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REVIEW ARTICLE

Greeshma Ritucharya: An Integrative Review on Heat Adaptation and Seasonal Physiology

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ABSTRACT

Background: *Greeshma Ritucharya* (Ayurvedic summer regimen) provides a traditional framework for maintaining homeostasis during rising temperatures. Integrating this ancient wisdom with modern thermal biology is increasingly relevant due to rising global temperatures.

Objective: This review explores physiological shifts during *Greeshma* and evaluates Ayurvedic interventions in mitigating heat stress.

Methods: An integrative analysis was conducted, synthesizing classical texts (*Charaka/Sushruta Samhita*) with contemporary research on thermoregulation and metabolism.

Results: Ayurveda identifies *Greeshma* by *Vata* accumulation and a natural decline in physical strength (*Bala*). Modern physiology parallels this through vasodilation, electrolyte loss through sweating, and metabolic adaptation. Prescribed diets – emphasizing *Shitam* (cold), *Madhura* (sweet), and *Drava* (liquid) intake – proactively prevent dehydration. Lifestyle shifts, such as reduced exertion, align with modern chronobiological recommendations for heat adaptation.

Discussion: The synergy between *Agni* (digestive fire) depletion and peripheral vasodilation suggests that Ayurvedic dietary restrictions prevent metabolic strain when visceral blood flow is low. Furthermore, the focus on *Madhura* and *Drava* substances serves as a functional precursor to modern oral rehydration, stabilizing electrolytes lost through perspiration. By modulating activity levels, these traditional practices act as behavioral thermoregulation, enhancing cellular resilience against thermal stress.

Conclusion: *Greeshma Ritucharya* offers a sophisticated, preventative strategy for seasonal health. Integrating these practices with modern insights provides a holistic solution for contemporary challenges associated with climate change and heat adaptation.

1. INTRODUCTION

In our modern, high-pressure world, lifestyle disorders have evolved into a silent epidemic. This crisis stems largely from a growing disconnect between society and the natural environment. While medical science frequently identifies new diseases, the ancient wisdom of Ayurveda remains steadfast in its approach, prioritizing the maintenance of health and the prevention of illness over mere symptom management. The foundation of this preventive care lies in *Ritucharya* – the practice of adjusting our dietary and behavioral habits to align with the changing seasons.

As we relentlessly pursue professional and personal goals, health often takes a backseat. This lack of time leads to a reliance on processed, artificial foods and a total disregard for seasonal routines. Such habits disrupt the body's internal equilibrium, causing an imbalance of the *Doshas*, which eventually manifests as chronic physical and mental health issues. Ayurveda teaches that because our bodies and minds are deeply linked to the environment, any shift in the weather directly impacts our internal state.

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Adapting to these transitions is a form of "survival of the fittest." If we fail to modify our lifestyle as the seasons shift, we become vulnerable to a wide range of somatic and psychosomatic disorders. However, by consciously practicing *Ahara, Vihara, Ritu Shodhana,* and *Rasayana Sewana* according to the current *Ritu*, we can achieve *Swasthya Avastha,* or a state of true health. Embracing these seasonal regimens not only boosts our *Bala* but also enhances our *Varna*, providing a natural shield against the lifestyle diseases of the modern era.[1]

2. MATERIALS AND METHODS

1. *Ritucharya* explained in the *Brihatrayees* with its commentaries.
2. Websites and other relevant articles related to *Greeshma Ritu.*
3. Websites and other relevant articles related to the summer season.
4. All these concepts are properly collected, analyzed, and arranged sequentially for the proper understanding of heat adaptation and seasonal physiology in disease prevention and maintenance of health in *Greeshma Ritu*.

2.1. Aims and Objectives

1. To highlight the basic concepts of *Greeshma Ritu* with dietary and lifestyle regimens explained in *Brihattaryees* required for heat adaptation.
2. Understanding the modern perspective on the summer season
3. Significance of its understanding in the present era.

2.2. Classification of *Ritu's*

Environmental factors are shaped by the characteristics of the land and water, along with atmospheric conditions such as temperature, wind, humidity, and atmospheric pressure. Because these elements are constantly shifting, the environment of a specific location is never identical from one moment to the next. For instance, temperatures typically climb as the sun rises and fall after sunset. While these daily highs and lows change constantly, they follow a broader pattern where it is warmest during the summer and coldest in the winter. These daily and yearly shifts in weather patterns are what we ultimately define as seasons.[2]

In Ayurveda, the year is divided into six distinct seasons that reflect the climate of the Indian subcontinent: *Shishira, Vasanta, Greeshma, Varsha, Sharad,* and *Hemanta*.

