Association of constitutional type of Ayurveda with cardiovascular risk factors, inflammatory markers and insulin resistance

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ABSTRACT

Context: Ayurveda propounds that diseases manifest from imbalance of doshas. There, have been attempts to indicate biochemical basis of constitutional types described in Ayurveda. **Aims:** The study was intended to assess the association of constitutional types (*Prakriti*) with cardiovascular risk factors, inflammatory markers and insulin resistance in subjects with coronary artery disease (CAD). **Settings and Design:** Hospital based cross sectional study. **Materials and Methods:** Three hundred patients with CAD >25 years were studied. Assessment of *Prakriti* was done by using Ayusoft software. Biochemical parameters, inflammatory markers (hsCRP, TNF-alpha and IL-6) and insulin resistance (HOMA-IR) were measured. **Statistical Analysis:** Was done using EPI INFO, version 3.5.3. **Results:** Mean age of patients was 60.97 ± 12.5 years. Triglyceride, VLDL and LDL was significantly higher ($P<0.0001$, $P<0.0001$ and 0.0355, respectively) and HDL cholesterol ($P<0.0001$) significantly lower in *vatta kapha* (*VK*) *Prakriti* when compared with other constitution type. *VK Prakriti* was correlated with diabetes mellitus ($r=0.169$, $P=0.003$), hypertension ($r=0.211$, $P\leq0.0001$) and dyslipidemia ($r=0.541$, $P\leq0.0001$). Inflammatory markers; IL6, TNF alpha, hsCRP and HOMA IR was highest in *VK Prakriti*. Inflammatory markers were correlated positively with both *VK* and *Kapha* group. **Conclusions:** There is strong relation of risk factors (diabetes, hypertension, dyslipidemia), insulin resistance, and inflammatory markers with *Vata Kapha* and *Kapha Prakriti*.

Key words: Cardiovascular disease, HOMA IR, IL6, *Vata Kapha*

INTRODUCTION

In the Ayurvedic system of medicine, predisposition to a disease as well as selection of a preventive and curative regime is primarily based on the assessment one's body constitution termed '*Prakriti*'. *Prakriti* of an individual is based on the dominance of any single or a combination of two or three *Doshas* (*Tri-Doshas*), *Vata* (V), *Pitta* (P) and *Kapha* (K), which are not only genetically determined (*Shukra Shonita*), but also influenced by season (*Rutu*), maternal diet and lifestyle (*Matur Ahara Vihara*), and age of parents and female reproductive system (*Kala-Garbhashaya*).[1] According to Ayurveda, constitutions are classified into seven varieties namely *vataja*, *pittaja*, *kaphaja*, *vata-kaphaja*, *vatapittaja*, *kapha-pittaja* and *sama Prakriti*, among which, the first three are considered as extremes.[2-4]

Distinct properties and functions have been ascribed to each *Dosha*. For instance, *Vata* contributes to manifestation of shape, cell division, signalling, movement, excretion of wastes, cognition and also regulates the activities of *Kapha* and *Pitta*. *Kapha* is responsible for anabolism, growth and maintenance of structure, storage and stability. *Pitta* is primarily responsible for metabolism, thermo-regulation, energy homeostasis, pigmentation, vision, and host surveillance.[2,5]

An individual may have a natural predominance of one or more doshas. Accordingly disorders arise from an augmentation or depletion of *doshas* or combination of

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both in conglomerations with *dushyas* manifest disease, whereas maintaining balance of the *doshas* results in good health. Over time, the natural balance of the *doshas* in an individual can be disturbed by a number of factors, such as improper diet, poor digestion, day-to-day stress levels and environmental pollution and chemicals.[6]

In recent years, there have been several studies indicating biochemical basis of constitutional types described in Ayurveda.[2,7-11] Coronary artery disease (CAD) has elements of cellular proliferation and metabolic abnormalities. Hence, an anomalous expression of certain element in the Prakruti of the individual will be more prevalent in CAD. No study has demonstrated the association of risk factors (diabetes, hypertension), inflammatory markers and insulin resistance with *Prakriti* in established cardiovascular patients. This study has been done with objective to find correlation of constitutional types with cardiovascular risk factors, inflammatory markers and insulin resistance among the subjects with established CAD.

