Original Article

Using Traditional Typologies to Understand Posture Movement and Cognitive Performance - A Cross Sectional Study

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Abstract

Context: We employed two classification methods that characterize psycho-somatotype categorization to understand motor and cognitive performance. The Trunk Index produces three somatotypes/body type categories: ectomorphs, mesomorphs, and endomorphs, and Prakriti classifications categorizes people into three categories: Vata, Pitta, and Kapha. Comparing these two categorization methods offers insights into anthropometric measures that combine psychological and physical characteristics to account for motor and cognitive behavior. **Aims:** The present study examined variations in cognitive and motor performances using the two typologies – *prakriti* and somato body types using cross-sectional study design. **Subjects and Methods:** The study employed fifty-eight healthy young adults, classified into *prakriti (vata*, *pitta*, *kapha*) and *ecto*-, *meso*-, *endo*- morph body types, to examine their cognitive performance (reaction time [RT] and accuracy), and motor performance (posture stability and posture accuracy) in standing yoga postures. **Statistical Analysis Used:** Analysis of covariance was performed to compare the cognitive and postural performance across the three somato and *prakriti* types after adjusting for age and gender as covariates. *Post-hoc* analysis of Bonferroni was performed with the consideration of Levene's test. Partial correlations were employed to investigate the correlation between postural stability and cognitive performance measures for each of the prakriti- and somato-body types as well as between the prakriti typology (scores) and trunk index values (adjusting the effects of age and gender as control variables). A $P < 0.05$ was selected at the statistical significance level. SPSS 26.0 version was used for the analysis. **Results:** Cognitive performance was observed to vary in terms of RT across somato- and prakriti body types ($P < 0.05$). Postural stability and cognitive performance are positively connected only for ectomorph body types ($P < 0.05$). Variations in motor performance were not significant. Barring ectomorph type, no other somato- and prakriti body types showed significant relationships between postural stability and cognitive performance. Likewise, the association between the features used for prakriti classification, and the trunk index scores showed marginal significance, only for a small subset of physical features of prakriti assessment ($P = 0.055$) (P1). **Conclusions:** Comparing classifications that use psychophysical attributes might offer insights into understanding variations in measures of motor and cognitive performance in a sample of healthy individuals.

Keywords: *Prakriti, somatotypes, postural (motor) performance, cognition*

Introduction

With an exponential increase in mindfulness-based practices, there is an increased focus on understanding the challenges in research pertaining to yoga, meditation, and mindfulness studies.[1] One challenge is that heterogeneous practices emerge from various schools of thought (e.g., yoga practice, breathing-based practice, meditation), and variability in the effects these practices have on mental and physical performance.[2] We contemplate that two traditional classification systems based on individual differences in mental and physical constitution might account for variation in engagement and outcome of mindfulness practices that rely on mental and physical resources. For instance, in Indian tradition, *Caraka Samhita* considers the human body composed of five basic elements – earth, water, fire, air, and ether, of which the whole universe is made up of.[3] Based on this principle, three *doshas* – *Vata*, *Pitta*, and *Kapha*, which are the unique combinations of the five elements, are present in all human beings.[3] The Theory of *Tridosha* proposed that the *tri-doshas* is associated with three types

How to cite this article: Gupta A, Garg R, Singh V. Using traditional typologies to understand posture movement and cognitive performance - A cross sectional study. Int J Yoga 2022;15:106-13.

Submitted: 14-Jan-2022 **Revised:** 26-Apr-2022
Accepted: 10-Jun-2022 **Published:** 05-Sep-2022

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Access this article online

Website: www.ijoy.org.in

DOI: 10.4103/ijoy.ijoy_12_22

Quick Response Code:

of body and psyche.[3] They are believed to determine a unique combination of physical, physiological, and psychological traits of an individual. Of the three *prakriti* body types, *Vata* types are characterized by thin body frame, *medium* body frames characterize *pitta* types, and *Kapha* are characterized by broad body frames.[4] Thus, *prakriti* classification encompasses a more holistic outlook via the inclusion of variable factors beyond physical matter or body type.

Similarly, Sheldon[5] encapsulated the theory of somatotypes, wherein body types are classified into Ecto-, Meso-, and Endomorphs. He proposed that the human body is categorized into three body types based on germ layers of embryonic development – the ectoderm (forming the skin and nervous system), the mesoderm (forming the muscles, heart, and blood vessels), and the endoderm (resulting in digestive tract). While the abdominal trunk area tends to be dominant over thoracic trunk area among Endomorphs, the thoracic trunk area tends to be dominant over the abdominal trunk area among Mesomorphs, and among Ectomorphs are present long, thin limbs and muscles, low-fat storage.[6] Therefore, Sheldon's classification draws on the physical body structure, namely the ratio of the upper and lower body.

