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Association of Mamsa Sara with Body Mass Index, Lean Body Mass, Muscular Strength and Harvard Step Test Performance in Healthy Young Adults

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ABSTRACT:

Background: Mamsa Sara is an Ayurvedic assessment of the quality and development of muscle tissue. Its association with modern measures of body composition and physical fitness requires further evaluation.

Objective: To assess the association of Mamsa Sara with body mass index (BMI), lean body mass (LBM), bilateral handgrip strength and Harvard Step Test performance in healthy adults.

Methods: This observational analytical cross-sectional study included 300 healthy volunteers aged 18-40 years. Mamsa Sara was assessed using a structured Sara Pariksha and classified as Avara, Madhyama or Pravara. BMI, four-site skinfold-derived LBM, bilateral handgrip strength and Harvard Step Test fitness index were recorded. Descriptive statistics, correlation analysis and chi-square tests were applied; $p < 0.05$ was considered statistically significant.

Results: Pravara, Madhyama and Avara Mamsa Sara were observed in 201 (67.0%), 87 (29.0%) and 12 (4.0%) participants, respectively. Mamsa Sara score was strongly correlated with LBM ($r = 0.71$, $p < 0.001$); mean LBM was 53.48 +/- 6.61 kg in Pravara, 43.51 +/- 5.10 kg in Madhyama and 37.02 +/- 4.65 kg in Avara Mamsa Sara. Mamsa Sara category was significantly associated with right-hand grip strength (chi-square = 68.97, $p < 0.001$), left-hand grip strength (chi-square = 56.98, $p < 0.001$), BMI category

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(chi-square = 103.79, p < 0.001) and Harvard Step Test category (chi-square = 13.85, p = 0.031).

Conclusion: Higher Mamsa Sara grading was associated with greater LBM, stronger handgrip ratings and more favourable fitness-related profiles. Mamsa Sara assessment may complement non-invasive evaluation of muscular and functional status; longitudinal studies are required to establish predictive value.

1. INTRODUCTION

In Ayurveda, the assessment of Sara is used to evaluate the excellence of individual body tissues. Mamsa Sara refers to the qualitative and functional adequacy of Mamsa Dhatu, the tissue described in relation to muscular bulk, firmness, stability and capacity for exertion. Classical descriptions of Mamsa Sara Purusha include a well-covered and firm physique, strength, endurance and resistance to illness [1,2]. These attributes suggest a potentially useful interface between Ayurvedic constitutional examination and modern measures of muscle-related health.

Modern fitness assessment commonly uses complementary measures because no single indicator captures body composition, muscular function and aerobic capacity. BMI is widely used to classify weight status, but it does not differentiate fat mass from lean tissue [3]. Skinfold-derived estimates of body fat and lean body mass, together with handgrip strength, add relevant information on body composition and muscular function [4,5]. The Harvard Step Test is a practical field test in which post-exercise pulse recovery is used to derive a fitness index [6,7].

Previous studies have reported associations between body mass index and physical fitness in adult and student populations [8,9]. A recent cross-sectional study using the Harvard Step Test also examined the relationship between body mass index and physical fitness index in university students [10]. However, evidence linking these modern measures with the Ayurvedic grading of Mamsa Sara remains limited. The present study was undertaken to evaluate the association of Mamsa Sara with BMI, LBM, bilateral handgrip strength and Harvard Step Test performance in healthy adults. We hypothesised that higher Mamsa Sara grading would be associated with stronger muscular and fitness-related indicators.

1.1. Ayurvedic Basis of Mamsa Sara

Ayurveda describes the body as being sustained by the harmonious state of Dosha, Dhatu and Mala. Mamsa Dhatu is one of the seven Dhatus and is understood as the tissue responsible for covering, supporting and stabilising the body. Its adequacy contributes to compactness of the body, protection of underlying structures and the capacity for physical activity. The Ayurvedic concept is therefore broader than anatomical muscle alone because it incorporates structural development and functional strength [1,2].

Sara Pariksha is a classical method of assessing the excellence or qualitative predominance of a particular Dhatu. In the assessment of Mamsa Sara, attention is given to the development, firmness and stability of muscles, the coverage of specific body regions and the individual's capacity for endurance. Classical descriptions associate Pravara Mamsa Sara with a well-developed and firm physique, good strength and tolerance for exertion; Madhyama and Avara grades represent intermediate and lower expression of these characteristics, respectively [1,2].