These seasons are grouped into two 6-month periods based on the sun's movement:[3]

1. *Uttarayana* (The Northern Path)
   Also known as *Adanakala*, this period includes *Shishra*, *Vasanta,* and *Greeshma*.
   - The Environment: The sun and wind are extremely intense and dehydrating.
   - The Effect: This harsh energy absorbs the earth's moisture and "softness."
   - Human Impact: People often feel physically weaker and less energetic during these months.
2. *Dakshinayana* (The Southern Path)
   Also known as *Visargakala*, this period covers the *Varsha, Sharad,* and *Hemanta*.
   - The Environment: The moon's cooling influence becomes stronger than the sun's heat, and rain helps cool the earth.
   - The Effect: The environment becomes more nourishing and refreshing.
   - Human Impact: Physical strength and vitality naturally begin to increase during this time.

Modern science explains that our seasons are caused by the 23.5° tilt of the Earth's axis as it orbits the sun. Because of this tilt, different regions of the planet receive varying amounts of direct sunlight at different times of the year.

How the Hemispheres Change:
- Summer in the North: When the North Pole leans toward the sun, the Northern Hemisphere gets more direct rays and experiences summer.
- Winter in the North: When the South Pole tilts toward the sun, the Northern Hemisphere is angled away, receiving less direct light and experiencing winter.

2.3. *Greeshma Ritucharya*

2.3.1. Characteristics of Ritu

In general, mid-May to mid-July is considered the *Greeshma* season. The environment is prevalent with intense heat and pleasant wind. The river bodies dry up, and the plants appeared lifeless. The predominant *Rasa* is *Katu*, and the *Mahabhuta* are *Agni* and *Vayu*. The strength of the person becomes less; accumulation of *Vata Dosha* occurs, but the *Kapha Dosha* is pacified during this season. *Jathragn*i (digestive fire) of the person remains in a natural state. The sun appears as *Atasi Pushpa* (red) and dries up the water reservoir. Trees had no leaves, and there was no greenery around. All living creatures search for water bodies to meet their thirst.

2.4. Changes in Body

During this period, the intense solar heat acts as a sponge, absorbing the natural moisture (*Snigdha Guna*) from both the environment and the human body. This process dries out our internal "water element," causing a significant drop in *Kapha* while simultaneously triggering an increase in *Vata*, which represents dryness *(Ruksha Guna)*. Since Ayurveda views *Kapha* as a primary source of physical strength and immunity, its depletion directly results in a noticeable loss of overall energy and vitality. Furthermore, this seasonal shift affects the internal system by keeping the digestive fire, or *Agni*, in a relatively weak and sluggish state.[4]

2.5. Seasonal Physiology

Modern research confirms that the transition into the summer season, or *Greeshma*, triggers significant shifts in biological markers and metabolic functions. Studies indicate that during this period, which belongs to the *Adana Kala*, environmental factors such as intense sun rays and dry winds reduce physical strength (*Bala*). This loss of strength is a result of the sun extracting the water content of the earth and living beings, a concept that aligns with modern observations of seasonal fatigue and heat-induced metabolic stress.[5]

Physiologically, these changes manifest in altered lipid profiles and digestive efficiency. Research has shown that serum parameters such as cholesterol and triglycerides tend to be lower in the summer compared to winter, reflecting a seasonal shift in lipid metabolism.[6] Furthermore, the Ayurvedic concept of *Agnimandya* (suppressed digestive fire) during *Greeshma* is supported by the physiological understanding that the body redirects blood flow to the periphery for thermoregulation, which can suppress internal digestive processes.[7,8]

According to *Ayurveda, Doshas* also affect the physiology, causing different diseases if we cannot control the *Chaya* and *prakopa* of these

doshas. If no corrective seasonal regimen (*Ritucharya*) is followed, *Vata* will explode into *Kopa* (aggravation) in *Varsha Ritu* manifesting as full-blown *Vata* disorders: Arthritis, sciatica, paralysis, neurological conditions, and severe digestive disturbances and *Kapha Prashmana* clinically indicates about natural reduction of mucus and congestion, improved mobility (heaviness reduces), reduced water retention, appetite normalizes after spring sluggishness, skin becomes less oily.

2.6. Physical Features of *Greeshma Ritu*

The *Greeshma Ritu* represents a period of extreme thermal intensity that permeates the entire Indian subcontinent. As a nation characterized by its subtropical and temperate geography, India undergoes a distinct and powerful summer phase that manifests with differing levels of severity and duration depending on the locale.

