Development Validation and Verification of Dhatu Sarata Assessment Questionnaire (DSAQ): Structural and functional status of Tissues

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ABSTRACT

Introduction: According to Ayurveda, there are ten-fold examination of patients, sarata (status of tissue excellence) is one of them. Acharya charak has mentioned total eight types of sarata which are used to assess the bala of an individual. Currently, no tools are available which is valid and reliable. **Objectives:** The primary objective was to develop a validated Dhatu Sarata Assessment Questionnaire (DSAQ) that will be easier to administer, less timeconsuming and more sensitive to even small changes. **Materials and Methods:** A questionnaire was prepared based on features explained in Charak Samhita. The study was conducted in the age group of 18-30 years among 250 healthy volunteers. Analysis of the questionnaire was evaluated based on validity and reliability test. **Results:** The content validity of the tool achieved satisfactory results. The reliability (inter-rater, intra-rater and internal consistency) and validity of the newly developed tool were found satisfactory on statistical analysis. **Conclusion:** The questionnaire has attained satisfactory level of validity and reliability test therefore this tool can be used for both research purposes and academics. This tool can be used for assessment of dhatu sara either by self-assessment or by an expert.

Keywords: Ayurveda, Dhatu sara, Questionnaire, Reliability, Validity.

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INTRODUCTION

Ayurveda considers the basic human body to be formed by Dosha, Dhatu and Mala.[1] They are described as the roots of our body. Each dhatu is generated in its srotas. Another is 'dhranaat dhatavah' which means 'that which bears.' Dhatus, one of the basic components of the body, fulfils the roles of poshana (nutritional reservoir) and dharana (structural framework).[2] Acharya Sushrut quoted 'त एते शरीरधारणादातव इत्युच्यन्ते which means the entity that supports the body is termed as dhatus. *Dhatu Sara* is a concept in Ayurveda, the traditional system of medicine in India as defined by *Acharya Chakrapani*,

"sara shabdena vishuddhataro dhaturucyate" i.e., the excellent status of *dhatu* is considered as *dhatu sarata*.[3] To identify the dhatu sarata, acharya charak has explained physical, physiological and psychological features of each dhatu sarata. Features represent the best quality of tissues.[4] This state of optimal tissue health is associated with overall well-being, vitality, strength and longevity.

Under Dashvidha Rogi Pariksha (tenfold examination of patient), the idea of sara is explained.[5] These principles comprise a person's physical constitution (Prakriti), morbidity (vikriti), excellence of tissue elements (Sara), compactness of tissues or organs (samhanana), measurement of body constituents (pramana), homologation (satmya), mental state (satva), ability to consume and digest food (aharashakti), ability to exercise (vyayam shakti) and age (vaya).

Seven types of dhatu sarata has been described in Ayurvedic texts as *Twak, Rakta, Mamsa, Meda, Asthi,*

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Majja And Shukra.[6] Acharya Dalhana has instructed to understand the meaning of *rasa sara* from *twak sara (twaksaram rasasaram)*. The word *twacha* only refers to the rasa present in the skin. Sushruta has said the characterstics of a twak *sara* individual that those whose skin and hair are pleasant and soft.[7] So, features of *rasa sara* individual are exhibited through *twacha* and therefore called as *twak sara purush* as per Sushruta. A person with the purest form of *rasa dhatu* is considered to be *Twak Sara Purush*. Much importance has been given to *rasa dhatu* in our texts. One of the reasons for this can be its extreme diffusibility as this *dhatu* circulates minutely in the entire body like the waves of sound, light and water.[8] *Twak* is a largest structure and it requires nourishment of *Rasa dhatu* for its well-being. The concept of *sara* is only related to *dhatu*, not *updhatu or mala*.

A physician might at times make a wrong decision solely only on the patient's appearance. Acharya Charaka used an analogy to emphasize this point. "Some people with small, slender bodies can be extremely powerful, much like an ant, which appears malnourished yet has a tiny body and can lift excessive weights. Nevertheless, large and obese people may be weaker than an elephant, which despite having a huge body falls weak in front of the lean-bodied lion." The reason for this discrepancy is the sarata and *asarata* of dhatus. For this reason, to comprehend a patient's bala, the *sarata* of dhatu must be examined.[9]

The main drawback of the available questionnaires and software is that all of them are time-consuming and hence cannot be administered efficiently. Many questionnaires record their responses in the form of either 'YES' or 'NO'.[10] If the response is given in the form of YES, the whole allotted score is given to the respondent, whereas a zero score for no response. There is no option available to give a score in between zero and to highest allotted score. For example, if an investigator wants to look into a person's twak snigdhta, using the proforma that is available, it is evaluated as either a person has full-fledged Snigdhta or not at all, with the NO option indicating that a person does not have Snigdhta at all, but no one is completely devoid of Snigdhta. In Ayurveda, the assessment of Dhatu Sara is primarily qualitative and is often done through detailed patient examination, including observation, palpation and questioning.[11] However, the literature is not very clear about how sarata should be graded or assessed in a person. Numerous scholars have put out a variety of objective standards for judging the dhatu sarata of all dhatus; nevertheless, these objective standards are not appropriate for judging the subjective standards (the attributes) of the sarata given by Acharyas.

