

Ayurveda daily regimen practices (Dinacharya): a scientific system model approach suitable as a quaternary prevention strategy for non-communicable diseases

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Author contributions

Shalini Rai was responsible for draft correction, editing and reviewing, revising the manuscript. Varnika Singh was responsible for article search, identification and original draft. Vijay Kumar Rai was responsible for article search, identification, original draft, review and corrections.

Competing interests

The author declare no conflicts of interest.

Abbreviations

NCDs, non-communicable diseases.

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Abstract

Background: Non-communicable or lifestyle diseases replaced infectious diseases at the end of the 20th century as the primary burden of disease worldwide, marking the epidemiological transition. The industrial revolution and technological advancements, as well as packaged processed foods, have greatly affected lifestyle, causing adverse health effects through chronic, low-level, and systemic inflammation known as “metaflammation”. The main contributors to lifestyle-related diseases are poor eating habits, physical inactivity, poor posture, and a disturbed biological clock. The study on lifestyle changes indicates that comprehensive lifestyle changes can prevent disease and reverse the progression of diseases like diabetes, heart disease, stroke, prostatic cancer and breast cancer. The concept of disease prevention is getting wider acceptability owing credit to early disease detection, better treatment modalities and reduced financial implications. However, the possible harms of over-testing and over-medicalization have led to the propagation of Quaternary prevention strategies. Ayurveda, too propagates the principle of health preservation, promotion, and disease prevention, along with early diagnosis and holistic disease management strategies, incorporating dietary and lifestyle components such as Dinacharya (daily regimen practices), Ritucharya (seasonal regimen practice). This paper critically explores the scientific relevance behind these ascribed daily regimen practices (Dinacharya) and their suitability as a quaternary prevention strategy and presents it for dialogue and research to the scientific community. **Method:** The classical texts of Ayurveda and the internet search engines were explored with keywords of relevant terms such as “research” “benefit” and “role in health” combined with the Ayurveda daily regimen terms and their English equivalents as provided in brackets and their different combinations and permutations, along with net surfing and hand search. The relevant articles were stored and screened for relevance and the matter is presented systematically for scientific deliberation principal findings – Ayurveda recognized the temporal effects of chronobiological cycles on human health and accordingly devised the daily regimen schedule, delineating the principles for healthy living and harmonization. The daily regimen practices of Ayurveda like timely sleeping, waking up early in the morning, proper defecation, massage, exercise, occupation, social bonding, appropriate dietary practices, etc. adopt a system biology approach with synchronization of chronobiological cycles, mind-body integration, system performance, and epigenetics, apart from other possible approaches and have considerable scientific evidence for the effectiveness as a quaternary prevention strategy. **Conclusion:** The adoption of these practices in the daily routine may play a crucial role in health preservation and disease prevention at all levels of preventive domains. However, prospective large scale, long-duration randomized controlled trials are yet needed to scientifically further establish the validity of the same.

Keywords: Ayurveda; daily regime; Dinacharya; non-communicable diseases; lifestyle; prevention

Background

Non-communicable diseases (NCDs) like heart disease, stroke, cancer, diabetes, chronic lung diseases, neurological diseases etc. are of growing concern globally due to their high mortality rate, affecting 70% of all deaths worldwide [1]. NCDs have turned into an epidemic, overwhelming the health systems and distressing health concerns for individuals as well as societies. The socioeconomic outlays linked with NCDs render prevention and control strategy for these diseases as a priority necessity for the 21st century [1]. Elements of self-management comprise an important risk factor and consequently a potential strategic tool for the prevention and management of NCDs.

Disease prevention has gained much popularity in recent years due to early disease detection, better treatment modalities, and reduced financial implications. Concerns have been raised over the possible harms associated with testing and overmedicalization, in absence of any actual disease or illness [2]. A study on usage and expenditure of low-value preoperative, diagnostic, preventive, and cardiovascular testing, cancer screening, imaging, cardiovascular, and other surgical procedures indicates that they may be reflective of overuse more broadly [3, 4]. Overuse is also indicated by similar studies for percutaneous transluminal coronary angioplasty, coronarography, cesarean section deliveries, knee and hip replacement surgeries, hysterectomy, and antibiotics for diarrhea [5–19]. Realizing the need to reduce this risk, Marc Jamouille raised the concept of quaternary prevention (P4) [20, 21].

