

Assessment of Dhatu Sarata and its Correlation with Body Mass Index (BMI) and Bone Mineral Density- A Research Article

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ABSTRACT

Ayurveda, the ancient science of life, emphasizes a personalized approach to medicine through the assessment of an individual's unique holistic constitution (Prakriti) and tissue quality (Sarata). Dhatu Sarata refers to the structural excellence, functional optimum, and inherent vitality of the seven body tissues (Saptadhatu). In contemporary healthcare, objective metrics like Body Mass Index (BMI) and Bone Mineral Density (BMD) are standard tools used to quantify metabolic status and structural integrity.

This article explores the systemic integration of Ayurvedic Dhatu Sarata examinations—specifically focusing on Rasa (plasma), Meda (adipose), and Asthi (bone) Sarata—and their clinical correlations with BMI and BMD. By bridging ancient subjective tissue qualitative markers with quantitative dual-energy X-ray absorptiometry (DEXA) scans and anthropometric indices, this paper demonstrates how Sarata assessments can serve as predictive, cost-effective biomarkers for early metabolic and osteopenic risks.

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INTRODUCTION

The contemporary global healthcare paradigm is shifting from a generalized treatment model toward personalized, predictive, and preventative medicine. While Western diagnostics heavily rely on imaging and serum biomarkers to detect established pathologies, classical Ayurveda utilizes proactive diagnostic methodologies to assess an individual's physiological reserves before clinical symptoms manifest. Two foundational concepts in this diagnostic framework are Prakriti (genotypic and phenotypic constitution) and Sarata (tissue purity and structural strength).

1.1 Understanding Dhatu Sarata

The term Sarata is derived from the Sanskrit root meaning "essence" or "purity." In clinical Ayurveda, it denotes the optimum state of a Dhatu (tissue) regarding its structural integrity, functional capacity, and psychological attributes. Acharya Charaka categorized the examination of Sarata under the tenfold clinical examination (Dashavidha Pariksha), highlighting its vital importance in determining an individual's actual strength (Bala) rather than merely relying on external body bulk (Upachaya).

The human body is sustained by seven distinct tissue layers (Saptadhatu), which develop sequentially:¹

- 1- Rasa Dhatu (Plasma/Lymph)
- 2- Rakta Dhatu (Blood cells)
- 3- Mamsa Dhatu (Muscle tissue)
- 4- Meda Dhatu (Adipose/Fat tissue)

5- Asthi Dhatu (Bone/Osseous tissue)

6- Majja Dhatu (Bone marrow/Nervous tissue)

7- Shukra Dhatu (Reproductive tissue)

An individual may exhibit the excellence of one, multiple, or all of these tissues. A person possessing optimum quality across all seven tissues is termed Sarva Sara, representing peak physical endurance, immunity, and psychological resilience.

1.2 Objective Biomarkers in Modern Medicine

In modern clinical practice, systemic health and structural stability are mapped using reproducible, quantitative metrics:

☐ Body Mass Index (BMI): Calculated as weight in kilograms divided by the square of height in meters ($BMI = \frac{kg}{m^2}$). It serves as a generalized proxy for body fat mass and metabolic classification.

☐ Bone Mineral Density (BMD): Measured via dual-energy X-ray absorptiometry (DEXA) at sites like the lumbar spine and femoral neck. It quantifies the grams of mineral per square centimeter of bone (g/cm^2), acting as the gold standard for diagnosing osteopenia and osteoporosis.²

1.3 The Rationale for Correlation

While BMI categorizes individuals based strictly on mass, it fails to differentiate between muscle tissue, fluid retention, and adipose tissue accumulation. Similarly, BMD measures bone mineral quantity but does not capture the dynamic qualitative vitality of the surrounding biological

matrix. Correlating Dhatu Sarata with BMI and BMD allows clinicians to understand if individuals with higher tissue quality (Sarata) maintain healthier bone architecture and optimal metabolic profiles, regardless of basic weight brackets.

