



Short Communication

Correlation of *prakriti* diagnosis using AyuSoft *prakriti* diagnostic tool with clinician rating in patients with psychiatric disordersHemant Bhargav^a, Nishitha Jasti^a, Pooja More^a, Vinod Kumar^b, Umesh Chikkanna^a, Ramakrishna Kishore Kumar^{a,*}, Shivarama Varambally^a^a Department of Integrative Medicine, National Institute of Mental Health and Neurosciences, Bangalore, India^b Central Council for Research in Yoga and Naturopathic Medicine (CCRYN), Department of Integrative Medicine, National Institute of Mental Health and Neurosciences, Bangalore, India

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ABSTRACT

Assessment of individual constitution (*prakriti*) has been an important basic construct of the Ayurveda system of medicine. The AyuSoft *prakriti* diagnostic tool has been extensively used in Ayurveda research. However, we could not find any literature regarding reliability of a *prakriti* diagnostic tool in patients with psychiatric conditions. One hundred and twelve patients ($M = 70$) suffering from various psychiatric disorders as per ICD-10 criteria were recruited (Depression = 31; Schizophrenia = 30, Anxiety disorders = 27; OCD = 9; BPAD = 15). The AyuSoft tool (developed by C-DAC, Pune, India) was applied to determine their *prakriti* after obtaining written informed consent. Two Ayurveda physicians independently assessed *prakriti* of the same patients through clinical examination. Inter-rater reliability was assessed between *prakriti* scores obtained from AyuSoft and those from the Ayurveda physicians by determining Cohen's Kappa intra-class correlation coefficient (ICC). ICC estimates and their 95% confidence intervals were calculated using SPSS statistical package (version 24.0) based on a mean-rating ($k = 2$), consistency and two-way mixed-effects model. We observed that there was a significant correlation between *dosha* scores obtained through AyuSoft and those from the two Ayurveda physicians (for all three *doshas*: $p < 0.01$). Inter-rater reliability was moderately strong for *vata* (ICC = 0.72; Cronbach's alpha = 0.83), good for *pitta* (ICC = 0.58; Cronbach's alpha = 0.62) and comparatively weak for *kapha dosha* (ICC = 0.44; Cronbach's alpha = 0.51) respectively. *Prakriti* diagnosis by AyuSoft was feasible in stabilized psychiatric patients and was found comparable to clinical diagnosis of *prakriti* by Ayurveda physicians in patients with psychiatric disorders.

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1. Introduction

There is a recent shift in the approach to management of psychiatric disorders, with more research focusing on exploring personalized, constitution-based, holistic approaches of management by integrating modern medicine with traditional systems [1]. The Ayurveda system of medicine, originating from ancient Indian culture, is one such treatment modality that emphasizes deeper understanding of individual constitution (*prakriti*) and its interaction with the environment in managing physical and mental disorders [2].

Prakriti consists of three humoral factors (*vata*, *pitta* and *kapha*), based on permutation and combination of five basic elements: air, water, earth, fire, and space. *Vata*-predominant constitution (air + space dominance) is characterized by attributes of dryness, lightness, hyper-activity and reduced sleep. *Pitta*-predominant constitution (fire + water dominance) types show higher metabolic rate, increased appetite, moderate built, oily skin, good memory and short temperedness. *Kapha*-predominant (water + earth) constitution on the other hand shows tendencies towards weight gain, lower metabolism, increased sleep and inertia [2].

Our literature search revealed that number of *prakriti* diagnostic tools have been applied in various researches but only a few of them have been standardized [3,4]. AyuSoft is a popular *prakriti* diagnostic instrument developed by Centre for Development of Advanced Computing (C-DAC), Pune, India. This is a software

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consisting of 90 items which involve components of both history and examination based on ancient Ayurveda scriptures. This tool is applied by a clinician to assess scores of three *doshas* (*vata*, *pitta* and *kapha*) for an individual. AyuSoft has been used in number of research studies including Ayurgenomic studies [5–8]. Although for psychiatric patients, a special scale exclusively based on the *manas doshas* (mental attributes) of the individual constitution would have been ideal, we could not find any previous study using such a tool in our literature search. Since, AyuSoft assesses both mental and physical aspects of the *prakriti* and is the most widely used tool in Ayurveda research studies, we decided to use it. But most of the studies using AyuSoft device have focussed only on healthy subjects [3,5–7], we could not find any literature where it has been applied or validated in patients with different psychiatric disorders. Thus, current study was planned with an objective of assessing inter-rater reliability of AyuSoft in psychiatric patients by determining Cohen's Kappa intra-class correlation coefficient (ICC) between *prakriti* scores from AyuSoft and those obtained from two independent Ayurveda physicians (through clinical history taking and examination).

