



## Review Article

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### A REVIEW ON TRIVIDH BALA AND FUNCTIONAL RESERVE IN AGING: AN INTEGRATIVE AYURVEDIC AND BIOMEDICAL PERSPECTIVE

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#### ABSTRACT

Aging is characterized by a gradual decline in the body's capacity to withstand physiological stressors. In classical Ayurveda, this capacity is described as Bala (strength/vitality), divided into three types — Sahaja, Kalaja, and Yuktikrita — collectively known as Trividh Bala. Contemporary biomedicine conceptualizes a similar phenomenon as functional (physiological) reserve, the surplus capacity of organs and systems allowing resilience against stress and delaying frailty. This integrative review elucidates the conceptual parallels between Trividh Bala and functional reserve in aging, mapping Sahaja Bala (innate constitutional strength) to innate, constitutionally endowed reserve; Kalaja Bala (age- and season-modulated strength) to age- and season-modulated reserve decline; and Yuktikrita Bala (acquired/lifestyle-dependent strength) to lifestyle-acquired reserve plasticity. It further examines the pathophysiology of reserve depletion, assessment modalities from both Ayurveda and biomedicine, and evidence-based interventions including Rasayana (rejuvenation) therapies, exercise regimens, and chronobiological adaptations aimed at preserving functional capacity and promoting healthy longevity.

**Keywords:** Trividh Bala, Sahaja Bala, Kalaja Bala, Yuktikrita Bala, Functional Reserve, Aging, Biomedical Geroscience

#### INTRODUCTION

Aging is accompanied by progressive loss in the body's ability to cope with internal and external stress, ultimately leading to frailty and morbidity. Both Ayurveda and modern biomedicine offer frameworks to understand this decline and strategies to mitigate it. Ayurveda's Bala (strength or vitality) is fundamental in determining an individual's robustness, immunity, and resistance to disease. The classical Ayurvedic concept of Trividh Bala divides this strength into Sahaja (innate), Kalaja (age/season-related), and Yuktikrita (acquired) categories.<sup>1,2</sup>

Modern geroscience employs the concept of functional or physiological reserve, defined as the extra capacity organs possess beyond basal needs, which enables an organism to maintain homeostasis under challenge. When reserve diminishes beyond a threshold, clinical frailty ensues. This review aims to bridge these traditions by exploring their shared constructs, assessment strategies, and integrative approaches to enhance resilience and delay age-related functional decline.<sup>3,4</sup>

#### Review Methodology

The study was planned on a conceptual basis using literary study of classical and modern texts. Concepts related to the title were compiled from Ayurvedic literature, modern textbooks, scientific journals, and internet sources. A comparative and analytical approach was applied to propose an integrated understanding of the subject matter.

#### CONCEPTUAL FOUNDATIONS

##### Trividh Bala in Ayurveda

Ayurveda describes Bala (vital strength/resilience) as the foundational capacity of the body to withstand disease, stress, and the ravages of time. According to Charaka Samhita, Bala is the product of the harmonious functioning of Doshas (biological humours), Dhatus (bodily tissues), and Malas (metabolic byproducts). Trividh Bala classifies this capacity into three distinct but interrelated types, as detailed in Table 1.<sup>1</sup>

**Table 1: Classification of Trividh Bala and Biomedical Parallels**

Domain	Definition	Determinants	Biomedical Parallel
Sahaja Bala	Innate, constitution-based strength	Genetics, prenatal environment	Innate immunity, baseline organ reserve
Kalaja Bala	Age- and season-influenced strength	Chronological age and seasons	Age-related reserve decline, circannual variation
Yuktikrita Bala	Strength acquired through lifestyle	Diet, exercise, sleep, Rasayana	Acquired/adaptive reserve, neuroplasticity, immunomodulation

Sahaja Bala represents the inborn robustness a person inherits from parental Shukra (spermatozoa) and Shonita (ovum) and is closely related to the concept of Ojas (vital essence/primary immunity). Kalaja Bala fluctuates with internal aging cycles and external seasonal rhythms, reaching its peak in young adulthood and declining progressively thereafter. Yuktikrita Bala is modifiable and can be enhanced through purposive behavior, dietary optimization, and targeted therapeutic interventions such as Rasayana (rejuvenation therapy).<sup>2</sup>