The present study does not equate Mamsa Sara with a single modern measurement. Rather, it examines whether a structured Ayurvedic assessment is associated with complementary contemporary indicators: lean body mass as an estimate of non-fat tissue, handgrip strength as a functional measure of muscular performance, BMI as an anthropometric screening index and the Harvard Step Test as a field measure of exercise recovery. This approach permits a cautious, evidence-based exploration of the clinical relevance of Mamsa Sara without reducing the Ayurvedic construct to any one biomedical variable.

2. AIM AND OBJECTIVES

Aim: To evaluate the Ayurvedic concept of Mamsa Sara Purusha in relation to modern indicators of body composition, muscular strength and physical fitness. Objectives: (1) To assess Mamsa Sara Lakshana using a structured Sara Pariksha and classify participants as Avara, Madhyama or Pravara Mamsa Sara. (2) To examine the association of Mamsa Sara with body mass index, lean body mass, bilateral handgrip strength and Harvard Step Test performance in healthy adults.

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3. MATERIALS AND METHODS

3.1. Study Design, Setting and Duration

This observational analytical cross-sectional study was conducted at Government Autonomous Ayurveda College and Hospital, Gwalior, Madhya Pradesh, India, in support with Laxmibai National Institute of Physical Education, Gwalior. The study was completed over 18 months, including literature review, participant assessment, data entry, statistical analysis and interpretation. The study was designed to examine associations between the Ayurvedic grading of Mamsa Sara and contemporary measures of body composition, muscular strength and physical fitness.

3.2 Study Size, Sampling, Participant Flow and Reporting Framework

The study enrolled 300 healthy volunteers using simple random sampling. It was conducted over 1 year and 6 months at Government (Autonomous) Ayurveda College & Hospital, Gwalior, and Laxmibai National Institute of Physical Education, Gwalior. Eligible participants were willing male and female volunteers aged 18-40 years who were free from acute or chronic systemic illness. Individuals with emergency medical conditions, hospitalisation at data collection, chronic systemic illness, severe acute disease, age below 18 or above 40 years, or inability to perform the Harvard Step Test because of musculoskeletal or functional limitations were excluded. Sample-size adequacy was assessed using Fisher z transformation for a two-sided correlation test (alpha = 0.05). A sample of 300 participants provided more than 99.99% power to detect a correlation of r = 0.33; approximately 93 and 114 participants were required for 90% and 95% power, respectively, for an association of this magnitude. Reporting was organised with reference to the STROBE guidance for cross-sectional studies [11].

3.3 Ethical Approval and Informed Consent

The study was initiated only after approval from the Institutional Ethics Committee of Government (Autonomous) Ayurveda College & Hospital, Gwalior, on 12 September 2023. Written informed consent was obtained from each participant before enrolment. The study was conducted in accordance with institutional requirements and the Declaration of Helsinki [12].

3.4 Materials and Instruments

The following materials were used:

➢ Hand grip dynamometer

➢ Skin fold caliper

➢ Weighing machine

➢ Measuring tape

➢ Bench or Steps (Female-16-inch, Male -20 inch)

➢ Stopwatch

➢ Sphygmomanometer

➢ Stethoscope

All measurements were recorded on the study proforma and subsequently entered into a structured electronic spreadsheet for analysis.

3.5 Assessment of Mamsa Sara

The assessment of *Mamsa Sara* was performed using a structured questionnaire based on classical *Ayurvedic* characteristics described for *Sara* determination.

The examination included:

- Inspection of major body regions (temporal region, forehead, eyes, zygomatic arch, mandible, neck, chest, shoulders, axilla, palms, soles, joints).

- Observation of muscle bulk, firmness, stability, and coverage of soft tissues.
- Evaluation of functional and psychological characteristics such as endurance, memory, tolerance, learning skills, and resistance to illness.
- Each feature was scored as "Present" or "Absent" based on the subject's physical appearance and answers.
- The questionnaire-based scoring proforma used in the research is shown in Table 1.

