Original Research (Survey Study)

Pramana Sharir Meets Contemporary Anthropometry: Correlation between *Jangha* Length and Height

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ABSTRACT

Background: Human stature estimation is a crucial component of anthropometry and forensic sciences, widely used in personal identification, ergonomics, and clinical evaluations. Ayurveda, a traditional holistic medical science, emphasizes body measurements under *Pramāṇa Śārīra*, focusing on individual constitution and symmetry. **Objective**: To integrate Ayurvedic concepts with modern scientific methods and investigate the correlation between tibial length (*Jaṅghā*) and total height in healthy individuals. **Methods**: A cross-sectional study was conducted on 100 healthy adults (50 males and 50 females) at a tertiary Ayurvedic institution in Uttar Pradesh, India. Tibial length was measured using standard anthropometric techniques, and total stature was recorded using a stadiometer. Statistical analyses, including linear regression, were performed to derive gender-specific predictive equations for stature estimation. **Results**: A significant positive correlation was observed between *Jaṅghā* length and stature, with correlation coefficients of 0.926 for males and 0.948 for females. Gender-specific regression equations were developed, showing minimal standard errors (±2.943 cm for males and ±1.974 cm for females). These results corroborate the reliability of tibial length as a predictor of stature and align with Ayurvedic principles of proportional body measurements. **Conclusion**: This study successfully bridges Ayurvedic principles with modern anthropometry, offering a reliable framework for applications in forensic medicine, public health, and ergonomic design. Further research should aim to standardize Ayurvedic units like *Aṅgula* and consider diverse demographic factors to improve the applicability of these findings.

Key words: *Pramaṇa Sharir*, *Jangha* length, Stature estimation, Ayurvedic anthropometry, linear regression analysis

1. INTRODUCTION

The harmony and beauty of nature, particularly the human form, have long fascinated scholars and physicians alike. In Āyurveda, beauty is not merely an aesthetic attribute but a reflection of internal health, known as *svastha*, or the state of individual well-being according to one's constitution (*sva*). A key aspect of this beauty is anatomical symmetry, which is intricately tied to proportion and anthropometric measurement.

Āyurveda, as a holistic medical science, includes extensive references to human anatomy under the concept of *śārīra sthāna*, focusing on both structure and function. Classical texts by Ācāryas like Suśruta, Caraka, and Vāgbhaṭa describe detailed anthropometric data to assess individual health and disease, emphasizing its clinical relevance [1].

Among these measurements, the study of *Pramāṇa Śārīra*—the science of human body measurements—is critical. Terms like *añjali pramāṇa* and *aṅgula pramāṇa* reflect indigenous measurement systems that are foundational in Ayurvedic diagnostic and therapeutic practices. Such ancient measures parallel the Western scientific tradition of anthropometry, notably exemplified by Leonardo da Vinci's *Vitruvian Man*, a symbol of ideal human proportions derived from geometric and anatomical principles [2].

Anthropometry has evolved into a multidisciplinary science impacting ergonomics, forensic science, evolutionary biology, and clinical medicine [3]. It provides crucial insights for personal identification, particularly through the correlation of height with limb measurements such as *Jaṅghā* (thigh). Accurate measurement of body parts supports diagnostics, prosthetic design, and even recruitment standards in military or civil services [4].

Identification, a fundamental human right, depends heavily on primary traits like age, sex, and stature. Stature estimation through limb dimensions has been widely explored in forensic and anatomical research. Studies have consistently demonstrated the reliability of lower limb measurements, especially tibial or femoral lengths, in approximating total height [5].

Such approaches remain vital in addressing physiological, pathological, and social applications of human measurement science [6]. In this context, the current study aims to explore the relationship between the length of *Jaṅghā* and overall height in healthy individuals, using anthropometric methods grounded in both Ayurvedic wisdom and contemporary biomedical standards.

Literature Review

Ayurvedic Perspective: The concept of *Pramāṇa Śārīra*, or the science of body measurement, is deeply rooted in classical Ayurvedic texts. Foundational works such as the *Suśruta Saṃhitā*, *Caraka Saṃhitā*, and *Aṣṭāṅga Hṛdaya* provide meticulous guidelines for the measurement of body parts, emphasizing the relationship between bodily proportions and health, longevity, and vitality [7].

In Ayurveda, *Māna* (measurement) is categorized into:

- *Pāyyamāna* (length)
- *Druvayamāna* (volume)
- *Pautavamāna* (weight)

A unique Ayurvedic unit of measurement is *Aṅgula*, typically based on the width of a person's own middle finger phalange [8]. This method reflects a personalized anthropometry, adapting measurements to the individual's constitution (*prakṛti*). *Suśruta* describes the ideal height of a healthy individual as 120 *Aṅgula*, with the *Jaṅghā* measuring 18 *Aṅgula* in length and 14 *Aṅgula* in circumference [9].

