

ORIGINAL RESEARCH ARTICLE

# Comparative Assessment of *Bala* in *Mamsa* and *Majja Dhatu Sarta* Individuals – An Observational Study

Author: Bhushan A. Bairagi<sup>1</sup>

Co Authors: Aniket A. Shilwant<sup>2</sup>

<sup>1,2</sup>Dept. of Panchkarma, Noble Ayurved College & Research Institute, Junagadh, Gujarat, India

<sup>2</sup>Dept. of Sharir Kriya, Noble Ayurved College & Research Institute, Junagadh, Gujarat, India

## ABSTRACT

**Introduction** – Concept of *Dhatu Sarta* in *Ayurveda* is the criteria for assessment of *Bala* – Strength of an individual. *Mamsa* and *Majja Dhatu Sarta* have *Bala* mentioned in them explores the capacity to perform physical work. This study focuses on the comparative assessment of status of *Bala* in the individuals of *Mamsa* and *Majja Dhatu Sarta*. **Methods** - Selected individuals of *Mamsa* and *Majja Sarta* were given task to perform physical work done as per the procedure of Hardward step test and Queens’s college step test. Fatigue index and oxygen consumption (VO<sub>2</sub> max) was determined. **Result** – *Vyayamshakti* and *Bala* was found to be slightly greater in *Mamsa Sarta* individuals than *Majja Sarta*. Thus, values of fatigue index and VO<sub>2</sub> max was also found to be differs significantly and tend to be higher in *Mamsa Sarta* individuals. In *Mamsa Sarta*, a total of 46 subjects having *Pravar* and *Madhyam Bala*, were having Physical strength as Good and Average respectively where maximum number of subjects (33) were having Good Physical strength Whereas, in *Majja Sarta*, a total of 45 subjects having *Pravar* and *Madhyam Bala*, were having physical strength as good and average, respectively where maximum number of subjects (34) were having Average physical strength. **Conclusion** – *Mamsa Dhatu* due to *Prithvi Mahabhuta* and *Sthira Guna* manifests a good physical strength, stamina as compared to *Majja Dhatu* which possess *Jala Mahabhuta* having enough *Snigdha Guna* in it.

Received 27<sup>th</sup> July 22 Accepted 23<sup>rd</sup> Septmeber22 Published 10<sup>th</sup> November 2022

## INTRODUCTION

Strength in *Ayurveda* is termed as *Bala*. *Ayurveda* believes certain entities to be solely responsible for inoculation of *Bala* in an individual which are – *Agni*<sup>1</sup>, *Vayu*<sup>2</sup>, *Shleshma*<sup>3</sup>, *Shukra*<sup>4</sup>, *Ojas*<sup>5</sup> and *Sarta* means tissue excellence<sup>6</sup>. *Ayurveda* keeps a dual approach

while considering *Bala* of an individual on Physical and Psychological level. However, *Bala* as per *Ayurveda* is classified in three subtypes as – *Sahaj* – by birth, *Kalaj* – benefited by geoclimatic conditions and *Yuktikrut* – achieved by a balanced diet and healthy lifestyle<sup>7</sup>.

## ORIGINAL RESEARCH ARTICLE

*Ojas* itself states that it is the essence present in every *Dhatu* (tissue) and is the collective *Sara* (nectar) of all the *Dhatu*s from *Rasa* to *Shukra* which is mainly responsible for strength, vigor and vitality of life. The presence of *Ojas* in body is relevant as like ghee present in milk itself. Being cumulated at every *Dhatu* level and highly nutritive in nature it is said to be extreme purest, finest *Sara* part of *Sneha*. Moreover, being omnipresent it represents *Bala*, *Veerya*, *Prana*, *Prakriti* and *Kapha* of body. *Ojas* and *Bala* in body explains the cause effect relationship where *Ojas* is cause and *Bala* or strength being the ultimate effect of the same<sup>8</sup>.

*Sarta* means excellence of bodily tissues which also reflects the *Vyadhikshamatva* – Resistance power of an individual. *Dhatu sarta* is meant to provide precise knowledge about extent and status of *Bala* i.e. Strength of an individual<sup>6</sup>. *Bala* in *Dhatu Sarta* appears in various places under different *dhatu* as like – *Balam* – *Mamsa Dhatu Sarta*<sup>9</sup>; *Balavanta* – *Majja Dhatu Sarta*<sup>10</sup> for two times.

