



AYURVEDIC PERSPECTIVES ON THE PHYSIOLOGY OF CIRCADIAN RHYTHMS

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ABSTRACT

Background: Circadian rhythms govern vital physiological, metabolic, and behavioral functions in alignment with environmental cues. Ayurveda, based on Loka-Purusha Samya Siddhanta, recognizes similar temporal patterns through Tridosha, Agni, and Sharira Bala. Disruptions in these rhythms can lead to disease and functional imbalance. **Objectives:** To explore the physiological relevance of circadian rhythms from both Ayurvedic and modern scientific perspectives, and examine the relationship between Dosha cycles and circadian biology. **Methods:** A comprehensive literature review was conducted using Boolean searches on PubMed and Google Scholar. Studies on Dinacharya (daily regimen), Rutucharya (seasonal regimen), and chronobiology were analyzed to identify correlations between Ayurvedic time-based concepts and biological rhythm mechanisms. **Results:** Ayurveda attributes time-specific physiological roles to Vata (movement), Pitta (metabolism), and Kapha Dosha (stability) affecting digestion, metabolism, and sleep-wake cycles. Modern science identifies the suprachiasmatic nucleus (SCN) as the body's master clock, regulating circadian rhythms. Disruptions due to irregular routines, stress, and lifestyle changes affect both systems, leading to metabolic, psychological, and immune disorders. Ayurvedic practices such as Dinacharya and Rutucharya help reestablish internal balance. Notable parallels between hormonal rhythms and Dosha dominance suggest an integrative potential. **Conclusion:** Circadian rhythm maintenance is essential for health. Ayurvedic time-guided regimens provide a structured approach to align internal functions with natural cycles. Integrating Ayurvedic and chronobiological principles can enhance systemic balance, immunity, and overall well-being.

KEYWORDS : Ayurveda, Circadian Rhythm, Dinacharya, Rutucharya, Suprachiasmatic nucleus, Sleep-wake cycle.**INTRODUCTION**

Rhythmic fluctuations in physiological and pathological processes are essential for maintaining the body's internal balance and overall health. Ayurveda, one of the oldest holistic medical systems, is grounded in the concept of Panchamahabhuta (Five Great Elements) Prithvi (Earth), Jala (Water), Tejas or Agni (Fire), Vayu (Air), and Akasha (Space) which form the fundamental building blocks of the universe and the human body.[1] Each element contributes distinct physical and functional qualities: Prithvi and Jala provide structure and fluidity, Tejas governs metabolic and transformative processes, Vayu controls movement and circulation, and Akasha represents space or the medium allowing interactions. These elements combine in specific proportions to create the three Dosha - Vata (Air and Ether principle), Pitta (Fire and Water principle) and Kapha (Earth and Water principle) which regulate all bodily functions.

The Ayurvedic principle of Loka-Purusha Samya Siddhanta (Theory of Universe and Human Being Equilibrium) explains that humans (Purusha) are a microcosm of the universe (Loka), meaning external environmental changes are inherently mirrored within the body, influencing internal physiological balance.[2] Consequently, fluctuations in environmental factors such as time of day, food intake, and seasonal transitions lead to dynamic shifts in the elemental and Doshic balance, creating rhythmic cycles in physiological functions.

Ayurveda recognizes these rhythms and promotes maintaining their harmony through time-based lifestyle practices like Dinacharya, Rutucharya, Sadvritta (Code of Ethical Conduct), and Ahara Vidhi (Dietary Guidelines). Disruption of these natural cycles results in Doshic imbalances, predisposing individuals to physical and mental disorders.