Some studies suggest that cognitive and motor performance covaries[2] and varies according to one's somatotype.[7-12] Comparatively, *in prakriti* body types, only one study examined cognitive parameters.[13] To the best of our knowledge, the comparison of cognitive and motor performances using the two classifications of Somatotypes and *prakriti* body types together remains unexplored.

Ayurveda Prakriti types and Sheldon's Somatotypes uses similar anthropometric features to classify individuals. It remains unknown whether the two classifications can account for individual variations resulting largely from physical body types (somatotype) and body and mind/mental activities such as nature, personality, temperament, and diet. The classification systems rely on anthropometric features such as body size, body weight, shape of the face, cheeks, and chin are used to characterize prakriti of an individual,[14] body frame characteristics such as muscular, plump, lean and delicate, body shapes are used to characterize Sheldon's Somatotypes.[5] With this background in mind, the purpose of this research was (a) to explore potential variation in cognitive and motor behavior of individuals with Somatic- and *Prakriti*-body types as well as (b) to understand the possible association between two classification systems that rely on anthropometric measures.

Subjects and Methods

Participants

This was a cross-sectional study wherein healthy participants (24 females and 34 males) in the age group of 17–32 years were classified into *Prakriti* and Somatotypes. Fifty-eight participants from a secondary data set have been used in this study. The dataset comprised participants who were recruited from the authors institution using convenience sampling.

Measures

Four cognitive tasks from the psychological experiment builder language were used to evaluate spatial and phonological working memory, decision-making, and inhibition.[15] Moreover, postural assessments were made using the scales developed by Singh and Mutreja.[15]

Corsi block test (forward)

This task evaluated the reaction time (RT) in milliseconds and visuospatial working memory span, wherein participants were asked to recall the sequence of blocks presented in increasing order.[16]

Digit span test (forward)

This task evaluated the RT in milliseconds and the memory span of the phonological working memory, wherein participants were presented digits in an increasing order and asked to recall the sequence of digits in the order presented.[17]

Iowa gambling task

This test assessed the decision-making as described by Bechara *et al*.[18] In the test, the participants were presented with four Decks, A, B, C, and D, each of which have a different probability of win versus loses. Among them, two decks were disadvantageous (A and B) and two were advantageous (C and D), depending on whether the selections lead to losses or gains over the others in the long run. Participants were shown a virtual amount of 2000$ on the computer screen and asked to gain money as much as possible and avoid losses. They had to select one card from each deck consecutively and were unaware whether the deck was advantageous (small gains with smaller losses) or disadvantageous (big gains with expensive losses). After each choice, the money gained or lost was updated on the screen.

Simon task

In this task, a colored circle (right and blue) appeared on the computer screen, and the participant must identify the color of the circle presented on the screen by pressing a keyboard button (blue = right shift and red = left shift). While during congruent trials, the red-colored circle appears on the left side of the screen and the blue circle appears on the right side of screen, exactly the opposite happens during incongruent trials. The task assesses the ability to inhibit a target location-based response.[19]

Postural performance assessments (posture stability and accuracy)

Singh and Mutreja[15] developed behavioral scales to assess motor performance during yoga postures. Posture accuracy (termed "posture rating") was assessed with ratings ranging from 0 to 4 where 0 indicates the great difficulty to perform a yoga posture, 1 indicates difficulty, 2 indicates moderate difficulty/ease, 3 indicates ease, and 4 indicates great ease, and posture stability (termed as "posture error frequency") were assessed with the number of unplanned movements (fall/tripping/loss of balance/deviation from planned posture movement) during the posture holding duration.

Anthropometric measurements

Body weight (in Kg) and height (in meters) were self-reported in the study.

