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Research Article

Standardization and contemporary validation of *Anjali Pramana* in Healthy Adults: A Cross-sectional observational study with pilot validation

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Abstract

Introduction: Ayurveda defines *Anjali Praman* as an individualized volumetric measure used to quantify bodily constituents such as Dhatus, Malas, and Doshas. Despite its clinical importance, this concept lacks standardization using modern scientific methods. Method: A cross-sectional study was conducted among 350 healthy adults (175 males and 175 females) aged 25–60 years at Dr. D. Y. Patil College of Ayurved and Research Centre, Pune, to standardize *Anjali Praman* and evaluate its correlation with anthropometric indices. *Anjali Praman* was measured as the average water volume held in both cupped palms across five trials, along with height, weight, and BMI. A pilot validation in 10 participants compared with four Anjali for urine volume with maximum daytime voided volume recorded over three consecutive days. A literature review of postpartum breast storage capacity and modern bladder capacity was also undertaken for comparison with the classical concepts of Stanya and Mutra Pramana. Results: The mean *Anjali Praman* was significantly higher in males (120.40 ± 20.52 ml) than females (94.63 ± 15.85 ml) ($p < 0.001$). It showed positive correlations with height ($r = 0.39$) and weight ($r = 0.36$) in both sexes, while BMI demonstrated a weaker association, significant only in females. The mean urine volume (449 ± 75.6 ml) closely matched the calculated four Anjali (427 ± 87.4 ml; $p = 0.557$), supporting the classical standard. Conclusion: The study establishes *Anjali Praman* as a physiologically meaningful and measurable individualized parameter. Its strong alignment with classical references for Mutra and Stanya volumes reinforces the empirical accuracy of Ayurvedic measurements and supports their relevance in modern research and clinical assessment.

Keywords: *Anjali Praman*, *Praman Sharir,* Cross-sectional study, Standardization of Ayurvedic Anthropometric values

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Introduction

Ayurveda, the ancient Indian science of life, encompasses a holistic understanding of health, disease, and longevity. It elaborates on both the structural and functional aspects of the human body (*Sharira*), which are essential for maintaining equilibrium and overall well-being. Among the fundamental concepts of Ayurveda, Pramana Sharira, the science of body measurements, forms an important basis for the assessment of an individual's physical constitution (*Deha Prakruti*), strength (Bala), and lifespan (Ayu). Acharya Charaka, emphasized that accurate measurement of the body is essential for understanding its normalcy and deviations (1).

Ayurveda describes ten methods of clinical examination (*Dashavidha Pareeksha*), among which *Pramana Pariksha* is a key determinant for evaluating strength and vitality (2). The concept of *Pramana* is elaborated in two major forms: *Anguli Pramana* (measurement by finger units) and *Anjali Pramana* (measurement by volume). While *Anguli Pramana* is used for assessing length, breadth, and circumference of body parts, *Anjali Pramana* is used to determine the volume of bodily constituents

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and fluids. According to Acharya Charaka, *Anjali Pramana* represents the amount of a substance that can be held in both hands cupped together, and it varies from person to person, making it an individualized and personalized measurement unit (3).

In the *Sharira Sthana* of *Charaka Samhita*, *Acharya Charaka* details the specific quantities of various *Sharira Bhava* (bodily constituents) *in Anjali Pramana*. These include ten *Anjali* of *Udaka* (body water), nine of *Rasa*, eight of *Rakta*, seven of *Purisha* (feces), six of *Kapha*, five of *Pitta*, four of *Mutra* (Urine), three of *Vasa* (Sub tissue of Muscle tissue), two of *Meda* (Fat tissue), one of *Majja* (Bone marrow), and half an *Anjali* each of *Shukra* (Semen), *Mastishka* (Brain), and *Ojas* (Essence of 7 tissue) (3). *Acharya Vagbhata* and *Kashyapa* also describe similar measurements with minor variations, suggesting the relevance of *Anjali Pramana* in understanding the physiological balance of *Dhatu's*, *Mala's*, and *Dosha's* (4).

