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# REVERSING THE CLOCK WITH REST: THE ANTI-AGEING ROLE OF NIDRA: A NARRATIVE REVIEW

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**ABSTRACT**

Sleep is an essential part of life. It is a dynamic brain activity that arises from the interaction of two fundamental systems, the circadian rhythm and the homeostatic desire to sleep, rather than a passive condition of unconsciousness. Ayurveda has identified Nidra (Sleep) as one of the three main pillars of health (Trayopastambha), and such sleep is considered the necessary solution to all aspects of physical, emotional, and mental well-being. Currently, there is a growing global interest in understanding the ageing process and improving the quality of life for older adults. This presents an opportune moment to delve into the potential of Ayurveda, which offers promising approaches to enhance longevity and delay ageing. Nidra acts as a highly effective Rasayana (rejuvenator), a pillar of longevity and anti-ageing. Ayurvedic knowledge on Nidra as a supreme rejuvenator and its role in anti-ageing is captured through this review study. Ayurvedic texts ensure the importance of Nidra in the sustenance of Ojas (vital essence) and Tridoshas equilibrium, which plays a significant role in the process of slowing down the ageing process. Quality and sufficient sleep help repair tissues, balance hormones, and prevent degenerative changes. From a contemporary perspective, sleep promotes cellular regeneration, enhances immunity, and reduces oxidative stress factors that are directly associated with ageing. This research paper emphasises the physiological and therapeutic significance of Nidra to retard the course of the ageing process. The concepts of Ayurvedic health and modern evidence are combined in this review, which highlights the importance of Nidra as the basis of whole-body restoration and supportive ageing.

**Keywords:** Sleep, Rasayana, Telomere, Inflammageing, Yoga-Nidra, Longevity.

## INTRODUCTION

In today's rapid-paced environment, where stress and lifestyle-related disorders are prevalent, the desire for everlasting youth and vitality continues to capture human interest. Ayurveda, the ancient art of living, provides deep insights for achieving longevity and wellness through the combination of dietary and lifestyle habits. Nidra holds a place of profound significance in both classical Ayurvedic philosophy and modern biomedical science. In the Ayurvedic tradition, Nidra is considered one of the Trayopastambha[1], the three fundamental pillars of life alongside Ahara and Brahmacharya. Classical texts such as the Charaka Samhita[2] and Ashtanga Hridaya[3] describe Nidra as essential for maintaining strength (Bala), immunity (Vyadhi kshamatva), mental clarity, and longevity (Ayushya). Sleep is a complex, highly organised physiological state influenced by many intrinsic and extrinsic factors, and some sleep processes are active, involving significant cortical brain interaction.[4]

Sleep disruption, termed Nidranasha, is associated with a range of degenerative outcomes such as early ageing signs, fatigue, cognitive decline, and weakened bodily functions. Both insufficient and excessive sleep can disrupt the balance of the Doshas. Therefore, Nidra is crucial for sustaining equilibrium in the mind (Sattva), body (Sharira), and spirit (Atma). From a modern perspective, sleep is increasingly recognised as a biological necessity that has profound effects on both mental and physical health. Global health surveys, such as those conducted by the Sleep Foundation and the WHO, indicate that a sizable section of the adult population currently gets inadequate sleep or poor-quality sleep, which is associated with a higher risk of premature mortality and several chronic illnesses. Indeed, meta-analyses reveal a U-shaped association between sleep duration and all-cause mortality, with negative health consequences linked to both short (less than 7 hours) and long (more than 9 hours) sleep durations.[5] In Ayurveda, the concept of ageing is due to the depletion of Ojas (vital essence) and the imbalance among the Tridoshas (Vata, Pitta, Kapha). A molecular perspective is increasingly being used to understand ageing, which is defined as a progressive loss of physiological integrity. In anti-ageing research, hallmarks like telomere attrition, epigenetic changes, mitochondrial dysfunction, inflammation, and loss of Proteostasis have become quantifiable objectives. Interestingly, new studies show that many of these same ageing processes are modulated by sleep. For instance, insufficient sleep has been linked to increased systemic inflammation, shortened telomeres, accelerated epigenetic ageing, and reduced glymphatic clearance of neurotoxins. Sleep is positioned as a natural rejuvenator. Though Nidra has been promoted by Ayurveda as a therapeutic and preventative measure, its potential as a scientifically validated anti-ageing intervention is only recently gaining mainstream research interest.