Table 1. Mamsa Sara questionnaire-based scoring proforma.

Mamsa Sara Questionnaire Based Scoring Proforma			
A. Physical characteristics: Steady, firm and heavy; good looking, fleshy and well covered with muscles			
S. No.	**Assessment feature / question**	**Score allotted**	**Score obtained**
1	Temporal region	**2**	
2	Forehead	**2**	
3	Eye	**2**	
4	Zygomatic arch	**2**	
5	Mandible	**2**	
6	Neck	**2**	
7	Nape (back side of neck)	**2**	
8	Chest	**2**	
9	Axilla	**2**	
10	Shoulder	**2**	
11	Palm	**2**	
12	Sole	**2**	
13	Abdomen	**2**	
14	Joints	**2**	
B. Functional and psychological characteristics			
S. No.	**Assessment feature / question**	**Score allotted**	**Score obtained**

1	Do you remember the happenings exactly as they have taken place?	**1**	
2	You don't have a tendency to store things	**1**	
3	You are not overambitious	**1**	
4	You are not stressed out because of minor problems	**1**	
5	Are your learning skills good?	**1**	
6	Are you having good patience/tolerance?	**1**	
7	Is your body compact and muscular?	**1**	
8	You do not frequently fall ill	**1**	
9	Are you having good working capacity?	**1**	
Total maximum score		**37**	

The 37-point scoring format was adapted from a published Dhatu Sarata assessment approach that enumerated 37 Mamsa Sara features [13]. Scores were classified as Avara (1-12), Madhyama (13-24) or Pravara (25-37) Mamsa Sara (Table 2).

Table 2. Mamsa Sara grading based on total score.

Mamsa Sara Scoring and Classification		
S. No.	**Score range**	**Mamsa Sara category**
1	1-12	**Avara Mamsa Sara**
2	13-24	**Madhyama Mamsa Sara**
3	25-37	**Pravara Mamsa Sara**

3.6 Anthropometry and Body Composition

Body mass index (BMI) was assessed using standard anthropometric procedures. BMI was calculated as body weight in kilograms divided by the square of height in metres (kg/m2) [3].

Procedure

1. The subject's body weight was measured using a digital weighing machine, ensuring the participant was barefoot and wearing light clothing.
2. Height was recorded with the help of a stadiometer, with the subject standing erect, heels together, and head in the Frankfurt plane.
3. BMI was calculated using the standard international formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

4. BMI values were classified using World Health Organization adult cut-offs: underweight (<18.5 kg/m2), normal (18.5-24.9 kg/m2), overweight (25.0-29.9 kg/m2) and obese (>=30.0 kg/m2) (Table 3) [3].

Table 3. Body mass index categories used for participant classification.

BMI Range	Category
< 18.5	Underweight
18.5 – 24.9	Normal
25 – 29.9	Overweight
≥ 30	Obese

ASSESSMENT OF BODY FAT CONTENT AND LEAN BODY MASS (LBM) USING SKINFOLD MEASUREMENTS

Skinfold Thickness Measurement Procedure

All skinfold measurements were obtained on the right side of the subject, seated comfortably on a stool. Standard anatomical landmarks and the four-site skinfold method were used to estimate body fat and lean body mass in accordance with Durnin and Rahaman [4].

1. **Biceps Skinfold**

   Measured at the mid-point of the biceps muscle belly with the arm supinated and resting on the thigh.

2. **Triceps Skinfold**

   Measured at the mid-point of the triceps muscle, halfway between the olecranon and the acromion, with the upper arm hanging vertically.

3. **Subscapular Skinfold**

   Taken just below the inferior angle of the scapula, at an angle of approximately 45° to the vertical.

4. **Suprailiac Skinfold**

   Measured just above the iliac crest along the mid-axillary line.

Skinfold Measurement Record

- **Biceps skinfold:** …… mm
- **Triceps skinfold:** …… mm
- **Subscapular skinfold:** …… mm
- **Suprailiac skinfold:** …… mm

Total Skinfold (mm): Sum of all four sites

Body Fat Percentage (Durnin & Rahaman Method)

Body-fat percentage was derived from the sum of the four skinfolds (biceps, triceps, subscapular and suprailiac) using the reference values in Table 4.