Considering these difficulties, AyuSoft (produced by C-DAC, Pune, India) has created a standardised computer-based Sara Parikshan software where features of sara and asara is assessed in the form of bar diagram.[12] Although the approach is good, but still it requires validation by making it available to ayurvedic hospitals and research institutes. When we look at the drawbacks, The Ayusoft CDAC has integrated Dhatu Sara into Sara and Asara and calculates the final score by subtracting asara from sara score. This method does not provide accurate result and shows the systematic error in the final score. Ayusoft measures nine different types of sarata, including *Sarva sara*, while *Acharya Charak* has defined eight different types of *sarata*. Nowhere does it include a single reference of *Madhyam sara*. There are several unvalidated tools that are available which needs to be validated. The *sarata* assessed by such types of tools are questionable.

Considering the limitations observed in the currently available tools and methods employed in dhatu sara determination, to fulfill the gap, we took a step to develop, validate and verify a *dhatu sarata* assessment questionnaire by using VAS (Visual Analog scale) scale, which provides the option for degree of agreement to the predictors of dhatu sarata. This scale allows to provide score between zero and highest allotted score and measures the predictors what the scale intended to measure. The two most important parameters on which a new tool can be judged for its dependable, unbiased use and to make this tool standardized are validity and reliability tests.

The dhatu sara assessment tool is known for the assessment of bala (strength) of an individual. Acharya Charak has mentioned the features of; I) All types of sara individually, II) Sarva sara, III) Madhyam sara, IV) Asara. Features of individual sara is explained independently. Further certain features has been explained by acharyas when an individual having excellence of all dhatus is called sarva sara. Those who have features opposite of sara is termed as asara and the features between sara and asara is termed as madhyam sara. It seems that acharyas have drawn a threshold line of madhyam sarata where the features more than madhyam sarata has been classified under sara and features less than madhyam sarata are classified under asara. So basically, classification of sarata can be concluded as; I) Sarata, II) Madhyam sara, III) Asarata

In this paper, sarata, madhyam and asara is written as pravar, madhyam and avara sara respectively. If bala needs to be assessed on the basis of dhatu sarata, then it can be said that *pravar* sara individual may have maximum bala (strength), avara sara has the minimum

bala and madhyam sara has moderate bala as both are directly proportional to each other.

The primary objectives of the present study was to develop a *Dhatu Sarata* Assessment Questionnaire (DSAQ) based on *Charak Samhita* and validate the DSAQ by using appropriate statistical tool. The secondary objective of the study was to verify the questionnaire using prakriti by finding association between *dhatu sara* and *prakriti*.

MATERIALS AND METHODS

Study design

This is an observational study that gathers information about a population at a moment in time. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines when reporting the findings.

Study setting

Individuals of age group between 18 to 30 years of either gender irrespective of race, religion, or socio-economic status were selected by non- randomized convenient sampling method. The developed questionnaire was floated among 250 healthy individuals through google form for data collection as per inclusion criteria. Those who were willing to participate and voluntarily provide requisite information to the questionnaire in English were eligible to participate in the study. The data generated was compiled in the excel sheet and was used for analysis.

Informed consent and ethical consideration

The questionnaire was created as a Google Form. Before completing the Google Form, participants must confirm that they voluntarily consent to participate in the study. Only those who voluntarily consented could have served as study participants. The user was given assurances that their anonymity and privacy would be respected and that the data they provided would only be used for research. Users were also informed that their participation in the Google form was making a substantial contribution to the the nation's literature and public health studies. Participants gave their voluntary authorisation to use the data for research purposes by taking part in the study, as was made very apparent. The ethical clearance of this study was issued by institutional ethics committee of the institute via reference number CBP-IEC/2022/KS/MD/28. The study was registered under the Clinical Trial Registry of India vide. CTRI/2023/11/059829.

Preparation of the preliminary tool

We created a Dhatu Sarata Assessment tool in light of the shortcomings and restrictions found in the existing techniques for determining dhatu sara. This tool is mostly based on the characteristics of each vishudhatara dhatu as described by Acharya Charak in the eighth chapter of the Charak Samhita Viman Sthan using iterative translation techniques. Because the Visual Analogue Scale (VAS) is visually appealing and assesses features on a continuous scale, it may be more sensitive to slight changes than ratings based on category lists of adjectives. For this reason, we employed it to record respondents' responses, which ranged from 0 to 10. Item creation is the first step in the questionnaire construction process, which is followed by questionnaire development and thorough scientific examination. Table 1 summarizes the systemic steps and respective tasks at each stage to build a good questionnaire.