Originally defined as “an action taken to identify a patient at risk of over-medicalization, to protect him from new medical invasion and to suggest to him interventions which are ethically acceptable” [22]. Now it is more widely accepted as “action taken to protect individuals (persons/patients) from medical interventions that are likely to cause more harm than good” [23]. P4 initially was intended for persons who though felt ill, but had no clinically established disease: and for those presenting with medically unexplained symptoms [3]. Currently, all four domains of prevention are included under the umbrella of P4, meaning it is applicable to all healthy and diseased persons (Figure 1). Quaternary prevention is a recently understood, well-devised concept, gaining popularity with contemporary medical science that embeds patients’ protection from overmedicalization and usage of ethical alternatives [24].

Ayurveda, too propagates the principle of health preservation,

promotion and disease prevention, along with early diagnosis and holistic disease management strategies, incorporating dietary and lifestyle components conglomerated under Dinacharya (daily regimen practices) and Ritucharya (seasonal regimen practices) [25–28]. This paper critically explores the scientific relevance behind these ascribed daily regimen practices (Dinacharya) and their suitability as a quaternary prevention strategy and presents it for dialogue and research to the scientific community.

Material and Methods

A review of literature ascribed in classical Ayurveda texts and conventional medical sciences was done to explore and document the relevant aspects to Ayurveda daily regimen practices. Further, search engines of google scholar and Pub Med were explored using keywords “research” “benefit” “role in health”, combining them with Ayurveda daily regimen terms and their English equivalents as provided in brackets and their different combinations and permutations along with net surfing and hand search. The articles retrieved were stored in a folder and screened for relevance. The matter was then critically analyzed and developed in a schematic manner to present the matter systematically.

Results

Ayurveda daily regimen (Dinacharya)

An observation of the quotidian Ayurveda routine reveals that it incorporates all the basic life sustaining practices of the civilized world today as Ahara (proper diet), Nidra (proper sleep) and proper daily lifestyle which encompasses hygienic grooming practices (bathing, brushing, tongue cleaning, wearing clean clothes, shoes, cutting nails and beards etc.), along with other specific components advocated to be practiced daily like Bramha Muhruta-Jagrana (awakening early in the morning), Puresha Vega Vidharana (proper timely defecation), Abhyanga (oil massage), Vyayama (exercise), Sandhya (Worshipping/offering prayers), Devata, Athithi, Vipra Pujana, (paying obsecience to Gods, guests, brahmins and those who are superior in age, experience, position etc.), Vritti, (having a means of livelihood) etc. [29–39]. The scientific aspects behind these daily Ayurveda practice, their relevance to health and disease conditions, and their role in quaternary disease prevention are detailed below.

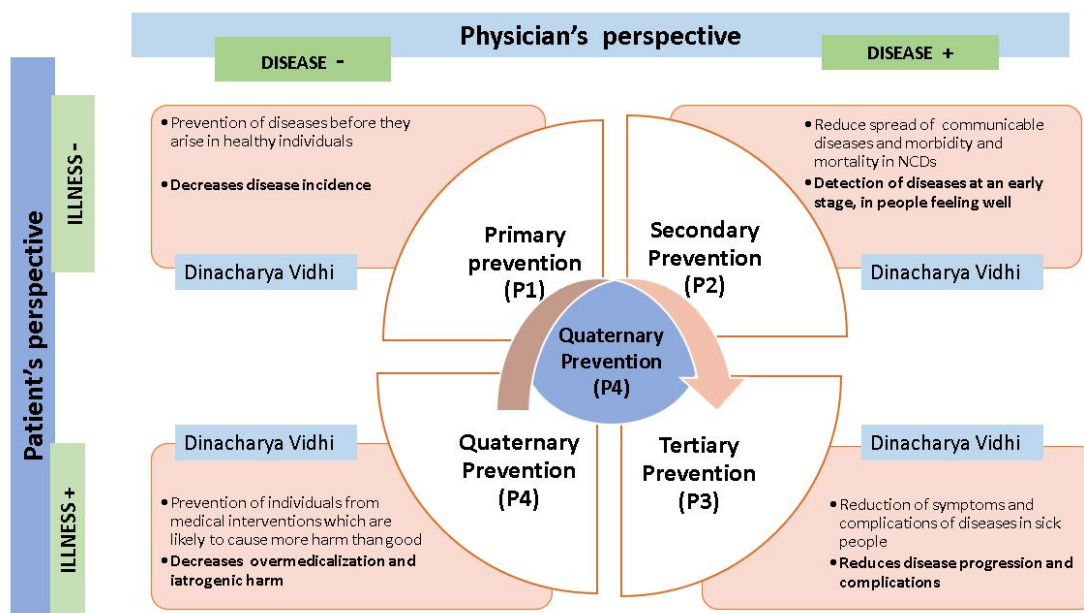


Figure 1 Quaternary prevention strategy and proposed role of Ayurveda daily regimen at all levels of prevention

Nidra (proper night sleep): restoring the circadian and neuroendocrine rhythms and rejuvenating health [30]

Sleep, in Ayurveda is addressed as a foster mother and considered as one of the three crucial elements (along with diet and lifestyle) on which sustenance of life depends [40, 41]. Proper sleep promotes health, happiness, nourishment status, reproductive capacities, sensory and cognitive facilities, and the life of an individual and vice versa [42]. Oversleeping, under sleeping, loss of sleep, improper sleep, sleeping at improper times (day sleep, sleeping after meals) are documented to have deleterious effects on health [43, 44].

