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An Observational Study to Find Correlation Between Dhatu Sarata (Tissue Excellence) And Alpha-Fit Fitness Test Battery

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Abstract: Ayurveda, the ancient system of medicine, designates a unique concept, Dhatu sarata, that categorizes the population into three subgroups Sarva Sara (optimal status of tissue health), Asara (suboptimal quality of tissue health), and Madhya Sara (average level of tissue health) as per health status of the tissue. Ayurved classic believes that the examination of tissue health is one of the best criteria to assess an individual's strength status of an individual irrespective of the person's physique. Acharya Charaka explained the relationship between physical fitness and Dhatu sarata in the eighth chapter of Vimansthan in Charaksamhita. Therefore, validating this association using contemporary parameters and scientific instruments is necessary. The present study aimed to assess physical fitness with a valid parameter and find its association with Dhatu sarata, a subjective parameter. In this era, quantitative data is needed to understand ancient subjective characteristic features. Hence this topic was selected for research. Institutional Ethics Committee permission was obtained, and normal healthy individuals aged 22 to 35 were enrolled in the study. Their Dhatu sarata (tissue excellence) evaluation was done using a standardized, validated questionnaire and software (Ayusoft C-DAC). The reliable, valid, and field-based set of ALPHA-FIT fitness test batteries assessed their health-related physical fitness. Pearson's correlation coefficient(r) was calculated to study the association between Dhatu sarata(tissue excellence) and fitness factors. It was observed that in the study population (n=50), statistical analysis (Pearson's correlation test) showed a significant positive correlation between the excellence of Mamsa, Asthi, Majja, Shukra, Rasa Dhatu and health-related physical fitness while no significant correlation between health-related physical fitness and excellence of Meda and Rakta Dhatu. Results of the study suggest that excellence of tissue is positively associated with health-related physical fitness.

Keywords: *Dhatu Sarata* (Tissue Excellence), Health Related Physical Fitness, and The ALPHA-FIT Test Battery.

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1. INTRODUCTION

A fit body with a cheerful mind is the secret to a healthy life. Good physical fitness and health are the two sides of the same coin. In the current era, advancements in the I.T. sector, urbanization, and industrialization have significantly minimized several physical or manual works conducted as household activity or outside. The sedentary lifestyle with reduced physical activity and fitness resulted in a rise in the prevalence of hypokinetic disorders such as hypertension, diabetes, obesity, cardiovascular diseases, etc[1]. In this scenario, acclimatization of an active lifestyle that boosts tissue health is a prerequisite. Ayurveda promotes a healthy lifestyle which has been well elaborated through the daily and seasonal regimens. Ayurveda believes that for healthy and fit life, Dosha, Dhatu, and Mala should be maintained in equilibrium. Seven Dhatus are the fundamental entities that sustain a living body. Well-nourished Dhatu gives strength to the body and maintains health and immunity. [2]. Exaggerated or diminished quantity of Dhatu or vitiated Dhatu is vulnerable to the genesis of disease. However, when Dhatu is present in its purest, excellent-quality state, it endows the body with strength, stability, and vitality. Such best, the supreme state of Dhatu is well known as Sara Dhatu[3]. Sara Dhatu performs various functions with utmost efficiency and endurance. Ayurved classics explained the characteristic features of excellence of all seven Dhatus[4,5]. Dhatu possessing the highest number of excellent characteristic features is known as the best Dhatu. The level of excellence of each Dhatu may differ from each other [6]. A person possessing more excellent Dhatu will be graced with great strength and vitality. According to Ayurved classics, the assessment of Dhatu Sarata plays a crucial role in the determination of the strength of the individual. Ayurved believes that strength cannot be correlated with the external appearance of an individual. The physician should not mislead as every bulky person possess good strength, and a lean-built individual is always weak as the contrary condition may exist. Hence, while determining strength, physicians should not merely correlate strength with body size but evaluate the health status of each Dhatu separately[7]. The more you have efficient Dhatu; the more will be strength, fitness, and tolerance you have; more will use the power to resist various disorders[8]. Thus assessing Dhatu sarata with reliable and valid tools helps to reveal the strength of an individual. According to experts, physical fitness is defined as a person's ability to carry out day-to-day activities proficiently, without excessive exertion, and to reserve adequate energy to enjoy recreational activities, hobbies, or holidays and face any emergency situation[9]. Physical fitness is positively associated with physical activity and exercise. Good physical fitness enhances the capacity to work hard or to carry out laborious work for a prolonged duration without energy declination. Physical fitness is characterized by superb qualities which bestow the person with great energy, enthusiasm, and efficiency. Nowadays, physical fitness has been classified as health-related physical fitness and skill or performance-related physical fitness. Health-related physical fitness is associated with good health and fitness that helps prevent metabolic disorders' premature appearance. Good physical fitness indicates that the body's organic systems healthy and function proficiently in a well-organized manner to execute daily and leisure activities with vigor. Therefore, assessing health-related physical fitness means we examine the structural, physiological, and functional status of all organic systems like skeletomuscular, cardiorespiratory, hemato-circulatory, psycho-neurological, and endocrine–metabolic systems[10]. Health-related physical fitness includes body composition, muscular strength, endurance, cardiorespiratory fitness, and flexibility. A set of tests that evaluate all the components of health-related physical fitness is essential to know the individual's health, strength, and fitness status. The ALPHA-FIT test battery is a population-based test battery that aims to provide evidence-based, reliable, valid, and easily applicable groups of tests to assess the health-related physical fitness of adults[11]. It consists of various field-based assessment tests that assess all the components of health-related physical fitness. It is also helpful to categorize individuals at risk of cardiovascular diseases or obesity. In previous work, Dhatu sarata has been associated with cardio-pulmonary efficiency (assessment parameter - Harvard step test)[12,13] muscle strength (assessment parameter-grip dynamometer)[14], Ergography[15]. In these studies, a single parameter was employed to assess the strength and fitness of study participants. The present study aimed to assess all components of health-related physical fitness with a valid parameter and to find its association with Dhatu sarata. It was hypothesized that individuals having the highest sara Dhatu may not be endowed with good health-related physical fitness. Dhatu sarata of the healthy participant was examined by using a standardized, validated questionnaire and software (Ayusoft C-DAC). Health-related physical fitness was assessed with the ALPHA-FIT test battery for adults.