MATERIALS AND METHODS

Three hundred patients having age more than 25 years, with known coronary disease were included in this study. Patients, who were admitted in cardiology department for evaluation of chest pain and found angiography positive, were selected in the study. Exclusion criteria were presence of chronic kidney disease; hepatic dysfunction; known endocrinal or rheumatological diseases or chronic infections. The inflammatory markers are significantly elevated in rheumatological disorders. Insulin secretion and synthesis are strongly influenced in endocrine disorders.[12,13] Chronically ill patients have multiorgan dysfunction. Hence, these were excluded from the study.

Assessment of Prakriti

Prakruti assessment tool of AyuSoft, which is in the form of a questionnaire was used for the study. Experienced staff, under the guidance of a Vaidya, accurately assessed the Prakruti of each individual. The AyuSoft database (www.ayusoft.cdac.in) includes more than 5 lakh records, and information from nine texts, including the Brihadtrayee and Madhava Nidana.[14] The standardized and validated software has been used by other authors in published studies[9, 10] and being used in ongoing trial.[15]

The classification broadly takes into account features like body built, physical and mental endurances, and physiology. Besides, the multiple-choice questionnaire also captures the information pertaining to history of disease. Each option further refers to a property attributed to Vata, Pitta or *Kapha* constitution. Individuals those showing characteristics of two doshas were considered that of dual constitution.[5] While defining a dual constitution dominance and sub-dominant among these two doshas were ignored. The individuals with dominant Vata and sub-dominant Pitta (Vata-Pitta individuals) and the individuals with dominant Pitta and sub-dominant Vata (Pitta-Vata individuals) were considered equivalent and were grouped as Vata-Pitta. Similarly, the Pitta-*Kapha* and *Kapha*-Pitta individuals were grouped as Pitta-*Kapha*, while Vata-*Kapha* and *Kapha*-Vata individuals were grouped as Vata-*Kapha*. Otherwise, we would have created six groups of dual Prakriti instead of three, which would have been a deviation from the Ayurveda classics.

Prakriti of these volunteers was designated as Vata-Pitta, Pitta-*Kapha*, or Vata-*Kapha*. While designating the *Prakriti*, the individuals with Vata as the primary Dosha and Pitta as the secondary Dosha (i.e., Vata-Pitta individuals) and the individuals with Pitta as the primary Dosha and Vata as the secondary Dosha (i.e., Pitta-Vata individuals) were considered to be equivalent and were grouped under Vata-Pitta. Similarly, the Pitta-*Kapha* individuals and the *Kapha*-Pitta individuals were treated to be equivalent and were grouped under Pitta-*Kapha*. On similar lines, the Vata-*Kapha* individuals and the *Kapha*-Vata individuals were treated to be equivalent and were grouped under *Vata Kapha*. This was done to avoid the necessity of creating six groups of dual *Prakriti*, which would have been a deviation from the Ayurveda textbooks.

Physical measurements

Data of all subjects were obtained on smoking, physical activity, height, weight, waist, and hip circumference. Body mass index (BMI) is weight (kg) divided by square of height in meters, and waist hip ratio (WHR) is waist circumference divided by hip circumference.

Biochemical measurements

Cardiovascular diseases are associated with traditional risk factors,[16-18] insulin resistance[19] and chronic systemic inflammation.[20,21] Hence we assessed biochemical parameters according to these risk factors. Fasting blood samples were collected after 14 hour fasting. Total Cholesterol, Triglyceride, HDL (high density lipoprotein), LDL (low density lipoprotein) and VLDL Cholesterol (very low density lipoprotein) were analysed. Cholesterol, triglyceride, HDL were measured by using CHOD PAP, LIP/GK, enzymatic clearance method, respectively, and LDL and VLDL were calculated by Friedewald formula. Interleukin-6 (IL6), tumor necrosis factor (TNF) alpha, highly sensitive C-reactive protein (hsCRP) and Insulin was done by ELISA and MEIA method.[22] Separated serum samples were stored at −80°C till analysis. Samples were processed together to reduce variability. Strict

quality control measures were followed. Intra and inter assay precisions were <5% and <10%, respectively, for all parameters. The HOMA Model was used to calculate insulin resistance (IR).[23] The formula is as follows:

Insulin resistance = FI × G/22.5

where FI = Fasting insulin μIU/ml, and G = Fasting glucose (mmol/l).