2. Materials and methods

2.1. Subjects

Based on a previous study on healthy subjects where correlation was determined for a *prakriti* assessment tool by correlating it with two independent observers, we calculated the sample size needed for a two tailed person correlation test in the current study [4]. Setting alpha at 0.05, power at 0.95 we used minimum correlation coefficient observed in the previous study (0.40) to obtain a required sample size of seventy-one using G-power sample size calculation tool [4]. Since present study dealt with psychiatric patients (we could not find any such published study in this population) we decided to further increase the power by increasing the sample size to above 100. One hundred and twelve patients (70 males, 42 females) diagnosed with common psychiatric disorders in the age range of 32.51 (± 11.69) years with duration of illness of 6.94 (± 5.19) years were recruited into the study from in-patient and out-patient services of a tertiary mental healthcare hospital in South India through convenient sampling procedure after obtaining written informed consent. Patients were diagnosed by a psychiatrist using ICD-10 criteria and belonged to the following diagnostic categories: Depression ($n = 31$), Schizophrenia ($n = 30$), Anxiety disorders ($n = 27$), Bipolar-affective disorder (BPAD, $n = 15$), and Obsessive-Compulsive Disorder (OCD) ($n = 9$). All subjects were on stable medications for management of respective disorders. Patients with other co-morbid illnesses such as diabetes, hypertension, or neurological disorders were excluded. Similarly, those with mental retardation, non-stabilized psychotic states, severe cognitive impairment or patients who were non co-operative, unwilling or were unable to comprehend questions asked during the interview were excluded.

2.2. Prakriti assessment by AyuSoft

AyuSoft software was purchased from C-DAC, Pune, Department of Information Technology, Ministry of Communications and Information Technology (MCIT), India. It has 90 items which are to be rated by the clinician trained in applying the software. The questionnaire involves aspects of both history taking and examination. The required duration for administration of AyuSoft is 15–20 min. At the end of assessment, it provides V, P and K scores in percentage

(out of a total of 100%). In current study, AyuSoft was administered by two independent physicians (those with post-graduation in modern medicine, naturopathy and/or yoga) who were trained in applying AyuSoft by an Ayurveda physician who was a certified AyuSoft trainer. AyuSoft assesses percentage contribution of each *dosha* on a “relative” basis i.e., the score is not absolute but relative percentage of each *dosha* if the sum total is 100%, it is the sum of the total scores “attained” for all the three *doshas* by that individual. We used the ‘default’ weightage assignment for each of the item (provided as default setting) in the AyuSoft software. The details regarding AyuSoft can be obtained from C-DAC, Pune, India (https://www.cdac.in/index.aspx?id=hi_dss_Ayusoft_products) or previous published studies [3,5–8]. The ‘AyuSoft rating’ column given in Table 2 is the average of score obtained by two independent physicians using AyuSoft device for each of the *doshas* (V, P and K) per patient.

2.3. Prakriti assessment by clinicians

To test inter-rater reliability of AyuSoft, the same patients ($n = 112$) were subjected to a *Prakriti* examination by two experienced Ayurveda physicians independently who were not aware of the results of the computer-based test [9]. Ten Ayurveda experts who had expertise in treating psychiatric patients were contacted, out of whom two agreed to be a part of current study. Both Ayurveda physicians had a post-graduate degree and more than 5 years of experience in treating psychiatric patients. The physicians were asked to examine the patients through standard clinical procedures of history taking and clinical examination based on Ayurveda principles as described in the *Caraka Samhita* (*Carakokta Prakriti*) [2] and provide scores for *vata* (V), *pitta* (P) and *kapha* (K) for each patient on a visual analog scale (VAS, 0–100 mm) [10]. The clinicians were instructed to mark with an “X” on the scale corresponding to each *dosha* (V, P and K) respectively for each patient in such a way that the total of scores ($V + P + K$) was equal to 100. The VAS score for each *dosha* was defined as the distance in millimeters (up to one decimal place) from the left extreme of the line to the “X” marked by the clinician (Table 2, Average physician ratings).