2. MATERIALS AND METHODS

For this study, 50 healthy participants who met the inclusion criteria from the College of Ayurved at Bharati Vidyapeeth Deemed to Be University in Pune were chosen. After thoroughly and in plain language describing the study's goal, informed consent was obtained in a bilingual consent form. The Institutional Ethics Committee of the Institute for Post Graduate Teaching and Research at Bharati Vidyapeeth Deemed to Be University, College of Ayurved, Pune approved the study as a component of the Ph.D. program. (Ref No: BVDUCOA/EC/1303). The CTRI registration number for the trial is CTRI/2020/07/026554

2.1 Study Design-Place of Study

Bharati Vidyapeeth Deemed to Be University, College of Ayurved, Pune.

2.2 Inclusion Criteria

1. Healthy male and female subjects.
2. Age group - 22-35 years.

2.3 Exclusion Criteria

1. A subject suffering from significant physical, cardiovascular, musculoskeletal, psychological, or systemic illness.
2. Pregnant and lactating women.
3. Subjects who are physically handicapped.
4. Subjects performing exercise or gym workouts regularly.

2.4 Assessment of Dhatu Sarata

In this study, for the assessment of Dhatu sarata, a validated questionnaire and software was used. This was done by Pro-forma and software designed by C-DAC (Centre for Development of Advance Computing- A scientific society of

The Ministry of Communications and Information Technology, Gov. of India). First, an assessment of Dhatu sarata was carried out based on the characteristic features of the particular Dhatu sarata. Then, the percentage score of Dhatu sarata was calculated and further considered for statistical analysis.

2.5 Health-Related Physical Fitness

Health Related Physical fitness of study participants was assessed by utilizing the protocol of ALPHA-FIT test battery for adults. A standard pre-test health screening was carried out to ensure safe testing. During fitness testing, participants were instructed to wear a t-shirt, short trousers, and sports shoes or other comfortable low heel shoes. Fitness test performance was conducted standardized to get valid and reliable test results. Table 1 represents fitness components, factors, and fitness tests shown per the ALPHA-FIT test battery.