Table 1: Flowchart demonstrating the various steps involved in the development of a questionnaire.		
Questionnaire Development	**Purpose**	**What to do?**
Step 1	Item generation	Literature review Focus group discussions English translation of terminology by using Namaste portal and Ayusoft CDAC Articles, journals Existing Questionnaires Expert and non-expert.
Step 2	Item formatting	Unambiguous Unloaded Unbiased Open-ended questions Selection of response scale and format.
Step 3	Preliminary questionnaire	Covering letter with consent form and detailed instruction Order of items Questionnaire layout Item scoring and response scale in terms of degree of importance and degree of clarity.
Step 4	Validation	Content validation Construct validation (pilot study).
Step 5	Preliminary research construct	Exploratory factor analysis Deletion of items (irrelevant) Sample size.
Step 6	Data collection	Data entry Data cleaning.
Step 7	Reliability	Inter-rater (equivalence) Intra-rater (stability) Internal consistency (homogeneity).

| Step 8 | Statistical analysis | Pearson Correlation coefficient Cohens'd Cronbach's alpha. |
| Step 9 | Verification of the tool | Association between Dhatu sara and prakriti by using Chi square and ANOVA test. |

Item Generation

Questions were generated from several sources including a literature review, expert interview, research articles, other classics with available comments and collaborative discussion with experts followed by iterative defining and refining. Necessary care was taken regarding the relevance of each item, chronology and wording of questions and selection of response formats, in a stepwise manner. Since, many characteristics are expressed in intricate Sanskrit terminologies, an operational definition, we therefore decided to refer Namaste Portal for standard meaning with their codes. The first line of the verse representing predictor variables was taken. The second line of verse represented the outcome variables that were not taken as they represent the outcome of predictors.

Item Formatting

The National Ayurvedic Morbidity Code and Standard Terminology Portal (NAMSTP) program, created by the Ministry of Ayurveda, Government of India, provided the standard terminologies for each feature. To make the questionnaire less complicated, we have omitted every feature found in other ancient Ayurvedic books. To evaluate each aspect of Dhatu Sara based on subjective criteria, a preliminary closed-ended questionnaire was constructed with straightforward, understandable questions or statements that were suitable for those with limited education and knowledge. Subjective parameter was adopted to reduce the complexity of the questionnaire and to make it more feasible and less time consuming.[13]

VALIDATION

First, a preliminary draft of the questionnaire was created by methodically organising all 123 predictors. An initial draft of the instrument was created, reviewed and then sent to Kriya Sharir's subject experts for content and face validation. Validity and reliability relate to standardization in the preparation of questionnaires. In this study, face validity was performed in the dept of Kriya Sharir among Post Graduate scholars and faculties who assessed its readability, feasibility, layout, style of wording and comprehensibility and appropriateness for the target group.

Content Validation

As a standard method of evaluating content validity, we evaluated the level of agreement among subject matter experts regarding the significance of a particular item. Every process expert was given a thorough item sheet with all 123 items on it and they were asked to indicate each item's relevancy. In order to evaluate the tool's content domain using a rating scale, Ayurvedic specialists who are now employed as Assistant Professors in the Department of Kriya Sharir at various Ayurvedic Institutions assessed it to judge the content domain of the tool through the use of rating scale and also included experts from clinical disciplines. Each item is ranked on two-point scale based on importance and clarity. A questionnaire was provided with a cover letter that included comprehensive instructions (such as a definition of measuring characteristics and an item rating system with a scale from 1 to 4) for importance and clarity and for their comments. Each of the subject experts on the judging panel responded to the following question as per the rating scale in Table 2.

Responses from the 11 subject experts of Kriya Sharir were obtained within the stipulated time period. All the data of 11 subject experts were collected and compiled in an Excel sheet. The item with an average score of three or above was chosen to frame the final index tool based on the summated replies of all eleven experts. The Content Validation Index (CVI) score, which in turn will provide information on the level of agreement among experts regarding the items in the questionnaire, was determined based on the expert's agreement with the question. The items in the questionnaire were defined, refined and

Criteria	Rank			
	1	2	3	4
Degree of Importance (DOI)	Very unimportant.	Somewhat unimportant.	Somewhat important.	Very important.
Degree of Clarity (DOC)	The item is not clear.	The item needs some revision.	The item is clear but needs some minor revision.	The item is very clear.

Table 2: Shows Rating Scale to Calculate Content Validity Index.

Table 3: The Content Validity Index of the Questionnaire.				
Variables	Degree of Importance		Degree of clarity	
Sarata	S-CVI based on I-CVI	S-CVI based on Proportion Relevance (PR)	S-CVI based on I-CVI	S-CVI based on Proportion Relevance (PR)
Twak	0.96	0.96	0.93	0.92
Rakta	0.931	0.96	0.964	0.965
Mamsa	0.99	0.99	0.995	0.99
Meda	0.98	0.981	1.00	1.00
Asthi	1.00	1.00	1.00	1.00
Majja	0.985	0.987	1.00	1.00
Shukra	0.985	0.987	1.00	1.00

formatted and reduced to 109 predictors according to the suggestions recommended by the subject experts. Based on results of Table 3, the questionnaire's scale has attained a satisfactory level of content validity. The S-CVI based on the Item Content Validity Index (I-CVI), Scale Content Validity Index (S-CVI) and Average based on proportional relevance all meet the criteria. Therefore, it was decided that the questionnaire's content validity scale was found satisfactory.