Liver function and renal function test were also done. Data on clinical history of hypertension (HTN), diabetes mellitus (DM), smoking, physical activity, and medications (antihypertensive and oral hypoglycemic agents) was also acquired. The study was approved by Institutional Ethics Committee of Deenanath Mangeshkar Hospital, Pune (Maharashtra). Informed consent was obtained from all individuals.

Definitions

Dyslipidemia was defined as Triglyceride level ≥150 mg/dl and HDL Cholesterol level <40 mg/dl (NCEP ATP III). Conventional risk factors were defined as follows: Body mass index (BMI); Normal <25 kg/m^2, Overweight/Obese <25 kg/m^2, DM (by history and treatment), HTN (systolic and diastolic blood pressures above 140 and 90 mmHg, respectively).

Statistical method

Statistical analysis was carried out using EPI INFO, version 3.5.3 (CDC; Atlanta; USA). Data were presented as mean±SD, median (range) or number (%) unless specified. All parametric data (age and biochemical parameters) were analysed by student's t-test. If Barlett's Chi-square test for equality of population variances was <0.05 then Kruskal-Wallis test was applied. All non-parametric data (sex, smoking, and presence and absence of DM, HT or dyslipidemia, etc.) were analysed by Chi-square test. Pearson correlation coefficient was used to assess correlation between *Prakriti* and cardiovasucar risk factors. Multiple linear regression analysis was used to assess the strength of association between *Prakriti* as outcome measure and cardiovascular risk factors and biochemical parameters as variables after adjusting for age, sex and BMI. A *P* value <0.05 was considered statistically significant.

RESULTS

Three hundred patients with known cardiovascular disease (M: 216; F: 84, age: 25-92) were studied. Mean age was 60.9±12.4 years. There was no age difference between males and females (M: 60.95±12.3; F: 61.03±12.9; P=0.10). Constitution types which were identified in this study were *Kapha*, *Pitta Kapha*, *Vata Kapha* and *Vata Pitta*. *VK* was more prevalent (62.3%) compared to others; K - 5%, KP - 15.7%, VP - 17%.

A comparison of cardiovascular risk factors with different constitution types (*Prakriti*) are given in [Table 1]. Anthropometric parameters were comparable in all constitution types. There was no correlation between body mass index, waist hip ratio and physical activity with *Prakriti* [Table 1]. Total cholesterol, triglycerides, VLDL and LDL cholesterol were significantly higher and HDL cholesterol significantly lower in *VK* when compared with other constitution type. For triglyceride, *VK* had highest and HDL has lowest values compared to all groups (K, PK, VP). Serum Cholesterol levels were also significantly high in *VK* group but in individual comparison *VK* was significantly high compared to VP only. Similarly, LDL was high in *VK* type but compared to VP only. All lipids levels were positively correlated with KV except HDL, which was correlated negatively in univariate analysis. Significance was maintained even after adjustment with age, sex and BMI [Tables 3 and 4].

DM and DM with HTN has significant association with *VK Prakriti*, it was highest in *VK* group compared to VP. There was no association between K and PK group. HTN was highest in *VK* group compared to PK and VP group but not associated with K group. 26.7%, 36.2%, 48.1% and 27.5% in K, PK, *VK*, VP types were diabetics, respectively [Tables 1 and 2].

Cytokines (IL6) and inflammatory markers (TNF alpha and hsCRP) were analysed, IL6 and hsCRP was highest in *VK* but TNF alpha had significantly highest values in K *Prakriti*. In univariate analysis IL6 was positively correlated with KV but not with K (r: 0.083, P: 0.150). However, TNF alpha and hsCRP were positively correlated with both KV and K group. (TNF-α; r: 0.137, P: 0.018, hsCRP; r: 0.123, P: 0.033) [Table 3]. Even after adjustment with age, sex and BMI significance level was maintained [Table 4].

Insulin and HOMA-IR was highest in *VK* compared to all *Prakriti* types [Tables 1 and 2]. Insulin resistance showed positive correlation *VK* (beta coefficient: 13.97, P<0.0001).

However, other biochemical parameters which were done in this study were Liver function test, serum electrolytes, calcium, phosphorus and magnesium. There was no correlation between Serum bilirubin, ALT, AST, Alkaline phosphatase, total protein, albumin, globulin, calcium, phosphorus, uric acid, sodium, potassium and chloride with individual constitution (data not shown).

