

Weighted mean: A possible method to express overall *Dhatu Sarata*

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ABSTRACT

Several questions are being raised regarding the accuracy of the methods of diagnosis and reporting of various clinical parameters according to Ayurveda in recent times. Uniformity in reporting, issues related to inter-rater variability, uniformity in applying statistical tests, reliability, consistency, and validation of various tools, - are some of the major concerns that are being voiced. *Dhatu Sarata* is one such domain where no substantial work has been carried out to address these issues. The Sanskrit term "*Dhatu*" roughly translates as a "tissue." *Sarata* stands for the status of *Dhatu* in a given individual, i.e., it describes whether the status is excellent, moderate, or poor. In the available research literature, there are several gaps while dealing with and reporting the clinical assessment of *Dhatu*. Most of the workers group an individual into any one of the categories of *Dhatu Sarata*, and this approach neglects the contribution of other *Dhatu*s to the overall *Sarata* in that individual. In this communication, we propose the usefulness of "weighted mean" in expressing the overall *Sarata* in an individual. This gives the researcher a freedom of not classifying an individual into any one group of *Sarata*, while also simultaneously allowing him/her to retain the focus on the status of an individual *Dhatu*.

Key words: *Dhatu Sarata*, methods, reporting

INTRODUCTION

In the recent years, several questions are being floated regarding the uniformity and reliability of the methods of clinical assessment and diagnosis of various Ayurveda parameters. Uniformity in reporting, issues related to inter-rater variability, uniformity in applying statistical tests, reliability, consistency, and validation of various tools, etc., are the major concerns being highlighted.^[1,2]

"*Dhatu Sarata*," according to the principles of Ayurveda, is a form of clinical examination that is, employed to assess

the structural and functional status (health) of different tissues in the body. The *Sarata* of an individual has been classified as *Sarva Sara* (optimal status of tissue health), *Asara* (suboptimal status of tissue health), and *Madhya Sara* (average status of tissue health).^[3,4]

CURRENT TRENDS IN REPORTING *DHATU SARATA*

There is no much clarity in the literature however, as to how should *Sarata* be recorded and graded in a given individual. For instance, whether the meaning of "*Sarva Sara*" is "optimal health status of all the tissues" and whether the meaning of *Asara* is "suboptimal health status of all the tissues," is not very clearly stated. Practically, in a given individual there are chances that a few tissues could be in excellent status, whereas others may be in a suboptimal status. Alternatively, some of the tissues may be in a status of "average health" and a few others may be in an "optimal" health status and

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still a few may be in a suboptimal status. In cases such as these, the classification of an individual to be belonging to “*Sarva Sara*” or “*Asara*” becomes difficult. Further, what constitutes “*Madhyama*” *sarata* has also not been defined precisely, that is, whether all the tissues are of moderate health or only few of them are of moderate health, is still an un-answered question. Similarly, there is a practice among Ayurveda researchers, of classifying the individuals into a single form of *Sarata*. For example, they classify the subjects into “*Tvak Sara*,” “*Rakta Sara*,” and so on. However, on what basis a single tissue is considered to be excellent and others not, is not clear. Further, this is possibly a deviation from the classical textbooks too, since no such reporting pattern has been mentioned therein. One more possibility is that of simultaneously having the features of both *Sarata* and *Asarata* of a *Dhatu* in the same individual. To tackle this problem to certain extent, the designers of AyuSoft (a decision support system developed by Center for Development of Advance Computing, Pune) have been able to provide *Sara* and *Asara* features as bar diagrams for each *Dhatu* separately.^[5]

Upon searching the literature related to the examination and reporting of *Dhatu Sarata*, we observed that no much work has been published in this domain. Different researchers tend to report *Sarata* in different ways.

In the one study, when more than 75% of all the positive features recommended (for all *Dhatu*s) in Charaka Samhita were found to be present, the individual was considered to be belonging to “*Sarva Sara*” category. When the positive features were between 75% and 25%, it was recorded as *Madhyama Sarata*. When the positive features were below 25%, it was recorded as “*Asarata*.” The problem with this kind of a calculation is that these scores represent the *Sarata* of all the *Dhatu*s, hence, one cannot have any idea about the independent scores of a specific *Dhatu*.^[6] In a few other studies, the researchers have calculated the *Sarata* of individual *Dhatu* and have classified the individuals into “*Rakta Sara*,” “*Mamsa Sara*” and other similar categories.^[7,8] However, such a classification neglects the contribution of remaining *Dhatu*s to overall *Sarata*. In a few more studies, it was not clearly reported as to how they categorized the individuals into *Sarata* of individual *Dhatu*s.^[9]

WEIGHTED MEAN SCORE: A POSSIBLE METHOD TO EXPRESS OVERALL DHATU SARATA

To overcome these problems in reporting *Sarata*, we propose a practical method of expressing *Sarata* in terms of weighted mean score. This proposition is based on one of the our recent works where we assessed *Sarata* in 254 healthy volunteers.^[10] Classical textbooks of Ayurveda mention several physical, physiological, and psychological features to be considered while assessing the *Sarata* of each

Dhatu. However, while recording the same, we observed that the number of characters/features listed for each *Dhatu Sarata* was not the same and differed to a large extent for different *Dhatu*s. Therefore, the total scores allotted to each *Dhatu* had to be different. Thus, each character/feature, when present, was awarded “one” point and then, the percentage scores for a specific *Dhatu* were calculated after taking the total characters ascribed to that *Dhatu* as the denominator. For example, *Tvak Sara* had a total of 16 characters. An individual scoring eight points on this *Sara* was allotted a percentage score of 50%. Similarly, *Rakta Sara* had 37 features, *Mamsa Sara* had 37 characters, *Meda Sara* had 16 characters, and so on. The complete tool that we developed for the purpose of recording *Sarata* has been given as Supplementary Data File 1.