3. Statistical analysis

Scores obtained for each *dosha* category by the AyuSoft tool and two independent Ayurveda physicians respectively were collected on a spreadsheet. Scores for V, P and K obtained from AyuSoft administration were correlated with mean-rating for V, P, K by the two physicians. Cohen's Kappa intra-class correlation coefficient (ICC) estimates and their 95% confident intervals were calculated using SPSS statistical package version 24.0 based on a mean-rating ($k = 2$), consistency and two-way mixed-effects model [9].

4. Results

4.1. Dosha scores across different psychiatric conditions

Total of 180 patients were screened to recruit 112 patients into the study. Table 1 provides the *dosha* scores as obtained through the AyuSoft device across different psychiatric conditions. As depicted in Table 1, it was observed that among various psychiatric conditions assessed in the current study patients suffering from anxiety disorders had highest *Vata* scores. Whereas, highest *Pitta* scores were observed in patients suffering from bipolar affective disorders (BPAD). On the other hand, higher *Kapha* scores were observed in patients suffering schizophrenia as well as depression.

Table 1
Doshā scores as obtained from the AyuSoft device across different psychiatric conditions.

Psychiatric condition	N	Age (mean ± SD, years)	Vata Score	Pitta Score	Kapha Score
Depression	31 (16 M, 15 F)	43.25 ± 9.17	23.25	27.75	49
Schizophrenia	30 (24 M, 6 F)	29.88 ± 6.54	24.11	26.33	49.55
Anxiety	27 (16 M, 11 F)	29.0 ± 8.81	29	24	47
BPAD	15 (9 M, 6 F)	32.33 ± 11.30	26.66	28.33	43.33333
OCD	9 (5 M, 4 F)	27.33 ± 7.85	28	27.33	44.66

Abbreviations: BPAD: Bipolar affective disorder, OCD: obsessive compulsive disorder, N: Number of subjects, M: Males, F: Females.

Table 2
Intra-class correlation coefficient for inter-rater reliability between dosha scores through AyuSoft and two independent ayurveda physicians.

Dosha item	N	AyuSoft Rating Mean ± SD	Average Physician Rating ^b Mean ± SD	95% CI Lower limit	95% CI upper limit	F value (df1, df2)	Cronbach's alpha	ICC	P-value ^a
Vata	112	31.31 ± 13.45	27.62 ± 12.75	0.61	0.79	6.13 (111, 111)	0.83	0.72	0.01*
Pitta	112	26.04 ± 5.44	34.94 ± 8.56	0.39	0.71	2.44 (111, 111)	0.62	0.58	0.01*
Kapha	112	42.38 ± 11.58	36.29 ± 11.44	0.29	0.66	2.06 (111, 111)	0.51	0.44	0.01*

Abbreviations: ICC: Cohen's Kappa Intra-class correlation coefficient.

Captions: a) AyuSoft Rating is average of scores obtained by two independent physicians using AyuSoft device for each of the doshas (V, P and K) per patient; b) Average Physician Rating is average scores for each dosha per patient obtained by two Ayurveda physicians on a Visual Analog Scale (VAS) based on history taking and clinical examination (as per Caraka Samhita); c) 95% CI: Confidence Interval indicates range of values within which the true mean of the population lies with 95% certainty; d) Cronbach's alpha denotes internal consistency or average inter-item correlation i.e. correlation between Average AyuSoft rating and Average Physician rating.

*p < 0.001.

^a Two-way mixed-effects model, based on a mean-rating (k = 2), consistency.

^b Average of scores given by physician 1 and physician 2.