Table 1: Basic characteristic in body constitution

Parameters	*Kapha* mean±SD, Median (range) *n*-15	*Pitta Kapha* mean±SD, Median (range) *n*-47	*Vata Kapha* mean±SD, Median (range) *n*-187	*Vata pitta* mean±SD, Median (range) *n*-51	*P* value
Age	60 ± 12.5	58.8 ± 11.3	61.2 ± 12.1	61.9 ± 14.5	0.5995
	65 (25-74)	60 (27-78)	62 (25-92)	66 (25-89)	
Sex, % (n)	M-86.7 (13)	M-76.6 (36)	M-69 (129)	M-74.5 (38)	0.3771
	F-13.3 (2)	F-23.4 (11)	F-31 (58)	F-25.5 (13)	
Cholesterol (mg/dl)	160 ± 23	174.7± 44.9	184.6 ± 49.1	166.4 ± 32.5	0.0661
	165 (109-196)	162 (98-315)	170 (91-343)	165 (91-301)	
Triglyceride (mg/dl)	144.8 ± 35.7	146.6 ± 31.5	184.7 ± 47.6	152 ± 35.3	<0.0001
	140 (69-237)	145 (64-213)	189 (71-341)	147 (86-298)	
HDL (mg/dl)	47.1 ± 5.8	44.9 ± 8.3	35 ± 7.6	45.3 ± 8.1	<0.0001
	48 (34-56)	45 (25-59)	35 (20-58)	46 (26-59)	
LDL (mg/dl)	83.9 ± 21.1	100.4 ± 48.6	112.6 ± 54.6	90.7 ± 35.8	0.0355
	86.2 (39.2-116.6)	86.2 (22.4-262)	96 (12.6-273.8)	88.2 (14.4-229.8)	
VLDL (mg/dl)	28.9 ± 7.1	29.2 ± 6.3	36.9 ± 9.5	30.4 ± 7.07	<0.0001
	28 (13.8-47.4)	29 (12.8-42.6)	37.8 (14.2-68.2)	29.4 (17.2-59.6)	
Smoking % (n)	46.7 (7)	29.8 (14)	40.6 (76)	27.5 (14)	0.1944
WHR	0.94 ± 0.03	0.92 ± 0.05	0.92 ± 0.06	0.92 ± 0.06	0.3805
	0.95 (0.89-1)	0.93 (0.76-1.02)	0.92 (0.7-1.07)	0.92 (0.75-1.18)	
BMI (kg/m^2)	28± 2.9	27.6 ± 4.2	27.9 ± 3.8	27.7 ± 3.5	0.9352
	28.1 (22.6-33.8)	26.7 (19.8-37.5)	27.2 (19.3-39.4)	26.9 (22.1-37.7)	
DM, % (n)	26.7 (4)	36.2 (17)	48.1 (90)	27.5 (14)	0.0241
HTN, % (n)	53.3 (8)	48.9 (23)	70.6 (132)	49 (25)	0.0038
DM and HTN, % (n)	26.7 (4)	27.7 (13)	36.9 (69)	13.7 (7)	0.0145
Physical inactivity, % (n)	40 (6)	40.4 (19)	39.8 (74)	33.3 (17)	0.8616
Dyslipidemia, % (n)	6.7 (1)	8.5 (4)	62 (116)	5.9 (3)	<0.0001
IL-6, pg/ml	91.8 ± 74	6.3 ± 4.5	92.5 ± 77.9	7.3 ± 4.5	<0.0001
	63.3 (10.3-210.6)	5.1 (2.0-19.9)	66.5 (2.0-253.2)	5.8 (2.0-19.4)	
TNF-alpha, pg/ml	49.6 ± 24.2	8.1 ± 0.61	32.3 ± 48.8	8.1 ± 0.24	<0.0001
	50.1 (9-101)	8.0 (8.0-12)	14.1 (8.0-525.8)	8.0 (8.0-8.9)	
hsCRP, mg/L	16.8 ± 2.5	2.3 ± 2.1	16.0 ± 9.0	2.6 ± 2.2	<0.0001
	17.8 (12-19.6)	1.6 (0.15-8.9)	16.2 (0.17-37.9)	2.2 (0.1-8.5)	
Insulin, mU/L	26 ± 24.8	41.5 ± 37	57.3 ± 46.1	38.8 ± 36.9	0.0002
	14.3 (3.03-78.5)	29.2 (2.9-135.4)	49.3 (2.14-274.8)	22.6 (2.4-213.4)	
HOMA-IR	7.5 ± 6.03	11.3 ± 10.7	22.9 ± 24.4	10.4 ± 10.6	<0.0001
	7.4 (0.58-19.19)	7.24 (0.63-51.8)	15.7 (0.5-135.7)	7.7 (0.65-68.4)	

DISCUSSION

The entire description of human physiology in Ayurveda is based primarily in the theory of *Tridosha*.[2,3,5] The "homeostatic mechanisms" as conceptualized in modern biomedicine have a very close resemblance with this theory.