Table 1: Description of ALPHA –FIT Test Battery

Sr. No.	Fitness Component	Fitness Test	Fitness Factor
1.	Body Composition	1.1 Body Mass Index	Obesity
		1.2 Waist circumference	Abdominal Adiposity
2.	Motor Fitness	2.1 One-leg stand	Balance
		2.2 Shape-of-Eight Run	Agility
3.	Musculoskeletal Fitness	3.1 Handgrip	Upper body muscular strength
		3.2 Jump and Reach	Lower body muscular strength
		3.3 Modified push-up	Muscular endurance of the trunk
4.	Cardiorespiratory Fitness	4.1 Two-Kilometre Walk	Aerobic capacity and capacity for brisk walking

2.6 Assessment of Body Composition

Body composition was assessed by measuring waist circumference and body mass index (BMI). Waist circumference was measured to evaluate abdominal adiposity by measuring tape held horizontally around the trunk midway between the lateral surface of the lowest rib and the highest border of the iliac crest in an upright posture while soft exhalation. The reading of circumference was recorded in centimeters. The fitness category was allotted gender-wise according to cardiovascular risk. Body weight (kg) and height (cm) were measured using a digital weighing machine and stadiometer with the subject barefoot and in a straight upright posture. Body mass index (BMI) was calculated by the equation as BMI = weight in kg/height in m^2 to estimate relative body fat. The fitness category is allotted according to the degree of overweight or underweight.

2.7 Assessment of Motor Fitness

Motor fitness was assessed by one leg stand test and figure-of-eight run test. For the one-leg stand test, the subject was instructed to stand on one leg for sixty seconds with the opposite leg placed at the inner side of the supporting leg, and the thigh rotated outwardly. Out of two trials the best performance duration was considered for the fitness category. The subject ran the 20-meter-long distance in the figure-of-eight run fashion as fast as possible for a figure-of-eight run. Two test trials with maximal effort were performed with a short resting period between attempts. The result was noted as the fastest time (in seconds) required to complete the run. The fitness category was allotted as per the calculation of fitness thirds.

2.8 Assessment of Musculoskeletal Fitness

Musculoskeletal fitness was assessed with a hand grip test, jump and reach test, and modified push-ups test. An electronic hand dynamometer measured hand grip with an adjustable grip to calculate the static grip strength of the upper extremity. The subject squeezed the dynamometer's handle as forcefully as possible, keeping the arm straight and without jerking the arm or body. Two test trials were conducted with an interval of about ten seconds between them. The best result of two attempts was recorded (in kg) as the test result. Fitness categories were allotted by calculating quartiles. The subject stands near the jumping board for the jump and reach test. First, the standing height of subject was noted with one hand raised straight and facing forward. Then, the subject jumped vertically as height as possible with maximum strength and marked the jumping board with magnesium powder, i.e., jumping height. The difference between standing and jumping height was calculated in centimeters to get the jump height. The maximum jump height of two trials was considered for the fitness category allotted by calculating quartiles. For the modified push-up test, the subject was asked to lie prone on the gym mat and perform as many as possible normal straight leg push-ups in forty seconds. The test result was recorded as the number of correctly performed push-ups in forty seconds. The fitness category was allotted by calculating quartiles.

2.9 Assessment of Cardiorespiratory Fitness

A two-kilometer walk test assessed cardiorespiratory fitness, and maximum oxygen uptake, i.e., $VO_{2\ max,}$ was calculated. Using an everyday walking style, the subject was asked to walk 2 km as fast as possible on a flat surface. The heart rate and walk time (in minutes and seconds) were measured instantly as the subject crossed the finish line. The VO_{2max} was calculated separately for men and women. Fitness was allotted by calculating quartiles separately for males and females. At the end, the total fitness score was calculated by adding the scores of all tests, and the total fitness score was considered for statistical analysis.

3. STATISTICAL ANALYSIS

The data presented as means and standard deviations for Dhatu sarata percentage and health-related physical fitness test variables. Statistical significance was set at $p<0.05$. The association between Dhatu sarata percentage and health-related physical fitness score characteristics was calculated using Pearson's correlation coefficient.

4. OBSERVATIONS AND RESULTS

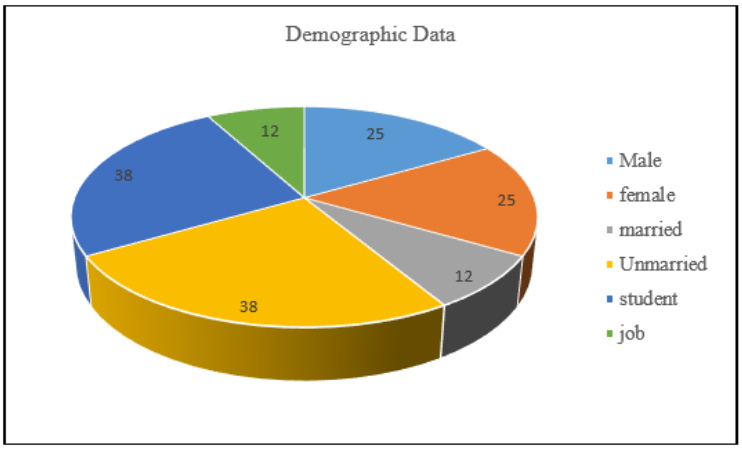

Fig 1: Pie Diagram Showing Demographic Data.