This review aims to critically assess existing evidence on the anti-ageing effects of sleep (Nidra) by examining both Ayurvedic perspectives and current scientific findings. It investigates how sleep affects ageing biomarkers, explores possible mechanisms, and considers how integrative approaches like Yoga-Nidra may enhance these effects.

## METHODOLOGY

Detailed information on the topic has been collected and reviewed through a systematic screening of various classical Ayurvedic texts, including the Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Rasa Vagbhata, and Ayurveda dictionaries, as well as commentaries by Chakrapani, Dalhana, and Arunadatta. Different literature databases such as PubMed, Scopus, Google Scholar, DHARA, and Namaste portal were searched by using keywords like 'Sleep', 'Nidra', 'Circadian rhythm', 'Telomeres', 'Ageing', 'Ayurveda', 'Yoga Nidra', 'Oxidative stress', and 'Inflammageing' with the help of Boolean operators 'AND', 'OR', 'NOT'. Filters such as review articles, clinical trials, those within the last 20 years and free full articles were applied.

### The Science of Ageing

Jara, also known as Vardhakya or ageing, is described as the process whereby the body becomes worn out over time. In Ayurveda, ageing is considered a natural occurrence, similar to hunger, thirst, rather than a disease. Acharya Sushruta mentioned a group of naturally occurring diseases named 'Svabhavabala Roga',[6] which includes Kshut (hunger), Pipasa (thirst), Nidra (sleep), Jara (old age), and Mrityu (death). According to Acharya Charaka's doctrine of natural cessation, i.e., 'Swabhavoparama vada',[7] while there are specific causes responsible for the manifestation of life, there is no particular cause for its termination. Death is simply a natural consequence following birth. The term Jara encompasses four aspects: Dhari (factors that sustain the body and delay ageing), Jeevitam (the force that sustains life), Nityaga (the ongoing presence of consciousness), and Anubandha (the link to rebirth or transmigration of the soul).[8] Ageing is shaped by various influences impacting the body (Shareera), the senses (Indriya), the mind and psyche (Satva), metabolism (Agni), and immunity or vitality (Bala/Ojas). Other contributors to the ageing process include cellular changes (Parinama), genetic and phenotypic traits (Sharira vriddhikara bhavas), and developmental processes initiated during pregnancy.[9] It's universally recognised that life follows a cycle of birth, growth, and death. Yet, while people accept this truth intellectually, most resist ageing and fear death. Despite perceiving ageing and related illnesses as abnormal, human behaviours and lifestyle choices often hasten biological ageing. The process of decay accompanies Jara and manifests in the form of various degenerative changes. Although these changes are natural (Kalaja Vriddhavastha), they are not pleasant.[10] The misuse of the senses, exposure to disruptive sensory inputs (Pancha jnanendriyas), and unhealthy choices that disrupt proper bodily and mental transformations (Parinama) all contribute to disease and suffering, both physical and mental. Such disturbances weaken the balance of bodily tissues (dhatusamya), leading to premature or pathological ageing (Akalaja Vriddhavastha).[11] Ayurveda takes a holistic approach, focusing on maintaining dhatusamya, a state of equilibrium that includes mental, physical, biological, physiological, and spiritual well-being. According to Ayurveda, homeostasis is preserved when the body's tissues (dhatu), energy (Dosha), fire (Agni), and waste products (Mala) stay in balance. This promotes healthy ageing, also known as 'Sukhayu' or Kalaja Vriddhavastha.[12] Several key elements significantly influence ageing, including Kala Parinama (Time and Transformation), Prakriti (Body Constitution), Doshas, Ahara (Diet), Agni (Digestion), Achara (Lifestyle), and others.