*Dhatu Sarta* is also one of the important examination criteria from the tenfold examination protocol of any patient<sup>11</sup>. *Balam* in *Mamsa Dhatu Sarta* is suggestive of only physical strength whereas *Balavanta* in *Majja Dhatu* appears twice reflecting physical and psychological strength. *Charak Samhita* quotes that *Bala* should be assessed by *Vyayam Shakti*<sup>12</sup> – which means capacity of physical exercise or work done<sup>13</sup>.

Physical bodily movements meant to produce firmness and inoculate enough strength and

stability in body is called as – *Vyayama*<sup>14</sup>. Ayurveda also advocates that the optimum extent of *Vyayama* should be half of the individual's present capacity<sup>15</sup>. This is considered to be upto the mark when there is presence of sweating on forehead<sup>16</sup>.

So, in view of this a study was conducted by comparing status of *Bala* only as physical strength of an individual, objectively using modern methods like - Harvard step test<sup>17</sup> and Queens College step test<sup>18</sup>.

Keeping above all considerations in mind researcher have chosen to assess status of *Bala* in *Mamsa* and *Majja Dhatu Sara* subjects comparatively.

## AIM & OBJECTIVES

### Aims

1. To assess the status of *Bala* in *Mamsa Sara* and *Majja Sara* subjects using Harvard Step Test and Queens College Step Test.
2. To compare the status of *Bala* in *Mamsa Sara* and *Majja Sara* subjects.

### Objectives

1. To evaluate the *Mamsa* and *Majja Dhatu sarta*.
2. To assess status of *Bala* in *Mamsa Sara* and *Majja Sara* subjects by assessing the fatigue index using Harvard step test and Queens College step test.

### Materials & Methods

The present study was designed to assess and compare the status of *Bala* in *Mamsa Sara* and

## ORIGINAL RESEARCH ARTICLE

*Majja Sara* subjects using Harvard step test and Queens college step test.

### Materials

1. An authentic *Dhatu Sarta* format of *Kriya Sharir* Journal accepted by Maharashtra University of Health Sciences (MUHS), Nashik.
2. A total 100 subjects with 50 each of *Mamsa* and *Majja Dhatu Sarta*.
3. Stopwatch
4. Two stable Gym benches of 16.5 inches and 20 inches in height.
5. Metronome
6. Other equipment's essential to perform Harvard step test and Queen's college step test.

### Methods

#### Selection criteria –

The current study was planned and executed on first to final year professional BAMS students and working staff of Noble Ayurved College & Research Institute, Junagadh, Gujarat.

1. Cooperative subjects were selected for study and given *Dhatu Sarta* questionnaire format to derive respective *Dhatu Sarta*. A total of 213 subjects were screened for the study.
2. The selected subjects were between the age group of 18 - 30 years irrespective of gender, religion, economical status, education, occupation, etc.

**Exclusive criteria** – Non-cooperative, and subjects with previously diagnosed severe illness or any systemic disorders, pregnant or lactating females were excluded for the study.

#### Methodology –

1. All the 213 screened subjects were given the *Dhatu Sarta* questionnaire, and *Dhatu Sarta* results were categorised as – *Pravar* (75% and above), *Madhyam* (50 – 74.9%) and *Avar* (0 – 49.9%) *Sarta*.
2. Subjects having *Pravar* and *Madhyam Mamsa* and *Majja Sarta* were selected for further study.
3. A total of 100 subjects were found having *Pravar* and *Madhyam Mamsa* and *Majja Sarta* altogether.
4. Assessment of *Bala* was done of selected subjects using Harvard step test and Queen's college step test.
5. Fatigue Index and maximum oxygen uptake capacity of each individual was calculated and later categorized as excellent, good, average, low average and poor.
6. Later, *Bala* was categorized into *Uttam*, *Madhyam* and *Heena* with appropriate categories of Fatigue index and Oxygen uptake capacity.