Procedure

All participants were classified into three somato- and *prakriti*-types using the following procedures:

Somatotype categorization

Sheldon[20] proposed using Trunk Index values to determine the somato body types. He postulated that the Trunk Index is the ratio of the thoracic trunk area to the abdominal trunk area and remains unaffected by an individual nutritional status and bodily changes.[20] To calculate the two areas, the photographs of the study participants were taken, and with the help of graph paper, the thoracic and abdominal trunks were transcribed onto it. The number of complete squares, exactly half squares, more than half squares, and those of less than squares that fell into the two areas were counted. On the graph paper, the dimensions of one square were measured as 0.5 cm length and 0.5 cm as breadth. Areas of complete squares and more than half squares were counted as those of one square, those of exactly half squares were counted as half square, and areas of less than half squares were excluded in calculating the thoracic and abdominal trunk areas. The trunk Index is then calculated as the ratio of thoracic (numerator) and abdominal areas (denominator). The participants with the lowest Trunk Index values were considered ectomorphs, those with mid-range values were considered mesomorphs, and those with higher values were considered endomorphs.[20]

Prakriti body type categorization

Sharira Sthana of *Ashtanga Hiradya*[21] and *Sushruta Samhita*[22] described *prakriti* based on the physical, physiological, and psychological features of *Vata*, *Pitta*, and *Kapha doshas*. Moreover, there are three ways to determine an individual's *prakriti*-(a) *sparshana* (touch based), (b) *prashnam* (questions based), (c) *darshanam* (visual based). Gayatri Gadre[23] used the visual-based approach to determine one's prakriti. The author used the nine visual features – body size, body weight, cheeks, face shape/chin, eyes, nose, lips, skin, and hairs – to classify the individuals into prakriti types. Adopting a similar approach, the prakriti assessment has been done manually based on the recorded videos; and only the visible, physical features were taken into consideration in the assessment. However, since we are comparing the two-body type classifications, we used only the anthropometric features in prakriti assessment to find an association between *Prakrti* and Sheldon's Somatotypes. Each feature had three options based on characteristics attributed to *Vata*, *Pitta*, and *Kapha*, respectively. Each respondent's visual feature was observed and assigned to either of the three options according to his or her body type. Based on the maximum attributes, *prakriti* body type was determined.

Afterward, cognitive, and postural measures were compared across the three categories of the two body typologies after adjusting for age and gender as covariates.

Yoga posture performance

For postural performance assessments, six standing yoga postures, performed by each participant, were selected from a secondary data of 20 postures. Among these six, four were bilateral postures and two were unilateral postures. Each posture was performed for 2 min in total, where bilateral postures were performed for 1 min on each side and unilateral postures were performed for 2 min. Details are given in Table 1.

Variables and data analysis

Cognitive and postural performance measures were considered continuous variables. Normality tests were performed to each of the cognitive and postural measures, and they were found to violate the assumption of normal distribution. Hence, all data sets have been transformed into normally distributed z-scores using a novel statistical technique known as the two-way approach for transforming continuous variables to normal.[24] Afterward, normality tests (Shapiro–Wilk and Kolmogorov–Smirnov tests) were again performed on each dataset and found that the datasets fulfill the assumption of normal distribution. Afterward, analysis of covariance (ANCOVA) was performed to compare the cognitive and postural performance across the three somato and *prakriti* types after adjusting for age and gender as covariates.

Post hoc analysis of Bonferroni was performed with the consideration of Levene's test. Data are presented as mean and standard deviation, and the results of the ANCOVA test are presented as estimated means and standard deviation. A $P < 0.05$ was selected at the significance level. Similarly, parametric partial correlations were employed to determine

Table 1: Standing yoga postures analysed in this study

Yoga posture (Asana)	Duration (min)
Tadasana	2
Eka Pada Pranamasana	2
Vrikshasana	2
Ardha Chakrasana	2
Tiryak Tadasana	2
Veer bhadrasana	2

Postures were done bilaterally with 1 min on each side the associations between error frequency (postural stability) and cognitive performance measures for each of the *Prakriti* and Sheldon's Somatotypes. For the association between prakriti scores and trunk index values, nonparametric partial correlations[25] were employed since the prakriti, and trunk index values were found to violate assumptions of normality even after applying the said transformation.[24] SPSS (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp) was used for the analysis.[26]

Results

The results are divided into five sections. The first section describes the general characteristics of the study participants across somato- and *prakriti*-types. The second section describes the differences in cognitive and postural performance measures across the three somatotypes with age and gender covariates. The third section describes the differences in cognitive and postural performance measures across the three *prakriti* types with age and gender as covariates. Forth section describes the correlations between postural and cognitive performance measures across the three *prakriti* and somatotypes. Moreover, section five describes the correlations between *prakriti* and trunk value indexes.

Section 1: General characteristics of participants

The mean age, height, and weight are given in Table 2. The mean age of all participants was 22.37 ± 3.94 years. No significant differences appeared in the mean age across the three somatotypes, F (2, 55) = 1.240, P = 0.297. Similarly, no significant differences were found in the mean age across the three *prakriti* groups, F (2, 55) = 0.841, P = 0.437.