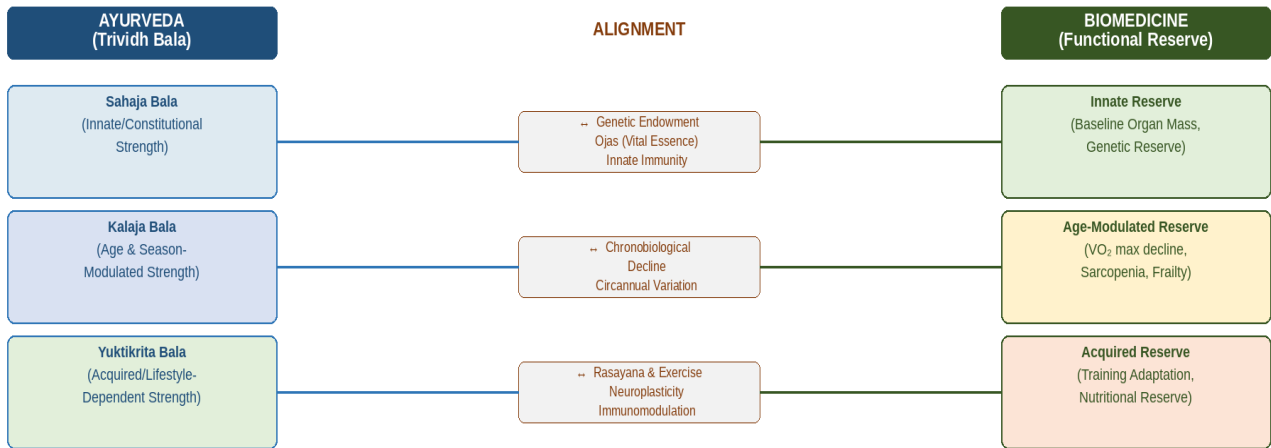
**Functional Reserve in Biomedicine**

Functional reserve reflects the difference between maximal organ or system capacity and usual basal demands.<sup>13</sup> It varies across organ systems — cardiac, musculoskeletal, cognitive, pulmonary — diminishing progressively with aging and disease burden. Reserve becomes clinically apparent when stressors challenge homeostasis, revealing underlying vulnerability or resilience.<sup>14,15</sup> Three key properties define functional reserve: organ specificity (different systems show differential depletion patterns),<sup>16</sup> stress-dependency (reserve reveals itself only under physiological challenge), and plasticity (reserve can be partially restored by lifestyle and therapeutic interventions). These properties closely mirror the attributes of Trividh Bala as described in classical Ayurvedic texts.

**MAPPING AYURVEDIC AND BIOMEDICAL CONSTRUCTS**

The conceptual alignment between Trividh Bala and functional reserve is not merely metaphorical but reflects shared biological realities. Sahaja Bala corresponds to innate reserve, encompassing genetic endowment of organ mass, immune function, and cellular repair capacity, which parallels the Ayurvedic concept of Ojas(vital essence).<sup>17</sup> Kalaja Bala maps onto age- and season-modulated reserve, reflecting the natural, time-dependent decline in organ function and the influence of circadian and circannual rhythms on physiological capacity.<sup>18</sup> Yuktikrita Bala corresponds to acquired and adaptive reserve; lifestyle factors such as diet, physical exercise, adequate sleep, and Rasayana (rejuvenation) therapies demonstrably enhance adaptive physiological reserve.<sup>19</sup> Modern clinical trials corroborate this: resistance training upregulates type II muscle fiber cross-sectional area, endurance exercise enhances mitochondrial biogenesis, and Mediterranean-style dietary patterns reduce inflammaging (chronic low-grade inflammation associated with aging), collectively augmenting physiological reserve.<sup>20</sup>

Figure 1: Conceptual Mapping of Trividh Bala and Functional Reserve in Aging



Aging progressively depletes all three layers of reserve. Yuktikrita Bala / Acquired Reserve is most amenable to intervention.