#### Methodology for Harvard step test –

1. Selected subjects were informed well about the procedure and possible risk factors of the test. However, a written formal consent was also recorded.
2. The subjects were asked to step up and down on a standard gym bench continuously for 5min.
3. The rate at which the subject steps up and down was fixed with the help of a metronome.
4. The experiment was voluntarily stopped if the subject gets exhausted earlier than 5min

**ORIGINAL RESEARCH ARTICLE**

5. The subject was asked to sit on a chair immediately after either exhaustion or completion of 5min.

6. After finishing the test the pulse rate was counted in three different slots at an interval of 1-1.5 min, 2-2.5 min, 3-3.5 min.

7. The fatigue index was then calculated with the help of following formula. Classification of Fatigue index is shown in **Table No. 1**

$$\text{Fatigue Index} = \frac{\text{Duration of exercise in second}}{\text{Sum of pulse count during Recovery}} \times 100$$

**2x (Sum of pulse count during Recovery)**

**Table No. 1** Classification of Physical fitness

Sr. No.	Fatigue Index	Fitness
1	Below 55	Poor
2	55 – 64	Low average
3	65 – 79	Average
4	80 – 89	Good
5	90 and above	Excellent

**Methodology for Queen’s college step test –**

Queen’s college step test is used to determine cardiorespiratory or endurance fitness. Physical strength is assessed through this test.

1. Subject steps up and down on the platform at a rate of 22 steps and 24 steps per minute for females and males respectively.

2. Stepping up and down is done using a four step cadence ‘up-up-down-down’.

3. This is done for next 3 minutes continuously.

4. Heart beats are then counted for 15 seconds from first 5-20 seconds of recovery. Later multiply this 15 seconds reading by 4, which will give the reading of heart beats per minutes (bpm)

5. An estimation of VO<sub>2</sub> max is then calculated from the obtained test results, using formula -

$$\text{Men: VO}_2 \text{ max (ml/kg/min)} = 111.33 - [0.42 \times \text{heart rate (bpm)}]$$

$$\text{Women: VO}_2 \text{ max (ml/kg/min)} = 65.81 - [0.1847 \times \text{heart rate (bpm)}]$$

6. Lastly, on the basis of this scoring pattern assessment of *Bala* was done. Where maximum oxygen uptake is marked as per Queen’s College step test standard for Men and Females as shown in **Table No. 2** and **Table No. 3**.

**Table 2** Maximal oxygen uptake norms for Men (ml/kg/min)

Rating	Age (Years)					
	18-25	26-35	36-45	46-55	56-65	65+
Excellent	> 60	> 56	> 51	> 45	> 41	> 37
Good	52-60	49-56	43-51	39-45	36-41	33-37
Above Average	47-51	43-48	39-42	36-38	32-35	29-32
Average	42-46	40-42	35-38	32-35	30-31	26-28
Below average	37-41	35-39	31-34	29-31	26-29	22-25
Poor	30-36	30-34	26-30	25-28	22-25	20-21
Very Poor	< 30	< 30	< 26	< 25	< 22	< 20

**Table 3** Maximal oxygen uptake norms for Female (ml/kg/min)

Rating	Age (years)					
	18-25	26-35	36-45	46-55	56-65	65+
Excellent	> 56	> 52	> 45	> 40	> 37	> 32
Good	47-56	45-52	38-45	34-40	32-37	28-32

**ORIGINAL RESEARCH ARTICLE**

Above average	42-46	39-44	34-37	31-33	28-31	25-27
Average	38-41	35-38	31-33	28-30	25-27	22-24
Below average	33-37	31-34	27-30	25-27	22-24	19-21
Poor	28-32	26-30	22-26	20-24	18-21	17-18
Very poor	< 28	< 26	< 22	< 20	< 18	< 17

**Observations and Results**

The aim of this study was to compare the *Bala* of *Mamsa sara* and *Majja sara* subjects with the help of Harvard step test and Queen’s college step test. A total 100 selected subjects were registered under two groups as – Group A and Group B.