Construct Validation

Construct validity is a quantitative method of evaluating how well a tool captures the characteristic or theoretical idea it is meant to capture. The following approach was taken to ensure construct validity when creating the Dhatu Sarata evaluation tool. For construct validation we conducted a pilot study on 40 healthy volunteers as per inclusion criteria in which the modified questionnaire after content validation was given to the volunteers. The instructions regarding the method of responding were clearly stated. The degree of agreement with a question/ statement was rated on a Visual Analog Scale (VAS) from 0 to 10, where zero represents strong disagreement with the statement and 10 represents strong agreement with the statement. After analyzing the results, we found that volunteers suggested in the remark section to modify the question. All the items were attempted by most of the volunteers therefore we did not reduce the number of items in the questionnaire. We only modified that item in the questionnaire which was suggested by the maximum number of volunteers. The result of construct validity of the questionnaire was compiled on Excel sheet for further analysis. The final questionnaire was then administered to 250 individuals. Statistical Package for Social Sciences (SPSS) version 22 was used to analyse the data. This coded Excel document was then brought into SPSS V.22 and used for statistical analysis. Reliability and validity tests were conducted. p-value<0.05 was considered significant.

Scoring to the individual variables and doshas

On a VAS, each variable or statement was assigned a score between 0 and 10, where 10 indicates strong agreement with the statement and 0 indicates strong disagreement. The degree of agreement is indicated by a score ranging from 0 to 10. Table 4 lists the number of constructions and scores assigned to each dhatu sarata. The final quantitative expression of a Dhatu sara is a cumulative percentage of the score attained by each question.

Table 4: The number of constructs and score allotted to dhatu sarata.		
Dhatu sara	Number of constructs	Total score alloted
Twak	9	90
Rakta	30	300
Mamsa	28	280
Meda	10	100
Asthi	11	110
Majja	7	70
Shukra	14	140
Total	109	1090

Test for the Reliability of the Tool

The reliability of the complete questionnaire having 996 participants was exported to the SPPS software in the data view. After going to analyze, scale, the reliability analysis was performed. After selecting all the variables/ constructs, reliability statistics was performed which included scale item if deleted, items and Cronbach's alpha. This reliability test was conducted for each dhatu sara separately and the result was obtained in the tabular form.

Statistical analysis

Test-Retest reliability measures the stability of an instrument over time. In other words, it measures the consistency of scores over time. In our study, stability was assessed stability was assessed between intra-rater

Sara	Observer 1		Observer 2		Cohen's d	Paired t-test		Pearson correlation	
	Mean	SD	Mean	SD		t-value	p-value	r-value	p-value
Twak	53.85	7.39	54.26	8.23	0.06	-0.89	0.375	0.56	<0.001
Twak (%)	59.84	8.21	60.29	9.14	0.08	-1.29	0.198	0.80	<0.001
Rakta	171.18	24.18	175.44	37.71	0.17	-2.63	0.009	0.74	<0.001
Rakta (%)	57.06	8.06	58.48	12.57	0.20	-3.10	0.002	0.84	<0.001
Mamsa	156.64	15.29	165.12	35.87	0.31	-4.92	0.000	0.71	<0.001
Mamsa (%)	55.94	5.46	58.97	12.81	0.31	-4.92	0.000	0.71	<0.001
Meda	63.38	6.09	62.71	10.04	0.10	1.63	0.105	0.78	<0.001
Meda (%)	63.38	6.09	62.71	10.04	0.10	1.63	0.105	0.78	<0.001
Asthi	57.21	6.38	64.70	11.05	1.28	-20.29	0.000	0.91	<0.001
Asthi (%)	52.01	5.80	58.82	10.05	1.28	-20.29	0.000	0.91	<0.001
Majja	41.30	3.57	41.74	3.49	0.21	-3.25	0.001	0.81	<0.001
Majja (%)	58.99	5.09	59.64	4.95	0.21	-3.26	0.001	0.81	<0.001
Shukra	91.16	8.22	92.35	13.41	0.14	-2.24	0.026	0.80	<0.001
Shukra (%)	65.12	5.87	65.97	9.58	0.14	-2.24	0.026	0.80	<0.001

Table 5: Inter-observer Comparison between the Observers.

(1st time) and intra-rater (follow-up after 10 days) as mentioned in Table 6. It was calculated by Pearson correlation coefficient as the measures are continuous. In general, the correlation coefficient Rvalue>0.7 are considered good, indicating the stability of the instrument.[14]

Equivalence refers to the consistency of the result among multiple administrators of an instrument. This form was assessed by comparing measurements obtained by two observers (subject experts) at a given time on the same population as mentioned in Table 5. We used cohen's d where value of 0.2 indicate small effect size, 0.5 indicate medium effect size and d≥0.8 indicates large effect size. The larger the effect size, the greater is the mean difference compared to the variability.