Regarding height, weight, and body mass index, no significant differences appeared among them belonging to three somatotypes and *prakriti* body types.

Section 2: Differences in cognitive and postural performance measures across the three somatotypes with age and gender as covariates

ANCOVA analyses were performed on the cognitive and postural performance measures after adjusting for age and gender as covariates. The results are presented in Table 3. Only corsi RT scores showed significant differences across the three somatotypes, wherein Ectomorphs showed greater RTs than mesomorphs. No significant differences appeared in the remaining cognitive and postural measures.

Section 3: Differences in cognitive and postural performance measures across the three *prakriti*-types with age and gender as covariates

The results of ANCOVA analysis for cognitive and postural performance measures are presented in Table 4. Significant differences appeared only in Simon RTs, wherein Kapha types were found to have greater RTs than Pitta types. No other significant differences appeared in cognitive and postural performance measures across the three *prakriti* types.

Section 4. Partial correlations between error frequency scores (postural stability) and cognitive performance measures across *Prakriti*- and somato-types adjusting the effect of age and gender as control variables

The results of partial correlations between error frequency scores (postural stability) and cognitive performance measures across *Prakriti- and* somato-types are presented in Table 5. Significant correlations appeared among ectomorphs only, wherein corsi span scores are found to correlate positively after adjusting the age and gender as control variables. No other significant correlations appeared between error frequency scores (postural stability) and cognitive performance measures in the remaining *prakriti* and somatotypes.

Table 2: General characteristics of the participants

	Ectomorphs (*n*=21)	Mesomorphs (*n*=19)	Endomorphs (*n*=18)	Total (*n*=58)	*F*	*P*
Age	22.52±3.79	21.32±3.65	23.33±4.35	22.38±3.94	1.240	0.297
Height	1.65±0.09	1.67±0.10	1.64±0.08	1.66±0.09	0.536	0.588
Weight	62.20±11.82	64.05±12.99	59.72±11.60	62.00±12.06	0.588	0.599
BMI	22.50±3.78	22.53±2.62	21.98±3.65	22.35±3.35	0.155	0.857

General characteristics of the study participants across somatotypes. Data for each group are presented as mean±SD. Age is in years; Height is in meters; Weight is in kilograms. SD: Standard deviation, BMI: Body mass index

	Vata (*n*=16)	Pitta (*n*=26)	Kapha (*n*=16)	Total (*n*=58)	*F*	*P*
Age	21.50±3.46	22.35±3.84	23.31±4.55	22.38±3.94	0.841	0.437
Height	1.68±0.07	1.66±0.10	1.63±0.08	1.66±0.09	1.274	0.288
Weight	60.88±12.28	61.73±12.62	63.56±11.51	62.00±12.06	0.204	0.816
BMI	21.45±3.70	23.86±3.64	21.97±2.69	22.35±3.35	2.492	0.092

General characteristics of the study participants across Prakriti types. Data for each group are presented as mean±SD. Age is in years; Height is in meters; Weight is in kilograms. BMI: Body mass index

Table 3: Estimated mean (standard deviation) of each somatotype when age and gender are used as covariates

	Ectomorphs (*n*=21)	Mesomorphs (*n*=19)	Endomorphs (*n*=18)	*F*	*Post hoc* test results
Corsi span	5.48±0.28	5.74±0.29	5.66±0.30	0.202	
Corsi reaction time	19.21±3.29	6.60±3.47	13.32±3.52	3.360*	Ecto >Meso
dSpan span	7.31±0.40	6.75±0.42	7.26±0.43	0.526	
dSpan reaction time	75.19±7.23	61.83±7.63	57.50±7.75	1.520	
Simon correct scores	136.79±28.81	148.87±30.40	172.44±30.85	0.362	
Simon reaction time	62.15±6.05	54.16±6.38	54.56±6.48	0.518	
IGT scores	13.06±6.04	16.35±6.37	23.60±6.47	0.726	
IGT reaction time	531.89±59.40	533.24±62.70	538.47±63.63	0.003	
Mean posture accuracy	2.99±0.110	3.19±0.116	3.19±0.118	1.106	
Mean posture error frequency	1.28±0.14	1.09±0.157	1.07±0.159	0.567	

*P<0.05. Data under each group is presented as estimated means (SD). SD: Standard deviation, IGT: Iowa Gambling task