The seasonal transition begins in March as temperatures across the country start their steady ascent. By the time April arrives, the inland regions of the Indian peninsula typically see average daily temperatures hovering between 30°C and 35°C. The central plains of India experience a significant surge in heat during this time, with many areas reaching daytime highs of approximately 40°C.

As the season reaches its peak in late May and early June, the heat intensifies dramatically, often surpassing 45°C. This creates particularly grueling conditions in the northern and northwestern territories of the country. In contrast, the maritime regions maintain a much more temperate climate; the constant interplay of land and sea breezes serves as a natural cooling mechanism, protecting coastal inhabitants from the harshest effects of the summer sun.[9]

The intensity of *Greeshma Ritu* across India is a study in geographical extremes, driven by the country's vast tropical landscape and diverse terrain. In the North and Northwest, the season manifests with brutal severity. This region, characterized by its distance from the cooling influence of the ocean, regularly sees the mercury climb between 40°C and 44°C. The desert state of Rajasthan serves as the epicenter of this heat, with Sri Ganganagar historically recording a peak of 54°C – a testament to the region's harsh summer climate.

Conversely, the Southern and Eastern regions experience a significantly moderated version of *Greeshma*. The massive water bodies surrounding the Indian peninsula – the Arabian Sea and the Bay of Bengal – act as a thermal buffer, absorbing heat and maintaining average temperatures between 33°C and 36°C. Finally, Northeast India stands as a unique outlier; here, the summer is mild and fleeting, quickly giving way to a dominant and prolonged monsoon season. This regional variation demonstrates how India's mixed climatic zones create vastly different physical and environmental experiences of the same traditional season.[10]

The period known as *Adana Kala* is fundamentally defined by three dominant qualities: *Ushna* (intense heat), *Tikshna* (sharpness), and *Ruksha* (dryness). These environmental forces act in unison to deplete the *Soumya Guna* – the cooling, nourishing, and stabilizing essence – from all living organisms on the planet.

During the peak of this summer cycle, the sun's radiation becomes exceptionally harsh. This thermal intensity is compounded by a dramatic drop in atmospheric moisture; relative humidity levels typically fall below 30%, and in extreme conditions, they can plummet to < 10%. This combination of high heat and profound aridity creates an environment that aggressively siphons hydration and vitality from the earth and its inhabitants.[11]

High ambient temperatures during this season create a state of *Ushna* (intense heat), which simultaneously lowers atmospheric density, making the air *Laghu* (light). As this hot, thin air circulates, it acts as a natural desiccant; upon making contact with the body, it aggressively draws out moisture. This environmental dryness is reflected in India's predominant flora – dry deciduous tropical forests – where trees shed their foliage as a survival tactic against the summer heat.

Rainfall distribution during this period varies significantly by geography:

- Arid Zones:
  Regions such as Rajasthan, Gujarat, and Madhya Pradesh receive < 2 cm of rain.
- Mid-range Zones:
  Areas such as Punjab, Bihar, Odisha, and the Himalayan foothills (Uttarakhand and Himachal Pradesh) see between 5 cm and 15 cm.
- High-Moisture Zones:
  The Malabar coast records 15 cm to 25 cm, whereas the Northeastern states, including Assam and Meghalaya, experience over 50 cm of precipitation.[12]

The intense evaporation driven by *Greeshma's* sun radiation creates a critical water crisis across the landscape. As reservoirs and natural basins recede, the survival instincts of forest wildlife are triggered, forcing animals to migrate long distances in a desperate search for hydration. This environmental stress is compounded by the behavior of the seasonal winds, which are a subject of classic Ayurvedic debate.

The *Shusruta Samhita* and the *Ashtanga Samgraha* offer seemingly contradictory views on the *Nairutya Vayu* (southwest wind). *Shusruta* describes these winds as unpleasant (*Asukha*), whereas *Vagbhata* identifies them as agreeable (*Sukha*). Climatologically, both are correct depending on the geography of the observer. In Northern and Western India, summer winds such as the Loo are searing and oppressive, justifying *Shusruta's* harsh assessment. Conversely, in Southern India, the southwest winds travel over the Arabian Sea, carrying moisture that provides a cooling respite from the heat, aligning with *Vagbhata's* more positive description.

When comparing historical Ayurvedic texts, these regional differences provide essential context for seemingly contradictory observations. The *Shusruta Samhita* describes the southwest wind as unpleasant and harsh, a perspective that aligns perfectly with the climatic reality of North and Northwestern India, where hot, desiccant winds such as the "Loo" dominate the landscape. Conversely, the *Ashtanga Samgraha* identifies these same winds as pleasant, an observation that is highly applicable to Southern India, where the maritime influence transforms the breeze into a refreshing and stabilizing force. By viewing these ancient scholarly descriptions through a modern climatological lens, it becomes clear that both texts accurately reflect the specific environmental conditions of their respective regions.