Cronbach's alpha (α), also known as αcoefficient, is one of the most used statistics to report internal consistency reliability estimates the average level of agreement in

Sara	1st time		Follow up		(Effect size) Cohen's d	paired t-test		Pearson correlation	
	Mean	SD	Mean	SD		t-value	p-value	r-value	p-value
TWAK	54.06	7.81	52.90	13.00	0.13	2.08	0.081	0.71	<0.001
TWAK_perc	60.06	8.68	58.78	14.44	0.13	2.00	0.106	0.64	<0.001
RAKTA	173.14	30.80	142.99	70.01	0.60	9.43	0.000	0.75	<0.001
RAKTA_per	57.71	10.27	47.66	23.34	0.55	8.61	0.000	0.67	<0.001
MAMSA	160.88	25.58	142.41	68.85	0.38	5.98	0.000	0.74	<0.001
MAMSA_per	57.46	9.13	50.86	24.59	0.38	5.98	0.000	0.74	<0.001
MEDA	63.04	8.07	63.94	14.69	0.11	-1.72	0.122	0.86	<0.001
MEDA_per	63.04	8.07	63.94	14.69	0.11	-1.72	0.122	0.86	<0.001
ASTHI	60.96	8.72	63.77	17.76	0.32	-3.36	0.098	0.85	<0.001
ASTHI_per	55.42	7.92	57.97	16.14	0.32	-3.36	0.098	0.85	<0.001
MAJJA	41.52	3.53	45.18	9.63	0.54	-8.47	0.000	0.86	<0.001
MAJJA_per	59.32	5.02	64.54	13.76	0.54	-8.46	0.000	0.86	<0.001
SHUKRA	91.76	10.82	93.12	20.42	0.10	-1.65	0.168	0.86	<0.001
SHUKRA_per	65.54	7.73	66.51	14.58	0.10	-1.65	0.168	0.86	<0.001

Table 6: Intra-observer Comparison between first time and follow-up.

Table 7: Internal Consistency of Sarata.

Sara	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
Twak	0.769	0.780
Rakta	0.985	0.985
Mamsa	0.990	0.990
Meda	0.877	0.880
Asthi	0.947	0.948
Majja	0.834	0.842
Shukra	0.904	0.906
Aggregate	0.898	0.928

all the possible ways.[15] A low value of alpha indicates poor inter-relatedness between items or heterogenous construct. In the present study, the alpha value of 0.898 was obtained for questionnaire which is considered exceptionally good for the reliability of the tool as given in Table 7.

Test for Validity of The Tool

Since the data were collected on a continuous scale of VASs, a Pearson's correlation table for each dhatu sara was obtained. Due to spaceconstrained in this paper, the whole table is not given here. For the validation process, the complete master sheet of 996 participants was exported to the SPSS software in the data view for advanced statistical analysis. The data was then analysed and checked by bivariate correlation. For validation, we used Pearson correlation coefficient for data analysis, two-tailed, upon calculation we found that the all the constructs are highly significant which concludes the validity of the questionnaire.

Calculation of Total Dhatu Sara Score

Table 8: Association of Sara Level with Prakriti.

Sara		Vata percentage		Pitta percentage		Kapha percentage	
		Mean	SD	Mean	SD	Mean	SD
Twak	Pravara	40.01	9.53	38.86	10.15	54.72	10.68
	Madhyam	43.64	11.36	43.70	11.65	55.41	9.32
	Avara	55.50		64.50		38.96	
	ANOVA	F=3.39, *p*=0.035		F=6.43, *p*=0.002		F=1.52, *p*=0.221	
Rakta	Pravara	39.78	9.21	40.86	11.52	55.50	9.76
	Madhyam	43.04	11.18	42.60	11.45	55.19	9.70
	Avara	55.50		64.50		38.96	
	ANOVA	F=1.81, *p*=0.165		F=2.15, *p*=0.119		F=1.41, *p*=0.246	
Mamsa	Pravara	41.23	8.25	49.36	11.77	61.79	7.81
	Madhyam	42.70	11.08	42.19	11.40	55.04	9.69
	Avara	55.50		64.50		38.96	
	ANOVA	F=0.74, *p*=0.480		F=3.21, *p*=0.042		F=3.08, *p*=0.048	
Meda	Pravara	39.64	11.42	40.83	11.98	54.84	10.13
	Madhyam	43.91	10.60	43.05	11.19	55.38	9.53
	Avara	55.50		64.50		38.96	
	ANOVA	F=4.71, *p*=0.010		F=2.84, *p*=0.061		F=1.48, *p*=0.230	
Asthi	Pravara	36.48	13.06	47.75	2.25	54.50	7.15
	Madhyam	42.81	10.93	42.32	11.57	55.14	9.75
	Avara	42.92	14.37	46.10	12.82	56.69	11.83
	ANOVA	F=0.65, *p*=0.523		F=0.69, *p*=0.504		F=0.07, *p*=0.931	
Majja	Pravara	40.46	11.19	44.28	11.80	56.94	9.91
	Madhyam	42.81	10.99	42.27	11.44	55.11	9.69
	Avara	55.50		64.50		38.96	
	ANOVA	F=1.02, *p*=0.362		F=2.08, *p*=0.127		F=1.67, *p*=0.191	
Shukra	Pravara	43.36	10.57	42.85	11.99	54.92	10.43
	Madhyam	42.03	11.37	41.99	10.97	55.50	9.01
	Avara	55.50		64.50		38.96	
	ANOVA	F=1.14, *p*=0.323		F=2.03, *p*=0.134		F=1.51, *p*=0.224	

Table 9: Association of Dhatu Sara with Prakriti.