Table 4: Estimated mean (standard deviation) of each *prakriti* type when age and gender are used as covariates

	Vata (*n*=16)	Pitta (*n*=26)	Kapha (*n*=16)	*F*	*Post hoc* test results	Partial eta squared	*P* (ANCOVA Significance)
Corsi span	6.00±0.32	5.48±0.24	5.48±0.33	0.930		0.034	0.403
Corsi reaction time	11.99±3.99	12.37±3.10	15.93±4.20	0.269		0.010	0.765
dSpan span	7.04±0.46	7.03±0.36	7.33±0.49	0.122		0.005	0.885
dSpan reaction time	56.79±8.27	62.12±6.43	79.07±8.72	1.738		0.062	0.186
Simon correct scores	139.66±33.24	157.81±25.84	154.21±35.03	0.098		0.004	0.907
Simon reaction time	58.07±6.57	47.83±5.11	71.48±6.92	3.65*	Kapha >Pitta	0.121	0.033
IGT scores	7.78±6.85	21.57±5.32	20.29±7.22	1.380		0.050	0.260
IGT reaction time	436.46±65.49	526.17±50.90	645.62±69.01	2.251		0.078	0.115
Mean posture accuracy	2.93±0.125	3.18±0.09	3.19±0.132	1.524		0.054	0.227
Mean posture error frequency	1.36±0.16	1.11±0.13	1.03±0.17	0.975		0.036	0.384

*P<0.05. Data under each group are presented as estimated means (SD). SD: Standard deviation, IGT: Iowa Gambling task

Table 5: Partial correlation between error frequency scores (postural stability) and cognitive performance measures across Prakriti-and somato-types when age and gender are used as control variables

	Vata (*n*=16)	Pitta (*n*=26)	Kapha (*n*=16)	Ecto (*n*=21)	Meso (*n*=19)	Endo (*n*=18)
Error frequency and Corsi span	−0.129, *P*=0.661	0.013, *P*=0.952	0.278, *P*=0.336	0.559*, *P*=0.013	−0.228, *P*=0.378	−0.029, *P*=0.915
Error frequency and Corsi reaction time	0.271, *P*=0.348	0.105, *P*=0.625	−0.251, *P*=0.387	−0.230, *P*=0.344	0.048, *P*=0.854	−0.087, *P*=0.750
Error frequency and dSpan span	0.478, *P*=0.084	0.152, *P*=0.478	0.402, *P*=0.154	0.439, *P*=0.060	0.427, *P*=0.088	0.207, *P*=0.442
Error frequency and dSpan reaction time	0.049, *P*=0.868	0.257, *P*=0.225	0.390, *P*=0.168	0.201, *P*=0.410	0.303, *P*=0.237	−0.289, *P*=0.277
Error frequency and Simon correct scores	0.414, *P*=0.141	0.400, *P*=0.053	0.127, *P*=0.665	0.064, *P*=0.794	0.466, *P*=0.060	0.245, *P*=0.360
Error frequency and Simon reaction time	0.126, *P*=0.667	0.311, *P*=0.139	0.066, *P*=0.824	0.050, *P*=0.840	0.163, *P*=0.531	−0.058, *P*=0.831
Error frequency and IGT scores	−0.151, *P*=0.607	0.057, *P*=0.790	0.045, *P*=0.877	0.178, *P*=0.466	−0.205, *P*=0.429	0.242, *P*=0.367
Error frequency and IGT reaction time	−0.051, *P*=0.863	0.158, *P*=0.461	−0.115, *P*=0.694	−0.098, *P*=0.691	−0.362, *P*=0.153	0.356, *P*=0.177

*Correlation is significant at 0.05 level (two-tailed). Data under each group are presented as partial correlation coefficient, and *P* values. IGT: Iowa Gambling task

Section 5. Nonparametric partial correlations between *prakriti* and trunk value indexes adjusting the effect of age and gender as control variables.

The nonparametric partial correlations between *prakriti* and trunk index values after adjusting the effect of age and gender as control variables are presented in Table 6. No significant correlations appeared between the two indexes.

Discussion

We used two classifications to understand variability in yoga posture performance and cognitive performance.