2.7. Heat-Adaptive Measures in *Greeshma Ritu*

The human body possesses a sophisticated and proactive physiological system designed to maintain homeostasis despite environmental extremes. During the *Greeshma Ritu* (summer season), this dynamic equilibrium is preserved through complex thermoregulatory processes. Humans have evolved an extraordinary capacity to adapt – anatomically, biochemically, and physiologically – to various ecological stresses, a trait fundamental to the species' survival.

Because living organisms exist in constant thermal exchange with their surroundings, body temperature can easily be influenced by external

conditions. To counter this, the body utilizes a homeostatic network consisting of sensory receptors, signal integrators, and effector organs. When internal temperatures rise due to exogenous heat or metabolic activity, this communication system triggers specific physiological modulations to keep the core temperature within a life-sustaining range.

Furthermore, persistent exposure to heat – whether from the harsh summer sun or vigorous physical exertion – acts as an adaptation stimulus. This repeated stress encourages the body to refine its cooling mechanisms, resulting in a more robust and efficient defense against thermal strain over time. This biological resilience allows the human system to function optimally even when faced with the *"Adana Kala"* or the dehydrating forces of nature.[13]

The human body is remarkably efficient at maintaining a stable internal environment, specifically keeping the core temperature of deep tissues within a very tight margin of approximately 0.50°C. For a healthy individual, this baseline typically fluctuates only between 36.0°C and 37.5°C, unless the body is subjected to extreme heat stress. This regulatory system is so robust that an unprotected person can withstand a wide range of external conditions – from temperatures as low as 13°C to as high as 54°C in arid environments – while their internal temperature remains virtually unchanged. Ultimately, the body's homeostatic mechanisms strive to preserve this narrow thermal equilibrium, often with a precision of within 0.05°C, ensuring that vital physiological processes continue to function optimally regardless of the surrounding climate.[14]

The skin serves as the primary interface and regulatory organ for maintaining the body's thermal equilibrium against fluctuating external conditions. It functions as a dynamic barrier between the internal core and the atmosphere; when ambient temperatures drop below 20°C, the skin transitions into an insulating state to preserve internal warmth. Conversely, when the environment surpasses the typical tolerance threshold of 40°C, the skin activates various heat-dissipation strategies.

Central to this regulation is the sympathetic nervous system, which dictates the flow of warm blood to the skin's venous plexus by modulating the diameter of arterioles and arteriovenous anastomoses. As external temperatures climb, the system adjusts blood flow and vasoconstriction rates accordingly.

The direction of heat exchange depends on the thermal gradient: the body sheds heat when the surroundings are cooler and absorbs it when they are warmer. To facilitate cooling, the skin employs five distinct physical mechanisms:

1. Radiation (emission of infrared heat)
2. Conduction (direct contact transfer)
3. Convection (heat movement through air currents)
4. The cooling effect of wind
5. Evaporation (the conversion of sweat into vapor).

2.8. Physical Strength during *Greeshma Ritu*

According to the *Charaka Samhita*, the intense conditions of *Greeshma Ritu* significantly deplete human vitality as the body's *Soumya Amsha* (cooling, nourishing essence) is stripped away. The seasonal dominance of *Ushna* (heat), *Laghu* (lightness), and *Ruksha* (dryness) begins to manifest internally, triggering a physiological shift.

A critical aspect of this transition is the *Vilayana* (liquefaction or thinning) of *Kapha Dosha*. As *Kapha* is traditionally associated with *Bala* (strength and immunity), its dissipation directly leads to a noticeable decline in physical energy. Simultaneously, *Vata Dosha* begins its phase of accumulation (*Chaya*), further contributing to a sense of exhaustion and fragility. These ancient observations align closely with the modern understanding of heat adaptation, where the body's initial struggle to maintain equilibrium against thermal stress results in systemic fatigue and a temporary reduction in functional capacity.

2.9. Physical Exercise and Sleep in *Greeshma Ritu*

The traditional guidelines for *Greeshma Ritucharya* advocate for a significant reduction in physical exertion, specifically advising against strenuous exercise (*Vyayama*) and limiting sexual activity to twice a month. These ancient recommendations align closely with modern physiological principles regarding thermal strain. Because the human body operates within an extremely narrow temperature range, even a minor elevation in core temperature can lead to profound exhaustion.