Despite its clear mention in Ayurvedic classics, the *Anjali Pramana* concept has not been scientifically explored in the modern era. Research so far has focused primarily on *Anguli Pramana* and general anthropometric correlations, while studies on *Anjali Pramana* are scarce. The few available references indicate variations in *Anjali Pramana* between Males and Females, with averages of 135 ml in males and 100 ml in Females (5).

Establishing standardized reference values *for Charakokta Anjali Praman* would aid in quantifying bodily fluids and internal constituents in scientific terms, facilitating better interpretation of Ayurvedic parameters using contemporary tools. Moreover, standardization in terms of the International System of Units (SI) is necessary to universalize Ayurvedic measurements and enhance their global applicability. Understanding *Anjali Pramana* in healthy individuals is crucial for defining the normal physiological range of *Dhatu's*, *Dosha's*, and *Mala's*, as equilibrium among these entities is fundamental to health according to *Ayurveda*.

Therefore, this study is undertaken to standardize *Charakokta Anjali Praman* in healthy individuals, to determine its average values, assess gender-wise differences, and compare findings with modern anthropometric parameters. By integrating traditional Ayurvedic knowledge with modern scientific methodology, this study aims to contribute toward validating and strengthening the clinical relevance of *Pramana Sharira* in present-day healthcare systems.

Materials and methods

Study Design and Setting

A cross-sectional observational study was conducted at the Department of Rachana Sharir, Dr. D. Y. Patil College of Ayurved and Research Centre, Pimpri, Pune, between March 2024 and May 2025. Participants were recruited from the general population residing in and around Pune through voluntary participation. The study was executed in two phases: an observational study, and a pilot validation.

Study Phases

1. Standardization of *Anjali Pramana* through observational study

The observational study was conducted to standardize *Anjali Pramana* in a sample of 350 healthy individuals and to explore gender-based differences. It also examined the relationship between *Anjali Pramana* and other physical parameters, including height, weight, and BMI.

2. Validation of Anjali Praman through

A pilot study was conducted among 10 healthy participants (without urinary or renal pathology) to measure urine volume and validate *Anjali Praman*

Participants

A total of 350 individuals aged 25–60 years were randomly selected from the general population. Individuals who voluntarily consented to participate and self-reported themselves to be healthy at the time of enrolment were included in the study. A physical examination of the hands was performed to identify any congenital, structural, traumatic, surgical, or accidental deformities that could affect the measurement of Anjali Praman. Participants with such deformities or a history of hand surgery were excluded.

For the pilot validation, ten participants from the main study cohort who had no self-reported history of urinary symptoms, renal disease, or lower urinary tract disorders were selected for urine volume measurement.

- Inclusion Criteria: Healthy adults of both genders willing to participate.
- Exclusion Criteria: Individuals with congenital, structural, traumatic, surgical, or accidental deformities of the hand.

Sample Size Determination

Sample size was calculated using the Denver formula: where Z = 1.96 (95% confidence level), P = 0.35, and d = 0.05, resulting in n = 349, rounded to 350 participants.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Dr. D. Y. Patil College of Ayurved and Research Centre, Pimpri, Pune (IEC No. DYPCARC/IEC/808/2023). As the study was observational and non-interventional in nature, registration with the Clinical Trials Registry–India (CTRI) was not mandatory. All participants were informed about the objectives and procedures of the study, and written informed consent was obtained prior to enrolment and data collection. Participation was entirely voluntary, and the confidentiality and anonymity of participant information were strictly maintained throughout the study.