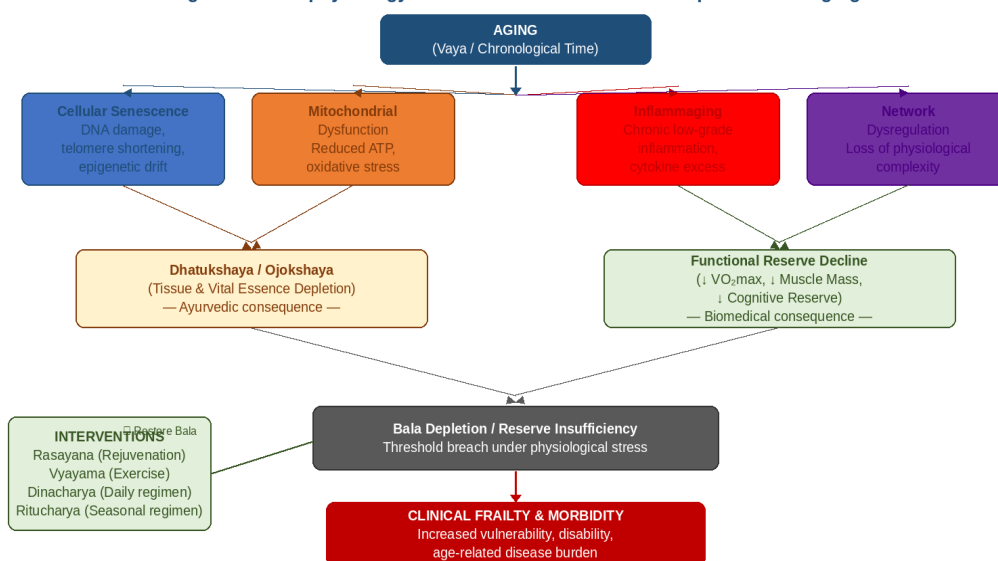
Figure 1: Conceptual Mapping of Trividh Bala and Functional Reserve in Aging

**PATHOPHYSIOLOGY OF RESERVE DEPLETION**

The depletion of both Bala and functional reserve in aging shares converging mechanistic pathways. Cellular senescence, driven by cumulative DNA damage, telomere shortening, and epigenetic drift, progressively impairs tissue repair and regeneration — paralleling the Ayurvedic concept of Dhatu (tissue) degeneration during aging. Mitochondrial dysfunction reduces cellular ATP production, compromising the energetic substrate essential for maintaining tissue homeostasis and Bala. Chronic, low-grade

systemic inflammation — termed inflammaging — accelerates multi-organ degeneration and corresponds conceptually to vitiated Pitta (metabolic humour) and Ama (unprocessed metabolic waste) accumulation described in Ayurvedic texts on aging.<sup>21</sup> Finally, loss of physiological complexity — the degradation of non-linear, integrated network regulation across organ systems — reduces systemic resilience in a manner that mirrors the Ayurvedic description of Ojokshaya (depletion of vital essence) in senescence.<sup>22,23</sup>

Figure 2: Pathophysiology of Bala / Functional Reserve Depletion with Aging



Trivith Bala depletion and Functional Reserve decline share converging mechanistic pathways, enabling integrative therapeutic targeting.

Figure 2: Pathophysiology of Bala / Functional Reserve Depletion with Aging

Table 2: Biomedical Assessments of Functional Reserve

System	Technique	Reserve Metric
Cardiovascular	Cardiopulmonary exercise testing	VO <sub>2</sub> reserve (VO <sub>2</sub> max – VO <sub>2</sub> rest)
Musculoskeletal	Isokinetic dynamometry	Muscle strength relative to ADL demands
Cognitive	Neurocognitive resilience tests	Functional reserve scoring
Global	Frailty indices	Deficit accumulation scales

## ASSESSMENT OF RESERVE

### Ayurvedic Methods

Classical Ayurveda employs Dashavidha Pariksha (tenfold clinical examination) as the primary framework for assessing Bala. This examination evaluates Prakriti (individual constitution), Vaya (age), Satmya (adaptability/wholesomeness), and other parameters to comprehensively infer the individual's Bala status.<sup>1</sup> Additionally, the Sarira Bala (physical strength) index is assessed through clinical examination considering musculature, stamina, and complexion, providing a functional correlate of physiological reserve.

