, and if suppressed will manifest disease symptoms. 2. *Dharaneeya Vegas* - Those urges which should be suppressed and if not suppressed will manifest disease symptoms. The thirteen *Adharaneeya Vegas* include *Mutra*, *Purisha*, *Shukra*, *Apanavayu*, *Chardi*, *Kshavathu*, *Udgara*, *Jrumba*, *Kshudha*, *Trishna*, *Bashpa*, *Nidra* and *Shramaswasa Vega*. *Acharya Vagbhata* added *Kasavega* as *Adharaneeya Vega* instead of *Udgara Vega*. If these *Vegas* are not addressed timely, they may lead to diseases. *Dharaneeya Vegas* also called as *Manasika Vegas* are supposed to be controlled at will with perfect restraint over our senses. Those include *Lobha* (greed), *Irshya* (envy/jealousy), *Dweshha* (aversion), *Maatsarya* (competitive mentality), *Raga* (attachment), and the other emotions like *Kama* (lust), *Krodha* (anger), *Bhaya* (fear), *Soka* (grief), *Chinta* (anxiety) etc.^[15]

Samashana, *Adhyashana* and *Vishamashana* are the conditions occurring due to derangement in the intake of food, these conditions can lead to death or dreadful diseases. It has been described that, sleep and diet are the main causes of obesity and emaciation.^[16] Disturbed sleep, untimely sleep and excess sleep will affect the normal rhythm of the body and may lead to diseases.^[17]

Factors like Disturbance in lifestyle due to irregular sleep pattern and improper diet intake cause impairment in the *Ahara Parinamakara Bhavas* and circadian rhythm of digestive enzymes which leads to

manifestation of *Agnimandya*, which is the root cause of all diseases.^[18]

RESULTS AND DISCUSSION

Based on the content from the reviewed papers, the summary of methods in Ayurveda to be followed to maintain proper circadian rhythm and management of disorders caused by its derangement is as follows. By following proper diet and lifestyle regimen according to diurnal and seasonal *Avasthas* of *Doshas*, normal rhythmicity can be maintained. The diurnal and seasonal variations in our body are represented by *Doshic* rhythms, that means the normal variations of *Tridoshas* according to age, time of day, food timings etc. Many studies have proved the change in physiological entities depending upon age, diurnal variation, meal, season etc. As an example, for age wise physiological changes, it can be said that RBCs count, WBC count, Hemoglobin, Heart rate etc are more in childhood. Diurnal change can be observed as leukocytes are more in evening and less in morning etc. As an adaptation to timings of meals, it is noted that, Systolic blood pressure will be increased up to one hour after the meal. Also, during cold climatic conditions systolic and diastolic blood pressure will be more, and during warm climatic conditions blood pressure will be less.^[19]

Dinacharya advises the best times for our daily activities, such as waking, exercise, bathing, meditation, prayer, meals, study, work, exercises, and sleeping which are necessary to maintain a healthy body, mind, and soul. *Dinacharya* mentioned in Ayurvedic classics aim to maintain our circadian rhythms or internal body clocks, in order to keep normalcy of *Dosha*, *Dhatu*, *Mala*, and *Agni*. Chronodisruption is the impairment in circadian rhythms and leads to poor cognitive function, mood and sleep disorders, daytime sleepiness, reduced school and work performance, substance abuse, heart disease, diabetes, obesity, and some cancers.^[20]

Considering *Ritucharya*, diet and regimens of each *Ritu* has been mentioned by *Acharyas* according to the *Doshic Avasthas* in each *Ritu*.^[9] Researches also pointed that circadian rhythm and innate defense

mechanisms balances each other, because it is reported that WBCs and other blood cells seemed to be more in winter than in summer. In case of digestion also, there exists a rhythm in the functioning and abundance of enzymes and gut microbiome in relation to seasonal variations.^[21]

In Ayurveda, health is defined as "a balance between body, mind, spirit, and social wellbeing. *Sadvritta* mainly focuses on non-pharmacological preventive aspect of life which fulfills the primary objective of *Ayurveda*. The code of conducts aims to increase the *Sattva Guna* which increase the potency of body and mind. One who follows these conducts gains all benefits of *Rasayana* therapy without physically consuming any material and result in the modification of behaviors in order to reverse the disease process and keep in balance.^[22]

As every individual is unique, *Ayurveda* suggests one should take food according to each one's constitution, and as per certain rules called *Aharavidhividhanas*, *Aharavidhivisheshayatanas* etc. mentioned by *Acharya Charaka* and *Dwadasa Asana Pravicharanas* and *Ahara Vidhis* by *Acharya Susruta*.^[23] *Acharya Charaka* has opined that one should consume food only after the digestion of previous food to avoid bad impacts on health. The factors *Matra*, *Ahara Parinama*, etc. and even *Agni* depend upon both *Anna Kala* and seasonal variations. A person having *Samagni* should consume food twice daily.^[24] When diet gets appropriate time for digestion, it assimilates properly and gives productive result on positive health.^[25] The digestive system also has intrinsic rhythms that interact dynamically with circadian rhythms. Food appears to trigger specific circadian rhythm oscillators. Many hormones like ghrelin, leptin, corticosterone, insulin, glucagon, etc. oscillate in a daily fashion to start feeding. Disruption of these circadian rhythms may lead to digestive disorders, including reflux, ulcers, inflammatory bowel issues, irritable bowel disease, and gastrointestinal cancer.^{[26],[27]}