Materials

1. Measuring jar
2. Measuring Cylinder
3. Tray
4. Urine pot male
5. Urine pot female

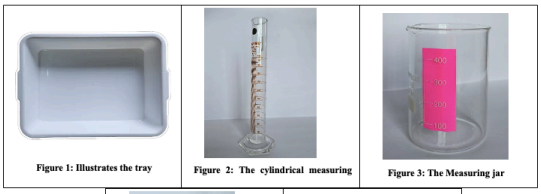

Figure 1: Illustrates the tray

Figure 2: The cylindrical measuring

Figure 3: The Measuring jar


Figure 4: The urine pot for males


Figure 5: The urine pot for females

Methods

Procedure for Measurement of *Anjali Praman*

As no standardized method for the quantitative measurement of *Anjali Praman* is described in the classical Ayurvedic literature, the procedure used in the present study was developed by the investigators based on the classical concept of *Anjali Praman* and inspired by the pilot study of Gadgil and Kulkarni (5), with suitable modifications to improve measurement reproducibility. Participants were instructed to cup both palms together to form a watertight cavity. A pre-measured volume of water was poured into the cupped hands until spillage occurred. The remaining water in the measuring jar was measured using a graduated measuring cylinder, and the difference between the initial and remaining volume was recorded as the participant's *Anjali Praman*. The procedure was repeated five times for each participant, and the mean value was recorded as the individual's *Swa Anjali Praman (5)*

Measurement of Urine Volume

A sub-sample of ten healthy participants was selected from the main cohort. Maximum voided urine volume was assessed using a three-day voiding diary, based on previously described methods for evaluating functional bladder capacity. Participants collected urine in gender-specific containers during episodes of maximum desire to void over three consecutive days, excluding the first morning void. The maximum voided volume recorded each day was documented, and the mean of the three maximum voided volumes was considered the final urine volume. (6,7)

Data Management and Analysis

Statistical analysis was performed using SPSS Statistics for Windows, Version 21.0. Descriptive statistics were expressed as mean ± standard deviation (SD). The independent *t*-test was used to compare the mean *Anjali Praman* values between groups. Spearman's rank correlation coefficient was used to assess the relationship between *Anjali Praman* and anthropometric variables. Simple linear regression analysis was performed to evaluate the association between BMI and *Anjali Praman*. A *p*-value of <0.05 was considered statistically significant.

Observations and Results

Demographic Characteristics

A total of 350 healthy individuals (175 males and 175 females) aged 25–59 years were enrolled in the study.

As shown in Table 1, the majority of participants (76%) belonged to the 25–29 years age group, followed by 10.3% in the 30–34 years range. Representation progressively decreased in higher age brackets, indicating a predominantly young adult population.

Table 1: Age group distribution of study participants

Age Group (years)	Frequency	Percentage (%)
25–29	266	76
30–34	36	10.29
35–39	23	6.57
40–44	11	3.14
45–49	6	1.71
50–54	3	0.86
55–59	5	1.43
Total	350	100

Anthropometric Characteristics

Height Distribution

Most participants had heights between 156–175 cm, accounting for 63.7% of the sample. The modal range was 156–165 cm (36.86%) (Table 2).

Table 2: Height distribution of study participants

Height (cm)	Frequency	Percentage (%)
126–135	3	0.86
136–145	3	0.86
146–155	61	17.43
156–165	129	36.86
166–175	94	26.86
176–185	60	17.14
Total	350	100

Weight Distribution

As shown in Table 3, most individuals weighed between 50–79 kg (72.3%), with the modal range being 60–69 kg (27.43%).

Table 3: Weight distribution of study participants

Weight (kg)	Frequency	Percentage (%)
40–49	43	12.29
50–59	90	25.71
60–69	96	27.43
70–79	67	19.14
80–89	48	13.71
90–99	6	1.71
Total	350	100

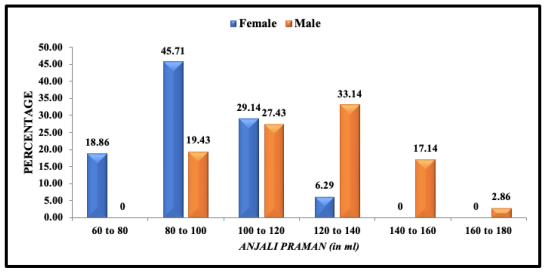
Anjali Praman Distribution

The *Anjali Praman* values demonstrated clear gender variation (Table 4). Among females, most values ranged between 80–100 ml (45.7%), whereas in males the predominant range was 120–140 ml (33.1%).

Table 4: Distribution of *Anjali Praman* among males and females

Anjali Praman (ml)	Female (n=175)	%	Male (n=175)	%
60–80	33	18.86	0	0
80–100	80	45.71	34	19.43
100–120	51	29.14	48	27.43
120–140	11	6.29	58	33.14
140–160	0	0	30	17.14
160–180	0	0	5	2.86
Total	175	100	175	100

Figure 6: Comparative distribution of *Swa Anjali Praman* in males and females



Descriptive Statistics

Table 5 presents the descriptive summary of demographic and anthropometric parameters. Males exhibited significantly higher mean values for height, weight, and *Anjali Praman* compared to females.