Contemporary medical science also documents that proper night sleep is crucial for maintaining physiology and behavior [45]. Sleep maintains the circadian and neuroendocrine rhythm by modulating the balance between serotonin and melatonin, repairing damaged cells and DNA, stabilizing mood, ensuring proper body growth and maintaining homeostasis of the body-mind unit [46, 47]. Sleep is researched to have a definitive role in creativity, insight, decision making, cognition, recalling capacity, and motor skill consolidation [48–51]. Cumulative long-term effect of inadequate or poor sleep is associated with a rise in inflammatory markers, poor mental health with problems like anxiety and depression, and increased risk of chronic diseases like hypertension, diabetes, obesity, depression, heart attack, stroke, along with social impact [52–55].

Bramha Muhruta Jagrana (waking up early in the morning): orchestrating to the morning sun and chronobiological rhythms [31]

Waking in the morning before dawn (Bramha Muhruta), after assessing the digestion status of the previously consumed food is ascribed as a daily regimen [56]. Bramha Muhruta is the time approximately 96 minutes before sunrise and varies throughout the different time zones [57]. Due to Vata Dosha dominance (one of the three Doshas which is responsible for all body-mind functions) in this period, it is advised as the apt time for leaving the bed for proper synchronized systems physiology.

The scientific literature reveals that a good sleep cycle keeps the body’s circadian rhythm in balance with the outer biological clock. Among the various synchronizing agents such as physical activity, melatonin, social behavior; light is the most powerful stimulant. Circadian rhythm affects immunity, regulates secretion of hormones like melatonin, cortisol, epinephrine, nor-epinephrine and also the

expression of several genes which modulate our daily diurnal activities (Figure 2) [58–60].

Shift duties, travel along very long distances (jet lag), night duties, light exposure at night (especially blue night) can all effect and disturb the circadian rhythm, leading to irritability, depressive behaviors, anxiety, poor learning and memory efficiency, disorders such as insomnia, depression, metabolism dysfunction, obesity, gastrointestinal problems as peptic disease, impaired digestion, cardiovascular abnormalities, genitourinary dysfunctions, increased tumorigenesis in the liver and gut, cognitive impairment and various neuroendocrinal problems [61–67].

Arising early morning may also impart the benefits of sun exposure like vitamin D production. Vitamin D maintains endothelial membrane stability, promotes autophagosome-lysosome fusion, and reduces the risk of viral infections, asthmatic attacks, hypertension, cardiovascular diseases, metabolic syndromes, and several cancers, owing to its immunomodulatory, anti-microbial, anti-viral effects [68–72]. Other benefits of sun exposure, unrelated to vitamin D production include immune modulatory effects, protection against oxidative stress, and DNA repair [72–76]. Infra-red rays of the sun reduce inflammation, improve circulation, promote cell regeneration, and also modulate gene expression [77].

Apart from regulating circadian rhythm, which affects various body functions, sunlight exposure may also have genomic and epigenomic considerations [78, 79]. It enhances the release of endorphins, which augments mood, stimulates wound healing, relieves pain, and supports the immune system [78, 80]. Nitric oxide release, which is a potent vasodilator with cardio-protective, anti-tumor, anti-oxidant, and free radical scavenging effects; aiding immune defense, apoptosis, and other benefits is also stimulated by sunlight [81].

Pureesha Vega Vidharana (proper timely defecation): unloading for healthiness [32]

Early morning is advised as the apt time for defecation, for proper synchronized systems physiology due to Vata Dosha dominance (one of the three Doshas, which is responsible for all body-mind functions and regulations). Delay in rising out of bed postpones bowel clearance and may even suppress the natural urge, later requiring straining at stool passage. Holding the urge to defecate has been linked to the development of headaches and derangement of digestion and metabolism [82].