Modern chronobiology similarly acknowledges biological rhythms, mainly circadian (approximately 24 hours), infradian, and ultradian cycles, which regulate key functions such as sleep-wake patterns, hormone secretion, and metabolism. The suprachiasmatic nucleus (SCN) in the hypothalamus acts as the central pacemaker synchronizing these internal rhythms with external cues like light and darkness. Melatonin secretion by the pineal gland also plays a critical role in maintaining circadian stability.[3]

This review aims to integrate Ayurvedic concepts of elemental and Doshic rhythms with modern scientific understanding of circadian biology. It highlights the physiological and pathological relevance of these cycles and emphasizes the role of Ayurvedic time-based

interventions in preserving biological harmony and promoting health.

MATERIAL & METHODS

Type of Study: This article is a review conducted to explore the conceptual and functional correlation between Ayurvedic principles and modern circadian science. The primary focus is to integrate classical time-bound principles such as Tridosha (three fundamental physiological energies), Dinacharya and Rutucharya with the contemporary understanding of biological rhythms.

Sources of Data: Data were obtained from electronic databases, including PubMed and Google Scholar. Additional references were retrieved from authentic Ayurvedic textbooks, classical commentaries, and relevant published literature.

Search Strategy: A comprehensive search was conducted using Boolean operators (AND, OR, NOT) to refine relevant publications. Search terms included combinations such as "Dosha chronobiology," "Dinacharya AND circadian rhythm," "Ayurveda AND biological clock," and "seasonal variations AND Rutucharya." The search was restricted to full-text articles published in the English language, preferably within the recent years.

Inclusion and Exclusion Criteria: Included studies were English-language publications focusing on human physiology and the integration of Ayurveda with circadian biology. Excluded were animal studies, in vitro research, irrelevant topics, inaccessible full texts, and non-scientific sources.

DISCUSSION**Ayurveda Perspective Of Circadian Rhythm**

Table 1: Ayurvedic Classification of Dosha Dominance According to Site, Age, Time, and Digestion[4]

S. No.	Parameter	Vata Dosha	Pitta Dosha	Kapha Dosha
1.	Primary site of action	Localized predominantly below the navel (lower abdomen, colon) governs movement and elimination.	Centred between the navel and the heart (e.g., liver, stomach) regulates transformation and metabolism.	Resides above the heart (e.g., lungs, head) — involved in structure, lubrication, and stability.

2.	Predominant Age Group	Dominates in old age (Vridhavadha) when degenerative changes and dryness increase.	Predominant during youth (Yauvana) a phase marked by intense metabolic and hormonal activity.	Governs childhood (Balyavastha) characterized by growth, building of tissues, and nourishment.
3.	Diurnal Activity (Day)	Most active during late afternoon (Aparahna) a period of increased movement and alertness.	Peaks around midday (Madhyahna) when digestive fire (Agni) and metabolism are at their strongest.	Dominant in the morning hours (Poorvahna) — promoting stability, heaviness, and restfulness.
4.	Nocturnal Activity (Night)	Intensifies in the late night (Apararatri) often associated with restlessness and dreaming.	Active around midnight (Madhyaratri) linked to internal processing and thermoregulation.	Functions primarily in the early night (Poorvaratri) fostering sleep initiation and physical rest.
5.	Digestive Phase Influence	Predominant at the end of digestion supports absorption and elimination processes.	Active during the peak of digestion responsible for enzymatic and chemical breakdown of food.	Initiates the beginning phase of digestion related to salivation and moistening of ingested food.

Table 2: Seasonal Dynamics of Dosha, Agni, and Bala in Ayurveda[5]