Prakriti	Twak					
	Pravara		Madhyam		Asara	
	N	%	N	%	N	%
Kaphaj	32	47.76%	56	30.76%	0	0.0%
Pittaj	0	0.0%	2	1.09%	0	0.0%
Vataj	0	0.0%	3	1.64%	0	0.0%
Pitta Kaphaj	7	10.44%	24	13.18%	0	0.0%
Vata Kaphaj	11	16.41%	21	11.53%	0	0.0%
Vata Pittaj	0	0.0%	3	1.64%	0	0.0%
Tridoshaj	17	25.37%	73	40.10%	1	100%
Significance	chi sq.=12.86, p=0.380					

Prakriti	Rakta					
	Pravara		Madhyam		Avara	
	N	%	N	%	N	%
Kaphaj	13	44.82%	75	34.09%	0	0.0%
Pittaj	0	0.0%	2	0.90%	0	0.0%
Vataj	0	0.0%	3	1.36%	0	0.0%
Pitta Kaphaj	5	17.24%	26	11.81%	0	0.0%
Vata Kaphaj	4	13.79%	28	12.72%	0	0.0%
Vata Pittaj	0	0.0%	3	1.36%	0	0.0%
Tridoshaj	7	24.13%	83	37.72%	1	100%
Significance	chi sq.=5.58, p=0.936					

Prakriti	Mamsa					
	Pravara		Madhyam		Avara	
	N	%	N	%	N	%
Kaphaj	2	28.57%	86	35.53%	0	0.0%
Pittaj	0	0.0%	2	0.82%	0	0.0%
Vataj	0	0.0%	3	1.23%	0	0.0%
Pitta Kaphaj	4	57.14%	27	11.15%	0	0.0%
Vata Kaphaj	0	0.0%	32	13.22%	0	0.0%
Vata Pittaj	0	0.0%	3	1.23%	0	0.0%
Tridoshaj	1	14.28%	89	36.77%	1	100%
Significance	chi sq.=15.56, p=0.212					

Prakriti	Meda					
	Pravara		Madhyam		Avara	
	N	%	N	%	N	%
Kaphaj	34	46.57%	54	30.68%	0	0.0%
Pittaj	2	2.73%	0	0.0%	0	0.0%
Vataj	1	1.36%	2	1.13%	0	0.0%
Pitta Kaphaj	7	9.58%	24	13.63%	0	0.0%
Vata Kaphaj	6	8.21%	26	14.77%	0	0.0%
Vata Pittaj	0	0.0%	3	1.70%	0	0.0%
Tridoshaj	23	31.50%	67	38.06%	1	100%
Significance	chi sq.=14.59, p=0.264					

Prakriti	Asthi					
	Pravara		Madhyam		Avara	
	N	%	N	%	N	%
Kaphaj	0	0.0%	85	35.26%	3	60%
Pittaj	0	0.0%	2	0.82%	0	0.0%
Vataj	0	0.0%	3	1.24%	0	0.0%
Pitta Kaphaj	2	50%	29	12.03%	0	0.0%
Vata Kaphaj	0	0.0%	32	13.27%	0	0.0%
Vata Pittaj	0	0.0%	3	1.24%	0	0.0%
Tridoshaj	2	50%	87	36.09%	2	40%
Significance	chi sq. =9.21, p=0.685					

Prakriti	Majja					
	Pravara		Madhyam		Avara	
	N	%	N	%	N	%
Kaphaj	5	31.25%	83	35.62%	0	0.0%
Pittaj	0	0.0%	2	0.85%	0	0.0%
Vataj	0	0.0%	3	1.28%	0	0.0%
Pitta Kaphaj	3	18.75%	28	12.01%	0	0.0%
Vata Kaphaj	1	6.25%	31	13.30%	0	0.0%
Vata Pittaj	0	0.0%	3	1.28%	0	0.0%
Tridoshaj	7	43.75%	83	35.62%	1	100%
Significance	chi sq.=3.79, p=0.987					

Prakriti	Shukra					
	Pravara		Madhyam		Avara	
	N	%	N	%	N	%
Kaphaj	39	33.05%	49	37.40%	0	0.0%
Pittaj	2	1.72%	0	0.0%	0	0.0%
Vataj	1	0.86%	2	1.52%	0	0.0%
Pitta Kaphaj	17	14.65%	14	10.68%	0	0.0%
Vata Kaphaj	13	11.20%	19	14.50%	0	0.0%
Vata Pittaj	1	0.86%	2	1.52%	0	0.0%
Tridoshaj	45	38.79%	45	34.35%	1	100%
Significance	chi sq.=6.32, p=0.899					

The dhatu sarata percentage of an individual was estimated by using a simple calculation based on the total score received for each dhatu sara, as illustrated below;

Dhatu Sarata Percentage = Scores obtained by individual dhatu sara X 100

Total score allotted to dhatu sara

The final dhatu sara of an individual is based on the highest percentage score among all the calculated sara. After calculating the percentage score, the individuals having equal or more than 66.6% were categorized under Pravara sara. The individuals having percentage between 33.3 to 66.6% were kept under madhyam sara

and those who scored equal or less than 33.3% were having asara.