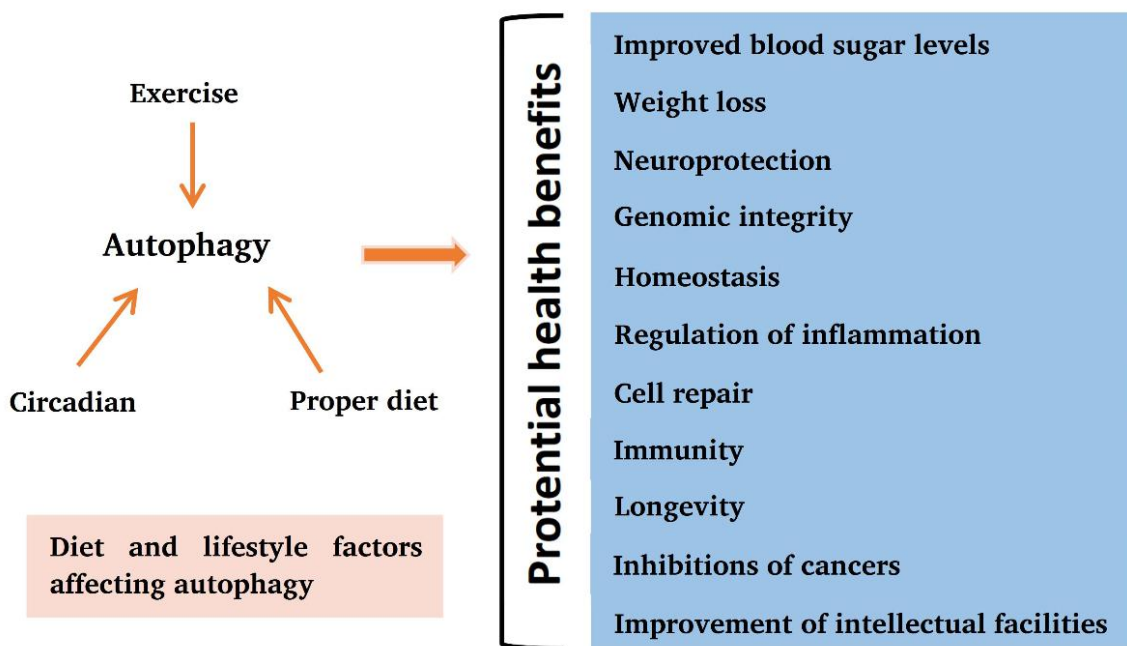


Figure 2 The daily lifestyle activities affecting autophagy and its potential health benefits

Contemporary medical science documents large coordinated contractions known as high-amplitude propagated contractions to bring stool from the ascending colon down to the left colon in mass movements, which typically occur in the morning soon after awakening [83]. Constipation is linked as a risk factor for cardiovascular disease, inducing atheromatous changes in the cardiovascular system by mechanisms like altered microbiota, and oxidative and mental stress [84–89]. Further linkage to other morbidity conditions such as colorectal cancers, benign neoplasms, and mortality is also documented [90, 91]. Straining at stool to defecate is documented to raise blood pressure and breathing, similar to the Valsalva maneuver [84]. Blood pressure fluctuation incorporating morning rise may trigger cardiovascular events [92].

Gut motility is a complex process comprising multilevel neural and hormonal control from the colon up to the central nervous system [93]. Gut functionality can also affect the microbiome and consequently the central nervous system through linkages of the enteric nervous system and microbiome [94–97]. This linkage between the gut and the brain called the gut-brain axis is bidirectional, with one affecting the other through neural, endocrine, immune, and humoral link signaling [98]. Recent microbiome researches suggest microbiome disturbances affect the central nervous system by pathways like vagal activation through the metabolites produced by the microbiome and that manipulation of the microbiome may reverse such disturbances [99, 100].

Abhyanga (oil massage) and Vyayama (exercise) [33]

Massage and exercise are important parts of the Ayurveda daily regimen. Numerous studies conducted on massage and its beneficial effects document that body massage is very useful in reducing transient stress, improving brain coherence, body immunity, and immunological status, and also impart immunomodulatory effects in human immunodeficiency virus-positive cases [101–104].

Inactivity is one of the major lifestyle components recognized as a risk factor and linked to over 35 different diseases [105]. Physical activity has numerous body-mind benefits, like managing weight, and blood pressure, decreasing the risk of heart attack, stroke, breast cancer, colon cancer, type 2 diabetes; preventing depression, osteoporosis, and impotence; lengthening life span, lowering stress levels, and cholesterol; relieving arthritis and back pain, strengthening muscles, bones and joints; improving sleep, elevating sense of well-being, and improving the brain functioning and coherence [106–108]. Exercise is also researched to induce autophagy in experimental studies [109]. However, it is important to consider the duration and intensity of exercise as health and activity share a U-shaped curve relationship, with excess on both sides i.e inactivity as well as excessive exercise causing deleterious health effects due to low-grade chronic systemic inflammation called metaflammation [110, 111].