This is possibly the first study to report an association of risk factors, inflammatory markers and insulin resistance with *Prakriti* type in angiographically proved cardiovascular patients. More than half of patients (62.3%) were of *Vata Kapha* type and it was more prevalent compared to other parkriti; *VK*>VP>PK>K. CAD have element of cellular proliferation and metabolic abnormalities. *Vata* contributes to manifestation of shape, cell division; *Kapha* is responsible for anabolism, growth and maintenance of structure and *Pitta* is primarily responsible for metabolism. Hence, combined abnormalities will be more prevalent in CAD, which is observed in this study. There have been many studies to provide an evidence base to the traditional systems of medicine.[24,25] Investigators have tried to provide interesting genetic, biochemical, hematological or anatomical basis to the concept of Ayurveda constitution.[2,7,9-11] But most of the recent investigations carried out in relation to *Prakriti* have included only those individual who are healthy or belonging to three extreme types of constitution (K,V and P), which is comparatively a rare occurrence.

Prasher B and others observed that individuals from the three most contrasting constitutional types exhibited striking differences with respect to biochemical and

Table 2: *P* values of different biochemical parameters during individual comparison of *Prakriti*

Parameters	K-VK	PK-VK	VK-VP	K-PK	K-VP	PK-VP
Cholesterol	0.1007	0.2102	0.0419	0.5158	0.4789	0.9518
Triglyceride	0.0018	<0.0001	<0.0001	0.8704	0.4917	0.4103
HDL	<0.0001	<0.0001	<0.0001	0.3558	0.4339	0.8223
LDL	0.0611	0.1652	0.0242	0.5268	0.6298	0.7328
VLDL	0.0018	<0.0001	<0.0001	0.8704	0.4917	0.4103
DM	0.1820	0.1910	0.0131	0.7159	0.6158	0.4777
HTN	0.2699	0.0084	0.0066	1.000	1.000	0.8461
DM andHTN	0.6070	0.3097	0.0029	0.6106	0.2100	0.1445
Dyslipidemia	<0.0001	<0.0001	<0.0001	0.6505	0.6532	0.4539
IL-6	0.9715	<0.0001	<0.0001	<0.0001	<0.0001	0.2597
TNF-alpha	0.0013	<0.0001	<0.0001	<0.0001	<0.0001	0.8579
hsCRP	0.7151	<0.0001	<0.0001	<0.0001	<0.0001	0.6215
Insulin	0.0014	0.0307	0.0087	0.1362	0.2143	0.7147
HOMA-IR	0.0005	0.0002	<0.0001	0.3121	0.4218	0.6709

K-VK = *P* value between kapha and *Vata Kapha*, PK-VK = *P* value between *Pitta Kapha* and *Vata Kapha*, *VK*-VP = *P* value between *Vata Kapha* and vata pitta, K-PK = *P* value between kapha and *Pitta Kapha*, K-VP = *P* value between kapha and vata pitta, PK-VP = *P* value between *Pitta Kapha* and vata pitta