Table 5: Descriptive statistics of study population

Parameter	Male (Mean ± SD)	Female (Mean ± SD)
Age (years)	28.65 ± 5.88	29.33 ± 6.19
Height (cm)	171.87 ± 6.92	157.96 ± 7.04
Weight (kg)	70.99 ± 10.30	57.61 ± 10.77
BMI (kg/m²)	24.08 ± 3.55	23.09 ± 3.68
Anjali (ml)	120.40 ± 20.52	94.63 ± 15.85

An independent *t*-test (Table 6) revealed a highly significant difference between male and female *Anjali Praman* values ($t = -13.15$, $p < 0.001$).

Table 6: Comparison of *Anjali Praman* between males and females

Gender	Mean (ml)	SD	*t*	*p*-value
Female	94.63	15.85	–13.15	<0.001
Male	120.4	20.52		

Correlation Analysis

A positive and significant correlation was observed between *Anjali Praman* and anthropometric parameters in both genders (Tables 7 & 8).

Table 7: Correlation between *Anjali Praman* and anthropometric variables (Females, n=175)

		Height	*Weight*	*BMI*
Anjali	P-value	0.000	*0.000*	*0.002*
	Corr. Coeficient	0.390	*0.360*	*0.230*

Table 8: Correlation between *Anjali Praman* and anthropometric variables (Males, n=175)

Variable	*r*	*p*-value
Height	0.378	<0.001
Weight	0.282	<0.001
BMI	0.054	0.477 (NS)

Regression Analysis

Females:
The model was statistically significant ($F(2,172) = 19.78$, $p < 0.001$, $R^2 = 0.187$). Both height and weight significantly predicted *Anjali Praman*:

$$\text{Anjali (ml)} = -22.858 + 0.627(\text{Height}) + 0.321(\text{Weight})$$

Males:
The model was significant ($F(2,172) = 18.80$, $p < 0.001$, $R^2 = 0.179$). Both variables contributed meaningfully:

$$\text{Anjali (ml)} = -74.371 + 0.971(\text{Height}) + 0.392(\text{Weight})$$

In both genders, height had a stronger predictive influence on *Anjali Praman* than weight.

Validation with Urine Volume

In a subsample of 10 participants, the mean *Anjali Praman* equivalent (4 Anjali) was 427.12 ± 87.42 ml, and the mean maximum voided urine volume was 449.00 ± 75.63 ml.

Figures 7 & 8: Comparison of observed and predicted *Anjali Praman* in males and females

Figure 7: Comparison of observed and predicted Anjali Praman in Males

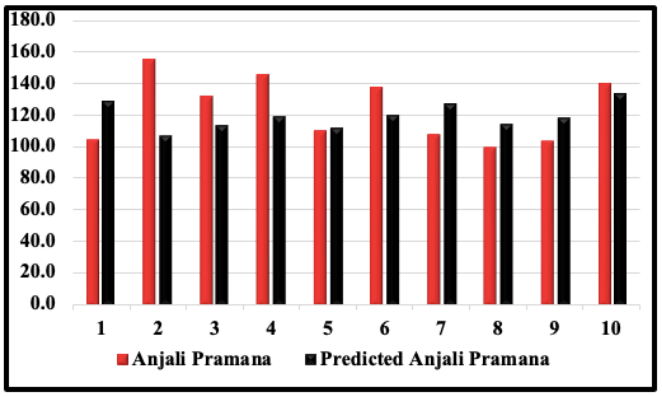
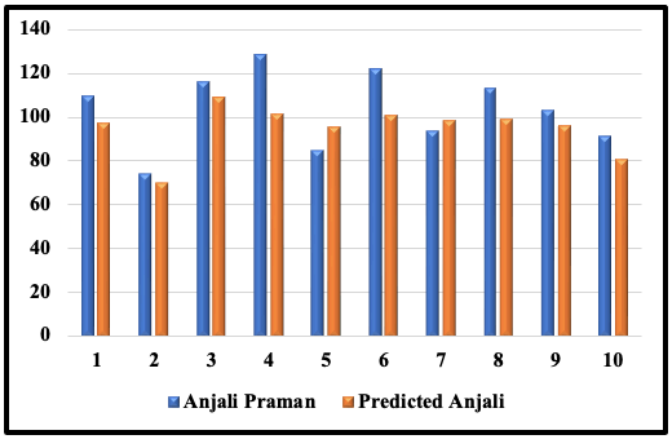