Athletes, regularly indulging in exercise and fitness training are documented to have a post-exercise transient decrease in cardiac functions, with longer exercise durations and lower training status [112–116]. Evidence suggests that an extended period of strength training can lead to long-standing adverse consequences, including myocardial fibrosis, coronary atherosclerosis, exercise-induced acquired form of arrhythmogenic right ventricular cardiomyopathy, atrial fibrillation, and ventricular arrhythmias [117, 118]. A meta-analysis reports a 5-fold increase in atrial fibrillation risk in athletes, which is reconfirmed in a Swedish study (N = 52,755) [119, 120]. The possible explanation for this could be the law of diminishing returns, responsible for the U-shaped relationship between physical activity and cardiac diseases, due to which after an upper threshold additional physical activity provides no further mortality benefits [117, 121, 122]. Some inconsistent evidence regarding this aspect has been reported; however, large-scale evidence is yet awaited to establish the same [111–122].

Ayurveda has described excessive exercise and physical activity as deleterious to health and cause several diseases [123]. In this context, determination of the right amount of exercise is crucial, which can be

done using the Ayurveda principle of individualization of exercise as per a person's strength and stamina, which is reflected by the appearance of features in an individual like labored breathing, perspiration, lightness in the whole body, some discomfort in the functioning of the heart; when exercise should be stopped [124].

Sandhya (worshipping/offering prayers) and Devata, Athithi, Vipra Pujana (paying obeisance to Gods, guests, brahmins, superiors): prayers and social bonding as tools for health and wellness [35–37]

The positive effects of prayers are scientifically documented [125]. Prayers performed by other people (not related to a person) are also reported with positive health outcomes [126]. Ayurveda lifestyle of offering obeisance to elders and superiors is similar to what the modern proverb says “to be humble to superiors is the duty, to equals courtesy and to those inferiors character” and is sufficient to increase the social acceptability of the person, ensuring companionship, guidance, peer support, love, and trust, which are all positive psychological factors and are documented to decrease the risk for diseases due to lower level of systematic inflammation (as compared to people with unsatisfactory relationships) [127]. Poor social, and personal relations and isolation are found to be associated with increased proinflammatory cytokine activity, inflammatory processes, and outcomes of chronic diseases like cardiovascular diseases, stroke, cancers, and all-cause mortality [128–136]. Lower levels of systemic inflammation are reported in people with supportive close relationships [137]. Social support is shown in studies to alleviate the inflammation with childhood adversities [138]. Social support and relations thus seem to be crucial to the maintenance of personal health and disease prevention as well as healing [128].

Ahara (proper diet): appropriate diet as a tool for longevity and health [29]

Diet (Ahara) is the first pillar of health as it plays a crucial role in health preservation and maintenance [139]. Ayurveda prescribes the intake of healthy, wholesome food to which one is habituated, in an amount which is as per the appetite, digestive capacity, and health status of the individual [140]. A person should eat food only when hungry and refrain from eating in a state of indigestion, as it results in the genesis of toxic, reactive intermediary metabolite (Ama) which can cause numerous diseases [141]. The food should be consumed piously, following the guidelines of the eight and twelve rules of dietetics (Ashtavidha Ahara Visheshayatana and Dvadashaashana Pravichaar) [142, 143]. There is a vivid description of several kinds of foods and their properties in Ayurveda [144]. Inadequate or overnutrition both are improper for health which is why Ayurveda stresses upon consumption of a proper amount of food as per the individual and food properties [145].

Improper amount of food is scientifically documented as a risk factor for NCDs like diabetes mellitus type-2, cardiovascular disease, deficiency disorders, or other chronic diseases [146, 147]. Excessive intake of even healthy foods has been linked to chronic metaflammation with negative extended outcomes [148]. Metaflammation appears to be a part of the metabolic cascade, including cellular oxidative stress, insulin resistance, increased allostatic load, dysmetabolism, and consequently NCDs. There exists controversy over the ideal diet, yet the dictum of “Eat food. Mostly plants. Not too much” by Michael Pollan is considered a brief yet precise long-term nutritional goal [149]. Ayurveda recommends kaalbhojanam (eating meals at specified times, when a person is really hungry and feels light in the body) as the best strategy for health (Arogya) which correlates closely to the contemporary concept of time-restricted feeding [150, 151]. Eating food with such frequency is linked to improved digestion and autophagy and is also proposed as a strategy to lower metabolic risks [151]. Reduced meal frequency along with intermittent fasting is also documented to modulate the gut microbiome, improve circadian rhythmicity, reduce inflammation and increase stress modulation [152]. 20 to 24 hours of fasting is documented to trigger autophagy and double the regenerative