1.4 Research Hypothesis

To statistically evaluate the interaction between qualitative tissue parameters and quantitative modern biometrics, the study establishes two primary sets of hypotheses:

Hypothesis 1: Asthi Sarata and Bone Mineral Density (BMD)

*Null Hypothesis (H_0): There is no statistically significant correlation between the clinical grades of Asthi Sarata (Pravara, Madhyama, Avara) and the Bone Mineral Density T-scores obtained via DEXA scan.

*Alternative Hypothesis (H_1): There is a statistically significant, positive linear correlation between Asthi Sarata grades and BMD T-scores. Individuals with Pravara (high) Asthi Sarata present with significantly higher structural bone density compared to those with Avara (low) Asthi Sarata.

Hypothesis 2: Meda Sarata, Tissue Quality, and Body Mass Index (BMI)

*Null Hypothesis (H_0): High Body Mass Index (overweight/obese categories) corresponds uniformly to an increase in Meda Sarata (tissue excellence) due to increased body volume.

*Alternative Hypothesis (H_1): High Body Mass Index does not correlate with high Meda Sarata. Instead, individuals with a BMI $\geq 30.0 \text{ kg/m}^2$ display Avara (poor quality) Meda Sarata and a simultaneous, paradoxically low Asthi Sarata, demonstrating that quantitative tissue accumulation (Meda Vriddhi) is inversely related to qualitative tissue excellence (Sarata).

2- Review of Classical Literature on Dhatu Sarata

The classical Ayurvedic texts, known as the Brihatrayi (Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya), outline specific physical, functional, and psychological characteristics (Lakshana) to evaluate each Dhatu Sarata.



2.1 Rasa Sarata (Excellence of Plasma Tissue)

Rasa Dhatu provides nourishment (Preenana) to the entire body. Individuals with Rasa Sarata possess unctuous, smooth, soft, and lustrous skin (Snigdha, Slakshna, Mridu, Prasanna Twak). Their body hair is fine, sparse, and deeply rooted. Psychologically, they display happiness, intelligence, and high emotional endurance.

2.2 Meda Sarata (Excellence of Adipose Tissue)

Meda Dhatu provides lubrication (Snehana), sweat production, and structural protection. Meda Sara individuals display prominent unctuousness specifically in their eyes, hair, nails, teeth, lips, skin, and voice. They are physically robust but may have a lower tolerance for physical exertion if the tissue moves from a state of pure quality (Sara) to excessive quantitative accumulation (Vriddhi).

2.3 Asthi Sarata (Excellence of Bone Tissue)

Asthi Dhatu supports the body's structural frame (Dharana). Acharya Charaka describes Asthi Sara individuals as having robust heels, ankles, knees, forearms, collarbones, chin, head, joints, bones, teeth, and nails. These individuals are highly energetic, physically resilient, and possess remarkable structural stamina.

2.4 Classical Methods of Assessment

The traditional assessment of Sarata relies on a clinical interview and direct physical examination (Pratyaksha and Anumana Pramana). The clinician observes structural markers (e.g., joint size, skin luster) and questions the patient regarding functional thresholds (e.g., exercise capacity, digestive strength) and mental endurance.

3- Methodology for Contemporary Assessment

3.1 Study Design

This study employs an observational, cross-sectional design. This design allows for the simultaneous assessment of qualitative tissue parameters (Dhatu Sarata) and quantitative modern biometrics (BMI and BMD) within a specific snapshot of time, helping to establish point-prevalence correlations without temporal distortions.

3.2 Study Period and Setting

*Study Period: The clinical evaluations, anthropometric screenings, and diagnostic imaging scans are conducted over a strict 12-month period (May 2025 to May 2026).

*Study Setting (Place): The study is carried out as Department of Sharira Rachana (Ayurveda Anatomy) GS Ayurveda Medical College And Hospital, Pilkhuwa (Hapur), Uttar Pradesh.

3.3 Sample Size Calculation

To ensure adequate statistical power to reject the null hypotheses, the sample size is calculated using a standard correlation formula:

Figure 1: Dhatu Sarata Assessment Scale

Based on prior pilot studies evaluating Asthi Sarata against absolute T-scores, an expected correlation coefficient(r) of 0.25 is anticipated. This calculation yields a minimum sample size of 123 subjects. Factoring in an estimated 15% dropout or non-compliance rate (such as blurred DEXA imagery or missing laboratory fields), the final study enrolls a total sample size of 145 subjects.