Ritu (Season)	Status of Dosha	State of Agni (digestive fire)	Level of Bala (strength/immunity)	Physiological interpretation
Shishira (late winter)	Kapha Chaya (accumulation) Vata aggravation (Kopa)	Teekshna (sharp)	Pravara (high)	Cold, dry conditions lead to heightened Vata and stored Kapha, while metabolism remains robust.
Vasanta (Spring)	Kapha Prakopa (aggravation)	Madhyama (moderate)	Madhyama (moderate)	The rise in temperature dissolves accumulated Kapha, stimulating its activity, while moderate metabolic and immune responses continue.
Greeshma (Summer)	Vata Chaya (accumulation) Pitta Prakopa (aggravation) Kapha Prasama (pacification)	Manda (Low)	Avara (Low)	Intense heat induces fluid loss and fatigue, aggravates Pitta, and accumulates Vata, reducing both Agni and Bala.
Varsha (Monsoon)	Vata Prakopa (aggravation) Pitta Chaya (accumulation) Tridosha aggravated	Manda (Low)	Avara (Low)	Moist, unstable climate disrupts all three doshas, particularly Vata, and impairs digestion and vitality.
Sharad (Autumn)	Vata Prasama (pacification) Pitta Prakopa (aggravation)	Madhyama (moderate)	Madhyama (moderate)	lingering heat from summer intensifies Pitta, but calming Vata supports stable digestion and overall balance.

Hemanta (Early Winter)	Vata Chaya (accumulation) Kapha Chaya (accumulation) Pitta Prasama (pacification)	Teekshna (Sharp)	Pravara (High)	Cold strengthens metabolic fire and immune power, while Vata and Kapha accumulate latently.
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Table 3: Chronobiological Association of Dosha with Daily and Seasonal Changes in Ayurveda[6]

Time of day (Dina)	Season (Ritu)	Dosha Status	Physiological interpretation
Poorvahna (morning)	Vasanta (spring)	Kapha Prakopa (Kapha aggravation)	increased mucus secretion, slower metabolism, and a tendency for lethargy due to residual cold and moisture.
Madhyahna (midday)	Greeshma (summer)	Pitta Chaya (Pitta accumulation)	rising body temperature, enhanced enzymatic activity, and initiation of heat-related biochemical changes.
Aparahna (afternoon)	Pravrita (pre-monsoon)	Vata Prakopa (Vata aggravation)	increased dryness, lightness, and nervous excitability with possible fluctuations in blood pressure and mood.
Pradosha (evening)	Varsha (monsoon)	Pitta Chaya (Pitta accumulation)	Digestion slows due to high humidity, bile components accumulate, and heat regulation becomes less efficient.
Madhyaratri (midnight)	Sharad (autumn)	Pitta Prakopa (Pitta aggravation)	Increased oxidative stress, disruption of normal sleep rhythms, and heightened inflammation due to retained body heat.
Pratyusha (early dawn)	Hemanta (early winter)	Pitta Samana (Pitta pacification)	Stable core body temperature, balanced metabolism, and improved digestive efficiency.

The above table highlights the critical association between daily and seasonal variations with the dynamic status of Dosha and their corresponding physiological effects, as described in Ayurveda. Understanding these chronobiological patterns is essential for aligning lifestyle practices and therapeutic interventions with the body's natural rhythms. This synchronization aids in maintaining Dosha balance, optimizing metabolic and physiological functions, and preventing the onset of diseases linked to temporal imbalances. The table underscores the significance of Ayurvedic time-based regimens, such as Dinacharya and Rutucharya, in promoting holistic health by integrating environmental cycles with internal biological processes.

Modern Perspective of Circadian Rhythm: Chronobiology is the science that studies how the biological clock works. Physiological processes including sleep, heart health, metabolism and body temperature regulation are all governed by biological rhythm. [7] The new strategies for optimal health and metabolic balances include chronopharmacology, chrononutrition and chronoexercise. The suprachiasmatic nucleus (SCN), located in the ventral hypothalamus, is the central pacemaker that regulates all overt rhythms in the body. Each of the two small neuron clusters forming the human suprachiasmatic nucleus (SCN) contains a molecular clock that operates independently and sustains its own rhythmic activity. According to recent research, each and every cell in the body has an internal clock and these clocks are the same as those in SCN neurons.