capacity of stem cells [153, 154]. Autophagy is supposed to positively affect human health through decreased inflammation, improved blood sugar levels, weight loss, improved brain function, longevity, neuroprotection, immunity, memory improvement, muscle maintenance, genomic integrity, cellular homeostasis, and negative regulation of inflammasome activation [155–158] (Figure 2). Circadian rhythm is linked to metabolism and the benefits in longevity due to autophagy is found to be related to circadian rhythm [153]. Defect in the autophagy mechanism is documented in neurodegenerative diseases like Alzheimer's disease, Parkinson's disease, Huntington's disease, and amyotrophic lateral sclerosis [155]. The role of autophagy in cancers is debatable, depending on the type and stage of cancers, due to which autophagy is also documented as a double-edged sword with many beneficial as well as negative effects attributed to it in different diseases conditions [155, 159].

Vritti (earning money and having an occupation): livelihood as a means for a healthy, happy life [38, 39]

Ayurveda describes that leading a life without proper means of livelihood (Vritti) is a sin, as then none of the four ultimate human life goals (Purushartha Chatushtaya) can be attained [160]. Linking occupation as a resource for the attainment of four human life goals clarifies the aspect of the utilization of the generated resources, to attain personal as well as social satisfaction. The description of the occupation to be a virtuous one also reinforces the concept of a job being beneficial to society [161]. Occupation scenarios, as observed today linked with job insecurities, work pressure, unending economic obligations, and desires are concurrent to increased work hours, physical inactivity, low self-esteem, depression, anxiety, ill health, “burn out” and damage to social relationships [162–167].

Discussion

Non-communicable or lifestyle diseases have replaced infectious diseases in the late 20th century as the main disease burden globally, marking the epidemiological transition. Contrary to the theory of the single germ responsible for communicable diseases, NCDs have multiple determinants and their interaction plays an important role. Lifestyle is a major factor of the NCD with daily choices having a major role. The Industrial Revolution and the technological advancements along with packaged processed foods have greatly affected the lifestyle, causing detrimental health effects through chronic, low-level, systemic inflammation known as “metaflammation” [110]. The main factors contributing to lifestyle diseases include poor food habits and postures, physical inactivity, and disturbed biological clock [168]. A study on lifestyle changes reports that including daily 30 minutes of walking, having a healthy diet, quitting smoking, and maintaining a healthy weight prevented diabetes in 93%, heart attacks in 81%, strokes in 50%, and cancers in 36% [169]. Having comprehensive lifestyle changes can also reverse the progression of diseases and induce epigenetic changes, which can radically reduce or eliminate the chances of diseases like heart disease, prostate cancer, breast cancer, and diabetes [170].

The prevention and treatment of these lifestyle diseases involve a whole system approach with corrective actions applied at several levels as in diet, thought process, activity, and behaviors [171]. The systems model approach of Ayurveda for health preservation and promotion, as well as disease prevention, links to the principles of healthy choices made daily in diet, activities, behaviors, and thought processes (Dinacharya). The aim of following Dinacharya is very obvious from the verse of Vagbhatta “now we will discuss all such activities which are to be done constantly, day after day by the healthy intelligent persons desirous of preserving health” [172]. Adoption of these daily practices can help restore health and prevent diseases in individuals and societies.

Maintaining daily hygiene is an integral component of the Ayurveda daily regimen schedule with practices of oral health care (Dant Dhawan (brushing teeth); Jihva Nirlekhana (tongue scraping)), washing the face and the eyes (Mukha-Netra Prakshalana), oil or

medicated decoction pulling (Gandusha and Kawala (gargle like practice)), instilling nasal drops (Nasya), bathing and body sponging (Snana and Shareera Parimarjana), wearing clean clothes (Nirmala Ambar Dharana), fragrance (Gandha-Malya Dharana), staying presentable (Ratna-Abharana Dharanam) [173–183]. Kshaura Karma (Cutting the nails, hair, and beard) is described to be done thrice within 15 days [184]. Further, the wearing of clothes worn before bathing; or clothes, footwear, flowers, etc. used by others is forbidden, as they could lead to the spread of diseases like cough, colds, fevers, skin problems, and consumption (diseases causing emaciation like tuberculosis, etc.) [185]. Hygiene is a scientifically documented measure to reduce the incidence of preventable diseases like scabies, body lice, tooth decay, gum problems, worm infestation, etc. [186]. Further, being hygienic and presentable is also linked to improved levels of health and wellness, better personal, and social relations and acceptability, and better self-esteem and mental health consequently [187]. The scientific benefits of Gandusha and Kawala, Nasya are scientifically detailed in other papers [188–193].