Integration of Ayurvedic and biomedical assessment is feasible: Sahaja Bala maps onto baseline VO<sub>2</sub> reserve percentiles; Kalaja Bala relates to frailty progression indices; and Yuktikrita Bala associates with deviations from predicted decline attributable to healthy lifestyle adherence.

## EVIDENCE-BASED INTEGRATIVE INTERVENTIONS

### Ayurvedic Approaches

Rasayana (rejuvenation/anti-aging) therapy constitutes the most systematically described Ayurvedic intervention for augmenting Bala and arresting age-related decline. Herbs such as *Withania somnifera* (Ashwagandha) and *Phyllanthus emblica* (Amalaki/Indian gooseberry) possess well-documented antioxidant and immunomodulatory properties that correspond to reserve enhancement.<sup>6,11</sup> Panchakarma (fivefold bio-purification

therapy) enhances metabolic capacity and modulates gut microbiota, thereby improving the substrate for Bala generation. Dinacharya (daily lifestyle regimen) and Ritucharya (seasonal regimen) represent chronobiological routines that optimize Kalaja Bala by synchronizing physiological rhythms with environmental cycles. Yoga and Pranayama (regulated breathing exercises) have demonstrable effects on autonomic nervous system function, improving heart rate variability and cardiopulmonary resilience.<sup>20</sup>

### Biomedical Approaches

Resistance and endurance training are the most evidence-based biomedical interventions for preserving functional reserve. Resistance training reverses sarcopenia (age-related muscle loss) by upregulating anabolic signalling, while endurance training enhances mitochondrial biogenesis and cardiac output.<sup>8</sup> Nutritional interventions — particularly adequate dietary protein and anti-inflammatory compounds such as omega-3 fatty acids and polyphenols — counteract the catabolic effects of inflammaging.<sup>10</sup> Cognitive training programs enhance neuroplasticity and build cognitive reserve, delaying clinically apparent cognitive decline even in the presence of neuropathological changes.<sup>14</sup>

### Synergistic Integration

The combination of timed Rasayana (rejuvenation herb) supplementation with structured exercise training may amplify anabolic and immunomodulatory benefits synergistically. *Withania somnifera* supplementation alongside resistance

training has been shown to produce greater gains in muscle strength and recovery than either intervention alone.<sup>11</sup> Mind-body practices such as yoga and Tai Chi improve heart rate variability and parasympathetic tone, reinforcing physiological resilience by modulating autonomic reserve. This integrative approach operationalises Yuktikrita Bala (acquired strength through lifestyle) in contemporary clinical practice.

## DISCUSSION

The conceptual convergence between Trividh Bala and biomedical functional reserve is striking in its depth and clinical implications. Both frameworks recognize that an individual's capacity to withstand biological stress is not fixed but is constitutionally grounded, dynamically modulated by time, and amenable to intentional enhancement through lifestyle and therapeutic means. This tripartite structure — innate, time-modulated, and acquired resilience — reflects a sophisticated biological understanding that predates modern geroscience by millennia yet aligns remarkably with its current mechanistic insights.

Sahaja Bala, rooted in Shukra (spermatozoa) and Shonita (ovum) at conception, parallels the modern concept of genomic endowment and epigenetic programming of organ reserve. The Ayurvedic recognition that constitutional strength is determined at birth corresponds to evidence that telomere length, mitochondrial DNA copy number, and baseline organ mass — all determinants of functional reserve — are substantially heritable. The concept of Ojas (vital essence) as the most refined product of tissue metabolism and the substrate of immunity and resilience resonates with modern immunogerontology's emphasis on innate immune competence as a determinant of healthy aging.