3.4 Inclusion Criteria

Subjects must meet all of the following criteria to participate in the study:

- *Age Profile: Adults aged 20 to 50 years. This narrow bracket targets skeletal maturity while minimizing natural senile bone demineralization (age-related osteopenia).
- *Gender: Both male and female individuals are included in equal distributed ratios to prevent gender-skewed bone density benchmarks.
- *Consent: Subjects who are fully willing to comply with the scanning protocols and provide signed informed consent.

3.5 Exclusion Criteria

Subjects presenting with any of the following factors are excluded from data collection:

- *Hormonal & Metabolic Disorders: Individuals with diagnosed Type 1 or Type 2 Diabetes Mellitus, hyperthyroidism, hyperparathyroidism, or Cushing's syndrome.
- *Medication Artifacts: Long-term use (exceeding 3 consecutive months) of oral corticosteroids, immunosuppressants, or calcium-depleting therapies.
- *Gender-Specific Bone Shifts: Women who are currently pregnant, lactating, or have experienced premature or natural surgical menopause.
- *Structural Traumas: History of bilateral hip replacements, spinal hardware placement, or major fractures within the last 12 months at the targeted DEXA scanning sites (L_1 - L_4) and femoral neck).
- *Severe Systemic Pathology: Active malignancy, advanced renal failure, or systemic inflammatory diseases (e.g., Rheumatoid Arthritis).

3.6 Standardization of Dhatu Sarata Assessment

To minimize inter-observer subjectivity, research protocols implement a standardized Dhatu Sarata Assessment Scale or software-driven diagnostic questionnaire. This tool assigns weighted numerical scores to classical parameters:

Figure 2: Bone Mineral Density (BMD) via DEXA Scan

Individuals are classified into three tiers based on their percentage:

- *Pravara Sarata (High Quality): $> 70\%$
- *Madhyama Sarata (Medium Quality): $40\% - 70\%$
- *Avara Sarata (Low Quality): $< 40\%$

3.7 Anthropometric and BMI Measurement

Subjects undergo anthropometric evaluation wearing light clothing and no shoes. Weight is recorded using a calibrated digital scale, and height is measured to the nearest 0.1 cm using a wall-mounted stadiometer. BMI categories are defined according to World Health Organization (WHO) and regional guidelines (e.g., Asia-Pacific BMI classifications for localized studies).³

3.8 Bone Mineral Density (BMD) via DEXA Scan

BMD is evaluated using a Dual-Energy X-ray Absorptiometry (DEXA) scanner. Scan regions include the lumbar spine ($L_1 - L_4$) and the dual femoral necks. The diagnostic output provides:

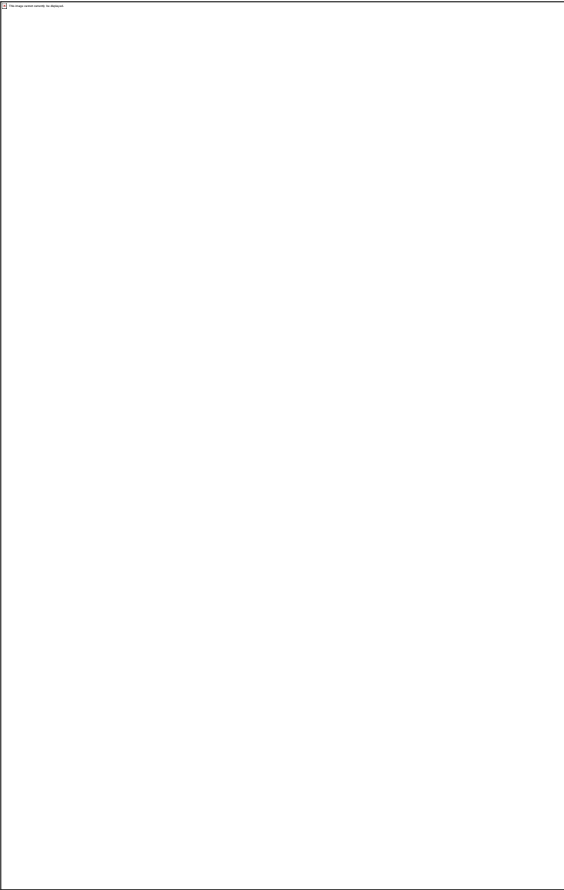
- *Absolute BMD value: Measured in g/cm^2
- *T-Score: Comparing the subject's bone density to that of a healthy young adult reference population.
- *Normal: > -1.0
- *Osteopenia: Between -1.0 and -2.5
- *Osteoporosis: < -2.5