Quality night sleep is vital for health sustenance by ensuring proper body growth, repair of damaged cells and DNA, and maintaining homeostasis of the body-mind unit [45–47]. Poor sleep is associated with several physical and mental disorders and inflammatory states [52–55]. Coupled with rising early in the morning, the proper sleep-wake cycle regulates the circadian and neuroendocrinal rhythms and linked physiological processes and immunity. Rising early morning also provides the benefit of early sun exposure, vitamin D production and its benefits, the release of endorphins and nitric oxide, protection against oxidative stress, DNA repair, improved circulation, and cell regeneration, cytokine secretion modulation, epigenetic considerations, etc. which aid promote health status and immunity of the individual and prevent disease occurrence [72, 76, 77, 79–81]. These practices are also vital to diseased individuals as they significantly affect body physiology and consequently disease progression or recovery.

Timely defecation practice in the morning at the time of high-amplitude propagated contractions cleanses the body of the waste remnants and also prevents the predisposition to cardiovascular diseases [84–86]. Mechanisms such as altered microbiota and oxidative and mental stress are linked to pathogenesis [87–89]. It is hypothesized that timely defecation could be addressing these mechanisms. Ayurveda emphasizes greatly on gut health, digestion and metabolism and links their status directly to the health status of the whole body and disease [194]. Timely defecation is a measure of regular cleansing of the gut from the metabolic waste products, which if retained can predispose to several diseases through the development of components of Udavarta and Purishaavritta Vata (pathologies due to retained and compacted feces) [195, 196]. The treatment procedure of Vasti (medicated enema with disease-specific oil and decoctions) is called half treatment to all diseases (Ardha-chikitsa) as it cleanses and nourishes the gut and the drug administered through this procedure gets absorbed through active absorption or passive diffusion and reaches the whole body [197]. It is also hypothesized that the lipid-soluble components of the drugs administered may also reach the brain via circulation by crossing the blood-brain barrier. Vasti is a component of routine seasonal regimen practice and the details can be seen in relevant papers [198, 199].

Massage and exercise are important parts of the Ayurveda daily regimen. Massage is useful in improving body immunity and immunological status, reducing transient stress, and improving brain coherence as per scientific research [103]. Ayurveda also documents daily massage to improve the skin quality, and complexion, impart nourishment and strength and also help in the prevention of joint disorders [200]. Exercise is effective for strengthening muscles, bones, and joints, improving stamina, relieving arthritis and back pain, lowering stress levels and cholesterols, managing weight, and blood pressure, decreasing the risk of heart attack, stroke, breast cancer, colon cancer, type 2 diabetes; preventing depression, osteoporosis and impotence, lengthening life span, improving sleep and elevating sense of well-being [101–109]. It is though important to exercise judiciously

as per the individual's capacity to prevent its detrimental effects [110–122]. Ayurveda can provide guidelines for the individualized exercise duration to reap its benefits without any adverse effects [124].

Having a means of livelihood is essential for the sustenance of health and life, and also to contribute to society [160–167]. Prayers, meditative practices, and social bonding all help positive psychology to play a role and improve immunity, health, and healing, thus increasing longevity with better quality of life. Both of these practices of Ayurveda reinforce the concept of financial dependence coupled with social bonding and health and their significance [126, 128].

Diet is widely accepted for its role in health and disease, especially NCDs [146, 147]. Time-restricted, a suitable healthy diet can play a crucial role in providing nourishment, reducing metaflammation, and improving metabolism; thus, sustaining health and preventing diseases [149]. Daily diet and lifestyle practices are accepted to affect gene expression, without actually altering the genome through the science of epigenetics, affecting the health and disease states of the individual as well as that of progenies [201].

The natural evolution synchronized the human body's physiology to the tune of mother nature through various biological clocks, also called chronobiology. The three important rhythms scientifically studied in biological systems are circadian (24-hour clock mimicking the cycles of day and night like melatonin secretion), ultradian (cycle repeated within 24 hours as enzymatic reactions and secretion, hormones), and infradian (cycle of duration greater than 24 hours as monthly or seasonal variations like menstrual cycle in humans, breeding period of animals) and are found to affect all life forms [202–204]. Research has documented the internal circadian rhythm to affect the physiological body functions in coordination with the external diurnal rhythm as body temperature, feeding behavior, blood pressure, mental concentration and activity, hormone release, sleep patterns, etc. [60] (Figure 3).

Ayurveda recognized the temporal effects of chronobiological cycles on human health and accordingly devised the seasonal and daily regimen schedules, delineating the principles for healthy living and harmonization as detailed above [25, 26]. These practices are crucial to all healthy as well as diseased individuals as they affect the physiology in a healthy state and turn to pathology when disturbed.