Similarly, *Caraka* and *Vāgbhaṭa* provided detailed values for various body parts, linking proper proportions with *uttama āyu* (long life), *bala* (strength), and *ojas* (immunity). The Ayurvedic view also recognizes *Jaṅghā* as an essential parameter in assessing symmetry, structural integrity, and overall wellness [10].

Modern Scientific Perspective: Anthropometry, derived from the Greek words *anthropos* (human) and *metron* (measure), is a scientific discipline that quantifies the physical dimensions of the human body [11]. It plays a crucial role in forensic science, ergonomics, auxology, nutrition, and growth studies.

Historically, the field evolved from the works of early anthropometrists such as Charles Roberts [12], who developed foundational methods for physical examination and measurement of the human body.

In forensic and anatomical science, the tibial length is considered a key determinant of stature due to its strong correlation with standing height [13]. The contributions of Weiner and Lourie helped standardize field methods for human biology, significantly enhancing anthropometric accuracy [14].

Trotter and Gleser re-evaluated stature estimation from long bones, affirming the tibia's predictive utility [15]. Regression equations derived from tibial length remain widely used in forensic practice [16]. These models have proven effective across populations when population-specific data is used [17].

Anthropometry also supports:

- Nutritional assessment, such as in cases of stunting or wasting [18]
- Ergonomic design for public spaces and workplaces [19]

While Ayurveda emphasizes personalized measurement systems based on the individual's own body proportions, modern science relies on standardized statistical techniques and calibrated instruments, creating opportunities for integration.

2. MATERIALS AND METHODS

Study Design: This study was a prospective, cross-sectional investigation conducted to analyze the relationship between the tibial length (*Jaṅghā*) and stature in healthy individuals. The aim was to derive a regression equation to estimate stature from tibial length among adults residing near Major S.D. Singh PG Ayurvedic Medical College, Farrukhabad, Uttar Pradesh, India.

Sample Size and Population: A total of 100 adult subjects were randomly selected from the General Medicine Outpatient Department (OPD). The cohort included 50 males and 50 females.

Inclusion Criteria

- Age group: 25–64 years
- Only healthy individuals were selected.
- Participants provided written informed consent.

The age range was chosen to exclude the influence of epiphyseal growth and ensure skeletal maturity.

Exclusion Criteria

- Congenital deformities of the spine or limbs.
- Individuals with fractures, musculoskeletal diseases, or endocrinal/metabolic disorders.
- History of leg amputation.
- Pregnant women.

Data Recorded

- Name
- Age
- Sex
- Height (in cm)
- Left tibial length (in cm)

Instruments Used

- **Stadiometer** – for measuring standing height.
- **Spreading Callipers** – for measuring tibial length.

Measurement Technique: All measurements were recorded in centimetres using standard anthropometric methods described by Vallois, with each parameter measured three times and the mean value recorded.

Height

- Subjects were measured barefoot using a stadiometer in the **Frankfurt horizontal plane**.
- Height was recorded from the **vertex to the heel**.

Tibial Length (*Jaṅghā*)

- Measured on the **left leg**.
- Subject positioned with the knee flexed at **90°** using a wooden stool.
- Landmarks:
  - **Upper point**: Upper border of the medial condyle of the tibia.
  - **Lower point**: Tip of the medial malleolus.

- Measurement taken with a **spreading calliper**, and read using a **steel tape**.

Statistical Analysis

- Data analyzed using **SPSS Version 20**.
- **Linear regression analysis** was conducted to derive the equation: **Y = a + bX**, where Y is the estimated height and X is the tibial length.
- Separate regression equations were derived for males and females.
- **t-tests** were used to test the significance of the regression coefficient (b).
- **F-tests** were applied to compare variance in male and female datasets.
- **Confidence intervals (95%)** were calculated for both constants and regression coefficients.

Pilot Study: A pilot study was conducted to test the feasibility and reproducibility of anthropometric measurements. Based on the results, measurements mentioned in classical Ayurvedic texts were finalized for the main survey.

Precautions Taken

- Clean and calibrated instruments were used.
- Subjects wore **minimal clothing** during measurement.
- **No pressure** applied to anatomical landmarks.
- Jewelry and accessories were removed.
- Uniform measurement units (centimetres) were maintained throughout.

3. OBSERVATION AND RESULTS

Study Demographics: A total of 100 healthy individuals were examined in this cross-sectional study, comprising **50 males and 50 females**, aged between **25 and 65 years**. The mean age was **35.95 years**, with males averaging **37.14 years** and females **34.47 years**.

Distribution by Religion: Participants included individuals from diverse religious backgrounds: **49 Hindus**, **31 Muslims**, **13 Sikhs**, and **7 Christians**. This reflects the demographic distribution of the study region.