**Tridoshas and Ageing:** In Ayurveda, the three fundamental bio-energies — collectively known as Tridoshas — Vata, Pitta, and Kapha —govern all physiological and metabolic functions. These forces correspond to anabolic (Kapha), metabolic (Pitta), and catabolic (Vata) processes described in modern science.[13] Throughout life, their dominance shifts: Kapha is prominent during childhood, supporting growth; Pitta governs adulthood, managing metabolism; and Vata predominates in old age, driving degeneration and decay. With ageing, Vata increases, leading to catabolic processes, including tissue depletion, dryness, and instability.[14] A decline in Kapha reduces structural integrity and nourishment, while a disturbance in Pitta impairs digestion and cellular function. An imbalance among the Tridoshas results in dysfunctions such as weakened immunity, loss of vitality, and reduced resilience. The decline of Kapha in old age disrupts essential functions such as lubrication, nourishment, and joint stability (Sleshma karmas). At the same time, impaired Agni (digestive/metabolic fire) due to Vishamagni contributes to a loss of vitality, strength, complexion, immunity (Ojas), and overall health. Maintaining Tridoshik balance is therefore vital to slow the ageing process and support healthy longevity.

**Table 1: Doshik set up in Ageing [15]**

| Dosha / Vaya | Balyavastha | Madhyamavastha | Vriddhavastha |
|---|---|---|---|
| Kapha | +++ | ++ | + |
| Pitta | ++ | +++ | + |
| Vata | + | ++ | +++ |

**Saptadhatus and Ageing:** The second major component of Sharira (body) in Ayurveda is the Saptadhatus, which comprises seven fundamental tissues responsible for structure, nourishment, and vitality. In old age, a hallmark feature is the gradual depletion or Kshaya of these Dhatus, often referred to as Heeyamana Dhatu. This degeneration is due to disturbed Vata, weakened Agni (metabolic fire), and diminished Kapha, which impair the formation and function of the primary nourishing fluid, Rasa Dhatu. When Rasa becomes defective, it fails to nourish subsequent tissues (Preenana Karma), triggering a chain reaction of weakened Dhatwagnis (tissue-level metabolic processes). As a result, each successive Dhatu from Rakta to Shukra undergoes both qualitative and quantitative deterioration, a condition synonymous with ageing. This state, characterised by loss of tissue strength (Ksheena Dhatu Bala) and vitality, is metaphorically described by Sushruta as a dilapidated house collapsing under the weight of rain. Furthermore, improper formation (Prasada and Kitta Paka) of Upadhatus (secondary tissues) and Dhatumala (metabolic waste products) compounds the degeneration, manifesting as geriatric symptoms such as chronic cough (Kasa), breathlessness (Swasa), and general debility. Thus, ageing in Ayurveda is deeply linked to the progressive decline of the Saptadhatus.

**Table 2: Tissue depletion in Ageing**

| Dhatus | Kshaya in Ageing |
|---|---|
| Rasa | Decline in hydration and nutrient absorption. |
| Rakta | Poor oxygenation and circulation. |
| Mamsa | Loss of muscle mass and strength. |
| Meda | Metabolic inefficiency. |
| Asthi | Osteoporosis and fragility. |
| Majja | Neurological degeneration. |
| Sukra | Fertility declining. |

**Prakriti and Ageing:** Prakriti refers to an individual's innate constitution, encompassing physical, physiological, and psychological traits. This unique constitution, established at birth, shapes core attributes such as metabolism, immunity, mental tendencies, and resistance or susceptibility to disease.[16] It defines a person's inherent strengths, vulnerabilities, and behavioural inclinations.[17] Since Prakriti governs how a person responds to internal changes and external environmental factors, it also plays a crucial role in the ageing process. For example, individuals with Vata-dominant Prakriti may experience quicker degeneration,

dryness, and instability in old age. In contrast, individuals with a Kapha-dominant Prakriti may age more slowly due to their stronger and more stable tissues. Individuals with a pitta type may be more prone to inflammation and metabolic imbalances as they age. Thus, one's Prakriti influences not only the rate of ageing but also the type of age-related changes and diseases they are more likely to encounter. Understanding Prakriti can help in designing personalised preventive and therapeutic strategies to promote healthy ageing.[18]

**Jatharagni and Ageing:** Jatharagni, the primary digestive fire, plays a pivotal role beyond digestion; it serves as the cornerstone of overall metabolic activity and vitality. It governs the breakdown, assimilation, and transformation of food into energy and tissues, while also influencing cellular functions, sensory perception, and even emotional and cognitive processing.[19] When Jatharagni functions optimally, nutrients are efficiently absorbed and toxins are minimised, supporting tissue regeneration and maintaining systemic balance. However, if this fire is sluggish, it leads to incomplete digestion and the buildup of ama (metabolic toxins), which accelerates ageing by weakening tissues and impairing the immune system.[20] On the other hand, an excessively intense Jatharagni can cause hypermetabolism, leading to premature tissue depletion and cellular wear. In essence, the stability and strength of Jatharagni are central to how gracefully or rapidly one ages. A well-regulated digestive fire ensures balanced nutrition, sustained energy, and better resilience against age-related decline, making it a crucial factor in both health and lifespan.