Table 4. Reference values for four-site skinfold sum and estimated body-fat percentage.

Total Skinfold (mm)	Men (% Fat)	Women (% Fat)
15	5.5	—
20	9.0	15.5
25	11.5	18.5
30	13.5	21.0
35	15.5	23.0
40	17.0	24.5
45	18.5	26.0
50	20.0	27.5
55	21.0	29.0
60	22.0	30.0
65	23.0	31.0
70	24.0	32.5
75	25.0	33.5
80	26.0	34.0
85	26.5	35.0
90	27.5	36.0
95	28.0	36.5

Body Composition Calculations

Fat Percentage: …… %

Body Weight: …… kg

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1. Total Fat Content (kg)

Body Fat (%) ÷ 100 × Body Weight (kg) = Total Fat Content (kg)

2. Lean Body Mass (LBM) (kg)

Body Weight (kg) − Total Fat Content (kg) = Lean Body Mass (kg)

3.7 Handgrip Strength Assessment

Hand grip dynamometry is used to measure the maximal voluntary grip strength, which reflects the functional status of forearm and hand muscles. Standardised positioning and measurement procedures were followed for grip-strength assessment [5].

Procedure

1. The subject is seated or standing comfortably.
2. The shoulder is adducted and neutrally rotated.
3. The elbow is maintained at 90° flexion (or fully extended—use the same method for all participants).
4. The wrist is kept in neutral position (not flexed or extended).
5. The digital dynamometer handle is adjusted according to hand size.
6. The subject squeezes the device with maximum effort for 3–5 seconds.
7. Record Right Hand Grip Strength (kg) and Left-hand Grip Strength (kg).
8. Two trials are taken, and the highest value is used for analysis.

Handgrip strength rating categories for participants aged 18-40 years are shown in Table 5; interpretation was based on standardised grip-strength assessment recommendations [5].

Table 5. Handgrip strength rating categories for adults aged 18-40 years.

Age group	Male			Female		
	Weak(kg)	Normal (kg)	Strong (kg)	Weak(kg)	Normal (kg)	Strong(kg)
18–19	< 35.7	35.7 – 55.5	> 55.5	< 19.2	19.2 – 31.0	> 31.0
20–24	< 36.8	36.8 – 56.6	> 56.6	< 21.5	21.5 – 35.3	> 35.3
25–29	< 37.7	37.7 – 57.5	> 57.5	< 25.6	25.6 – 41.4	> 41.4
30–34	< 36.0	36.0 – 55.8	> 55.8	< 21.5	21.5 – 35.3	> 35.3
35–39	< 35.8	35.8 – 55.6	> 55.6	< 20.3	20.3 – 34.1	> 34.1
40–44	< 35.5	35.5 – 55.3	> 55.3	< 18.9	18.9 – 32.7	> 32.7

3.8 Harvard Step Test Assessment

For data collection, the following standardized experimental procedure was used to assess physical fitness and endurance level using the Harvard Step Test, which provides an easy and reliable method to determine the Physical Fitness Index (PFI).

Procedure

- The subject was instructed to perform stepping exercise on a standard Harvard Step Bench at the rate of 30 steps per minute for 5 minutes continuously. This procedure was based on the Harvard Step Test protocol [6].
- Rhythm was maintained consistently ensuring that the same leading leg was used each time while stepping up and down.
- After completing the exercise, the subject was asked to sit down comfortably for recovery pulse measurement.
- Pulse rate was recorded three times, each for 30 seconds, at the following intervals:

1:00 – 1:30 minutes

2:00 – 2:30 minutes

3:00 – 3:30 minutes

- All three pulse readings were documented carefully for further analysis.
- The Fitness Index (FI) score was calculated by applying the formula below:
- $\text{Fitness Index score} = \frac{100 \times \text{Test Duration (seconds)}}{2 \times (\text{Pulse1} + \text{Pulse2} + \text{Pulse3})}$

Fitness Rating Categories

Participants were rated into fitness categories as shown in Table 6, using the Harvard Step Test classification approach [6].

Table 6. Harvard Step Test fitness-index rating categories.