Figure 8: Comparison of observed and predicted Anjali Pramana in Females



The difference was not statistically significant ($t = -0.599$, $p = 0.557$), supporting Charaka's reference value of 4 Anjali for *Mutra* volume.

Table 9: Comparison of *Anjali Praman* (4 Anjali equivalent) and measured urine volume

Parameter	Mean ± SD (ml)	*t*	*p*-value
4 *Anjali* Equivalent	427.12 ± 87.42	–0.599	0.557
Measured Urine Volume	449.00 ± 75.63		

Discussion

In the present study, an attempt was made to standardize the measurement of *Anjali Pramaṇa* and evaluate its anatomical and physiological relevance in healthy adults. The majority of participants were between 25 and 29 years of age, representing young adults with completed skeletal growth and relatively stable anthropometric characteristics. This age group minimizes the influence of developmental changes in body proportions and hand dimensions, thereby providing a suitable population for anthropometric assessment. (12,13,14)

A positive correlation was observed between *Anjali Pramaṇa* and height, weight, and BMI in females, whereas in males, significant

positive correlations were observed only with height and weight. These findings suggest that *Anjali Pramāṇa* is influenced primarily by overall body size rather than body mass alone. Height and body weight are well-established determinants of anthropometric dimensions, and body measurements generally increase proportionately with body size.(12)

No significant correlation between *Anjali Pramaṇa* and BMI was observed in males. This may be explained by the relatively narrow range of BMI values among the male participants, which limits the statistical ability to detect an association. Furthermore, BMI reflects body mass relative to height but does not directly represent hand dimensions or body volume, both of which are more closely related to stature and overall body size than to adiposity alone. (15)

A significant difference was observed between genders, with males showing a higher mean *Anjali Pramana* (120.4 ml) than females (94.6 ml). This corresponds with established anthropometric findings that males generally have larger hand dimensions and overall body build. These observations support the Ayurvedic concept that volumetric measures like Anjali reflect an individual's inherent biological constitution.

In the study, a positive correlation was seen between *Anjali Pramana* and height, weight, and BMI in females, and with height and weight in males; however, no correlation with BMI was noted in males. This may be due to the limited BMI variability within the male population studied (6).

According to the pilot study conducted on 10 individuals (5 males and 5 females) already included in the *Anjali Pramana* standardization study, the maximum voided urine volume measured using a voiding diary closely matched the quantity of urine described by Acharya Charaka as 4 Anjali. Based on the findings, bladder capacity and 4 *Anjali Pramana* were comparable—approximately 480 ml in males (120 × 4) and 376 ml in females (94 × 4), which also corresponds with physiological observations that an average adult feels the urge to void when bladder volume reaches around 500 ml. A noteworthy outcome of the study was this close agreement between the measured urine volume and the *Charakokta* reference, strengthening the concurrent validity of the classical standard. Importantly, insights from the pilot voiding-diary study further clarified that the *Anjali Pramana* described by the Acharyas for urine does not represent the quantity of urine produced in the body but reflects the functional bladder storage capacity. Modern urological evidence supports this interpretation, as voiding diaries—recognized as reliable, non-invasive tools—consistently show that maximum bladder capacity in natural settings (median ~400 ml) is significantly higher than cystometric measurements (median ~215 ml), especially in individuals with detrusor instability. Contemporary guidelines recommend three-day diaries to accurately estimate bladder capacity and frequency patterns, and diary-derived volumes closely reflect true physiological storage capacity (7-11). These insights align with the Ayurvedic description of *Mutra Pramana* in *Anjali*, suggesting that ancient authors were referring to bladder capacity rather than the amount of urine present in the body.