VERIFICATION OF THE TOOL

After satisfactory validation and reliability of the tool, we further tried to verify the newly developed questionnaire by finding association between Dhatu sara and Prakriti of an individual using For this, we calculated Prakriti using SAQDP (self-assessment questionnaire for determining the Prakriti.[10] We further analysed the association between sara level (pravar, madhyam and asara) and prakriti types using ANOVA and chi-square test as described in Tables 8 and 9 respectively. The comparison of *dhatu sara* among *prakriti* types were also examined. Also, Pearson correlation was utilized between dhatu sara and prakriti percentage as shown in Table 10. Negative correlations were found for twak, rakta, mamsa, meda and majja in vata prakriti. However, the *p*-value was found to be statistically significant in twak, rakta and meda sarata. For pitta prakriti, negative correlation were found for twak, rakta, meda, majja and shukra with significant *p* value for twak sara. The kapha prakriti shows a positive correlation with all the dhatu sarata and non-significant *p*-value.

Table 10: Correlations of Sara with Prakriti Component Percentages.						
Sara	**Vata %**		**Pitta %**		**Kapha %**	
	r-value	*p*-value	r-value	*p*-value	r-value	*p*-value
Twak	-.254	.000	-.276	.000	.098	.121
Rakta	-.158	.012	-.041	.516	.023	.712
Mamsa	-.102	.107	.010	.873	.103	.104
Meda	-.166	.009	-.104	.099	.090	.158
Asthi	.001	.983	.089	.160	.052	.413
Majja	-.097	.126	-.042	.508	.095	.134
Shukra	.008	.905	-.010	.878	.098	.120

DISCUSSION

The concept of Dashvidha Atura pariksha has been explained by Acharya Charak for the examination of a patient. Among tenfold examination of rogi pariksha, sara Pariksha is one. Sara assessment is used to assess the bala of an individual. Acharya charak has explained the subjective parameters of each sara in detail in the form of predictors and outcomes. Till now there is no such reliable and valid tool is available which can assess dhatu sarata based on objectivity. Thus, the study was designed to close the gap by creating a questionnaire to ascertain dhatu sarata and

evaluating the validity and reliability of the instrument. We chose healthy volunteers between the ages of 18 and 30 in an effort to reduce the impact of variability. The main aim behind selecting individuals aged 18-30 was that this phase is emerging adulthood and all the dhatus are in well-nourished state. Many studies are conducted to develop and validate a tool but no such tool was found to be reliable statistically. An online software AYUSOFT was created by C-DAC, Pune to examine sara but it was paid and based on dichotomous scale.[16] One study was conducted to assess dhatu sarata based on weighted mean score, where the independent score in form of percentages is an issue as these scores represent total sarata of an individual. For the reliability assessment of the tool, inter-rater, intra-rater reliability and internal consistency tests were conducted. Follow up details of multiple parameters, encompassing mean values, Standard Deviations (SD), effect size (Cohen's d), paired t-test outcomes and Pearson correlation for dhatu sara were conducted. Internal consistency of 996 samples was calculated. Overall, the aggregate internal consistency was high, with Cronbach's Alpha of 0.898 and 0.928 (based on standardized items), confirming the reliability of the Sara assessment tool. For the validity test, after calculating the Content Validity Index (I CVI), the questionnaire's scale was found to have a sufficient level of content validity. The validity of the questionnaire was tested among 996 people using Pearson correlation. At the 0.01 level (2-tailed), we discovered that the Pearson correlation is statistically significant. The distribution of sara across different categories highlights the predominance of madhyam sara across all the categories, with varying levels of Pravara and minimal representation of Avara sara. The chi-square test was used to analyse the association of dhatu sara with prakriti which revealed that there is no significant association between Prakriti types and dhatu sara characteristics. This means that both dhatu sara and prakriti are two independent concepts of ayurveda. Acharya charak has rightly quoted there two variables independently during the examination of a patient.

Even with the noteworthy findings, this study has limitations of its own. Since the study was conducted primarily on healthy volunteers, it was more focused on the 18–30 age group (91%). Because there were only 250 participants in the study, it was limited in its potential to collect data that could be applied to a larger population. An information bias during the interrogation could not be ruled out because the participants were primarily Ayurvedic students. Due to social desirability or other biases, participants may exaggerate or underestimate

their health status, a phenomenon known as response bias. There is currently no gold standard Sara assessment instrument available. The utilisation patterns shown in this study provide a foundation for future researchers to launch additional interventional studies.