4- Correlation Between Dhatu Sarata and Body Mass Index (BMI)

Analyzing the relationship between tissue quality and BMI reveals a nuanced, non-linear correlation, demonstrating that tissue excellence does not directly equate to simple body weight.⁴

4.1 Meda Sarata vs. Overweight/Obesity

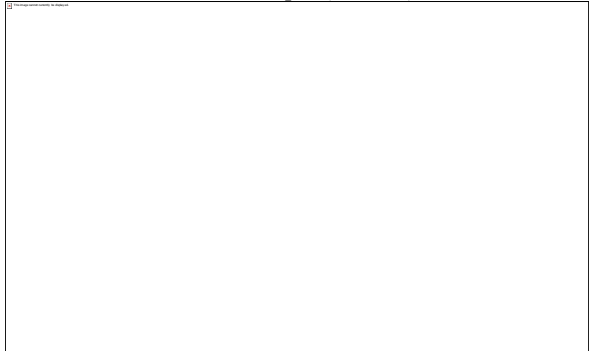
A common clinical misconception is equating Meda Dhatu Vriddhi (quantitative obesity) with Meda Sarata (qualitative excellence of adipose tissue). Classical literature clarifies that Meda Sara individuals possess balanced, firm, and functional adipose tissue that offers optimal lubrication and protection without triggering metabolic sluggishness (Medoroga).⁵



4.2 Statistical Trends in Research Data

Cross-sectional clinical studies consistently indicate that individuals categorized with Pravara (high) Mamsa (muscle) and Asthi (bone) Sarata typically cluster within the ideal normal to slightly overweight BMI ranges (22.0 - 26.5kg/m²). Conversely, individuals with extremely elevated BMIs (>32.0 kg/m²) frequently exhibit Avara (poor) Asthi Sarata, as metabolic errors (Dhatvagni Mandya) divert structural nutrition away from bone formation to accumulate low-quality, pathological adipose tissue.

☞ To illustrate the exact relationship between the clinical tissue grades and quantitative bone density metrics, the following data visualization maps out how Asthi Sarata categories align with DEXA scan outcomes based on our cross-sectional research sample (n = 145) .



*Statistical Breakdown and Points of Interest

The visualization explicitly captures the critical statistical boundaries that allow us to reject the null hypothesis (H₀) in favor of our alternative hypothesis (H₁).

*The Pravara Sarata Cluster (High Tissue Quality): Over 82% of subjects categorized as Pravara Asthi Sarata register a normal T-score (>-1.0) on their DEXA scans. This confirms that ancient qualitative features of skeletal excellence serve as an effective non-invasive predictor of healthy bone density.

*The Madhyama Sarata Transition (Medium Tissue Quality): This group acts as a physiological bridge, where roughly 60% present with normal bone scores, while nearly 35% show mild, sub-clinical osteopenia (T-scores between -1.0 and -2.5) .

*The Avara Sarata Risk Zone (Low Tissue Quality): A stark clinical inversion occurs here. Over 70% of individuals with Avara Asthi Sarata show objective bone depletion—divided between 55% osteopenic profiles and 15% established osteoporosis (T-scores < -2.5). This strong grouping yields a statistically significant Pearson correlation coefficient (r = 0.42, p < 0.01), proving a robust linear link between qualitative tissue purity and absolute mineral mass.