**Age wise distribution –**

**Table 4** Age wise distribution of subjects

Age Group	<i>Mamsa Sara</i>		<i>Majja Sara</i>	
	Number of Subjects	%	Number of Subjects	%
Age 16 to20	28	56%	27	54%
Age 21 to25	14	28%	13	26%
Age 26 to30	8	16%	10	20%
Total	50	100%	50	100%

**Gender wise distribution –**

In this observational study, there were 30% and 36% females in *Mamsa* and *Majja Sarta*

**Table 5** Gender wise distribution of subjects

Gender	<i>Mamsa Sara</i>		<i>Majja Sara</i>	
	No. of Subjects	%	No. of Subjects	%
Female	15	30%	18	36%
Male	35	70%	32	64%
Total	50	100%	50	100%

**Diet wise distribution –**

A total of 76% and 68% subjects in *Mamsa Sara* and *Majja Sara* were indulged in taking mixed

**Table 6** Diet wise distribution of subjects

Diet	<i>Mamsa Sara</i>		<i>Majja Sara</i>	
	No. of Subjects	%	No. of Subjects	%
Mixed	38	76%	34	68%
Veg	12	24%	16	32%
total	50	100%	50	100%

**Ahara-Shakti wise distribution –**

*Ahara Shakti* – the food intake capacity was found to be *Pravar* in 78% and 30% subjects of *Mamsa* and *Majja Dhatu Sarta* respectively. The same was found to be *Madhyam* in 22% and 64%

Highest number of subjects were registered under the age group of 16-20 in both *Mamsa Sarta* (56%) and *Majja Sarta* (54%). There were 28% and 26% registered subjects for *Mamsa* and *Majja Sarta*, respectively under the age group – 21-25, and the lowest number of subjects 16% and 20% were registered under the age group of 26-30 for *Mamsa* and *Majja Sarta*, respectively shown below in **Table No. 4**

respectively. Whereas, there were 70% and 64% as Males in *Mamsa* and *Majja Sarta*, respectively shown below in **Table No. 5**

type of diet whereas 24% and 32% subjects in *Mamsa Sara* and *Majja Sara* were taking vegetarian diet shown below in **Table No. 6**

of subjects belonging to *Mamsa* and *Majja Dhatu Sarta* respectively. Whereas 0% and 3% of the subjects of *Mamsa* and *Majja Dhatu Sarta* respectively, were having their *Ahara Shakti* as *Heen* shown below in **Table No. 7**

**ORIGINAL RESEARCH ARTICLE**

**Table 7** Ahara-Shakti wise distribution of subjects

Ahara Shakti	Mamsa Sara		Majja Sara	
	No. of Subjects	%	No. of Subjects	%
<i>Pravar</i>	39	78%	15	30%
<i>Madhyam</i>	11	22%	32	64%
<i>Heen</i>	0	0%	3	6%
<b>Total</b>	50	100%	50	100%

**Vyayamshakti wise distribution –**  
56% and 18% of *Mamsa* and *Majja Sara* subjects were found to have *Pravar Vyayamshakti* respectively. *Madhyam Vyayamshakti* was noted

in 36% and 72% subjects of *Mamsa* and *Majja Sara* subjects respectively, whereas 8% and 10% of *Mamsa* and *Majja Sara* subjects had *Heen Vyayamshakti* shown below in **Table No. 8**

**Table 8** Vyayamshakti wise distribution of subjects

Vyayamshakti	Mamsa Sara		Majja Sara	
	No. of Subjects	%	No. of Subjects	%
<i>Pravar</i>	28	56%	9	18%
<i>Madhyam</i>	18	36%	36	72%
<i>Heen</i>	4	8%	5	10%
<b>Total</b>	50	100%	50	100%