4.2. Intra-class correlation coefficient for inter-rater reliability between dosha scores through AyuSoft and two independent ayurveda physicians

4.2.1. Vata (V)

It was observed that there was a significant correlation between V scores obtained from AyuSoft and the average of vata scores determined by the two Ayurveda physicians (p < 0.01). Also, the inter-rater reliability for V scores between AyuSoft and physicians was moderately strong with ICC value (Cohen's Kappa) of 0.72.

4.2.2. Pitta (P)

The P scores from AyuSoft and average P scores from physicians showed good inter-rater reliability and the correlation was statistically significant (p < 0.01; ICC = 0.58).

4.2.3. Kapha (K)

For K scores though correlation between AyuSoft scores and average of physician scores was significant (p < 0.01), the inter-rater reliability was comparatively weaker (ICC = 0.44).

For details of scores and Intra-Class Correlation, please see Table 2.

5. Discussion

In the current study we assessed correlation of scores on AyuSoft for diagnosis of prakriti in psychiatric patients by correlating the V, P, K scores from AyuSoft with those obtained from clinical examination by two independent Ayurveda physicians. We observed that overall, there was a good inter-rater reliability for all the three aspects of prakriti with vata scores showing the highest ICC scores, followed by pitta and then kapha.

Previously, reliability was assessed for AyuSoft in a large population of healthy subjects (N = 3416), and it was observed that there was 80% concordance between the diagnosis made by the software and that by the two ayurvedic physicians independently (κ = 0.7) [3]. Similarly, another previous study correlated a Prototype Prakriti Analysis Tool (PPAT) with Physician scores for prakriti diagnosis in

34 healthy subjects and obtained ICC scores of 0.80 for vata, 0.52 for pitta and 0.40 for kapha [4]. These scores show similar trend as observed in the current study where we obtained ICC scores of 0.72, 0.58 and 0.44 for vata, pitta and kapha respectively. This shows that the inter-rater reliability patterns for prakriti do not differ much between those for psychiatric patients and healthy subjects.

Highest ICC scores for vata suggests that diagnosis of vata is easier as compared to pitta and kapha. We observed lowest ICC scores for kapha, this may be due to the fact that some traits are relatively common between pitta and kapha {for e.g., snighdhata (unctuousness), dravata (fluidity), sthirata (stability), both are pacified by tikta (bitter) and kashaya (astringent) tastes etc.} and these prakriti traits are more difficult to differentiate from each other than vata. Especially, psychiatric patients who are on psychotropic drugs may pose a greater challenge in diagnosis as the traits of a particular dosha may be masked due to side-effects of the medications; for example, a patient who pre-morbidly had pitta prakriti may develop weight gain and metabolic syndrome due to anti-psychotic medications [11]. This may lead to falsely higher kapha scores. Such factors may have caused discrepancy between scores obtained from AyuSoft and those from the physicians thus leading to lower ICC for kapha as compared to other two doshas. Also, as shown in Table 2, we observed that among patients with psychiatric disorders (across all categories), both AyuSoft as well as physicians on an average rated kapha to be the most dominant dosha (approximately 40%), followed by pitta and vata which are around 30% each. This may also be influenced by the higher kapha scores due to side effects of medications.

Strengths of the current study include a larger sample size and following 'Good Reporting Practices of Prakriti-based Research' [12], respectively. This study also has some limitations: first, we could get ratings from only two Ayurveda physicians; secondly, the physicians were not chosen following a systematic random sampling procedure, and thirdly we did not keep a record of side-effects of the psycho-tropic medications in patients which may have influenced the results. Future researches should overcome these limitations. Future researches can use prakriti diagnostic tool in psychiatric patients and design studies to test the add-on efficacy of

recommended lifestyle modifications based on the *prakriti* of the patient. A *prakriti* diagnostic tool focussing exclusively on *manas doshas* can also be developed for psychiatric patients in future.

6. Conclusion

Prakriti assessment by AyuSoft tool was feasible in stabilized patients with common psychiatric disorders. It was observed that diagnosis of *prakriti* by AyuSoft device in this population was comparable to the diagnosis made by two Ayurveda physicians based on their clinical experience. AyuSoft may serve as a useful tool in designing holistic and personalized interventions for mental disorders.

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Conflict of interest

None.

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