Rating Category	Male FI Score Range	Female FI Score Range
Excellent	≥ 90	≥ 85
Good	80 – 89	75 – 84
Average	65 – 79	60 – 74
Low Average	55 – 64	50 – 59
Poor	< 55	< 50

3.9 Data Management and Statistical Analysis

Data were checked for completeness before analysis. Descriptive statistics were reported as frequency and percentage for categorical variables and mean with standard deviation for continuous variables. Correlation coefficients were used to examine the relationships of Mamsa Sara score with LBM and of BMI and LBM with Harvard Step Test score. Chi-square tests were used to assess associations between Mamsa Sara category and BMI category, Harvard Step Test category, and right- and left-hand grip-strength categories. All tests were two-sided, and $p < 0.05$ was considered statistically significant.

4. RESULTS

The sample comprised 192 males (64.0%) and 108 females (36.0%). Most participants were aged 23-27 years (75.33%), and 97.0% were students. Normal BMI was observed in 233 participants (77.67%); 34 (11.33%) were overweight, 27 (9.00%) were underweight and 6 (2.00%) were obese. Excellent Harvard Step Test performance was observed in 197 participants (65.67%), followed by good performance in 80 (26.67%), average performance in 19 (6.33%) and low-average/fair performance in 4 (1.33%). The distribution of principal study variables is shown in Table 7. Participant inclusion and analysis are summarised in Figure 4.

Table 7. Distribution of principal study variables.

Measure	Category / value	n (%) or mean
Mamsa Sara	Pravara	201 (67.00%)
	Madhyama	87 (29.00%)
	Avara	12 (4.00%)
BMI	Normal	233 (77.67%)
	Overweight	34 (11.33%)
	Underweight	27 (9.00%)
	Obese	6 (2.00%)
Harvard Step Test	Excellent	197 (65.67%)
	Good	80 (26.67%)
	Average	19 (6.33%)
	Low average/fair	4 (1.33%)

Pravara Mamsa Sara was associated with the highest mean LBM (53.48 +/- 6.61 kg), followed by Madhyama (43.51 +/- 5.10 kg) and Avara Mamsa Sara (37.02 +/- 4.65 kg). The correlation between Mamsa Sara score and LBM was strong and positive ($r = 0.71$, $p < 0.001$; 95% CI 0.64-0.76). BMI was also positively correlated with LBM ($r = 0.70$, $p < 0.001$; 95% CI 0.64-0.75). All prespecified correlation and association analyses are presented in Table 8.

Table 8. One-by-one comparative analysis of all study criteria. HST: Harvard Step Test; LBM: lean body mass.

Comparison	Key observation	Statistical evidence	Interpretation
Mamsa Sara vs right handgrip strength	Strong grip: Pravara 44.67%, Madhyama 8.33%, Avara 0.67%. Weak grip: 0.67%, 4.33% and 1.67%, respectively.	Chi-square = 68.97; df = 4; $p < 0.001$.	Right-hand grip-strength category differed significantly across Mamsa Sara grades.

Mamsa Sara vs left handgrip strength	Strong grip: Pravara 36.33%, Madhyama 5.33%, Avara 0.67%. Weak grip: 2.00%, 5.67% and 1.67%, respectively.	Chi-square = 56.98; df = 4; $p < 0.001$.	Left-hand grip-strength category also differed significantly across Mamsa Sara grades.
Mamsa Sara score vs LBM	Mean LBM: Pravara 53.48 +/- 6.61 kg; Madhyama 43.51 +/- 5.10 kg; Avara 37.02 +/- 4.65 kg.	$r = 0.71$; $p < 0.001$; 95% CI 0.64-0.76.	A strong positive correlation showed higher Mamsa Sara score with higher LBM.
BMI vs LBM	Mean LBM: obese 61.92 kg; overweight 57.41 kg; normal 49.61 kg; underweight 40.51 kg.	$r = 0.70$; $p < 0.001$; 95% CI 0.64-0.75.	BMI increased in parallel with LBM in this sample.
LBM vs Harvard Step Test score	Mean LBM: excellent 49.02 kg; good 50.11 kg; average 54.96 kg; low average/fair 66.07 kg (n = 4).	$r = 0.33$; $p < 0.001$; 95% CI 0.23-0.43.	A moderate positive correlation was observed; category means should be read with the small low-average/fair subgroup in mind.
BMI range vs Harvard Step Test rating	Normal BMI: excellent 55.00%, good 20.67%, average 2.00%. Overweight: 4.67%, 2.00%, 4.00% and 0.67% low average/fair.	Chi-square = 113.68; df = 9; $p < 0.001$.	Harvard Step Test rating was significantly associated with BMI category.
Mamsa Sara vs BMI range	Pravara: normal 54.00%, overweight 10.67%, underweight 0.33%, obese 2.00%. Madhyama: normal 22.67%, overweight 0.67%, underweight 5.67%. Avara: normal 1.00%, underweight 3.00%.	Chi-square = 103.79; df = 6; $p < 0.001$.	BMI-category distribution differed significantly across Mamsa Sara grades.
Mamsa Sara vs Harvard Step Test rating	Excellent: Pravara 41.00%, Madhyama 22.67%, Avara 2.00%. Good: 19.00%, 5.67%, 2.00%. Average: 5.67%, 0.67%, 0%.	Chi-square = 13.85; df = 6; $p = 0.031$.	Harvard Step Test rating was significantly associated with Mamsa Sara grade.