**Sattva and Ageing:** Ageing affects not only the body but also the mind (Manas), with Vata Dosha playing a central role in this process. As Vata naturally increases in old age, it disrupts both physiological and psychological balance. Manas, which acts as a bridge between sensory input and motor response, becomes unstable when Vata is aggravated. Ideally, the mind should be Sattva-dominant, meaning it should be calm, clear, and emotionally resilient. However, with advancing age and rising Vata, the Sattva guna declines, resulting in a decline of mental faculties such as perception (Grahana), retention (Dharana), speech (Vachana), memory (Smarana), and judgment (Vijnana).[21] Most of the psychiatric problems occur due to Alpa sattva. This mental decline increases susceptibility to neuropsychiatric disorders such as anxiety, depression, confusion (Pralapa), and cognitive impairments, including dementia.

**Theories of Ageing**

**Table 3: Correlation of various theories of ageing with Ayurvedic principles**

| Theories of Ageing | Ayurvedic principles |
|---|---|
| Wear and Tear theory | Sapta dhatus and Srotodushti |
| Waste accumulation theory | Trimalas and Ama |
| Free radical theory | Vata |
| Mutation and telomere theory | Kala or Parinama |
| Mitochondrial damage theory | Agni |

**Wear and Tear theory:** The wear and tear theory of ageing proposes that the body, like a machine, deteriorates over time due to the accumulation of damage from use and exposure to environmental stressors. Over time, cellular components fail to repair efficiently, leading to dysfunction and degeneration. According to Ayurveda, the body is composed of Sapta Dhatus, which support the structure and functions of the body. Continuous improper lifestyle, diet, and stress lead to Dhatu Kshaya (tissue depletion) and Srotodushti (vitiation of body channels), similar to cellular wear and tear. Just as machinery rusts or breaks from overuse, the improper maintenance of Dhatus results in systemic decline.

**Waste accumulation theory:** This theory of ageing proposes that the buildup of cellular waste products impairs cell function and contributes to the ageing process. As cells age, they accumulate damaged molecules, misfolded proteins, and other cellular debris that interfere with normal cellular processes, leading to dysfunction and, in some cases, cell death.[22] Accumulation of lipofuscin pigment is an example of this waste material. The accumulation of lipofuscin within postmitotic cells is a recognised hallmark of ageing, occurring with a rate inversely related to longevity.[23] Ayurveda outlines three primary excretory products (Trimalas): Purisha (faeces), Mutra (urine), and Sweda (sweat). Inefficient elimination or digestion results in Ama, a toxic, undigested metabolic residue that accumulates in the body, blocking Srotas and initiating disease and early ageing.

**Free radical theory:** According to this view, superoxide and other free radicals hurt the cell's macromolecular parts, which build up over time and make cells and eventually organs stop working. The macromolecules, such as nucleic acids, lipids, sugars, and proteins, are susceptible to free radical attack. In Ayurveda, among the three Doshas, Vata governs movement, nerve impulses, and decay. With age, Vata naturally increases, becoming excessive in Vriddhavastha, which causes dryness, instability, and tissue breakdown —hallmarks of oxidative stress and free radical damage.

**Mutation and telomere theory:** The mutation theory of ageing suggests that DNA damage and mutations accumulate over time, leading to cellular dysfunction and ultimately, ageing. The telomere theory of ageing focuses on the role of telomeres, protective caps on chromosome ends, which shorten with each cell division. As telomeres shorten, they reach a critical length, leading to cellular senescence or apoptosis, contributing to the ageing process. These two theories are interconnected, as telomere shortening can increase DNA damage and mutations, while DNA damage can also accelerate telomere erosion.[24] Ayurveda explains that all changes happen through Parinama (transformation) under the influence of Kala (time). Everything in nature, including cellular life, follows a time-bound transformation. Ageing is inevitable, but can be influenced by our actions (Karma) and habits.