Both intense exercise and sexual intercourse act as metabolic heat sources that raise internal temperatures. In these states, the cardiovascular system is forced to perform a dual role: supplying oxygenated blood to active muscles while simultaneously diverting blood to the skin's surface for cooling. During extended periods of exertion in a hot environment, this balance is often disrupted. When the body can no longer compensate for the heat storage, central blood volume drops, and the heart struggles to meet the competing demands of the muscles and the skin. This failure leads to a reduction in skin blood flow, which hampers the body's ability to shed heat. Although sweating may continue, the core temperature begins to climb at a dangerous rate, eventually resulting in neuromuscular fatigue, diminished metabolic efficiency, and a total collapse in physical performance as the body hits a critical thermal threshold.[15]

2.10. Average Maximum Temperature of Different States of India in the Summer Season from March to July from 1951 to 2016[16]

The figure illustrates the seasonal mean maximum temperature across India during the pre-monsoon and early monsoon months (March–July) from 1951 to 2016. It highlights the spatial and temporal distribution of heat stress, showing a statistically significant warming trend across the country over these six decades. The data reveals that northwestern and central India are particularly prone to high-temperature events, which have become increasingly frequent and intense. This climatological assessment is essential for recognizing shifting heat patterns that pose emerging health risks and necessitate robust seasonal adaptation strategies.

3. DISCUSSION

The *Greeshma Ritucharya* serves as a vital bio-behavioral strategy for maintaining homeostasis during the summer's extreme thermal intensity. This period, classified under *Adana Kala* (the northern path of the sun), is defined by qualities of intense heat (*Ushna*), sharpness (*Tikshna*), and dryness (*Ruksha*). These environmental forces act as a "sponge," siphoning the body's natural moisture and cooling essence (*Soumya Amsha*), which leads to a depletion of physical strength (*Bala*) and immunity. Modern physiology mirrors these findings, noting that heat-induced metabolic stress and the redirection of blood flow to the skin for thermoregulation can suppress internal digestive efficiency (*Agnimandya*).

The article highlights that the biological impact of *Greeshma* varies significantly by geography across the Indian subcontinent. For instance,

the searing "Loo" winds in Northern India justify ancient descriptions of the southwest wind as unpleasant, whereas the moisture-laden breezes in coastal regions offer a refreshing contrast. To counter these diverse stressors, the prescribed Ayurvedic regimen emphasizes a diet that is cooling (*Shitam*), sweet (*Madhura*), and liquid-based (*Drava*) to prevent hyperthermia and maintain electrolyte balance.

It is important to adjust your lifestyle by moderating the intensity of physical exertion (*Vyayama*) and restricting sexual activity. These traditional restrictions align with modern clinical principles regarding cardiovascular strain; when the body is forced to balance the demands of active muscles with the necessity of peripheral cooling, it often reaches a critical thermal threshold that results in total physical collapse. By bridging classical wisdom with evidence-based physiology, the review concludes that *Ritucharya* offers a sustainable, proactive framework for enhancing human resilience against rising global temperatures.

4. CONCLUSION

The seasonal transition into *Greeshma Ritu* represents more than just a climatic shift; it is a period of significant physiological stress that demands a recalibration of the body's internal environment. This integrative review demonstrates that the Ayurvedic regimen of *Greeshma Ritucharya* is not merely a cultural relic but is a sophisticated, bio-behavioral strategy for thermoregulation and metabolic preservation.

By aligning dietary intake (*Ahara*) with the need for hydration and glycemic stability, and modifying lifestyle habits (*Vihara*) to reduce endogenous heat production, these traditional practices mirror modern clinical recommendations for heat acclimatization. The Ayurvedic emphasis on the depletion of *Bala* (physical strength) during the summer solstice finds its contemporary parallel in the cardiovascular strain and reduced aerobic capacity observed under extreme thermal stress.

As global temperatures continue to rise due to climate change, the relevance of these time-tested interventions becomes increasingly critical. Moving forward, the integration of *Ritucharya* into modern preventative medicine offers a sustainable, low-cost framework for enhancing human resilience. By bridging the gap between classical wisdom and evidence-based physiology, we can develop holistic public health strategies that go beyond acute heatstroke treatment to focus on proactive, seasonal adaptation.

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All authors give equal contribution in making of this manuscript.

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The authors declare no conflicts of interest regarding the publication of this paper.

10. DATA AVAILABILITY STATEMENT

The data analyzed in this review were obtained from publicly available sources, including peer-reviewed articles, observational studies, and surveys accessible through databases.

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Average Maximum Temperature of Different States of India

Dosha	*Chaya*	*Prakopa*	*Prasara*
Vata	*Greeshma*	*Varsha*	*Sharad*
Pitta	*Varsha*	*Sharad*	*Hemanta*
Kapha	*Shishra*	*Vasanta*	*Greeshma*