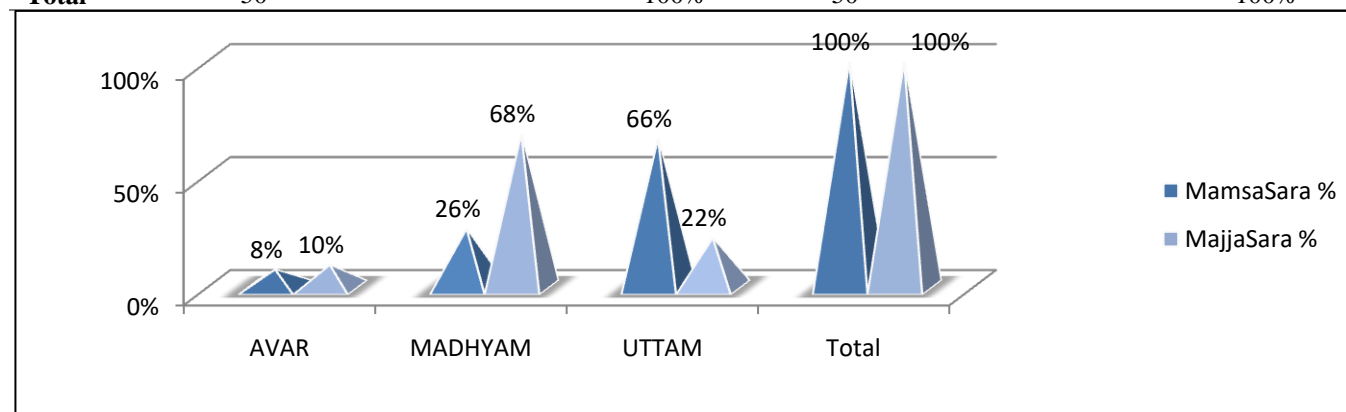
**Bala Wise Distribution –**

A total of 66% and 22% subjects of *Mamsa* and *Majja Sara* found to have *Uttam Bala* respectively while 26% and 68% of *Mamsa* and *Majja Sara* subjects were found to have

*Madhyam Bala* whereas only 8% and 10% of *Mamsa* and *Majja Sara* subjects had *Avara Bala* respectively shown below in **Table No. 9** and figure 1.

**Table 9** Bala Wise Distribution of subjects

Bala	Mamsa Sarta		Majja Sarta	
	Number of Subjects	Percent	Number of Subjects	Percent
<i>Pravar</i>	33	66%	11	22%
<i>Madhyam</i>	13	26%	34	68%
<i>Avar</i>	4	8%	5	10%
<b>Total</b>	50	100%	50	100%



**Figure 1** Bala Wise Distribution of subjects



ORIGINAL RESEARCH ARTICLE

STATISTICAL ANALYSIS

The current observational study was conducted on 100 subjects with 50 each of *Mamsa* and *Majja Sarta* and a statistical analysis was carried using a suitable method to establish an absolute assessment of *Bala* in both the *Sarta*.

**Ho (Null hypothesis)** means there is no any significant difference of *Bala* in *Mamsasara* and *Majjasara* subjects, while **H1 (Alternative hypothesis)** indicates that the *Bala* of

*Mamsasara* and *Majjasara* subjects differs significantly.

**Rejection Region** – In the below given **Table No. 10**, significance level is  $\alpha=0.05$ , and the critical value for a two-tailed test is  $z_c = 1.96$ . The rejection region for this two-tailed test is  $R = \{z: |z| > 1.96\}$ . Since, it is observed that  $|z| = 3.922 > z_c = 1.96$ , also the p-value is  $p=0.0001$ , as  $p = 0.0001 < 0.05$ , it is then concluded that the null hypothesis is rejected.

Table 10 Statistical analysis of Fatigue index by Hardward Step Test –

Variable	Procedure	Estimated Mean	Standard Deviations	Z Score (Two sided)	P Value	Remark
Fatigue Index Values	<i>Mamsa Sarta</i>	78.95	5.713338	3.922	<0.01	Differs Significantly
	<i>Majja Sarta</i>	74.188	6.396065			

**Rejection Region** – In the below given **Table No.11 and Figure 2**, significance level is  $\alpha=0.05$ , and the critical value for a two-tailed test is  $z_c = 1.96$ , Also, the rejection region for this two-tailed

test is  $R = \{z: |z| > 1.96\}$  Since it is observed that  $|z| = 4.343 > z_c = 1.96$ , also the p-value is  $p=0$ , as  $p = 0 < 0.05$ , thus it is concluded that the null hypothesis is rejected.

Table 11 Statistical analysis of Vo2 Max by Queens College Step Test –

Variable	Procedure Group	Estimated Mean	Standard Deviations	Z Score (Two sided)	P value	Remark
VO2 Max	<i>Mamsa Sarta</i>	50.7204	6.574376	4.343	<0.01	Differ Significantly
	<i>Majja Sarta</i>	44.76	7.137598			