**Mitochondrial damage theory:** According to this theory, oxidative stress-induced damage to mitochondria, specifically the buildup of mutations in mitochondrial DNA (mtDNA), is a primary cause of ageing. It is believed that this damage initiates a "vicious cycle," in which mitochondrial function declines, producing more reactive oxygen species (ROS) and exacerbating the damage.[25] In Ayurveda, Agni is the transformative energy responsible for digestion and cellular metabolism. Weakening of Agni leads to improper tissue nutrition (Dhatu Poshana), accumulation of Ama, and decreased vitality. Just as mitochondrial failure causes cellular decline, impaired Agni initiates systemic deterioration.

**Nidra and its role in Anti-Ageing**

The word ‘Nidra’ is derived from the Sanskrit root “Nidi kutsyayaam”.[26] By adding the suffix “rak”, which means to lie down, sleep, or rest. Nidra is defined as the state where the mind, along with sensory and motor organs, becomes exhausted and dissociates from their respective objects.[27] Sleep occurs due to the aggravation of ‘Tamas’, which primarily occurs at night. According to Acharya Sushrut, the Hridaya is the seat of ‘Chetana’, i.e., consciousness, which explains that sleep occurs when it is subdued by Tamas. Tama Guna acts as a cause for Nidra

and Sattva Guna is responsible for awakening. As per Ayurveda, sleep is dependent on Tridoshas also. Imbalance in these doshas can disrupt the quality and duration of sleep and leading to various health issues.

**Anti-ageing role of Nidra:** Sleep is a crucial physiological process that humans spend almost one-third of their lives engaged in. Despite making them vulnerable to predators, sleep has been universally preserved in mammals, birds and reptiles. Sleep was once thought to be a passive condition of unconsciousness. However, it has been evident since the latter part of the 20th century that human sleep is a highly structured and intricate physiological state, impacted by several internal and external variables, and that certain sleep processes are active, including substantial cortical brain activity.[28] The quantity and quality of sleep contribute greatly to our physical and mental well-being and performance the next day, and thus sleep has a huge impact on our overall quality of life. Sleep (Nidra) holds a foundational place in Ayurveda, being considered one of the three primary pillars (Trayopastambha) essential for maintaining overall health, alongside a balanced diet and a healthy lifestyle. Just as nutrition plays a critical role in ensuring a long and healthy lifespan, sleep also plays a crucial part. However, contemporary lifestyles, shift work, social jet lag, and environmental blue light pollution significantly compromise sleep quality in an increasing number of people in all age groups, especially in working adults and the elderly. Ayurveda warns that inadequate or irregular sleep may contribute to the early onset of age-related disorders and accelerate the ageing process. The Charaka Samhita emphasises that proper sleep is critical for happiness and sorrow, nourishment and emaciation, strength and debility, knowledge and ignorance, and ultimately, life and death are all influenced by sleep.[29] The concept of Nidra in Ayurveda states that it is not just rest; it is a process of withdrawal of sensory and motor functions, which are natural and cyclic. It occurs following the detachment of the mind from the sense organs and the objects of the senses, enabling the body and mind to recover. As Acharya Charaka tells us, during Nidra, the mind, along with the sensory organs, becomes fatigued or out of sync with their workings. This mental disengagement promotes the recovery of Ojas, a vital force associated with immunity, strength, and longevity. Moreover, Ashtanga Hridaya states that the sleep that is yatha kala (timely) and prakurta (natural) causes strength, vitality, nourishment, intelligence, happiness, sexual power, and longevity.[30] Thus, Nidra is not only perceived as a passive state but an active regenerative process through which life continues, and degeneration is delayed. Poor sleep quality and impaired sleep hygiene are associated with an increased risk of various diseases like HTN, Coronary artery diseases, etc[31] Ayurveda recognises Nidranasha (sleep deprivation) as a pathological state, leading to accelerated ageing. Improper sleep hurts carbohydrate metabolism and endocrine function. Besides, it also reduces the metabolic activity in the brain. Symptoms include dryness of the body, heaviness in the eyes and head, loss of mental clarity, and early wrinkling or greying of hair are clear indicators of premature senescence. Therefore, sleep debt may increase the severity of age-related chronic disorders.[32] Sleep deprivation is associated with DNA damage and impaired repair mechanisms, accelerating cellular ageing.[33] Deep stages of sleep (in particular, REM slow-wave sleep) correlate with cellular repair. During sleep, growth hormone is secreted, which stimulates tissue repair and regeneration.[34] Shorter telomere length is a biomarker of ageing. Studies have shown that people with poor sleep quality or reduced sleep duration have significantly shorter telomeres.[35] Sleep alleviates oxidative stress, a key driver of cellular ageing. Sustained sleep deprivation leads to a high concentration of reactive oxygen species (ROS) that destroy proteins, lipids, and DNA.[36] Restorative sleep reestablishes antioxidant mechanisms and decreases inflammation, which slows down the ageing process.[37] The brain is detoxified through the glymphatic system during sleep, and especially during REM sleep. It clears the beta-amyloid and other neurotoxins, which are involved in such age-related neurodegenerative diseases as Alzheimer's disease.[38] Sleep promotes optimal levels of secretion of hormones such as melatonin, cortisol, insulin, and growth hormone. Another potent antioxidant (melatonin) preserves the activity of mitochondria as well as the integrity of mitochondrial DNA. Interruptions in the melatonin rhythms have been attributed to rapid ageing and chronic illnesses.[39] Poor sleep is associated with signs of intrinsic skin ageing, such as fine lines, reduced elasticity, and uneven pigmentation. Sleep improves skin barrier function and supports collagen synthesis.[40] According to Acharya Charaka, 'Samajagaranasvapnam',[41] i.e., balanced in sleep and wakefulness, is also mentioned in the context of Achara Rasayana.