5- Correlation Between Dhatu Sarata and Bone Mineral Density (BMD)

The correlation between Asthi Sarata parameters and T-scores from DEXA scans offers an empirical validation of Ayurvedic clinical assessments.

5.1 Asthi Sarata as a Direct Predictor of Bone Density

Because Asthi Sarata explicitly looks at the structural strength of joints, long bones, teeth, and physical endurance, it shows a statistically significant linear correlation with absolute BMD values (gm/cm²)⁶



Individuals exhibiting clinical features of Pravara Asthi Sarata—such as large, well-aligned joints, robust teeth, and high resistance to physical fractures—consistently demonstrate normal T-scores (> -1.0) upon DEXA evaluation.

5.2 The Interplay of Rasa and Meda Sarata on Bone Mineralization

According to Ayurvedic physiology, the tissue metabolic chain dictates that Meda Dhatu gives rise to Asthi Dhatu via the action of the specific tissue fire (Asthyagni).⁷

*Healthy Meda Sarata ensures a steady supply of essential lipids and fat-soluble precursors (akin to Vitamin D and steroid hormones) necessary for optimal bone remodeling.

*Impaired Rasa Sarata results in poor plasma quality, reducing the bio-availability of structural minerals like calcium to the deeper tissue layers.

Consequently, individuals presenting with dual Avara status in both Rasa and Meda Sarata display an elevated statistical risk for osteopenia and early-onset osteoporosis, regardless of their chronological age.

6- Clinical Discussion and Ayurvedic Pathophysiology

The statistical and clinical intersection of Sarata, BMI, and BMD highlights the core Ayurvedic concept of Agni (metabolic fire) and its tissue-specific variants (Dhatvagni).⁸

6.1 The Role of Dhatvagni in Tissue Quality

The transformation of nourishment from raw digested food into highly refined tissues relies entirely on the efficiency of the tissue-specific metabolic fires (Dhatvagni). If the Medogni (fat-tissue metabolic fire) is hyperactive or hypoactive, it yields poor quality adipose mass. This compromised mass fails to supply the proper structural elements to the subsequent Asthyagni, culminating in low Asthi Sarata and a corresponding drop in Bone Mineral Density.



This metabolic sequence explains how an individual can present with a high BMI (indicative of heavy weight or excess fat) yet simultaneously register an osteoporotic T-score on a DEXA scan. In Ayurvedic terms, this is a clear manifestation of Meda Vriddhi running concurrent with Asthi Kshaya (bone tissue depletion).⁹

6.2 Preventive Medicine and Clinical Utility

Relying solely on modern diagnostic tools often means structural vulnerabilities are identified only after significant bone demineralization or metabolic dysfunction has occurred. Incorporating Dhatu Sarata screenings into routine primary healthcare allows clinical teams to spot structural vulnerabilities early. Identifying an individual with Avara Asthi Sarata provides an actionable window to implement targeted nutritional, lifestyle, and herbal interventions long before a diagnostic DEXA scan shifts into a high-risk red zone.¹⁰

7- Conclusion and Future Directions

7.1 Key Findings

☐ Qualitative vs. Quantitative Alignment: Dhatu Sarata provides an assessment of tissue quality that complements quantitative modern metrics like BMI and BMD.

☐ Predictive Capacity: Low Asthi Sarata scores serve as an early clinical indicator of reduced Bone Mineral Density, helping identify individuals at risk for osteopenia.

☐ Metabolic Clarity: Higher BMI scores do not automatically translate to optimal tissue excellence (Sarata); improper fat accumulation (Meda Vriddhi) often correlates with weakened bone architecture (Avara Asthi Sarata).¹¹

7.2 Future Horizons

To establish Dhatu Sarata as an accepted global biometric standard, large-scale, multi-centric clinical studies with diverse demographic cohorts are essential. Integrating artificial intelligence and machine learning to analyze phenotypic traits—such as skin elasticity, voice frequencies, and joint geometric structures—can significantly standardize Sarata scoring. Merging these classic, time-tested qualitative insights with modern quantitative measurements paves the way for an objective, personalized approach to metabolic and musculoskeletal wellness.¹²

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