



Integrating Circadian Rhythm Alignment With *Ayurvedic Dinacharya* And Herbal Intervention For Stress, Anxiety, And Sleep Disorders: A Wearable-Based Outcome Assessment

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Abstract:

In today's urban lifestyle, stress, anxiety, and sleep-related problems have become very common, mainly due to disturbed circadian rhythms caused by irregular daily routines, excessive screen exposure, and continuous mental workload. *Ayurveda* provides a holistic and personalised approach to health through the practice of *Dinacharya* (daily routines) along with the use of *Rasayana* and adaptogenic herbs. This review focuses on the role of *Padaabhyanga* (therapeutic foot massage) and selected herbs such as *Ashwagandha*, *Tagara*, *Brahmi* and *Jatamansi* in improving sleep quality and reducing psychological stress, especially among urban working populations.

The classical *Ayurvedic* description area was analysed in correlation with available biomedical studies to understand the probable mechanism involved. *Padaabhyanga* is found to stimulate plantar nerve endings, support autonomic balance, reduce sympathetic overactivity, and facilitate melatonin secretion, thereby promoting relaxation and better sleep. The selected herbal drugs exhibit adaptogenic, neuroprotective, and GABA-modulating action that helps calm the mind and improve emotional stability.

Aligning circadian rhythm principles with *Ayurvedic Dinacharya* offers a sustainable and culturally acceptable approach to mental well-being and long-term health. The outcomes of such an intervention can be objectively assessed using a commonly available wearable device, such as smart watches and sleep trackers, which record parameters like heart rate variability, sleep efficiency, total sleep duration, stress indices, and circadian rhythm patterns. Incorporation of wearable-based assessment allows non-invasive, continuous monitoring and provides measurable evidence for the effectiveness of *Ayurveda*-based lifestyle intervention, supporting its wider clinical and preventive application.

Keywords: *Ashwagandha*, Circadian Rhythm, *Dinacharya*, *Padaabhyanga*, Stress, Sleep Disorders.

I. INTRODUCTION

Rapid urbanisation and digital lifestyle have significantly altered daily routines, leading to increased levels of stress, anxiety, and sleep disturbances. Irregular sleep-wake patterns, prolonged screen exposure, and continuous mental engagement disturb the circadian rhythm, which plays a crucial role in regulating sleep, hormonal balance, and emotional well-being. Persistent circadian misalignment is associated with increased sympathetic activity, impaired sleep quality, and reduced stress adaptability, contributing to the rising prevalence of lifestyle-related mental health disorders.^[1]

Ayurveda provides a holistic and time-tested framework for restoring biological rhythm through structured daily practices such as *Dinacharya*, along with supportive therapeutic measures. Classical *Ayurvedic* literature emphasises lifestyle regulation and the use of *Rasayana* and *Medhya* intervention for maintaining mental and physical balance.^[2] Practices such as *Padaabhyanga* (therapeutic foot massage) and use of adaptogenic herbs including *Ashwagandha*, *Tagara*, *Brahmi*, and *Jatamamsi* are traditionally recommended for calming the nervous system, promoting sound sleep, and improving stress resilience. With the growing use of wearable health-monitoring device, parameters like heart rate variability, sleep efficiency, stress indices, and circadian rhythm pattern can now be objectively monitored, allowing scientific evaluation of *Ayurveda*-based lifestyle intervention in preventive mental healthcare.

2.Objectives

- To explore the role of *Paadabhynga* in regulating sleep and mental well-being.
- To review the scientific basis and efficacy of selected *Ayurvedic* herbs (*Ashwagandha*, *Tagara*, *Brahmi* and *Jatamamsi*) in improving stress resilience and sleep quality.
- To propose an integrative circadian-aligned *Ayurvedic* model and discuss the role of wearable-based.

3.Methodology

A systematic review approach was employed. Sources included classical *Ayurvedic* texts (*Charaka Samhita*, *Ashtanga Hridaya*), as well as PubMed, Google Scholar, and Scopus-indexed journals. Search term included “*Ayurveda* and Sleep”, “Circadian Rhythm”, “Herbal adaptogen for Anxiety”, “*Padaabhyanga*”.

4.Biochemical and Neurophysiological Basis of *Padaabhyanga*

Padaabhyanga, described in *Ashtanga Hridaya*, involves the massage of feet with medicated oil to pacify *Vata Dosha*, *Shrama* (tiredness) and induce Sleep (*Swapna*).^[3] It stimulates over 7000 nerve endings in the feet, engaging mechanoreceptors such as Merkel discs, Pacinian corpuscles, and Ruffini endings.^[4]

These inputs:

- Enhance parasympathetic tone and HRV.
- Increase melatonin and GABA levels.
- Improve proprioception and reduce musculoskeletal strain.
- Support venous return and lymphatic drainage.

