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Review Article

INTERRELATIONSHIP BETWEEN SLEEP DISORDERS AND EARLY PRESBYOPIA: AYURVEDIC INSIGHTS INTO PREVENTIVE CARE

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ABSTRACT

Presbyopia, traditionally considered an inevitable consequence of aging, is now increasingly observed in younger individuals, driven by modern lifestyle stressors such as screen overuse, psychological strain, and irregular sleeping patterns. Ayurveda echoes these findings, identifying *Swapna Viparyaya* (irregular sleeping pattern) as a primary *Nidana* (causative factor) *Netra Roga* (ocular disorders). **Objective:** To explore the connection between poor sleep quality and early-onset presbyopia through an integrative- merging modern ocular physiology with Ayurvedic preventive strategies. **Methods:** This analysis was conducted through classical Ayurvedic texts like *Charak Samhita* and *Ashtanga Hridaya*. Both contemporary clinical insights and historical perspectives from traditional medicine were examined to provide a comprehensive understanding of the topic. **Discussion:** Scientific evidence underscores the role of circadian rhythms in regulating the redox state of the lens, with key elements such as Bmal1 gene expression, aqueous humour secretion, and glutathione transport closely linked to sleep-wake cycles. Sleep deprivation leads to impaired blood flow, oxidative stress, and cellular degeneration in ocular tissues. Ayurveda offers neuro-restorative therapies- *Shirodhara*, *Abhyanga*, and *Shiropich*- which help regulate the hypothalamic-pituitary-adrenal axis, improve melatonin synthesis. When combined with good sleep hygiene practices, these interventions promote redox homeostasis and delay presbyopic changes. **Conclusion:** Both modern science and Ayurvedic principles recognize poor sleep quality as one of the causative factors for pre onset of presbyopia. Integrating sleep hygiene with classical Ayurvedic regime for quality sleep presents a holistic and evidence-aligned approach to delay the onset of presbyopia. This integrative model holds global relevance in preventive ophthalmology.

INTRODUCTION

Presbyopia is a universal age-related decline in accommodation caused by the gradual loss of lens elasticity and ciliary muscle function. While it typically appears after the age of 40, modern lifestyle stressors- screen exposure, Stress, and irregular sleep- are contributing to its earlier onset.[1]

The onset may be heralded by development of asthenopic symptoms with blurring of near vision especially in dim light, heaviness of eyes or tiring of eyes on prolonged near work. The patient prefers to keep the near objects at a greater distance than usual because less accommodative efforts is needed at an increased distance.[2]

In Ayurvedic understanding, *Swapna Viparyaya* - (irregular sleeping pattern)- is considered a causative factor (*Nidana*) for *Netra Roga* (ocular disorders). From a modern viewpoint, sleep deprivation disrupts the circadian rhythm and elevates oxidative stress, affecting ocular metabolism and accelerating lens aging. Therefore, understanding sleep as a physiological regulator and adopting integrative approaches for its normalization are crucial for presbyopia prevention.

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उष्णाभितप्तस्य जलप्रवेशाद् दूरेक्षणात् स्वप्नविपर्य्ययाच्च ।
प्रसक्तसंरोदनकोपशोकक्लेशाभिघातादतिमैथुनाच्च
शुक्तारनालाम्लकुलत्थमाषनिषेवणाद्वेगविनिग्रहाच्च
स्वेदादथो धूमनिषेवणाच्च छर्दिर्विघाताद्वमनाति
बाष्पग्रहात् सूक्ष्मनिरीक्षणाच्च नेत्रे विकाराञ्जनयन्ति दोषाः (सु.उ 1/26-27)

The Role of Sleep and Circadian Rhythms in Regulating Lens Redox State and Preventing Oxidative Damage[3]

- Research suggests that the redox state of the eye's lens is regulated by circadian rhythms. During deep sleep, the body actively clears reactive oxygen species (ROS) and repairs cellular damage. This restorative process is essential for maintaining cellular health and preventing oxidative stress.
- Poor or irregular sleep patterns disrupt these natural rhythms, leading to the accumulation of oxidative damage in the lens. Over time, this can accelerate age-related degeneration. Maintaining a consistent sleep schedule and ensuring adequate deep sleep may therefore play a crucial role in preserving eye health and delaying the onset of lens-related aging.

The Role of Aqueous Humour and Circadian Rhythms in Supplying Antioxidants to the Lens[4]

- The lens relies on the aqueous humour for its supply of the antioxidant glutathione, which is essential for protecting it from oxidative stress. The production and secretion of aqueous humour are regulated by the circadian rhythms.
- These daily biological rhythms ensure that the lens receives a steady and timely supply of nutrients and antioxidants. Disruption of circadian rhythms can impair aqueous humour production potentially reducing glutathione availability and increasing the risk of oxidative damage and age-related lens disorders.

Bmal1: A Key Clock Gene Linking Circadian Rhythms to Lens Antioxidant Defense[5]

- Recent research has identified the presence of the clock gene Bmal1 in the nuclear cells of the lens. This gene plays a crucial role in maintaining cellular homeostasis and regulating the antioxidant response.
- Bmal1 is closely associated with the management of reactive oxygen species (ROS), helping to protect the lens from oxidative damage. Its function is tightly linked to circadian rhythms, suggesting that the lens has its own internal biological clock that contributes to its ability to cope with oxidative stress. This discovery highlights the importance of circadian regulation in maintaining lens health and preventing age-related degeneration.