Similarly, *Stanya* is described as 2 Anjali (3), which corresponds to 188 ml (94 × 2), and modern physiological studies in lactating women report an average breast storage capacity of 169 ± 51 g on the left side and 175 ± 54 g on the right side, showing a close agreement between classical measures and contemporary findings. A similar pattern is evident when examining the classical description of *Stanya Matra* by Acharya Charaka (3)(13), as modern lactation physiology shows that the quantity attributed to a single breast represents its storage capacity rather than total daily milk production. Research reports breast storage capacities ranging from 74 to 382 ml, with averages around 180–210 ml per breast during active lactation (16,17). These values reflect functional storage rather than breast size, and studies confirm that milk availability depends on breast tissue efficiency and infant demand rather than external appearance. This contemporary evidence mirrors the Ayurvedic understanding that Stanya *Pramana* indicates the inherent storage capacity of the breast rather than its daily output or external dimensions.

In classical Ayurvedic literature, the quantities of *Mutra* and *Stanya* are understood to represent the functional storage capacity of the bladder and breast rather than the total daily volume produced by the body. In the present study, *Stanya Pramaṇa* was not directly measured, as the study was conducted in healthy adults and did not include lactating women. Consequently, no correlation between *Stanya Pramaṇa* and anthropometric parameters was analysed. The discussion of the classical value of *Stanya* (2 Anjali) is therefore presented only as a theoretical comparison based on Ayurvedic descriptions and a narrative review of contemporary lactation literature, rather than as empirical validation. Furthermore, several qualitative attributes of *Stanya* described by Acharya Charaka could not be evaluated because reliable contemporary scientific equivalents for these parameters are not yet established. These aspects should be considered limitations of the present study and warrant future research involving lactating women to explore the relationship between *Stanya Pramaṇa*, anthropometric characteristics, and physiological milk production.

For example, Acharya Charaka states that *Rakta* (Blood) measures 8 *Anjali*. If *Rakta* is compared directly with blood, modern literature states that total blood volume is about 4–5 liters. In contrast, according to our findings, the amount corresponding to 8 *Anjali* would be 963.2 ml in males (120.4 × 8) and 756.8 ml in females (94.6 × 8), which clearly does not match modern values. However, if we consider the combined quantities of *Rakta*, *Rasa*, and *Udaka*—that is, 10 + 9 + 8 = 27 *Anjali*—the total approximates around 3 liters, which is closer to the modern estimation of blood volume.

Furthermore, modern science does not provide clear equivalents for *Udaka* (water content of body) and *Rasa* (first by product after digestion of food). It is possible that Acharya Charaka considered these components as part of the broader concept of blood or circulating fluids. Due to this conceptual disparity, an exact comparison and derivation of the quantities of the remaining attributes remain challenging.

Together, these parallels between classical Ayurvedic measures and modern physiological research provide compelling support for the interpretation of *Anjali Pramana* as a storage-capacity indicator for specific organs. In the present study, the harmony between measured values, anthropometric correlations, and *Charakokta* standards strongly validates the continued relevance of *Anjali Pramana* as a scientifically grounded and individualized volumetric measure. Future multicentric studies with broader demographic representation may further refine normative values and enhance the utility of this classical metric across clinical settings.

Limitations

The study's findings are limited by its single-population sample and cross-sectional design, which establishes associations but not causality. Urine volume was self-reported over three days,

potentially introducing minor measurement error. Data on *Stanya* were derived from literature rather than direct observation. Future multicentric studies with broader demographic representation and urodynamic validation are warranted.

Conclusion

This study demonstrates that *Anjali Pramaṇa* is a measurable and physiologically relevant concept. It showed significant sex-based differences and positive correlations with height and weight, indicating its association with body size. The close correspondence between four Anjali and maximum voided urine volume supports the classical concept of *Mutra Pramaṇa* as a reflection of functional bladder capacity. The comparison of *Stanya Pramaṇa* with modern lactation data remains theoretical and requires further validation. Overall, *Anjali Pramaṇa* has potential as a simple, individualized, and non-invasive parameter linking classical Ayurvedic concepts with contemporary physiology.

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