Figure 1 represents the demographic details of the study population (n = 50). 25 male and 25 female participants were enrolled in the study. In addition, 12 participants were married, and 38 were unmarried. In addition, 38 participants were students and 12 participants were non-teaching faculty.

4.1 Dhatu Sarata

In this study, each participant's Dhatu sarata was assessed, and the percentage score of Dhatu sarata was obtained by calculation. Table 2 represents mean and standard deviation data calculated for Dhatu sarata score.

Table 2: Mean and SD calculated for Dhatu sarata Score

Dhatu sarata (%)	Mean ± SD (Men) n= 25	Mean ± SD (Women) n=25
Rasa sarata (%)	70.51 ±10.00	70.83±11.26
Rakta sarata (%)	57.02 ± 8.40	59.48± 10.46
Mamsa Sarata (%)	68.53±13.17	65.52 ± 12.67
Meda sarata (%)	43.21 ± 10.33	40.47 ± 6.87
Asthi sarata (%)	68.98±12.02	62.5 ±11.93
Majja sarata (%)	63.29±9.56	62.5 ±11.86
Shukra sarata (%)	68.34±11.78	63.22± 11.94
Satva sarata (%)	71.79 ± 8.70	70.55±8.99

In the present study, the mean ± S.D. of Dhatu sarata score was higher in men than women. However, in both genders, the mean ± S.D. of the medasarata score was lower than other Dhatu sarata scores.

4.2 Health-Related Physical Fitness

This study represents mean values and standard deviation data calculated gender-wise for height, weight, BMI, waist circumference, one leg stand test, shape of eight run, hand grip test, jump and reach test, modified push up test, 2 km walk test time duration, and Vo_{2max}. The data is represented in Table 3.

Table 3: The Descriptive Statistics for Health Related Fitness Test Variables by Gender

Health-Related Fitness Test Variables	Men (X±SD) N =25	Women (X±SD) N =25
Height (cm)	171.32 ± 5.54	157.83 ± 4.87
Weight(kg)	65.25 ± 7.73	52.25 ± 5.95
BMI	22.26 ± 2.77	20.9 ± 2.11
Waist Circumference (cm)	85.73 ± 7.18	74.08 ± 5.94
One leg stand test (sec)	59.57 ± 1.79	59.70 ± 1.08
The shape of an eight-run (sec)	7.6 ± 0.62	8.01 ± 0.68
Hand grip test (kg)	40.56 ± 5.30	23.85 ± 2.49
Jump and reach test (cm)	33.56 ± 6.73	24.54 ± 2.81
Modified push-up test (No.)	11.96 ± 2.89	10.66 ± 2.20
2 km walk test (min: sec)	19.11 ± 1.76	21.24 ± 1.45
VO_{2max}	86.47 ± 14.80	77.37 ± 12.94

In this study, participants show normal BMI with a mean of 22.26 ± 2.77 for men and 20.9 ± 2.11 for women. Five of 25 men showed waist circumference above 90cm and were classified as having a moderate risk of cardiovascular disease. Female participants show average waist circumference with a mean of 74.08 ± 5.94. In this study, almost all participants performed well in one leg stand test and completed 60 seconds. The mean value of the shape of eight run test for men was 7.6 (± 0.62) seconds and for females 8.01 (± 0.68) seconds. The mean value of hand grip in men (40.56 ± 5.30) was higher than in women (23.85 ± 2.49). The mean value of the jump and reach test in men (33.56 ± 6.73) was higher than in women (24.54 ± 2.81). Similarly, the mean value of modified push-ups in men (11.96 ± 2.89) was higher than in women (10.66 ± 2.20). Men (19.11 ± 1.76 min: sec) finished the 2km walk test earlier than women (21.24 ± 1.45 min: sec). The mean value of VO_{2max} in men (186.47 ± 14.80) was observed higher than in women (77.37 ± 12.94).