The eight comparisons summarised in Table 3 are explained one by one below.

1. Mamsa Sara and right-hand grip strength. Pravara Mamsa Sara had the largest strong-grip proportion (44.67%), whereas weak grip was uncommon in Pravara (0.67%) and more frequent in Madhyama and Avara groups. The association was highly significant (chi-square = 68.97, df = 4, $p < 0.001$).

2. Mamsa Sara and left-hand grip strength. Strong left-hand grip was also most frequent in Pravara (36.33%). The pattern differed significantly by Mamsa Sara grade (chi-square = 56.98, df = 4, $p < 0.001$).

3. Mamsa Sara score and LBM. Mean LBM declined from Pravara (53.48 kg) to Madhyama (43.51 kg) and Avara (37.02 kg). The correlation was strong and positive ($r = 0.71$, $p < 0.001$).

4. BMI and LBM. LBM was highest in the obese and overweight groups and lowest in the underweight group. BMI and LBM had a strong positive correlation ($r = 0.70$, $p < 0.001$).

5. LBM and Harvard Step Test score. LBM and Harvard Step Test score showed a moderate positive correlation ($r = 0.33$, $p < 0.001$). The low-average/fair subgroup was small ($n = 4$), so its mean should be interpreted cautiously.

6. BMI range and Harvard Step Test rating. Normal-BMI participants formed the largest excellent-performance group (55.00% of the full sample). The association between BMI category and Step Test rating was highly significant (chi-square = 113.68, df = 9, $p < 0.001$).

7. Mamsa Sara and BMI range. Normal BMI was most common in Pravara (54.00%) and Madhyama (22.67%) groups, whereas underweight status was concentrated in Avara (3.00%) and Madhyama (5.67%) groups. This association was highly significant (chi-square = 103.79, df = 6, $p < 0.001$).

8. Mamsa Sara and Harvard Step Test rating. Excellent Step Test performance was most frequent in the Pravara group (41.00% of the full sample), followed by Madhyama (22.67%) and Avara (2.00%). The association was significant (chi-square = 13.85, df = 6, $p = 0.031$). The corresponding patterns are visualised in Figures 1-3.

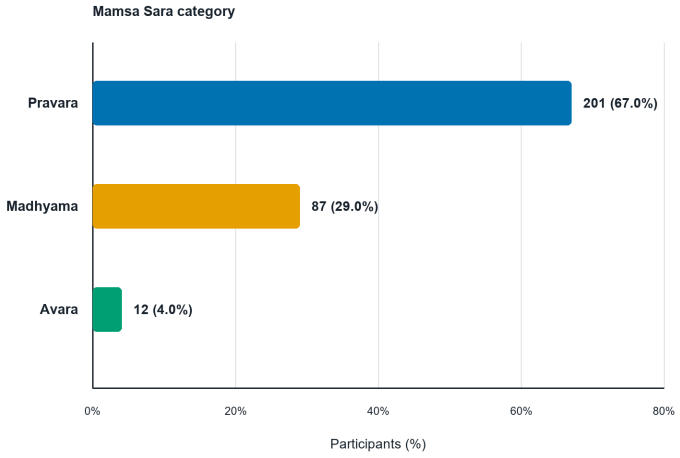


Figure 1. Distribution of Mamsa Sara categories among the 300 study participants.