Several hormones are secreted during the sleep-wake cycle, and their concentrations vary throughout the day. These hormonal fluctuations significantly influence an individual's appetite, metabolic activity, and behavioural patterns. Research indicates that a disruption in the sleep-wake cycle, particularly in otherwise healthy individuals, can be a primary factor contributing to various diseases. These include early mortality, obesity, diabetes, depression, cancer progression, and chronic fatigue. The Kapha Dosha controls the optimal sleep state.

Melatonin and its Role in Circadian Regulation: With its strong circadian rhythmicity, melatonin is one of the main hormones affecting sleep. Melatonin plays a key role in maintaining the body's internal biological clock or circadian rhythm. All of the Nidra Janaka Dravya

that science has indicated aims to balance out Kapha and Tama, promote sleep by lowering sleep latency, and increase sleep timing. [8]

Melatonin, a hormone involved in regulating circadian rhythms, is secreted by the pineal gland, a neuroendocrine structure in the brain. It coordinates behavioral and physiological adjustments to the geographical day and season and is produced in relation to the sleep-wake cycle. [9] Recent research indicates that maternal melatonin triggers the fetus's behavior and physiology to adjust to the light-dark cycle of its surroundings. Melatonin receptors are expressed by human SCN in both adult and fetal stages. The fetus receives photoperiodic information from maternal melatonin, which enters the fetal circulation transplacentally and influences the child's internal cycles. [10]

Exposure to light during nighttime suppresses melatonin synthesis, a function regulated by the nervous system and retinal melanopsin pathways. Additionally, melatonin is believed to affect the expression of clock genes by directly inhibiting proteasome activity. Due to its antioxidant properties, it helps safeguard DNA from damage and degradation. The rising evening phase, the night time peak phase, and the dawn-fall phase are the three separate phases that make up the melatonin circadian production cycle. The immediate effects of melatonin are determined by these phases.

Cause for Impaired/Reduced Circadian Rhythm: Circadian rhythm disorders are caused by certain environmental circumstances and changes in the body that throw off the circadian rhythm, which can lead to a number of harmful illnesses. Insufficient combination (Heenayoga), perverted combination (Mithayoga), or excessive combination (Atiyoga) of Kala (season), Artha (things), and Karma (activity) are acknowledged as the sole causes of the illness. [11] Time is referred to by Kala. Because time has a natural and inevitable influence, this etiological element is significant. Day and night, seasons, and life stages are all representations of diverse facets of time that have a variety of consequences on the human body.

In certain seasons, each Dosha achieves the states of Chaya, Prakopa, and Prashama, which is unavoidable and also reliant on the fluctuations of the day. Additionally, all living things on this planet undergo constant metamorphosis. Diseases will undoubtedly result from Heenayoga, Mithayoga, and Atiyoga of Kala, which cannot be prevented. However, even the status of health is out of balance these days.

The Pathogenesis for Impaired Rhythm: Nowadays, the primary causes of circadian rhythm impairment include traveling, working night shifts, excessive nighttime electronic device use that confuses our internal clock, stress, inappropriate social and personal behavior, not adhering to proper day/season routines, Prajanapradha etc [12]. These have detrimental impacts on the human body by decreasing SCN output, which leads to incorrect entrainment of the different body clocks. The body's diminished circadian rhythm, which interferes with the proper rhythmic functions and causes imbalances, stress, and a variety of lifestyle illnesses, is caused by differences in the body's regular functioning.

Reset the Internal Biological Clock with Ayurveda: The classical texts of Ayurveda have detailed an appropriate routine that outlines a daily, as well as seasonal, schedule that people should adhere to in order to live a peaceful and healthy life. By maintaining Doshic rhythms at their ideal levels, the ideas presented in Ayurveda help us comprehend when everyday tasks should be carried out.

Kapha is used to attribute strength, forbearance, joint stability, unctuousness, and body stability when analyzing the Doshic pattern. [13] Similarly, Dosha predominance at a given time has functional significance and can be synchronized with daily activities to get the Dosha pattern back on track while also providing functional utility.