Table 6: Nonparametric partial correlations between *prakriti* scores and Trunk Index values adjusting the effect of age and gender as control variables

	Prakriti scores (P1)	*Prakriti* scores (P2)	*Prakriti* Scores (P1 + P2)
Trunk index values	−0.258, P=0.055	−0.125, P=0.360	−0.216, P=0.111

Although somatotype classification is associated with sets of psychological traits, validated in studies.[27] The results align with other studies where somatotype was associated with motor[28-30] and cognitive differences[10] among the three somatotypes. However, we observed that the holistic typology of *prakriti* might also be associated with cognitive performance. While studies[31,32] have shown a relationship between somatic and prakriti body types, there is a scarcity of research on cognitive and motor function utilizing the two most generally used typologies, which represent diametrically opposed schools of thought.

Pitta body types performed better than *Kapha* body types in this research; particularly, response time was longer for *Kapha* body types than for *Pitta* or *Vata* body types. Rapolu *et al*.[33] discovered that *Kapha* body types exhibit physiological modulation that is distinct from *Vata* and *Pitta* body types, as well as others who have shown body-type distinctions at the brain level,[34] implying that typology derived from *prakriti* may account for individual variances in response time. Similarly, Sheldon[5] classified ectomorphs as socially nervous persons, mesomorphs as assertive, and endomorphs as slow, methodical thinkers among the three somatotypes. In addition, social anxiety has been shown to improve visuospatial working memory ability.[35] This may account for the present study's conclusion concerning the visuo-spatial working memory performance of the three somatotypes, which indicates that ectomorphs perform worse on the corsi block test than mesomorphs.

The seven physical features identified by Gadre[23] were used to determine the prakriti of study participants. This was the fundamental weakness of the research. Konjengbam *et al*.,[31] used a set of 41 features to delineate the *prakriti* types of healthy individuals. Rotti *et al*.,[36] used visual, tactile, vocal features, movement, and gait characteristics, and dietary and lifestyle-related parameters in the identification of *prakriti* types. Bhalerao, Deshpande, and Thatte[3] used 37 features to classify thirty healthy participants into prakriti body types. Godke *et al*.[37] used physical, physiological, and psychological traits to evaluate prakriti. Govindaraj *et al*.,[38] carried out the prakriti assessment in three stages. In the first stage, assessments were carried out by the Ayurveda physician using classical Ayurveda parameters. In the second stage, Ayusoft was used. Moreover, in the third stage, another set of Ayurveda physicians who were blind to the first two assessments analyzed and compared prakriti of the study participants. Similarly, others[39-44] have used anatomical, physiological, as well as psychological characteristics in determining the prakriti. Therefore, employing only the physical attributes in determining the prakriti of the study participants is one possible explanation for the lack of significance in the motor results for the three *prakriti* groups. In addition, the participants were classified into different body types according to their physical attributes, and improvements were observed in cognitive parameters during the study. This is fascinating since establishing one's *Prakriti* type after considering psychological characteristics would likely clarify or improve cognitive performance. It is imperative that future studies consider this aspect. Similarly, the present study used the Trunk Index method as the basis for classifying the body types into three somatotypes,[20] others have used the Heath Carter method of somatotyping assessing motor and cognitive differences among individuals.[9,11,45,46] Alternate methods such as Parnell's method,[46] and equation-based somatotyping methods as described in Heath Carter's method should be included with other methods such as photographic assessment of characterizing somatotypes. Like others, we acknowledge that a limited sample size might be an important determining factor.[47] Including experienced practitioners would offer insights into our understanding of body classification systems and cognitive performance.[48,49] Our preliminary findings using a small sample size, and our brief assessment from two typology systems suggest that a thorough comparison of *prakriti* and somatotype classification systems applied to the understanding of motor control (e.g., postures and movements) and cognitive control (e.g., working memory, inhibition, and flexibility) might provide a holistic understanding of mind, body, and cognition.

Conclusions

A comprehensive categorization system that encompasses mental and physical activities, as well as somatotypes that are solely centered on a body type, may help explain some aspects of cognitive function.

Financial Support and Sponsorship:

The study was funded by the Faculty Interdisciplinary Research Project (FIRP), IIT Delhi provided to the two authors (VS and RG).

Ethical clearance

The study was approved by Institute Ethics Committee of IIT Delhi in 2017 [IEC No P003].

Conflicts of interest

There are no conflicts of interest.