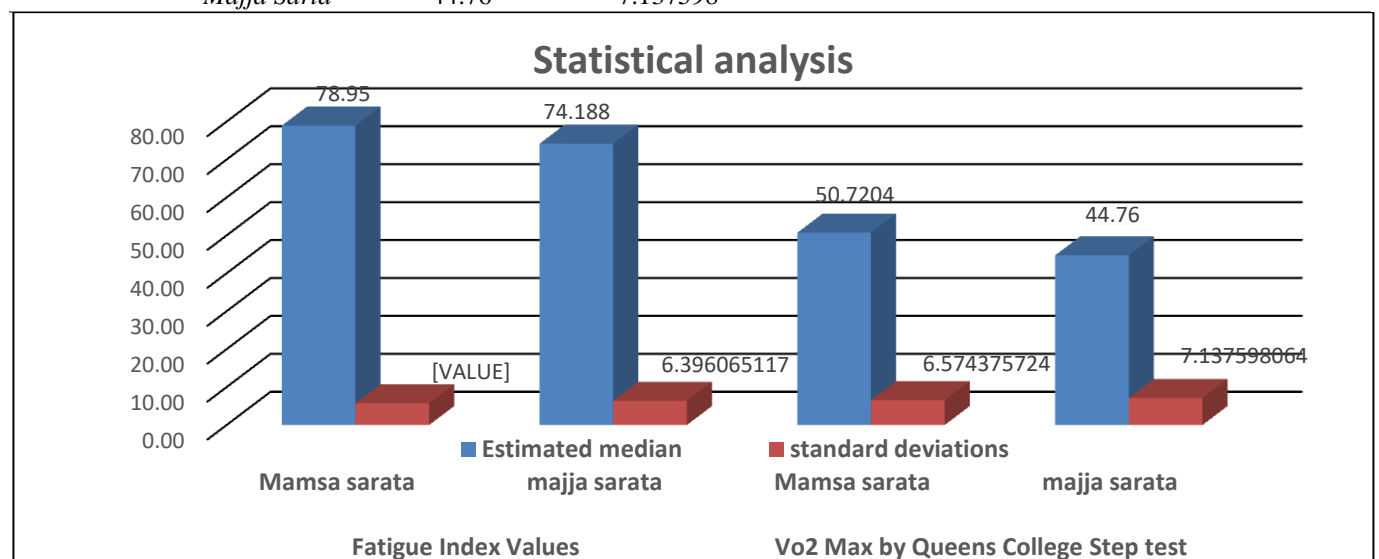


Figure 2 Statistical analyses of data

### ORIGINAL RESEARCH ARTICLE

In *Mamsa Sarta*, a total of 46 subjects having *Pravar* and *Madhyam Bala*, were having Physical strength as Good and Average respectively where maximum number of subjects (33) were having Good Physical strength shown below in **Table No. 12**

Whereas in *Majja Sarta*, a total of 45 subjects having *Pravar* and *Madhyam Bala*, were having Physical strength as Good and Average respectively where maximum number of subjects (34) were having Average Physical strength shown below in **Table No. 12**

**Table 12** Comparison of *Bala* and Physical strength in between subjects of *Mamsa* and *Majja Sarta* –

<i>Bala</i>	Physical strength	Number of Subjects from <i>Mamsa Sarta</i>	Number of Subjects from <i>Majja Sarta</i>
<i>Pravar</i>	Good	33	11
<i>Madhyam</i>	Average	13	34

### DISCUSSION

This study depicts about the status of *Bala* means physical strength and relative oxygen consumption in the subjects having tissue excellency in *Mamsa* and *Majja Dhatu*.

*Bala* is of three types, *Sahaj* – Congenitally gained, *Kalaj* – achieved or benefitted due to favorable geoclimatic conditions and *Yuktikrut* – achieved by practicing healthy diet and lifestyle enhancing nutrition of body with appropriate growth and development. *Dhatu Sarta* is one of the examination protocol which assess the status of *Bala* – strength of an individual. However, *Bala* – Strength in *Dhatu Sarta* may be physical, and psychological factor as well.

*Mamsa* and *Majja* both the *Dhatu* are having *Ashraya-Ashrayi* relation to *Kapha Dosha*<sup>19</sup>. Physical constitution of *Kapha Dosha* is *Prithvi* and *Jala Mahabhuta*<sup>20</sup>, however *Mamsa* is having *Prithvi*<sup>21</sup> and *Majja* is having *Jala*<sup>22</sup> as its dominant *Mahabhuta*. *Sthira Guna* of *Kapha dosha* which means firmness is mainly responsible to enhance the capacity of physical work done is inoculated in *Mamsa Dhatu* due to

*Prithvi Mahabhuta*. *Majja Dhatu* is having *Snigdha Guna* of *Kapha Dosha* which means unctuousness is mainly responsible for binding and inoculation of collective strength due to *Jala Mahabhuta*.