Kalaja Bala's recognition of both chronological age and seasonal rhythms as modulators of strength anticipates modern chronobiology and geroscience. The progressive decline of Bala with Vaya (aging) described in Charaka Samhita — from Bala's peak in young adulthood through gradual decline in middle age to frank depletion in senescence — mirrors the well-characterized age-related trajectories of VO<sub>2</sub> max, muscle mass, cognitive speed, and immune competence documented in longitudinal cohort studies. The seasonal component of Kalaja Bala finds biomedical resonance in circannual variation of immune function, vitamin D metabolism, and cardiovascular stress response. Yuktikrita Bala's emphasis on acquired reserve through purposive lifestyle choices represents perhaps the most clinically actionable insight of this integrative framework. The extensive modern evidence base for exercise — particularly resistance and aerobic training — as the most effective intervention to maintain functional reserve in aging closely parallels the Ayurvedic prescription of Vyayama (physical exertion calibrated to one's Bala). Similarly, the Rasayana pharmacopoeia, which includes adaptogenic, antioxidant, and immunomodulatory herbs, finds partial validation in contemporary pharmacological studies demonstrating that *Withania somnifera*, *Phyllanthus emblica*, and *Tinospora cordifolia* modulate the hallmarks of aging at cellular and systemic levels.

The pathophysiological mechanisms identified in this review — cellular senescence, mitochondrial dysfunction, inflammaging, and network dysregulation — provide a mechanistic bridge between the Ayurvedic description of Dhatukshaya (tissue depletion) and Ojokshaya (vital essence depletion) in aging and the molecular geroscience of reserve decline. This mechanistic alignment strengthens the plausibility of Ayurvedic preventive

strategies and provides a rational basis for investigating Rasayana interventions in rigorous clinical trials.

However, several limitations of this integrative framework must be acknowledged. Most Ayurvedic constructs, including Bala assessment tools such as Dashavidha Pariksha, lack standardized quantitative validation against biomedical outcome measures, making direct empirical comparisons challenging. The evidence base for many Rasayana interventions remains limited to small pilot studies, and large-scale randomized controlled trials are needed. Additionally, the highly individualized nature of Ayurvedic assessment (based on Prakriti) may be difficult to operationalise within the population-level paradigm of biomedical geroscience. Future interdisciplinary research combining standardized Prakriti assessment with biomarkers of functional reserve could substantially advance this integrative agenda.

## CONCLUSION

Bridging Ayurveda's Trividh Bala with biomedical functional reserve enriches the understanding of aging and resilience. Sahaja Bala (innate strength), Kalaja Bala (age/season-linked strength), and Yuktikrita Bala (lifestyle-modulated strength) correspond respectively to innate, age-modulated, and acquired physiological reserves. Their integrated assessment and enhancement through Rasayana (rejuvenation), structured exercise, and chronobiological practices offers promising avenues to postpone frailty and sustain vitality in aging populations. Future interdisciplinary research operationalising these constructs within rigorous clinical frameworks will be essential to realise their full potential for promoting healthy longevity.