4.3 Association of Health-Related Physical Fitness with Dhatu Sarata

Findings of this cross-sectional observational study are indicated in Tables 4, 5, 6 and 7 by computing Karl Pearson's correlation coefficient (r) to find the association of health-related physical fitness with Dhatu sarata. Pearson's correlation coefficient (r) is interpreted as the strength of association is strong positive if the r value is 0.5to1.0, medium positive if the r value is 0.3 to 0.5, and slightly positive if the r value is 0.1 to 0.3. Similarly, the strength of association is strong negative if the r value is -0.5 to -1.0, medium negative if the r value is -0.3 to -0.5, and slightly negative if the r value is -0.1 to -0.3.

Table 4: Association of Body Composition with Dhatu sarata

Body Composition Tests	Statistical Analysis	Dhatu sarata							
		Rasa	Rakta	Mamsa	Meda	Asthi	Majja	Shukra	Satva
BMI – Obesity	Pearson Correlation	0.551	0.147	0.776	0.388	0.734	0.681	0.661	0.594
	P-Value	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000
Waist Circumference (cm) – Abdominal obesity	Pearson Correlation	0.490	0.126	0.544	0.454	0.484	0.470	0.434	0.436
	P-Value	0.000	0.179	0.000	0.000	0.000	0.000	0.000	0.000

Pearson's correlation coefficient (r) was calculated to test the correlation between BMI and Dhatu sarata. Pearson's correlation coefficient (r) value was 0.776 for Mamsa sarata, 0.734 for Asthi sarata, 0.681 for Majja sarata, 0.661for Shukra sarata, 0.594 for Satva sarata, 0.551 for Rasa sarata and 0.388 for Meda sarata. The P-value observed is less than 0.05. In the context of Rakta sarata, Pearson's correlation coefficient (r) was 0.147, and the p-value is more significant than 0.05. Hence we conclude that a significant strong positive correlation is observed between BMI and Mamsasarata, Asthisarata, Majjasarata, Shukrasarata, Rasasarata, and Satva sarata; while medium positive strength of association between BMI and Meda sarata. There is no significant correlation with Rakta sarata. Pearson's Correlation coefficient (r) was calculated to test the correlation between waist circumference and Dhatu sarata. Pearson's correlation coefficient (r) value was observed as 0.544 for Mamsa sarata, 0.490 for Rasa sarata, 0.484 for Asthi sarata, 0.470 for Majja sarata, 0.454 for Meda sarata, 0.436 for Satva sarata and 0.434 for Shukra sarata, P-value observed for is less than 0.05. Pearson's correlation coefficient (r) value followed 0.126 for Rakta sarata and P-value observed is more significant than 0.05. Hence we conclude that a significant strong positive correlation is observed between waist circumference and Mamsa sarata. At the same time, there is a medium positive strength of association between waist circumference and Rasa sarata, Asthi sarata, Majja sarata, Meda sarata, Shukra sarata, and Satva sarata. There is no significant correlation between waist circumference and Rakta sarata.

Table 5: Association of Motor Fitness Component with Dhatu sarata

Motor Fitness Tests	Statistical Analysis	Dhatu sarata							
		Rasa	Rakta	Mamsa	Meda	Asthi	Majja	Shukra	Satva
One Leg Stand Test (sec) - Balance	Pearson Correlation	0.096	0.020	0.243	0.011	0.131	0.148	0.080	0.152
	P-Value	0.310	0.836	0.009	0.911	0.164	0.115	0.396	0.105
Shape of Eight Run(sec) – Agility	Pearson Correlation	0.367	0.099	0.557	0.255	0.398	0.428	0.576	0.464
	P-Value	0.000	0.292	0.000	0.006	0.000	0.000	0.000	0.000

Pearson's Correlation coefficient (r) was calculated to test the correlation between the balance fitness factor (one-leg stand test) and Dhatu sarata. The value of Pearson's correlation coefficient (r) was observed at 0.243 for Mamsa sarata. P-value kept for is less than 0.05. Pearson's correlation coefficient (r) value was 0.096 for rasa sarata, 0.020 for Rakta sarata, 0.011for Meda sarata, 0.131for Asthi sarata, 0.148 for Majja sarata, 0.080for Shukra sarata and 0.152 for Satva sarata and P-value observed for is more significant than 0.05. Hence we conclude that an essential small positive correlation was observed between the balance fitness factor and Mamsa sarata. There is no significant correlation between the balance fitness factor and Rasa sarata, Rakta sarata, Meda sarata, Asthi sarata, Majja sarata, Shukra sarata, and Satva sarata. Pearson's Correlation coefficient (r) was calculated to test the correlation between the agility fitness factor (shape of eight run test) and Dhatu sarata. Pearson's correlation coefficient (r) value was observed as 0.576 for Shukra sarata, 0.557 for Mamsa sarata, 0.464 for Satva sarata, 0.428for Majja sarata, 0.398 for Asthi sarata, 0.367for Rasa sarata and 0.255 for Meda