References

1. Van Dam NT, van Vugt MK, Vago DR, Schmalzl L, Saron CD, Olendzki A, *et al*. Mind the hype: A critical evaluation and

prescriptive agenda for research on mindfulness and meditation. Perspect Psychol Sci 2018;13:36-61.
2. Sharma PV. Charaka Samhita. Vol. 1. Delhi: Chaukhambha Orientalia; 2014.
3. Bhalerao S, Deshpande T, Thatte U. Prakriti (Ayurvedic concept of constitution) and variations in platelet aggregation. BMC Complement Altern Med 2012;12:248.
4. Sheldon WH, Steven SS, Tucker WB. The Varieties of Human Physique. New York: Harper; 1940.
5. Carter JE, William DR, Duquet W, Stephen PA. Advances in somatotype methodology and analysis. Am J Phys Anthropol 1983;26:193-213.
6. Lindzey G, Hall CS, editor. Theories of Personality: Primary Sources and Research. New York: John Wiley & Sons; 1965.
7. Genovese JE. Physique correlates with reproductive success in an archival sample of delinquent youth. Evol Psychol 2008;6:369-85.
8. Jakšić D, Cvetković M. Neural network analysis of somatotype 812 differences among males related to the manifestation of motor abilities. Acta Kinesiol 2009;3:107-13.
9. Çinarli FS, Kafkas A, Özgür EK, Kafkas ME. The effect of somatotype character differences on cognitive and biomotor abilities. Asia Pac J Sport Soc Sci 2016;32:1-4.
10. Irandoust K, Taheri M, Mirmoezzi M, H'mida C, Chtourou H, Trabelsi K, *et al*. The effect of aquatic exercise on postural mobility of healthy older adults with endomorphic somatotype. Int J Environ Res Public Health 2019;16:4387.
11. Cinarli FS, Kafkas ME. The effect of somatotype characters on selected physical performance parameters. Phys Educ Stud 2019;23:279-87.
12. Sharma S, Balsavar A, Beniwal RP, Bhatia T, Deshpande SN. A pilot study of correlation between intelligence quotient, social quotient, and Ayurveda parameters in children. Indian J Psychol Med 2018;40:74-9.
13. Piper B, Mueller ST, Talebzadeh S, Ki MJ. Evaluation of the validity of the psychology experiment building language tests of vigilance, auditory memory, and decision making. Peer J 2016;4:e1772.
14. Walker RN. Sheldon's trunk index and the growth of the thoracic and lumbar trunk. Ann Hum Biol 1979;6:315-36.
15. Singh V, Mutreja V. Enhancing executive control: Attention to balance, breath, and the speed versus accuracy tradeoff. Front Psychol 2020;11:180.
16. Fischer MH. Probing spatial working memory with the Corsi blocks task. Brain Cogn 2001;45:143-54.
17. Conway AR, Kane MJ, Bunting MF, Hambrick DZ, Wilhelm O, Engle RW. Working memory span tasks: A methodological review and user's guide. Psychon Bull Rev 2005;12:769-86.
18. Bechara A, Damasio AR, Damasio H, Anderson SW. Insensitivity to future consequences following damage to human prefrontal cortex. Cognition 1994;50:7-15.
19. Bialystok E, Craik FI, Klein R, Viswanathan M. Bilingualism, aging, and cognitive control: Evidence from the Simon task. Psychol Aging 2004;19:290-303.
20. Sheldon W. The New York study of physical constitution and psychotic pattern. J Hist Behav Sci 1971;7:115-26.
21. Kunte AM, Navre KR. Ashtanga Hridaya of Vagbhata. Varanasi: Chowkambha; 1982. p. 413-7.
22. Sushruta SS. English Translation by Sharma PV. Vol. II, Sharir Sthana (4:64-76). Varanasi: Chaukhambha Vishvabharati; 2005.
23. Gadre G. Classification of Humans into Ayurvedic Prakruti Types Using Computer Vision. [Master's Thesis]. San Jose: San Jose State University; 2019.
24. Templeton GF. A two-step approach for transforming continuous variables to normal: Implications and recommendations for IS research. Commun Assoc Inf Syst 2011;28:4.
25. Bradburn S. How to Perform a Non-Parametric Partial Correlation in SPSS? Available from: https://toptipbio.com/spearman-partial-correlation-spss/. [Last accessed on 2022 Mar 23].
26. SPSS I. IBM SPSS Statistics for Windows. Armonk, New York, USA: IBM SPSS; 2019. p. 2.
27. Yates J, Taylor J. Stereotypes for somatotypes: Shared beliefs about Sheldon's physiques. Psychol Rep 1978;43:777-8.
28. Awotidebe TO, Olawoye AA, Fasakin OM, Odetunde MO, Okonji AM, Afolabi TO, *et al*. Relationships between body somatotype and handgrip strength of young Nigerian undergraduate students. Arch Physiother 2021;25:17-26.
29. Ayuningtyas NT. Relationship between somatotype and physical fitness: Study on badminton athletes of PB Djarum Kudus. J Keolahragaan 2021;9:128-36.
30. Kolokoltsev M, Kuznetsova L, Makeeva V, Ustselemova N, Romanova E, Savchenkov A, *et al*. Physical education of girls from different somatotypes and health groups. J Phys Educ Sport 2021;21:852-9.
31. Konjengbam H, Leona Devi Y, Meitei SY. Correlation of body composition parameters and anthropometric somatotypes with Prakriti body types among the Meitei adults of Manipur, India. Ann Hum Biol 2021;48:160-5.
32. Metri GK. First Direct Experimental Evidence Correlating Ayurveda Based Tridosha Prakriti with Body Mass Composition and Western Constitutional Psychology Somatotypes [Dissertation]. Bangaluru: S-VYASA; 2014.
33. Rapolu SB, Kumar M, Singh G, Patwardhan K. Physiological variations in the autonomic responses may be related to the constitutional types defined in Ayurveda. Cell Med 2015;5:7-1.
34. Travis FT, Wallace RK. Dosha brain-types: A neural model of individual differences. J Ayurveda Integr Med 2015;6:280-5.
35. Moriya J, Sugiura Y. Socially anxious individuals with low working memory capacity could not inhibit the goal-irrelevant information. Front Hum Neurosci 2013;7:840.
36. Rotti H, Mallya S, Kabekkodu SP, Chakrabarty S, Bhale S, Bharadwaj R, *et al*. DNA methylation analysis of phenotype specific stratified Indian population. J Transl Med 2015;13:151.
37. Ghodke Y, Joshi K, Patwardhan B. Traditional medicine to modern pharmacogenomics: Ayurveda Prakriti type and CYP2C19 gene polymorphism associated with the metabolic variability. Evid Based Complement Alternat Med 2011;2011:249528.
38. Govindaraj P, Nizamuddin S, Sharath A, Jyothi V, Rotti H, Raval R, *et al*. Genome-wide analysis correlates Ayurveda Prakriti. Sci Rep 2015;5:15786.
39. Prasher B, Negi S, Aggarwal S, Mandal AK, Sethi TP, Deshmukh SR, *et al*. Whole genome expression and biochemical correlates of extreme constitutional types defined in Ayurveda. J Transl Med 2008;6:48.
40. Bhushan P, Kalpana J, Arvind C. Classification of human population based on HLA gene polymorphism and the concept of Prakriti in Ayurveda. J Altern Complement Med 2005;11:349-53.
41. Mahalle NP, Kulkarni MV, Pendse NM, Naik SS. Association of constitutional type of Ayurveda with cardiovascular risk factors, inflammatory markers and insulin resistance. J Ayurveda Integr Med 2012;3:150-7.
42. Tripathi PK, Patwardhan K, Singh G. The basic cardiovascular responses to postural changes, exercise, and cold pressor test: Do they vary in accordance with the dual constitutional