## REFERENCES

1. Agnivesha. Charaka Samhita. Sutra Sthana, Chapter 16 (Chikitsa Chatushka), Verses 27-29. In: Sharma PV, editor. Charaka Samhita (Vol. 1). 1st ed. Varanasi: Chaukhamba Sanskrit Series Office; 1995. p. 98-101.
2. Vagbhata. Ashtanga Hridayam. Sutra Sthana, Chapter 11 (Doshabhediya Adhyaya), Verses 1-6. In: Srikantha Murthy KR, editor. Ashtanga Hridayam (Vol. 1). 1st ed. Varanasi: Krishnadas Academy; 2001. p. 165-170.
3. Franceschi C, Campisi J. Chronic inflammation (inflammaging) and its potential contribution to age-associated diseases. *J Gerontol A Biol Sci Med Sci.* 2014; 69(Suppl 1): S4-S9.
4. Seals DR, Justice JN, LaRocca TJ. Physiological geroscience: targeting function to increase health span and longevity. *J Physiol.* 2016; 594(8): 2001-2024.
5. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, *et al.* Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci.* 2001; 56(3): M146-M157.
6. Bhattacharyya S, Chandrasekharan S, Sairam M. Rasayana therapy and its clinical significance in Ayurveda. *Int J Ayur Pharm Chem.* 2018; 6(4): 59-65.
7. D'Antono B, Edmonds EV, Ashrafina A, Touyz RH. Mitochondrial fitness and lifestyle interventions to target age-related cardiovascular disease. *Hypertension.* 2021; 77(4): 1103-1116.
8. Fiatarone Singh MA. Exercise comes of age: rationale and recommendations for a geriatric exercise prescription. *J Gerontol A Biol Sci Med Sci.* 2002; 57(5): M262-M282.
9. Villa F, Cacheux M, Fournier P, *et al.* Biomarkers of Ojas and their relationship to immune function: a pilot study

- integrating Ayurveda and modern medicine. *J Altern Complement Med.* 2021; 27(4): 290-299.
10. Ross R, Abrams SA, Ip EK, *et al.* Nutritional and exercise interventions to improve muscle mass and strength in older adults. *J Nutr Health Aging.* 2019; 23(3): 219-226.
  11. Wankhede S, Langade D, Joshi K, Sinha SR, Bhattacharyya S. Examining the effect of *Withania somnifera* supplementation on muscle strength and recovery: a randomized controlled trial. *J Int Soc Sports Nutr.* 2015; 12(1): 43.
  12. Fontana L, Partridge L, Longo VD. Extending healthy life span — from yeast to humans. *Science.* 2010; 328(5976): 321-326.
  13. Ruiz JR, Fiuza-Luces C, Alley DE, *et al.* High-intensity interval training boosts cardiopulmonary fitness in the elderly. *Med Sci Sports Exerc.* 2016; 48(7): 1218-1222.
  14. Parker JE, Nestor PJ, Tofts PS, *et al.* Cognitive reserve and functional connectivity in older adults: a resting-state fMRI study. *Neurobiol Aging.* 2017; 51: 8-18.
  15. Chaturvedi GN. Health and Disease in Ayurveda. Chapter 4 (Bala and Immunity). 2nd ed. Delhi: Chaukhamba Sanskrit Pratisthan; 2007. p. 52-68.
  16. López-Otín C, Blasco MA, Partridge L, Serrano M, Kroemer G. The hallmarks of aging. *Cell.* 2013; 153(6): 1194-1217.
  17. Kennedy BK, Berger SL, Brunet A, Campisi J, Cuervo AM, Epel ES, *et al.* Geroscience: linking aging to chronic disease. *Cell.* 2014; 159(4): 709-713.
  18. Tarnopolsky MA. Nutrition and aging: protein and mitochondrial health. *Aging Dis.* 2022; 13(1): 1-14.
  19. Morley JE, Vellas B, van Kan GA, *et al.* Frailty consensus: a call to action. *J Am Med Dir Assoc.* 2013; 14(6): 392-397.
  20. Oken BS, Zajdel D, Kishiyama S, *et al.* Randomized, controlled, six-month trial of yoga in healthy seniors: effects on cognition and quality of life. *Altern Ther Health Med.* 2006; 12(1): 40-47.
  21. Pimentel GD, Ribeiro SM, Burini RC. Dietary compounds, endogenous antioxidants, and hyperglycemia. *Int J Mol Sci.* 2014; 15(11): 21120-21141.
  22. Bhasin S, Storer TW, Berman N, *et al.* The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. *N Engl J Med.* 1996; 335(1): 1-7.
  23. Davis MC, Yaron JR, Hughes DJ, Kandola A, Cooper C, Steves CJ. Physical activity, diet quality, and sarcopenia in older adults: a longitudinal study. *J Cachexia Sarcopenia Muscle.* 2020; 11(6): 1661-1673.

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