## DISCUSSION

Nidra holds a foundational place in Ayurveda, being considered one of the three primary pillars essential for maintaining overall health, alongside a balanced diet and lifestyle. Just as nutrition plays a critical role in ensuring a long and healthy lifespan, sleep also plays a crucial part. However, factors such as age, daily habits, dietary patterns, and environmental influences can significantly affect sleep quality. Ayurveda warns that inadequate or irregular sleep may contribute to the early onset of age-related disorders and accelerate the ageing process. Scientific evidence supports this Ayurvedic insight. Studies have shown that insufficient sleep can disturb the body's internal biological clock, or circadian rhythm, which may lead to several chronic health conditions, including obesity, heart disease, and cognitive decline. In one notable study, Möller-Levet CS et al., 26 individuals were subjected to a week of restricted sleep followed by a week of adequate rest. Blood samples collected after each phase underwent RNA transcriptome analysis, revealing that sleep deprivation altered the expression of 711 genes. These genes were primarily linked to biological functions like circadian regulation, chromatin remodelling, inflammation, immunity, stress responses, oxidative damage, and metabolism. Inadequate sleep doesn't just affect gene expression; it also increases the risk for serious metabolic conditions such as type 2 diabetes, obesity, and cardiovascular diseases. A large-scale meta-analysis of long-term cohort studies, mainly involving individuals over the age of 60-demonstrated a clear link between poor sleep quality and the likelihood of developing type 2 diabetes, as well as a higher risk of premature death in those who slept less than six hours per night.[42] These scientific findings strongly support the Ayurvedic perspective that sleep is essential for maintaining strength, radiant skin, immune resilience, and overall bodily health throughout the lifespan. Modern research thus validates Ayurveda's age-old wisdom that restorative, high-quality sleep is indispensable for promoting optimal health and slowing the ageing process.

## CONCLUSION

Sleep, or Nidra, is not merely a passive state but an essential physiological function with regenerative, restorative, and Rasayana-like properties. Classical Ayurvedic wisdom, dating back thousands of years, emphasises Nidra as Trayopastambha, a vital practice necessary for maintaining life, strength, and longevity. This is echoed in modern science, where high-quality sleep is now recognised as a key modulator of oxidative stress, telomere attrition, neurodegeneration, and hormonal imbalance—all of which are hallmarks of ageing. The convergence of ancient Ayurvedic knowledge and modern biomedical evidence positions Nidra as a natural and accessible intervention to delay

degenerative changes and enhance quality of life in later years. Incorporating proper sleep hygiene, alongside Ayurvedic lifestyle principles, may offer a comprehensive and low-cost strategy for promoting healthy ageing in the global population. Future interdisciplinary studies should explore the clinical applications of Nidra-based interventions in geriatric healthcare and longevity research.

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