Adoption of these daily health lifestyle practices could affect the disease pathogenesis through the approaches mentioned above and possibly through other mechanisms like psychogastroenterology, psychoneuroimmunology, gut-brain linkage, and gut microbiota linkages, microbiome and immunity linkages, which also play vital integrative functions in the same. However, the detailed approach of these aspects is beyond the domain of this paper.

The idea of preventing illness and disease has gained much popularity in recent years, owing credit to early disease detection, better treatment modalities, and reduced financial implications. The concept of quaternary prevention aims to reduce the harm due to excessive, unnecessary medical interventions and suggests ethical alternative interventions [205]. Ayurveda, due to its inherent principles of health preservation, promotion, and, disease prevention through the daily regimen practices described above can play a crucial role as a quaternary prevention strategy for the healthy or diseased, applicable in all the four stages of prevention, customized in a tailored manner to suit the needs of the individual. Prospective large-scale long-duration randomized controlled trials are yet needed to scientifically further establish the validity of the same.

Conclusion

Ayurveda, due to its inherent principles of health preservation, promotion, and disease prevention along with holistic disease management strategies can play a very vital role as a primary (P1) as well as quaternary prevention (P4) strategy for the healthy as well as diseased globally. The systems model approach of Ayurveda for health preservation and promotion, as well as disease prevention, links to the principles of chronobiology, mind-body integration, and epigenetics. The adoption of daily Ayurveda regimen practices could potentially help in health maintenance and promotion; disease prevention; as well as in the disease stage customized to suit the individual's need. NCDs which are associated with poor lifestyle choices including unhealthy eating habits, physical inactivity, poor sleep, posture, and disturbed biological clock can be addressed significantly with these daily regimen practices of Ayurveda. However, the realization of the actual benefits warrants prospective large sample-sized randomized controlled trials to establish the same.

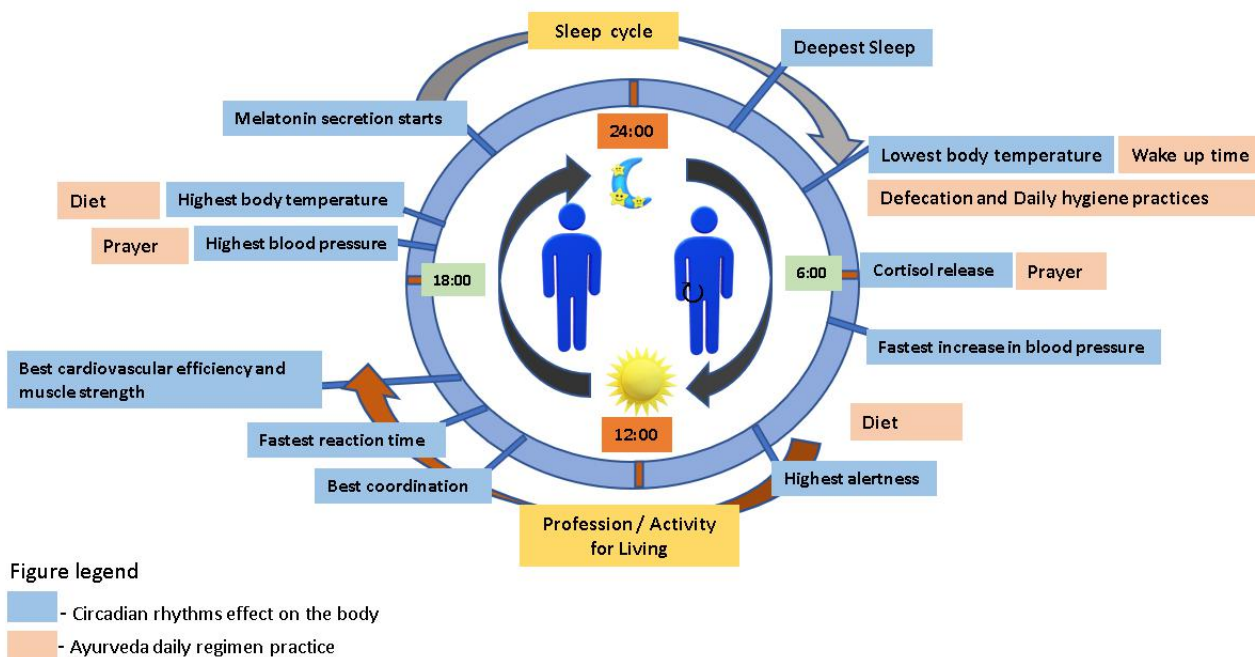


Figure 3 Internal circadian clock regulating physiological activities in coordination to the external diurnal rhythm and the Ayurveda daily regimen planning as per different times of day

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