sarata. The P-value observed is less than 0.05. Pearson's correlation coefficient (r) value was observed at 0.099 for Rakta sarata, and the P-value is more significant than 0.05. Hence we conclude that there is a compelling strong positive correlation observed between agility fitness factor and Mamsa sarata, Shukra sarata; medium positive strength of association between agility fitness factor and Majja sarata, Satva sarata, Asthi sarata; small positive strength of association between agility fitness factor and Rasa sarata, Meda sarata. There is no significant correlation between the agility fitness factor and Rakta sarata.

Table 6 : Association of Musculoskeletal Fitness Component with Dhatu sarata

Health-Related Physical Fitness Tests	Statistical Analysis	Dhatu sarata							
		Rasa	Rakta	Mamsa	Meda	Asthi	Majja	Shukra	Satva
Hand Grip (Kg) – Upper body muscular strength	Pearson Correlation	0.535	0.111	0.712	0.337	0.616	0.620	0.641	0.595
	P-Value	0.000	0.238	0.000	0.000	0.000	0.000	0.000	0.000
Jump and Reach(Cm) - Lower body muscular strength	Pearson Correlation	0.553	0.256	0.492	0.176	0.430	0.528	0.534	0.523
	P-Value	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000
Push-ups (Number) - Muscular endurance of trunk	Pearson Correlation	0.699	0.158	0.825	0.287	0.800	0.802	0.761	0.720
	P-Value	0.000	0.091	0.000	0.002	0.000	0.000	0.000	0.000

Pearson's correlation coefficient (r) was calculated to test the correlation between upper-body muscular strength (hand grip) and Dhatu sarata. Pearson's correlation coefficient (r) value was 0.712 for Mamsa sarata, 0.616 for Asthi sarata, 0.620 for Majja sarata, 0.641 for Shukra sarata, 0.595for Satva sarata, 0.535 for Rasa sarata and 0.337 for Meda sarata. The P-value observed is less than 0.05. In the context of Rakta sarata, Pearson's correlation coefficient (r) was 0.111, and the p-value is more significant than 0.05. Hence we conclude that a compelling, strong positive correlation was observed between upper-body muscular strength and Mamsa sarata, Asthi sarata, Majja sarata, Shukra sarata, Rasa sarata, and Satva sarata; small strength of association observed between upper-body muscular strength and Meda sarata. There is no significant correlation between upper body muscular strength and Rakta sarata. Pearson's correlation coefficient (r) was calculated to test the correlation between lower body muscular strength (jump and reach test) and Dhatu sarata. Pearson's correlation coefficient (r) value was 0.528 for Majja sarata, 0.534 for Shukra sarata, 0.523 for Satva sarata, 0.553 for Rasa sarata, 0.492 for Mamsa sarata, 0.430 for Asthi sarata, 0.256 for Rakta sarata and 0.176 for Meda sarata. The P-value observed is less than 0.05. Hence we conclude that a significant strong positive correlation was observed between lower body muscular strength and Majjasarata, Shukrasarata; medium strength of association was observed between lower body muscular strength and Mamsasarata, Asthisarata; small strength of association was observed between lower body muscular strength and Meda sarata, Rakta sarata. Pearson's correlation coefficient (r) was calculated to test the correlation between the muscular endurance of the trunk (Push-ups) and Dhatu sarata. Pearson's correlation coefficient (r) value was 0.825for Mamsa sarata, 0.800 for Asthi sarata, 0.802for Majja sarata, 0.761for Shukra sarata, 0.720 for Satva sarata, 0.699for Rasa sarata and 0.287for Meda sarata. The P-value observed is less than 0.05. In the context of Rakta sarata, Pearson's correlation coefficient (r) was 0.158 for Rakta sarata, and p value is greater than 0.05. Hence we conclude that, there is significant strong positive correlation observed between muscular endurance of trunk and Mamsa sarata, Asthi sarata, Majja sarata Shukra sarata, Rasa sarata and Satva sarata; small strength of association observed between muscular endurance of trunk and Meda sarata. There is no significant correlation between muscular endurance of the trunk and Rakta sarata.