types of ayurveda? Evid Based Complement Alternat Med 2011;2011:251850.

43. Bhanushali D, Tyagi R, Limaye Rishi Nityapragya N, Anand A. Effect of mindfulness meditation protocol in subjects with various psychometric characteristics at high altitude. Brain Behav 2020;10:e01604.
44. Rotti H, Raval R, Anchan S, Bellampalli R, Bhale S, Bharadwaj R, *et al.* Determinants of Prakriti, the human constitution types of Indian traditional medicine and its correlation with contemporary science. J Ayurveda Integr Med 2014;5:167-75.
45. Rudnev SG, Negasheva MA, Godina EZ. Assessment of the heath-carter somatotype in adults using bioelectrical impedance analysis. J Phys Conf Ser 2019;1272:012001.
46. Rempel R. A Modified Somatotype Assessment Methodology [Doctoral Dissertation]. Simon Fraser University: School of Kinesiology; 1994.
47. Matthews G, Gruszka A, Szymura B. Conclusion: The state of the art in research on individual differences in executive control and cognition. In: Handbook of Individual Differences in Cognition. New York: Springer; 2010. p. 437-62.
48. Froeliger BE, Garland EL, Modlin LA, McClernon FJ. Neurocognitive correlates of the effects of yoga meditation practice on emotion and cognition: A pilot study. Front Integr Neurosci 2012;6:48.
49. Cassady K, You A, Doud A, He B. The impact of mind-body awareness training on the early learning of a brain-computer interface. Technology (Singap World Sci) 2014;2:254-60.