The Kapha Dosha pattern can be used to improve immunity, sleep quality, joint stability, strength, and mental attributes like patience because it peaks between 6 am to 10 am and 6 pm to 10 pm. By focusing a little physiological increase on enhancing the body's functional utility of Kapha, which is important in relationships and the workplace, one might indirectly reach peak performance. A quicker recovery will occur from the Kapha Dosha dominance in the biological rhythm, which will increase immunity and speed up all repair processes.

Dinacharya: In addition to cleaning one's teeth and waking up at Brahma Muhurth, [14] Ayurveda also specifies various practices like as Danta Dhavana, [15] Gandusha, [16] Kavala, [17] Vyayama, [18] Snana, [19] and others.

Table 4: Ayurvedic Lifestyle Guidelines Based on Dosha Chronobiology

Pre-dominant Dosha	Time Period	Recommended Routine	Purpose/Benefits
Vata	2 AM – 6 AM	Light, subtle, mobile qualities; increased alertness and inspiration	Wake up before sunrise (Brahma Muhurta), meditate, perform Pranayama, gentle Yoga, and eliminate waste (natural urges)
Kapha	6 AM – 10 AM	Morning routine during Kapha period: evacuation, Danta Dhavana (tooth brushing), Jivha Nirlekhana (tongue scraping), Gandusha (mouth gargling), Kavala (oil pulling), Nasya (nasal administration), Pranayama (breathing exercises), Abhyanga (body massage), Snana (bathing). Perform these preferably before Kapha Kala.	Avoid sluggishness, invigorate body and mind
Pitta	10 AM – 2 PM	Main meal of the day during Pitta period, following Ahara Vidhi (dietary guidelines). [20]	Support optimal digestion and metabolism
Vata	2 PM – 6 PM	Creative, restless, variable; mental energy rises	Ideal for creative tasks, problem-solving, studying; take a light snack if needed
Kapha	6 PM – 10 PM	Evening routine: follow Laghu Ahara (light diet), engage in moderate Vihara (activity), avoid artificial lights and screen exposure, go to bed early.	Promote restful sleep and prevent Kapha-related heaviness
Pitta	10 PM – 2 AM	Avoid staying awake	sleep during this time to support natural detoxification and tissue repair.

Rutucharya: From the universal standpoint, it is exceedingly challenging to define Rutucharya as seasons have got many variables even within a single nation. The Rutucharya story in our classics is relevant to India's seasons as well as those of other countries with comparable topographies.

Naturally, however, the Ritu changes are the same everywhere in the world. Dosha that reach aggration during a given Ritu should be calmed during that season to avoid additional disruption of the circadian rhythm caused by Prakopa condition.

Therefore, each Ritu different regimens outlined in our classics are meant to pacifying Sanchita Dosha and avoid Dosha Sanchaya. Maintaining the correct operation of the internal clock that leads to Swasthya is made possible by acclimating ourselves to the variations of each Ritu by adhering to the routines described in the classics. Circadian rhythm includes mental and behavioral shifts in addition to physiological rhythms. Achara Rasayana, [21] Dharaneeya Vega, [22] and Sadvrutta, [23] are concepts mentioned in Ayurveda for this.

It can be suggested that Ayurveda has guided the human body in adjusting to environmental changes by daily routine, seasonal regimen and various lifestyle practices related to sleep, dietary habits, and social conduct through the framework of ethical behavior, among others.

CONCLUSION

The Ayurvedic understanding of circadian rhythms, rooted in the dynamic interplay of the Tridosha, offers a profound physiological perspective on maintaining health through temporal alignment. By adhering to time-appropriate practices such as Dinacharya and Rutucharya one can synchronize internal biological functions with nature's cycles. This alignment not only preserves Doshic balance but also enhances metabolic efficiency, immunity, and mental clarity. In an era marked by lifestyle-induced circadian disruptions, integrating Ayurvedic principles with modern chronobiological insights presents a comprehensive and preventive approach to health and well-being.

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