Anthropometric Measurements

- **Mean Height**:
  - Males: **164.05 cm**
  - Females: **156.38 cm**
- **Mean Tibial Length (*Jaṅghā*)**:
  - Males: **35.99 cm**
  - Females: **33.83 cm**

Statistical Analysis: Statistical analyses were conducted using **SPSS Version 20**. The study revealed a **strong positive correlation** between **percutaneous tibial length (PCTL)** and **stature** in both sexes:

- **Correlation Coefficient (r)**:
  - Males: **0.926**
  - Females: **0.948**

This high degree of correlation justified the use of **linear regression analysis** to derive predictive equations for estimating stature.

Regression Equations: Separate regression equations were formulated for males and females due to significant differences in regression coefficients:

- **For Males**:
  Height (S)=71.361+2.575×Tibial Length (T)\text {Height (S)} = 71.361 + 2.575 \times \text {Tibial Length (T)} Height (S)=71.361+2.575×Tibial Length (T)
  - Standard Error (SE): ±2.943
- **For Females**:
  Height (S)=65.344+2.691×Tibial Length (T)\text{Height (S)} = 65.344 + 2.691 \times \text{Tibial Length (T)}Height (S)=65.344+2.691×Tibial Length (T)
  - Standard Error (SE): ±1.974

Confidence Intervals

- **Height Prediction (95% CI)**:
  - Males:
    - Minimum PCTL: 144.1 – 149.02 cm
    - Maximum PCTL: 174.35 – 178.01 cm
  - Females:
    - Minimum PCTL: 142.41 – 143.83 cm
    - Maximum PCTL: 164.94 – 171.36 cm
- **Regression Coefficient (b) 95% CI**:
  - Males: 2.575 ± 0.336
  - Females: 2.691 ± 0.337
- **Intercept (a) 95% CI**:
  - Males: 71.361 ± 12.137 (59.2 – 83.3)
  - Females: 65.344 ± 11.546 (53.8 – 76.9)

Hypothesis Testing

A t-test confirmed that the regression coefficients were statistically significant (**$p < 0.05$**). An F-test revealed a **significant difference** between male and female regression coefficients, affirming the necessity for gender-specific equations.

4. DISCUSSION

The current study highlights the significant relationship between the tibial length (*Jaṅghā*) and overall height in healthy individuals, integrating the principles of *Pramāṇa Śārīra* from Ayurvedic texts with modern anthropometric methods. This dual approach enriches our understanding of human body measurements by blending traditional insights with contemporary scientific rigor.

From an Ayurvedic perspective, the measurements derived using individualized units like *Aṅgula* underscore the emphasis on personalized assessment. These traditional units not only align with the concept of "*sāmānya-viśeṣa siddhānta*"—the principle of similarity and dissimilarity—but also provide a holistic diagnostic framework that integrates structural, functional, and spiritual dimensions. The classical descriptions of *Jaṅghā* measurements in Suśruta Saṁhitā and Caraka Saṁhitā reinforce the clinical utility of anthropometric parameters in assessing health and longevity. However, as highlighted in this study, there is a need to standardize these ancient units for practical application in modern biomedical contexts. Modern statistical methods employed in this study demonstrate a strong positive correlation between *Jaṅghā* length and stature in both males (ρ = 0.926) and females (ρ = 0.948). The derived regression equations for males and females exhibit significant predictive accuracy, with minimal standard errors (±2.943 cm for males and ±1.974 cm for females). These findings align with existing literature, where lower limb measurements are consistently recognized as robust predictors of stature [20].

Notably, the observed gender differences in regression coefficients (β) highlight the influence of sexual dimorphism on anthropometric parameters. Such distinctions are crucial for developing gender-specific standards in fields like ergonomics, forensic science, and public health. Studies have shown that other body segments—such as foot length, ulna length, and hand span—also provide effective estimates of stature, which may enhance the versatility of prediction models [21].

Moreover, the incorporation of demographic factors like age, ethnicity, and geographical variation could further refine these predictive models, ensuring broader applicability. This view is supported by both ancient Ayurvedic philosophy and historical Western anthropological studies, which emphasize the importance of population-specific measurements [22].

While the study provides valuable insights, it also identifies key areas for future research. Expanding the sample size and incorporating diverse populations would enhance the generalizability of the findings. Furthermore, exploring correlations among other lower limb parameters and total body height could yield additional diagnostic indices. Integrating Ayurvedic principles with advanced imaging techniques could also facilitate the development of innovative tools for non-invasive health assessments.

5. CONCLUSION

The study validates the relevance of *Jaṅghā* length as a reliable anthropometric parameter for estimating stature. By bridging Ayurvedic wisdom with contemporary scientific methods, it underscores the enduring utility of traditional knowledge in modern health sciences. The derived regression equations provide a robust framework for applications in forensic medicine, ergonomics, and public health, particularly for population-specific height estimation.

This research reaffirms the potential of Ayurvedic anthropometry as a valuable resource for holistic health assessment and identification. Future studies should aim to standardize these ancient measures and integrate them with modern technologies to create comprehensive diagnostic tools.

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