The Impact of Sleep Deprivation on Eye Health and Oxidative Stress[6]

- Sleep deprivation negatively affects blood circulation throughout the body, including the eyes. Reduced blood flow leads to insufficient delivery of oxygen and nutrients to ocular tissues, which can contribute to eyestrain and discomfort.
- In addition, lack of sleep increases oxidative stress, resulting in the accumulation of reactive oxygen species (ROS) and free radicals. These harmful molecules can damage cells and tissues, including the blood vessels and nerves within the eyes. Over time, this oxidative damage may contribute to visual problems and accelerate age-related eye conditions.

Recent researches

- A study found that poor sleep quality- caused by shift work and disruptions to the circadian rhythm- accelerate the development or worsening of presbyopia.[7]
- A recent study on the starting time of presbyopia and lifestyle factors reported that individuals with poor subjective sleep quality had an earlier onset of near correction (p=0.019). The same study also found that participants in higher income groups demonstrated more favourable sleep habits and circadian rhythm patterns, which were associated with a later age of first near correction compared to those in lower income groups [8].

Ayurvedic Perspective: *Swapna Viparyaya* and Eye Health

आहारशयनब्रह्मचर्यैर्युक्तया प्रयोजितैः।
शरीरं धार्यते नित्यमागारमिव धारणैः।। अ.हृ.सू.-7/52 [9]

In Ayurveda, sleep is considered one of the three supporting pillars of life

निद्रायतं सुखं दुःखं पुष्टिः कार्श्यं बलाबलम्।
वृषता क्लीबता जीवितं न च।। च.सू.21/36 [10]

Benefits of Good sleep

1. Health in the body
2. Increase in strength
3. Increase in reproductive vitality (*Shukra*)
4. Proper functioning of the sensory organs

Consequences of Sleep Deprivation

1. Emaciation (leanness/underweight condition)
2. Loss of strength
3. Impotence
4. Improper functioning of the sensory organs in relation to their objects

हलीमकः शिरः शूलं स्तैमित्यं गुरुगात्रता ।
अङ्गमर्दोऽग्निनाशश्च प्रलेपो हृदयस्य च।। च.सू.-21/46 [11]
स्मतिबुद्धिप्रमोहश्च संरोधः स्रोतसां ज्वरः।
इन्द्रियाणामसामर्थ्यं विषवेगप्रवर्त(र्ध)नम्। च.सू.-21/48 [12]

Harmful effects of sleeping during the day at an improper time

1. Loss of appetite
2. Weakness or impairment of the sense organs
3. Confusion or impairment of memory and intellect

Mode of Action of Ayurvedic Interventions

***Shirodhara*[13]**

Continuous pouring of medicated oil over the forehead induces neuro-sedative and anxiolytic effects. The mild, rhythmic stimulation activates alpha brain waves and helps balance the hypothalamic–pituitary–adrenal (HPA) axis, producing calmness and improving sleep onset. This deep relaxation supports cellular repair and antioxidant recovery processes in ocular tissues.

Abhyanga

Abhyanga (oil massage) improves peripheral circulation and increases hydrostatic pressure in skin extracellular space, facilitating the absorption of phytonutrients.[14]

Massage enhances levels of tryptophan and serotonin in the bloodstream- precursors of melatonin, the sleep-regulating hormone- thereby improving sleep quality, regulate sleep - wake cycle and reducing stress-related oxidative damage.[15]

***Shiropichu*[16]**

Shiropichu is an ayurvedic therapy in which a sterile cotton pad soaked in medicated herbal oil is placed over the anterior fontanelle region and then secured with a bandage cloth, ensuring prolonged contact and deeper transdermal absorption. This therapy acts on the central nervous system, relieving tension headaches and muscular strain while calming mental stress. It promotes sleep regulation and enhances cerebral oxygenation.

Role of Sleep Hygiene in Prevention

Along with Ayurvedic interventions, maintaining sleep hygiene is essential for restoring natural circadian balance

Key sleep hygiene recommendations include[17]

1. Aim to get between 7 and 9 hours of sleep.
2. Have a consistent sleep time.
3. Exercise regularly
4. Avoid late afternoon/evening naps and long naps.
5. Avoid light exposure (electronics, etc.) near bedtime.
6. Limit caffeine consumption in the afternoon/ evening.
7. Limit alcohol consumption.
8. Avoid large mixed meals and unhealthy foods near bedtime.
9. Practice mindfulness techniques.
10. Create a dark, cool, and quiet sleeping environment.
11. Have a constant bedtime routine.
12. Use comfortable mattress, pillow, and bedding.

DISCUSSION

Modern ocular physiology emphasizes oxidative stress and circadian rhythm disruption as contributors to presbyopic lens changes. Ayurveda's description of *Swapna Viparyaya* mirrors these modern findings, viewing disturbed sleep as a primary factor of systemic and ocular degeneration.

Integrating sleep hygiene with Ayurvedic neuro-restorative therapies addresses both the root cause and the manifestation- enhancing sleep, balancing Vata, and promoting redox homeostasis in ocular tissues. This integrated model offers a scientifically valid, holistic strategy for delaying or preventing presbyopia progression.

CONCLUSION

Swapna Viparyaya represents an important modifiable risk factor for presbyopia. Both classical Ayurvedic wisdom and modern evidence demonstrate that poor sleep quality induces oxidative stress, impairs redox balance, and accelerates ocular aging.

Preventive strategies involving proper sleep hygiene and Ayurvedic therapies such as *Shirodhara, Abhyanga,* and *Shiropichu* help restore circadian rhythm, promote antioxidant activity, and preserve lens function.

Thus, an integrative approach uniting modern sleep science with Ayurvedic principles holds promise for preventing or delaying early-onset presbyopia.

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