Table 7: - Association of Cardiorespiratory Fitness with Dhatu sarata

Health Related Physical Fitness Tests	Statistical Analysis	Dhatu sarata							
		Rasa	Rakta	Mamsa	Meda	Asthi	Majja	Shukra	Satva
2 km Walk - Time (min.sec)	Pearson Correlation	-0.690	-0.185	-0.629	-0.262	-0.677	-0.718	-0.584	-0.620
	P-Value	0.000	0.047	0.000	0.005	0.000	0.000	0.000	0.000
$VO_{2\ Max}$	Pearson Correlation	0.605	0.205	0.600	0.218	0.577	0.656	0.591	0.556
	P-Value	0.000	0.028	0.000	0.019	0.000	0.000	0.000	0.000

Pearson's correlation coefficient (r) was calculated to test the correlation between time required to complete 2km walk test and Dhatu sarata. Pearson's correlation coefficient (r) value was -0.718 for Majja sarata, -0.629 for Mamsa sarata, -0.677 for Asthi sarata, -0.620 for Satva sarata, -0.584 for Shukra sarata, -0.690 for rasa sarata, -0.262 for Meda sarata and -0.185 for Rakta sarata. The P-value observed is less than 0.05. Hence we conclude that there is a significantly strong negative correlation observed between the time required to complete a 2km walk test and Majja sarata, Mamsa sarata, Asthi sarata, Satva sarata, Shukra sarata, and Rasa sarata; small strength of association was observed between the time required to complete 2km walk test and Meda sarata, Rakta sarata. Pearson's correlation coefficient (r) was calculated to test the correlation between $VO_{2\ max}$ and Dhatu sarata. Pearson's correlation coefficient (r) value was 0.656 for Majja sarata, 0.600 for Mamsa sarata, 0.605 for rasa sarata, 0.577 for Asthi sarata, 0.556 for Satva sarata, 0.591 for Shukra sarata, 0.218 for Meda sarata and 0.205 for Rakta sarata. The P-value observed is less than 0.05. Hence we conclude that there is a significant strong positive correlation observed between VO_{2max} and Majja sarata, Mamsa sarata, Rasa sarata, Asthi

sarata, Satva sarata, and Shukra sarata; small strength of association observed between the time required to complete VO_{2max} and Meda sarata, Rakta sarata