CONCLUSION

A detailed study of needs and available resources must be the first step in the complex process of designing a dhatu sara determination method. Once it is determined that the craft can generate consistent, believable results over a range of settings, it should be tested and retested on several parameters. The questionnaire to assess Dhatu Sara is designed and analysed in this study, along with its validity and reliability was tested. It is possible to conclude that the validity and reliability assessment of the tool was performed by using appropriate statistical analysis. For all constructs, the validity of the questionnaire is confirmed by the statistical significance of the Pearson correlation at the 0.01 level (2-tailed). With Cronbach's alphas of 0.898 and 0.928 (based on standardised items), the overall internal consistency was good, demonstrating the Sara evaluation tool's dependability. Using the Chi-square test and ANOVA analysis, the tool was further validated by determining the association between Sara level and Prakriti levels. However, we discovered that there is no relationship between these two variables, indicating their independence from one another. The questionnaire has attained satisfactory level of validity and reliability test therefore this tool can be used for both research purposes and academics. This tool can be used for assessment of dhatu sara either by self-assessment or by an expert. The final questionnaire can be used alongside

Sl. No.	Variables to identify Twak sara	Total acquired VAS score (A)
1	My skin is oily (not dry) in nature.	
2	My skin is smooth (not rough) on touch.	
3	My skin is soft (not hard) on touch.	
4	My skin complexion is without blemishes and moles.	
5	I have a glowy skin.	
6	My body hair is thin (not thick).	
7	I have less body hair.	
8	My scalp hair does not fall easily.	
9	My body hair is soft on touch.	

Sl. No.	Variables to identify Rakta sara	Shining and Oily/moist (not dry). (a)	Reddish. (b)	Pleasant (c)	Total acquired VAS score (a+b+c)= B
1	Pinna				
2	Whitish part of my eyes				
3	Face				
4	Tongue				
5	Nose				
6	Lips				
7	Palm				
8	Sole				
9	Nail				
10	Forehead				

Sl. No.	Variables to identify Mamsa sara	Stable and large (a)	Beautiful and Well covered with muscles. (b)	Total acquired VAS score (a+b)= C
1	Temporal region			
2	Forehead			
3	Back side of the Neck			
4	Eyes			

Sl. No.	Variables to identify Mamsa sara	Stable and large (a)	Beautiful and Well covered with muscles. (b)	Total acquired VAS score (a+b)= C
5	Cheek bone			
6	Lower jaw			
7	Neck			
8	Shoulder			
9	Abdomen			
10	Armpit			
11	Chest region			
12	Hands			
13	Feet			
14	Body joints			

Sl. No.	Variables to identify Meda sara	Total acquired VAS score (D)
1	My complexion is shiny/glossy.	
2	My voice is pleasant.	
3	My eyes are shiny (not dry).	
4	My scalp hair is shiny/oily.	
5	My body hair is shiny/ oily.	
6	My teeth appear shiny.	
7	My nails appear shiny.	
8	My lips appear shiny/ glossy.	
9	My urine is clear and transparent.	
10	I evacuate my faeces smoothly.	

Sl. No.	Variables to identify Asthi sara	Total acquired VAS score (E)
1	My heels are large/big.	
2	My ankles are large/big.	
3	My knees are large/big.	
4	My forearm is large/big.	
5	My clavicle is large/big.	
6	My chin is large/big.	
7	My head is large/big.	
8	My bodily joints are large/big.	
9	My bones are large/big.	
10	My teeth are large/big.	
11	My nails are large/big.	

Sl. No.	Variables to identify Majja Sara	Total acquired VAS score (F)
1	My body parts are soft.	
2	My physical strength is good.	
3	My complexion is glowy.	
4	My voice is pleasant.	
5	My joints are strong and well-formed.	
6	My joints are large/big.	
7	My joints are round.	

Sl. No.	Variables to identify Shukra Sara	Total acquired VAS score (G)
1	I am a kind-hearted person.	
2	I look like a gentleman.	
3	The whitish part of my eyes is milky-white.	
4	I am a highly enthusiastic person.	
5	My teeth are shiny.	
6	My teeth are round.	
7	My teeth are strong.	
8	My teeth are evenly distributed.	
9	My teeth have no gaps.	
10	The denture of my teeth is beautiful.	
11	My complexion is glossy and pleasant.	
12	My voice is pleasant.	
13	My skin is healthy and glowing.	
14	My buttocks are prominent.	

Dhatu sara	Twak	Rakta	Mamsa	Meda	Asthi	Majja	Shukra
Obtained Score (A)							
Total Score alloted (B)	90	300	280	100	110	70	140
Percentage (%) A/Bx100							
Dhatu Sara	Twak	Rakta	Mamsa	Meda	Asthi	Majja	Shukra
Status (Pravar, Madhyam, Avara)							

modern diagnostic methods, providing holistic view of patient health.

VALIDATED DHATU SARA QUESTIONNAIRE

Please indicate your degree of agreement for the given statement below on the Visual Analog Scale (VAS) from 0 to 10, where zero represents strong disagreement to the statement and 10 represents strong agreement to the statement.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

DSAQ: Dhatu Sarata Assessment Questionnaire.

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