Table 3: Correlation of *Prakriti* with risk factors

Parameters	*Vata Kapha* *n*-187		Vata Pitta *n*-51		*Pitta Kapha* *n*-47		Kapha *n*-15	
	r value	*P* value	r value	*P* value	r value	*P* value	r value	*P* value
Cholesterol	0.165	0.004	−0.122	0.035	−0.038	0.508	−0.094	0.104
Triglyceride	0.378	<0.0001	−0.188	0.001	−0.231	<0.0001	−0.0131	0.023
HDL	−0.546	<0.0001	0.314	<0.0001	0.281	<0.0001	0.203	<0.0001
LDL	0.180	0.002	−0.133	0.021	0.044	0.452	−0.098	0.090
VLDL	0.378	<0.0001	−0.188	0.001	0.231	<0.0001	−0.131	0.023
DM	0.169	0.003	−0.130	0.024	−0.048	0.407	−0.070	0.228
HTN	0.211	<0.0001	−0.128	0.027	−0.122	0.034	−0.044	0.445
DM and HTN	0.164	0.004	−0.169	0.003	−0.031	0.591	−0.021	0.711
Dyslipidemia	0.541	<0.0001	−0.326	<0.0001	−0.287	<0.0001	−0.162	0.005
IL-6	0.480	<0.0001	−0.344	<0.0001	−0.334	<0.0001	0.083	0.150
TNF-alpha	0.222	<0.0001	−0.191	0.001	−0.181	0.002	0.137	0.018
hsCRP	0.585	<0.0001	−0.425	<0.0001	−0.415	<0.0001	0.123	0.033
Insulin	0.213	<0.0001	−0.118	0.041	−0.085	0.140	−0.127	0.027
HOMA-IR	0.286	<0.0001	−0.167	0.004	−0.140	0.015	−0.115	0.046

r value: Correlation of *Prakriti* with risk factors

hematological parameters and at genome wide expression levels. They also reported that biochemical profiles like liver function tests and lipid profiles and hematological parameters like hemoglobin levels exhibited differences between *Prakriti* types. Thus, they concluded that Ayurveda-based method of phenotypic classification of extreme constitutional types may be utilized to uncover genes that may contribute to system level differences in normal individuals.[2]

Prakriti fundamentally and *dosha* as its applied extension, presented themselves as the central dogma of Ayurveda. Fascinated by its possible application to Ayurvedic diagnostics and for its being as an evidence to help decision making for personalized treatment, it has recently evoked the scientific community to look at the issue in their own perspectives.[26] The identification of biochemical correlates and whole genome expression to the extreme constitutional types as described in Ayurveda.[2] Almost a decade back, *Prakriti* was seriously thought as an important factor determining the final outcome of any therapeutic intervention in a given population. Dahanukar and Thatte in a revealing study were able to correlate the therapeutic outcomes with phenotypical specifications as described in Ayurveda.[27] A definitive role of *Prakriti* to the prevalence and prognosis of rheumatoid arthritis (RA) was identified by Rastogi *et al.* This report identified a *vata-pitta* constitutional subtype as more prone yet fairly treatable fraction among the RA population.[28] Tripathi and others suggest that these basic cardiovascular responses do not vary significantly as per the dual constitutional types and noted a significant fall in the diastolic blood pressure immediately after performing the isotonic exercise for five minutes, in *Vata-Kapha* individuals in

Table 4: Multi-regression analysis of constitutional types with risk factor after adjustment with age, sex, BMI

Parameters	*Vata Kapha* n-187		*Vata Pitta* *n*-51		*Pitta Kapha* *n*-47		*Kapha* *n*-15	
	Beta coefficient	*P* value	Beta coefficient	*P* value	Beta coefficient	*P* value	Beta coefficient	*P* value
Cholesterol	15.122	0.0054	−14.935	0.0334	−3.892	0.5939	−19.21	0.1137
Triglyceride	36.048	<0.0001	−22.917	0.0012	−29.58	<0.0001	−27.199	0.0273
HDL	−10.29	<0.0001	7.659	<0.0001	7.005	<0.0001	8.465	0.0004
LDL	18.210	0.0024	−18.011	0.0202	−4.980	0.5371	−22.235	0.0976
VLDL	7.210	<0.0001	−4.583	0.0012	−5.917	<0.0001	−5.440	0.0273
DM	0.164	0.0053	−0.174	0.0214	−0.051	0.5187	−0.147	0.2628
HTN	0.201	0.0004	−0.168	0.0233	−0.147	0.0556	−0.085	0.5055
DM and HTN	0.145	0.0082	−0.207	0.0034	−0.027	0.7109	−0.024	0.8420
Dyslipidemia	0.543	<0.0001	−0.423	<0.0001	−0.383	<0.0001	−0.347	0.0076
IL-6	73.996	<0.0001	−69.120	<0.0001	−67.96	<0.0001	30.095	0.1325
TNF-alpha	18.832	<0.0001	−19.993	0.0012	−21.378	0.0008	26.163	0.0149
hsCRP	11.776	<0.0001	−11.026	<0.0001	−11.012	<0.0001	5.412	0.0354
Insulin	18.978	0.0002	−13.576	0.0431	−10.041	0.1494	−25.189	0.0296
HOMA-IR	12.115	<0.0001	−9.259	0.0042	−7.820	0.0200	−10.395	0.0640