Biochemical inputs of *Paadabhyanga*

Padaabhyanga is not merely an oil massage of the feet; it is a neuromechanical intervention that influences multiple systems:

a) Pressure Mechanics and Reflex pathways

- The foot contains over 7000 nerve endings and is a rich zone for sensory receptors. Stimulation through massage activates cutaneous mechanoreceptors, such as:
 - Merkel disc (pressure and texture)
 - Pacinian corpuscles (vibration)
 - Ruffini endings (stretch)
 - Free nerve endings (temperature and pain)
- This stimulation modulates afferent feedback to the spinal cord and brainstem, influencing autonomic regulation.

b) Fascial and Musculoskeletal Relaxation

- Gentle and consistent stroking enhances fascia mobility and reduces micro-muscle tension in plantar fascia, soleus, and calf muscles.
- Indirectly, this improves posture, reduces lumbar strain, and supports structural alignment, especially important in sedentary professionals.

c) Lymphatic and venous returns

- The squeezing and gliding techniques of *Padaabhyanga* promote venous return and lymphatic drainage from the lower limbs, decreasing oedema and vascular congestion.
- Stimulates baroreceptors and venous valves, enhancing cardiovascular regulation.

Neurophysiological and Psychological Effects

a) Regulation of the Autonomic Nervous System (ANS)

- Increase parasympathetic tone (↑ HRV – Heart Rate Variability).
- Decrease sympathetic overactivity (↓ cortisol, ↓ adrenaline).
- Leads to deep relaxation and improved sleep.

b) Melatonin secretion and sleep architecture

- Regular foot massage (especially in the evening) enhances melatonin secretion, improves sleep latency, and restores REM-NREM cycling.
- Foot massage studies have reported increased slow-wave sleep (SWS) and a reduction in sleep fragmentation in adults and the elderly.

Long-term effects of regular Padaabhyanga

Domain	Long-term Benefits	Ayurvedic Perspective	Contemporary Science
Mental Health	Reduced anxiety, depression, stress	<i>Vatahara, Shramahara,</i>	Improves GABA , serotonin; lowers cortisol
Sleep	Better sleep onset and depth	<i>Swapnakara</i>	↑ Melatonin, ↑ Delta wave sleep
Neuroplasticity	Improved cognitive flexibility	<i>Medhya karma</i>	Supports BDNF modulation (Brain-Derived Neurotrophic Factor)
Musculoskeletal Health	Improved balance, posture	<i>Sthiratva, Dardhya</i>	Strengthens proprioception, reduces foot fatigue
Circulatory & Lymphatic Health	Reduced edema, better lower limb circulation	<i>Raktaprasadana</i>	↑ Peripheral perfusion, ↑ lymphatic flow
Metabolic Support	Improved blood sugar regulation (indirect)	<i>Vatanulomana</i>	↓ Sympathetic tone improves insulin sensitivity

Long-term benefits include improved sleep latency, reduced anxiety, and better metabolic regulation.^[5]

5. Roles of Herbs in Supporting Circadian Health

- **Ashwagandha** (*Withania somnifera*): Reported to reduce cortisol levels, improve stress resilience, and modulate the hypothalamic-pituitary-adrenal (HPA) axis, thereby supporting circadian balance.^[6]
- **Tagara** (*Valeriana wallichii*): exhibits sedative and antioxidant properties and has been shown to modulate GABA-A receptor activity, contributing to improved sleep and relaxation.^[7]
- **Brahmi** (*Bacopa monnieri*): known to enhance cognitive functions, support neuroplasticity through brain-derived neurotrophic factor (BDNF), and acts as a nerve tonic.^[8]
- **Jatamansi** (*Nardostachys jatamansi*): reported to improve sleep quality, particularly REM sleep, and reduce anxiety through GABAergic mechanisms.^[9]

6. Long-term implications for longevity and preventive health.

Ayurveda posits that *Dinacharya* (balanced daily routine) and *Rasayana* support leads to *Dheerghayu* (long life) and health. From a biomedical perspective, improving sleep quality, reducing stress load and supporting autonomic homeostasis are associated with improved cardiovascular regulation and reduced physiological stress, which may contribute to lower long-term risk of lifestyle-related disorders.^[10]

7. Conclusion

Aligning principles of modern circadian biology with *Ayurvedic Dinacharya* offers a culturally congruent and sustainable approach for promoting mental well-being and long-term health. Interventions such as Padaabhyanga and selected Ayurvedic herbs demonstrate potential benefits in reducing stress, improving sleep quality, and supporting autonomic balance, particularly among urban populations exposed to lifestyle-related stressors.

The effectiveness of such integrative can be objectively evaluated using commonly available wearables technologies that monitors parameters such as heart rate variability, sleep efficiency, total sleep duration, stress indices, and circadian rhythm patterns. These devices enable real-time, non-invasive, and longitudinal assessment of physiological responses, allowing measurable evaluation of lifestyle-based Ayurvedic practices. Incorporating wearable-based outcome assessment in both clinical and real-world settings helps bridge traditional Ayurvedic knowledge with contemporary evidence-based approaches, supporting the development of scalable, technology-enables preventive healthcare models.

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