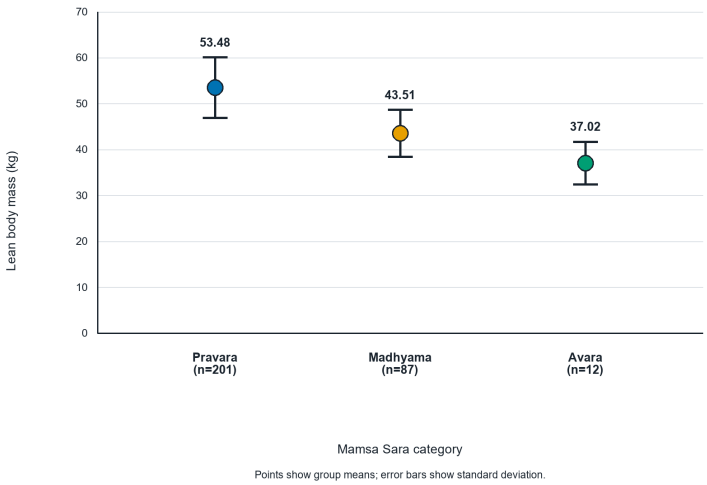


Figure 2. Mean lean body mass by Mamsa Sara category. Points show group means and error bars show standard deviation.

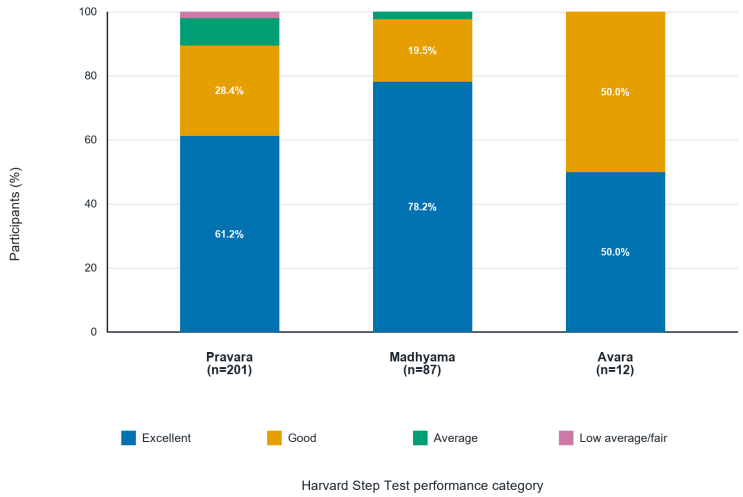


Figure 3. Percentage distribution of Harvard Step Test performance categories within each Mamsa Sara group.

Healthy volunteers enrolled (n = 300)

↓

Mamsa Sara, anthropometry, skinfold, handgrip and Harvard Step Test assessments completed (n = 300)

↓

Included in descriptive, correlation and chi-square analyses (n = 300)

Figure 4. STROBE-style participant flow from enrolment to analysis. Screening and exclusion counts were not retained in the thesis dataset.

5. DISCUSSION

This study found consistent associations between the Ayurvedic grading of Mamsa Sara and modern measures related to muscular tissue and physical performance. The strongest finding was the positive correlation between Mamsa Sara score and LBM. Mean LBM increased across the Avara, Madhyama and Pravara categories, providing quantitative support for the classical description of Pravara Mamsa Sara as a well-developed, firm and strong muscular constitution [1,2].

The handgrip findings complement this result. Both right- and left-hand strength categories were strongly associated with Mamsa Sara grading. Handgrip strength reflects voluntary force production by the forearm and hand musculature and is commonly used as a simple functional measure of muscular performance [5]. The predominance of strong grip ratings among Pravara participants, and the greater frequency of weak ratings in lower Sara categories, suggests that Mamsa Sara assessment may capture a functional dimension in addition to external body build. A prior volunteer study also reported alignment between Mamsa Sarata and grip-dynamometry measures [14]. Grip strength is an established general marker of muscular function and health-related risk, although it is not a diagnosis in itself [15].