Beta coefficient: Association of *Prakriti* with risk factors

comparison to the other two groups, namely, Pitta-*Kapha* and *Vata-Pitta*.[11] Udupa KN and others reported that the normal persons with features of *Vata*, *Pitta* and *Kapha* constitutions exhibited a relative preponderance of Blood Cholinesterase, Monoamine oxidase and Histaminase activity, respectively.[7] Ghodke and others carried out CYP2C19 genotyping in 132 unrelated healthy subjects of either gender, and, observed significant association between CYP2C19 genotype and major classes of *Prakriti* types. They reported that the extensive metabolizer genotype was found to be predominant in *Pitta Prakriti*, and the poor metabolizer genotype was highest in *Kapha Prakriti* when compared with other two *Prakriti* groups.[10] 76 subjects were evaluated both for their *Prakriti* and HLA DRB1 types, finding significant correlations in support of it. The study concluded that Ayurveda based phenomes may provide a model to study multigenic traits, possibly offering a new approach to correlating genotypes with phenotypes for human classification.[9] Hence, this study adds to existing knowledge base regarding relation of various *Prakriti* and cardiovascular risk factors.

Dyslipidemia was more common in *kapha vata* subjects and lowest prevalence of 5.9% was found in *vata pitta* subjects. Total cholesterol, triglycerides, VLDL and LDL cholesterol were significantly higher and HDL cholesterol significantly lower in subjects with *VK*. All lipid parameters had positive correlation with *VK* except HDL; which was negatively correlated with *VK*. Prasher et al. found high levels of triglyceride, total cholesterol, VLDL and low levels of HDL in *Kapha* individuals in healthy subjects.[2]

Vata Kapha group had higher number of patients with cardiovascular risk disease than other groups. There are significantly higher number of subjects of DM, HTN and dyslipidemia in *Vata Kapha* type indicating *VK* is common in these conditions. All these risk factors were more prevalent in *VK* type. We could not find any correlation between WHR and BMI with type of *Prakriti*, but contrary to our study, Hankey A said that age and BMI correlates with *Prakriti* of individual.[29] Most of the population based studies have reported relation between WHR and BMI.[30] However, in this study we have taken subjects who underwent coronary angiography and detected CAD. Most of our patients had mean WHR >0.9 and mean BMI >25 which were already higher than normal population according to International and Indian Guideline.[31,32] Hence, probably we did not find the association. Perhaps due to higher individual of dual *Prakriti*, larger study may be required.

Cytokines and inflammatory markers IL6, TNF alpha and hsCRP were high in *Kapha Prakriti* when compared with *VK* and VP, however, in *Vata Kapha* inflammatory markers were high compared to *Vata Pitta* only. However, HOMA-IR and Insulin was more prevalent in only KV ($P<0.0001$ for both) *Prakriti*. Insulin resistance were correlated positively with *VK*. IL6 was positively correlated with KV but not with K. Inflammatory markers; TNF alpha and hsCRP were positively correlated with both *VK* and K group. From an ayurvedic perspective the inflammation (pericarditis) is associated with *Pitta*, while fluid accumulation (pericardial effusion) with *Kapha* and stiffness (constrictive pericarditis) with *Vata*.[33]

Ayurveda identifies five distinct kinds of heart diseases as per their clinical description. This disease classification is essentially the etiological classification where the symptoms originating as result of some specific cause are grouped under the heading of disease. As per the *doshic* distinction of causes, the heart diseases of Ayurveda can either be caused by independent doshas (*vata*, *pitta*, and *kapha*) or a combination (*tridoshaja*) or else as a complication (*krimija*).[34]

The aetiological factors are generally classified as psychological factors, diet, activity, excessive sexual indulgence, suppression of natural urges, alcohol in excess, bacteria, viruses, worms and other toxins, iatrogenic, causes effects of drugs, improper management of disease, abnormal or excess use of emetics, purgatives or enemas, trauma to the heart, complications of other diseases. These will cause abnormal increase or decrease in *Vata*, *Pitta* and *Kapha* and in turn *Rasa* which enters the heart and gives rise the cardiovascular disease.[11] In summary, the eight basic elements that maintain the integrity of the cellular structure and functions of the heart are, *Rasa*, *Rakta*, *Mamsa*, *Ojas*, *Prana vata*, *Vyana vata*, *Sadhaka pitta* and *Avalambaka kapha*. *Rasa vruddhi* and *rasa vikruti* (vitiated) may lead to *kaphaja* heart disease. On the other hand congestive cardiac failure can lead to increased blood volume, due to impaired circulation.[33]