5. DISCUSSION

Seven Dhatu are the pillars of the body that sustain the body throughout life. Dhatu sarata represents the essence of Dhatu, which is the most excellent, best, strong, and devoid of impurity. [16] Being most efficient, Sara Dhatu functions energetically and provides strength and vitality to the body.[17] Ayurved classics designated Sara examination as one of the key parameters for assessment of strength. In the present study, Dhatu sarata percentage score was correlated with the fitness score. The fitness score was calculated separately for each fitness test that evaluates components of health-related physical fitness i.e., body composition, motor fitness, musculoskeletal fitness, and cardiorespiratory fitness[18]. In the present study, Mamsa sarata, Asthi sarata, Majja sarata, Shukra sarata, rasa sarata, Meda sarata, and Satva sarata showed a statistically significant positive correlation with body composition component, while Rakta sarata had no significant correlation. Because of contemporary science, body composition is the morphological component that gives idea regarding lean body mass and body fat.[19] Lean body mass includes the weight of muscle, bone, body organs etc. Body composition helps to compare the relative proportion of body fat with that of bone, muscle and other vital organs. Excess body fat or trunk fat affects the fitness test performance and the capability to work hard for a long time[20]. In the perspective of Ayurved classics, Mamsa sara individuals possess a strong, stable, muscular body with muscular, well covered joints and bones.[21] Majja sara individuals look delicate but are strong and possess bulky, long, rounded joints. Asthi sara persons possess stout and sturdy body with stout joints and strong bones. Shukra sara individuals are pleasant, charming personalities with unctuous, compact, white bones, teeth, and nails. Rasa sara individuals possess smooth, unctuous, fresh skin, and they remain fresh till the end day. Stava sara individuals have firm gait, stable and steady activity. Meda sara individuals are bulky. Rakta sara individuals have delicate and tender organs. Hence individuals with the excellence of Mamsa Dhatu, Asthi Dhatu , Majja Dhatu , Shukra Dhatu , Rasa Dhatu, and Meda Dhatu may be endowed with good body composition that improves body physique and musculature, minimizes chances of obesity and helps to maintain health. In the context of motor fitness, all subjects scored higher in the balance test and completed the one leg stand test duration. It was observed that there is no significant correlation between Dhatu sarata and balance factor. On the other hand, Mamsa sarata, Shukra sarata, Majja sarata, Satva sarata, Asthi sarata showed significant positive correlation with agility factor of motor fitness while Rakata sarata had no significant correlation. Balance refers the ability to maintain the body position in equilibrium while in motion or static situation.[22] Agility is the ability to move position of the whole body quickly with a change of velocity or direction in response to a stimulus.[23] It enables individuals to shift or to move the direction of the entire body rapidly with speed and accuracy without losing balance.[24] Individuals with the excellence of Mamsa Dhatu , Shukra Dhatu , Majja Dhatu , Asthi Dhatu may be endowed with good agility as these Dhatu give strength and support to the body. In the context of musculoskeletal fitness, Mamsa sarata, Asthi sarata, Majja sarata Shukra sarata, Rasa sarata, and Satva sarata showed a significant positive correlation with upper body and lower body muscular strength as well as muscular endurance of trunk. In contrast, Meda sarata and Rakta sarata had no significant correlation. Good musculoskeletal fitness enhances muscle tone, muscular strength, and muscular endurance.[25] Good muscular strength helps to work with enthusiasm and adequate energy without exertion. It improves stability, muscle build, quality of life, and confidence and prevents injuries and falls.[26,27,28] Higher muscular endurance helps to persist in specific activity for an extended duration without undue fatigue. It enhances stamina as well as the aerobic capacity of muscles. Mamsa sara individuals have well-covered muscular body with great muscular strength and stability. Asthi sara individuals are enthusiastic, active, and capable of working long without exhaustion. Majja sara individuals have good joint strength and can sustain the work without joint pain. Sukra sara and rasa sara individuals are good-looking and charming.[29] They have good strength and remain fresh till the end day. Satva sara individuals are enthusiastic, capable, courageous, and heroic. On the other hand, rakta sara and meda sara individuals are delicate, tender and cannot tolerate hard work, harsh treatment and heat. Hence we can say that individuals with the excellence of Mamsa sarata, Asthi sarata, Majja sarata Shukra sarata, Rasa sarata and Satva sarata may be endowed with good musculoskeletal fitness. In cardiorespiratory fitness, Majja sarata, Mamsa sarata, Asthi sarata, Satva sarata, Shukra sarata, and Rasa sarata showed a significant negative correlation with the time required to complete 2 kilometer walk test. Majja sarata, Mamsa sarata, Rasa sarata, Asthi sarata, Satva sarata and Shukra sarata showed significant positive correlation with $VO_{2max.}$ Rakta sarata and Meda sarata showed little strength of association with $VO_{2\ max.}$ Cardiorespiratory fitness represents the health status of cardiovascular and respiratory systems and their capability to provide sufficient oxygen to working muscles.[30,31] It sustains the circulatory system, respiratory system, and musculoskeletal system to work efficiently and permit speedy retrieval following exhaustive workouts. This mechanism facilitates muscles to work continuously for an extended duration. $VO_{2\ max}$ i.e. the maximum rate of oxygen uptake, is the benchmark for assessing cardiorespiratory fitness. It represents an individual's ability to utilize oxygen to produce ATP aerobically.[32] People with a good level of cardio endurance can perform activities such as walking, swimming or cycling for sustained duration without experiencing much exertion or premature fatigue. Because of Ayurved classics, the excellence of Mamsa Dhatu , Asthi Dhatu , Majja Dhatu , shukra Dhatu , Rasa Dhatu impart positive health effects and provide great strength. During embryogenesis, the Dhatu play a significant role in forming different organs and systems of the embryo. More we excellence of Dhatu, the excellent will be functioning capacity of various organ systems and more will improve the physical fitness of an individual. Further study can be conducted on a large sample size to get the idea regarding health-related physical fitness of the population as well as the health status of all the Dhatu. It will be help full to know the impact of habitat, seasonal variations, food habits, occupations etc. on Dhatu sarata and physical fitness. Such a study will be beneficial to classify the population based on risk factors of metabolic disorders.

6. CONCLUSION

In context of Dhatu sarata, statistical analysis (Pearson's correlation test) shows that there is significant positive correlation between Mamsa sarata, Asthi sarata, Majja sarata, Shukra sarata, Rasa sarata and health related physical fitness as well as according to statistical analysis there is no significant

correlation between Rakta sarata, Meda sarata and health related physical fitness.

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8. AUTHORS CONTRIBUTION STATEMENT

Dr. Sharayu P. Phule, Dr. Umesh S. Ghate :methodology, detail review & editing. Dr. Sharayu P. Phule, Dr. Ganesh B. Patil: validation, data analysis, supervision. All authors interpreted the results and critically revised the manuscript for scientific content. All authors approved the final version of the article

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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