BMI must be interpreted carefully in muscular populations because it cannot distinguish adipose tissue from lean tissue [3]. In the present sample, BMI showed a strong positive correlation with LBM. Higher mean LBM in the overweight and obese BMI groups does not establish that higher BMI is desirable, nor does it identify the proportion attributable to fat. Rather, it emphasises the value of accompanying BMI with direct or indirect body-composition measures. The finding that normal BMI was predominant overall and especially common in the Pravara group is compatible with the study population being largely

healthy young adults. Skinfold-based estimation provides a practical field method but depends on standardised technique and appropriate prediction equations [16].

LBM was moderately positively correlated with Harvard Step Test score, and both BMI category and Mamsa Sara category were associated with Harvard Step Test performance. A majority of participants achieved excellent scores. The association of Mamsa Sara with test category was statistically significant but smaller than its associations with LBM and grip-strength classifications. Cardiorespiratory performance is multifactorial; age, sex, training status, body-fat distribution, habitual activity, familiarity with the test and recovery physiology may all contribute. Therefore, these cross-sectional findings demonstrate association rather than causal prediction. Exercise-test performance is also influenced by training status, pacing and other physiological factors that must be considered when interpreting field tests [17].

The results offer a possible bridge between Sara Pariksha and contemporary functional assessment. A structured Mamsa Sara examination could be used alongside anthropometry, skinfold evaluation, dynamometry and exercise testing in a comprehensive health assessment. It should not replace validated measures or be used alone to diagnose nutritional status, obesity or disease. Its potential value is as a low-cost constitutional and clinical assessment that can be evaluated further in diverse populations. These measures should complement, not replace, individualised clinical assessment and physical-activity counselling [18].

Across the eight comparisons, the strongest relationships were Mamsa Sara score with LBM ($r = 0.71$) and BMI with LBM ($r = 0.70$), whereas the relationship between LBM and Harvard Step Test score was moderate ($r = 0.33$). This gradient is meaningful: the Mamsa Sara and BMI measures tracked more closely with the structural component of body composition than with the multifactorial exercise-performance outcome. The concordant associations of Mamsa Sara with both right- and left-hand grip categories ($p < 0.001$ for each) further support that the observed pattern was not limited to one side of the body. The distinction between body size and composition remains particularly important when BMI is used as an exposure or interpretive measure [19].

The endurance findings require a measured interpretation. Although Mamsa Sara category and BMI category were each significantly associated with Harvard Step Test rating, the Mamsa Sara-Harvard Step Test association was comparatively smaller ($p = 0.031$). In addition, the low-average/fair Harvard Step Test category contained only four participants; its higher mean LBM should therefore not be treated as a group-level performance pattern. These details reinforce the need to interpret the statistically significant findings alongside subgroup size, body composition and training-related factors, rather than as evidence of causal effects. Physical activity, exercise and fitness are related but distinct constructs; future analyses should measure these potential confounders explicitly [20].

5.1. Limitations

The cross-sectional design prevents causal inference. The sample was predominantly young, student and male, limiting generalisability. No a priori sample-size or power calculation was reported, and screening and exclusion counts were not retained. The study did not report multivariable adjustment for sex, habitual physical activity, dietary intake or other potential confounders. BMI is not a direct measure of adiposity, and skinfold estimates have method-related limitations. The Mamsa Sara assessment was based on a structured questionnaire and examination, but independent psychometric validation and inter-rater reliability were not evaluated. Future studies should use prospectively planned sample-size calculations, complete participant-flow recording, reliability testing, multivariable models and more diverse participants with direct body-composition methods where feasible.

6. CONCLUSIONS

Among 300 healthy adults, higher Mamsa Sara grading was associated with greater LBM, stronger bilateral handgrip ratings, BMI category and Harvard Step Test performance. The strongest observed relationship was between Mamsa Sara score and LBM ($r = 0.71$, $p < 0.001$). These findings support further investigation of Mamsa Sara as a complementary, non-invasive Ayurvedic assessment of muscular and functional status. Larger, longitudinal and methodologically controlled studies are required to clarify its predictive value and clinical utility.

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