The ways and timings of sleep varies from person to person according to the age, constitution, seasonal

impacts and also health conditions. Modern science also considers proper and adequate sleep is necessary to stay healthy. Naturally night is described as a proper time for sleep. Sleeping during day time is only indicated in summer season because nights become shorter and *Vata* becomes aggravated in the body due to dehydration. Individuals with excessive *Medas*, those who regularly use unctuous substance, those with *Kaphaja* constitution, those suffering from disease due the vitiation of *Kapha* and those suffering from *Dushivisha* should never sleep during the day time. Unhealthy pattern of sleep includes improper timing, excessive sleep, diminished sleep, cessation of sleep etc. When properly aligned, a circadian rhythm can promote consistent and restorative sleep. But when there is an imbalance in this rhythm, it can create significant sleeping problems, including insomnia and many physical and mental health problem.^[28]

It is believed that *Agnimandya* is the root cause for all the diseases such as *Prameha*, *Sthaulya* etc.^[29] Researches have proved that there exists a gut-brain-endocrine axis which involves ghrelin-leptin hormones, insulin and orexins. Improper diet pattern, disturbed sleep pattern etc. can cause disturbance in this axis and leads to diseases such as obesity and diabetes mellitus which are the most common lifestyle disorders. According to estimates from various worldwide and domestic organizations, it is found that with the increase in the prevalence of lifestyle disorders in India, one out of four Indians is facing a risk of dying from diseases like diabetes, cardio-vascular ailments or cancer before the age of 70.^[30]

As per *Vagbhatacharya* majority of the diseases are manifested by *Vega Udheerana* and *Dharana*.^[31] Both the conditions lead to vitiation of *Vata* and this vitiated *Vayu* moves in undesired directions which leads to majority of diseases. Control of *Vata* is the key remedy for managing such types of diseases. In the present era, due to busy and stressful lifestyle and for achieving the big targets in short period, people are suppressing some or most of the natural urges of the body, which leads to various disorders. If the non-

suppressible *Vegas* are not suppressed, the centers of the limbic system (emotional brain) will get activated and leads to untimely release of neurotransmitters and thus results in a deranged rhythm of nervous system.^[32]

Causes for circadian rhythm variation and its impacts

The circadian rhythm may vary due to hereditary causes, external stimulus like light / seasons / temperature / ecosystem / high altitude etc. (termed as zeitgeber), Life style changes - shiftwork, sleep / wake cycle, food habits etc. Many astronauts and transoceanic flight travelers face a drastic shift in the circadian cycle, which leads to a certain period for readjustment, and may cause a lot of mental and physical fatigue, which is called phase shift or jet lag. Circadian Rhythm disruption can cause cognitive impairment, psychiatric illness, metabolic diseases like diabetes, dysplasia, hypertension, dyslipidaemia, cancer, etc.^[33]

Management of Circadian Rhythm Disorders

Normal rhythms of the body can be maintained by following proper *Ahara*, *Achara*, and *Nidra*.^[34] This can be achieved by following, *Dinacharya*, *Ritucharya*, *Ritusodhanas*, *Aharavidhi Visesa Ayatanas*, *Aharavidhi Vidhanas*, *Sadvrithapalana*, *Achara Rasayanas* etc. Digestive disorders can be managed by correcting impaired *Ahara Parinamakara Bhavas* (factors responsible for digestion) and circadian rhythm. In case of diseases, the normal rhythm of the *Doshas* can be brought back by doing procedures like *Sodhana* and *Samana* therapies, and administering internal medications according to *Bheshaja Kala* mentioned for each disease. *Satvavajayachikitsa* and *Yoga* helps to overcome ill effects of psychological disturbances.^[35] As per modern medicine also, the circadian disorders can be prevented by following a regular sleep-wake cycle and proper diet and lifestyle regimen. In case of such disorders, Behaviour therapy, Bright light therapy, Medications like melatonin, sleep aids etc are provided.^[36]

CONCLUSION

In the present era, due to the increased demand of shift working, circadian rhythm disharmonies contribute to various life style disorders and psychological illness. We can maximize our health, mental alertness, immunity, awareness, and physical strength by aligning our circadian rhythm by methods suggested by Ayurveda like *Dinacharya*, *Ritucharya*, *Ritusodhanas* etc. In Ayurveda, the timings mentioned for administration of medicines (*Bheshaja Kala*) in a diseased person is in accordance with the rhythmicity of *Doshas*. So, administration of medicine according to that can improve the effectiveness of a drug. By modifying the diet and lifestyle according to the nature of work and the work schedule of organization and also applying the knowledge of circadian rhythm in the fields like Chrono Pathology, Chrono pharmacology, Chrono therapeutics, Chrono exercises, Chrono therapy, Chrono dietetics etc. Ayurveda can help to overcome such disorders.

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