Ayurveda provides insights into the development of the disease process, showing how the doshas when aggravated by certain aetiological factors affect the *dhatus* (tissue) and srotas (channel) of the body, eventually manifesting in disease. Degeneration of the blood vessels is caused by increased *Vata* in the blood vessels, which make them hard, thin, dry and rough. Deposits of lipids and calcium represent deposition of *Kapha* (water and earth element) in the degenerated vessels resulting in irregular thickening of blood vessels. However, no separate data was collected to find out *ahaar* (dietary), *vihaar* (lifestyle), *manas* (psychological) and *hetus* (causes). Moreover, *Hridya* is *kapha* predominant organ hence not predisposed to *pitta vikruti*.

It is important to maintain and protect the volume and composition of *Rasa*, the body fluids, at all times. Any disturbance in *Rasa* can impair the movement of essential nutrients to our bodies cells and organs. This will then affect all our tissues (*dhatus*), *Rakta* (blood), *Mamsa* (muscle), *Meda* (fat), *Asthi* (bone), *Majja* (nervous tissue), *Shukra* (reproductive tissue), *Ojas* (vital fluid) which in turn will effect our sense organs and mind. Any effect to the channel that carries *Rasa* (*Rasa* Vaha Srotas) will cause imbalance in *Rasa*. *Rasa* can be vitiated (*rasa*-dusthi), increased (*rasa*-vruddhi) or decreased (*rasakshaya*). As per modern understanding *meda dhatu* is the adipose tissue. It provides support to *asthi dhatu* and also lubricates the body. The abnormality of *meda dhatu* leads to obesity, accumulation of fat, early syndromes of polyuria, glycosuria, undesirable growth of glands, hyperglyceamia, excessive sweating, etc. However, attributes like Sthira, manda, guru, snigdha and sheeta which in combination with ruksha, khara, tend to cause a *Vata Kapha vikruti* in form of CAD. Any *Prakriti* can develop CAD but *VK* were more predisposed due to aforementioned reasons.

Heart disease occurs as a complication of many diseases: Anemia, infectious fever, rheumatic fever, vatarakta, diabetes, chronic respiratory disease, vomiting, bleeding disorders, worms, alcoholic intoxication, side effects of drugs, neurological disorders.[33] There was no association between Serum bilirubin, ALT, AST, Alkaline phosphatase, total protein, albumin, globulin, calcium, phosphorus, uric acid, sodium, potassium and chloride with individual constitution but study by Prasher et al. showed elevated levels of serum uric acid in *kapha* and serum phosphorus in *pitta* individuals in healthy subjects.[2]

Though, the present study does not suggest any significant association of PK and VP with risk factors and biochemicals but a strong association was found between risk factors (Diabetes, Hypertension and dyslipidemia), Insulin resistance and serum magnesium with individual having *VK* type of *Prakriti*. Similarly, association was found of IL6, TNF alpha, hsCRP with individual having *VK* and K type of *Prakriti*. *VK* was strongly associated with CAD risk factors, whereas other *Prakriti* was not associated and showed reverse association with risk factors, hence other factors like "*ahar, vihar, manas*" may be contributing factor in them.

It may be presumed that dominance of *VK* group has got some positive relationship with cardiovascular risk factors. Insulin resistance, Cytokines and inflammatory markers has got positive relation with *VK* and K group both. These factors may be taken as a lead and further studies may be designated to explore this relationship.

Limitation of the study was male predominance and less number of cases in some groups of *Prakriti*s. Further, no detailed data was collected to find out *ahaar* (dietary), *vihaar* (lifestyle), *manas* (psychological) and *hetus* (causes).

CONCLUSIONS

Half of cardiovascular disease patients have *Vata Kapha* constitution type. It may be concluded that as there is dominance of *Vata Kapha Prakriti* and there is strong correlation with risk factors, insulin resistance, cytokine (IL6) and inflammatory markers. But IL6, TNF alpha

and hsCRP is positively correlated with *Kapha* group also. Hence, identifying an individual with *Vata Kapha* and *Kapha Prakriti* will help in taking precautionary measures for future risk of cardiovascular disease.

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