Upon completion of this exercise, we noted that there were several individuals who had scored equal or almost equal percentage scores for more than one *Dhatu*. This situation is not like that of *Prakriti*, where one can have the categories such as “*Dvandva*” (due to the dominance of two *Doshas*) or “*Sama-Doshaja*” (due to an equal dominance of all the three *Doshas*) *Prakriti*. Therefore, it was difficult for us to categorize any individual to be belonging to any one *Sarata*. This prompted us to think in terms of weighted mean scores to represent the overall *Sarata* of an individual. The weighted mean is similar to an arithmetic mean (the most common type of average), where instead of each of the data points contributing equally to the final average, some data points contribute more than others.^[11]

UTILITY OF THE WEIGHTED MEAN SCORES

When this method is used to express *Dhatu Sarata*, each individual will receive a calculated *Sarata* in terms of weighted mean score. This enables a researcher to further classify the study sample into three equal categories of 33.3% each, where the 0 to 33.3 category represents *Asarata*, the 33.4 to 66.6 category represents *Madhya Sarata*, and the 66.7 to 100 category represents *Sarva Sarata*. Further, it gives the researcher the liberty of dividing the study sample into two equal halves based on the calculated weighted mean scores taking the “*Median*” as the midpoint. In this case, the sample falling in “above the median category” can be understood to represent “better *Sarata*” whereas that falling in “below the median category” can be understood to represent relatively “suboptimal *Sarata*.” Since a focus on individual *Dhatu* is also essential from a clinical point of view, it may be noted that this method does not impose the limitation of not allowing the researcher to concentrate on an individual *Dhatu* too. This can be done on the basis of percentage *Sara* scores obtained for each *Dhatu*. Table 1

Table 1: Scores obtained for individual *Dhatu Sarata* (Mean±SD)

<i>Sarata</i> (maximum <i>Sara</i> scores allotted)	Minimum scores obtained (n=254)	Conversion into percentage	Maximum scores obtained (n=254)	Conversion into percentage	Obtained scores (n=254)	Median of the obtained scores (n=254)
Twak (16)	4	25.0	15	93.8	9.37±2.2	9
Rakta (37)	5	13.5	33	89.2	19.24±5.0	19
Mamsa (37)	5	13.5	36	97.3	20.61±6.6	21
Meda (16)	1	6.3	15	93.8	9.28±2.9	9
Asthi (16)	1	6.3	16	100.0	8.61±3.6	8
Majja (12)	2	16.7	11	91.7	6.62±1.7	7
Sukra (19)	0	0.0	18	94.7	11.47±3.3	12
Total score (153)	30	19.6	131	85.6	85.21±17.9	85
Weighted mean	4.88	-	22.79	-	14.14±3.1	14.3

The last row shows the weighted mean. The last column shows the median of the obtained scores for individual *Sarata* and also of the weighted mean. SD=Standard deviation

summarizes all these possibilities based on the sample that we have studied.

Further, to show that this method may be a good addition to the other methods, we are providing the results that we have obtained while correlating the weighted mean scores with some anthropometric parameters in our study sample [Table 2]. As the results show, the overall extent of *Sarata*, expressed as weighted mean scores, positively correlated with all these parameters, the correlation being statistically significant in each case. It may be noted that when such a correlation is explored for individual *Sara* scores, the overall *Sarata* remains unexposed, and the present method helps in overcoming this problem. For instance, while exploring for a possible correlation between the “*Sara* scores of individual *Dhatu*” and the “anthropometric parameters,” we found that *Twak Sara* scores to be independent of most of these anthropometric parameters. *Meda Sara* scores were independent of height. Further, our findings were suggestive of a positive correlation between hip circumference and *Sukra Sara* scores.

With these results, what we are trying to emphasize is that to explore a one-to-one correlation between individual *Dhatu Sarata* and other parameters, one does not need to group an individual into any “one” category of *Dhatu Sarata*. Further, he/she can also explore for an overall correlation of *Sarata* with the help of “weighted mean score” which takes into consideration the contribution of individual *Dhatu* very well.

Since we are planning to publish the other findings of this study as a separate communication the details such as the study design, validation of the tool, sampling procedure, etc., are not being described in this short communication. We are only trying to highlight the fact that “weighted mean score” may be a good method to express and report the overall *Sarata* in the research publications related to *Dhatu Sarata*.

Table 2: The correlation between various anthropometric parameters and weighted mean scores

Anthropometric parameters	Correlation coefficient (n=254)	
	r	P
Height (cm)	0.36	<0.001
Weight (kg)	0.47	<0.001
Skin fold thickness at biceps (mm)	0.29	<0.001
Skin fold thickness above iliac crest (mm)	0.31	<0.001
Waist to hip ratio	0.26	<0.001
Head circumference (cm)	0.37	<0.001
Shoulder width (cm)	0.34	<0.001

Limitations

In the data set that we have studied there were no outliers. This was confirmed using the Grubb's test. However, when there are outliers in a given data set, weighted mean tends to be influenced easily. Therefore, we recommend that the outliers be detected before applying this method.

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Conflicts of interest

There are no conflicts of interest.

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