## ORIGINAL RESEARCH ARTICLE

### CONCLUSION

*Bala* means physical work done, is easily assessed by Hardward step test and assessment of the oxygen consumption capacity of an individual by Queens College Step Test. *Bala* understood as physical strength is depicted to be good in *Mamsa Sarta* as compared to *Majja Sarta*. *Mamsa Dhatu* due to *Prithvi Mahabhuta* and *Sthira Guna* manifests a good physical strength, stamina as compared to *Majja Dhatu* which possess *Jala Mahabhuta* equipped enough with *Snigdha Guna*. However, same study with larger subject involvement may depict different results.

## ORIGINAL RESEARCH ARTICLE

### References

1. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Chikitsa Sthana: Grahani Chikitsa; (15:3-4), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
2. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Chikitsa Sthana: Vividhashitapita Adhyaya; (28:2), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
3. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Sutra Sthana: Chikitsaprabhutiya Adhyaya; (17:117), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
4. Sushruta, Samhita, Sushruta, Vaidya Yadavji Trikamji Acharya, Sutra Sthana: Doshadhatumalakshayavruddhi vignyaniya; (15:5), Chaukhambha orientalia; Varanasi, Reprint 2007.
5. Sushruta, Samhita, Sushruta, Vaidya Yadavji Trikamji Acharya, Sutra Sthana: Doshadhatumalakshayavruddhi vignyaniya; (15:19), Chaukhambha orientalia; Varanasi, Reprint 2007.
6. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Viman Sthan: Rogabhishagjitiya Adhyaya; (8:102), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
7. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Sutra Sthan. Tistraishaniya Adhyaya; (11), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
8. Aniket A. Shilwant (2016). Immunology: An Ayurvedic Aspect with reference to Oja and Vyadhikshamatva. IJAPC, 5 (1), 53-64.
9. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Viman Sthan: Rogabhishagjitiya Adhyaya; (8:105), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
10. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Viman Sthan: Rogabhishagjitiya Adhyaya; (8:108), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
11. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Viman Sthan: Rogabhishagjitiya Adhyaya; (8:94), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
12. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Viman Sthan: Trivividha Roga Vishesh Vijyaninya Adhyaya; (4:8), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
13. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Viman Sthan: Rogabhishagjitiya Adhyaya; (8:121), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
14. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Sutra Sthan: Navegandharaniya Adhyaya; (7:31), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
15. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Sutra Sthan: Navegandharaniya Adhyaya; (7:32), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.
16. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Sutra Sthan: Navegandharaniya Adhyaya; (7:33), Choukambha Surbharati Prakashan, Varanasi, Reprint edition 2004.

**ORIGINAL RESEARCH ARTICLE**

17. E.N. Keen, A.W. Sloan (1958). Observations on the Hardward Step Test. Journal of Applied Physiology. Available on – <https://doi.org/10.1152/jappl.1958.13.2.241>
18. Chatterjee, Satipati, et al. (2005) “Validity of Queen's College Step Test for Estimation of Maximum Oxygen Uptake in Female Students” The Indian Journal of Medical Research, Vol. 121, No. 1, Ser. 32.
19. Pt. Hari Sadasiva Sastri Paradakara, Editor of Astanga Hridaya of Vagbhata, Sutra Sthana. Chapter 11, Verse 27, Chaukhambha Sanskrit Sansthan, Varanasi, reprint edition 2012,
20. Tripathi Ravidatt, Editor of Ashtang Sangraha with Hindi Commentary, Sutra Sthana 20, Verse 1. Choukhamba Surbharti Prakashan Varanasi, reprint 2008.
21. Sushruta, Samhita, Sushruta, Vaidya Yadavji Trikamji Acharya, Sutra Sthana: Doshadhatumalakshayavruddhi vignyaniya; (15:8), Chaukhambha orientalia; Varanasi, Reprint 2007.
22. Agnivesa, Charaka Samhita, Brahmanand Tripathi, Sharir Sthan. Sharira Vichaya Sharira Adhyaya; (6), Choukhamba Surbharati Prakashan, Varanasi, Reprint edition 2004.