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Distal Radial Artery Dimensions in Different Body Constitutions (Prakriti)- an Observational Study

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Background: The fundamental principle of *ayurveda* is the *tridosha theory (*three *doshas)*. These *dosha* are the causative and governing bio-energies responsible for the formation of body constitution. The *vata dosha* dominant personality have classical features like a small body frame when compared to *kapha* with large body built and broad anatomical structures. Pittaja body constitution has medium body built with reddish colouration and sharp features.

Aim: This study aimed to correlate the radial artery *intima-media* thickness (IMT) and luminal diameter (LD) and further study its association with different body constitution (*prakriti*) and check the difference between the groups of *prakriti*.

Methods: This observational cross-sectional study was done between May 2021 and June 2021 in the Department of Radiology, KLE Prabhakar Kore Charitable Hospital, Belagavi. Non-randomly selected volunteers ≥23 ±5years (n = 35) were divided into body constitution (*prakriti*) groups and evaluated for the IMT, LD (luminal diameter) of the radial artery using B-mode ultrasonography. Pearson's co-relation was used to test the co-relation between the luminal diameter and intimae media thickness of distal radial artery. Chi-square test of independence was used to check the association between luminal diameter and intimae media thickness of distal radial artery with body constitution. One-way ANOVA was used to study the difference between the groups of *prakriti*.

Results: The mean luminal diameter (LD) in *vataja* body constitution (5%) was 1.450 ± 0.495 mm, *pittaja* body constitution (11%) was 1.750±0.10 mm, *kaphaja* constitution (11%) was 1.70± 0.30 mm, *vatapittaja* body constitution (11%) was 4.15±0.47 mm, *vatakaphaja* body constitution (26%) was 1.64±0.83 mm, *pittakaphaja* constitution (23%) as 2.3±0.15 mm and *samadhatuja* constitution (11%) had 1.8±0.189 mm. The mean intima media thickness (IMT) in *vataja* body constitution (5%) was 0.05± 0 mm, *pittaja* body constitution (11%) was 0.03±0 mm, *kaphaja* constitution (11%) was 0.05± 0.014 mm, *vatapittaja* body constitution (11%) was 0.107±0.09 mm, *vatakaphaja* body constitution (26%) was 0.83±0.07 mm, *pittakaphaja* constitution (23%) was 0.313±0.006 mm and *samadhatuja* constitution (11%) had 0.350 ± 0.012 mm.

As per the analysis a low positive Pearson's correlation was found between IMT and LD (r = 0.254) between the luminal diameter (LD) and intima medial thickness (IMT) of distal radial artery. Chi square test of independence has shown significant association between DRA dimensions (IMT, LD) and body constitution (*prakriti)*, palpatory blood vessel consistency. Among the observed values the v*atakaphaja* body constitution (0.83±0.07 mm) had increased intima media thickness (IMT). Among all the observed values the *vatapittaja* body constitution had broadest DRA luminal diameter (LD) of 4.15±0.47mm. One way ANOVA showed no significant difference between the groups of prakiti and IMT, LD of distal radial artery.

Conclusion: As per the observations of the present study different body constitution *(prakriti*) did not show any significant impact on distal radial artery dimensions (IMT and LD) as there are various factors like hormones, neural, blood volume regulators involved in vascular constriction and dilation. The *prakriti* assessment is a strong marker for prediction and the early diagnosis of diseases. This body constitution (*prakriti*) of an individual is the basic constituent on which the pulse wave variability of distal radial artery (DRA) acts.

Key words: Distal radial artery, Intima-media thickness, Luminal diameter, Naadi Pariksha, Prakriti, Ultra-sonography

Arterial pulse examination is the most ancient practices in the history of traditional medicine practiced all over the globe. Many superficial palpated arteries are listed in this examination. Among all arteries, the distal radial artery is the best for the pulse examination hence this is named as "*Jeeva Naadi*(represents life)" (Murthy, 1997).

In Ayurveda the *panchamahabhoota* theory, three *doshas* theory -*vata, pitta, kapha* (representing the transport functions, metabolic functions, accumulation functions of the body respectively), are the fundamentals of body functioning. The arterial pulse wave variability (PWV) signifies the physiological components like *doshas (*various bio-chemical regulatory factors*).* Various *naadi* features like feeble pulse, a thin, low-pressure pulse is seen in *vataja naadi*, high pressure, warm pulse felt in *pittaja naadi*, medium pressure and volume with slow pulse felt in *kaphaja naadi* (Pandey, 2019) . The pulse wave variability is represented through many factors like pulse rate, rhythm, pulse wave amplitude, arterial luminal diameter, arterial intima media thickness. The perception of pulse waves depends on the blood vessel consistency. The blood vessel consistency in *vataja* body constitution as per classical text has increased the number of blood vessel networks, with small arterial lumen, *pittaja* body constitution will have a medium arterial lumen, *kaphaja* body constitution had broad arterial lumen (Govindaraj *et al.*, 2015). In Ayurveda, body constitution *(Prakriti)* is a thoughtful phenotype that is determined on the basis of physical, physiological, psychological, and behavioural traits. There are seven types of *Prakriti* mentioned in the classics (Bhushan, *et al.*, 2005). Earlier studies have reported association of *Prakriti* with various single nucleotide polymorphisms in HLA-DRB1, inflammatory and oxidative stress-related genes (Juyal *et al.* 2012), CD markers for blood cells (Rotti *et al.* 2014; Rotti *et al.* 2014a). Studies have reported the risk of cardiovascular risk factors associated with *vatakapha* and *kapha* body constitution (Mahalle, Kulkarni 2012). The *Prakriti* (genetic body constitution) of an individual was determined using *Naadi vijyana* (pulse-based diagnosis) by age-old Ayurveda physicians (Dey, Pahwa, 2014).

The objective of this study is to study the co-relation between LD (luminal diameter) and IMT (intima-media thickness) of the distal radial artery, study the association between the distal radial arterial luminal diameters, intimae media thickness with the different body constitution (*Prakriti*), and study the difference of LD,IMT of distal radial artery between the groups of *Prakriti* in healthy middle-age volunteers.

MATERIALS AND METHODS

Study design and site:

This observational cross-sectional study was done between May 2021 and June 2021 in the Radiology Department of Radiology, KLE Prabhakar Kore Charitable Hospital Belagavi. This institutional ethical clearance was obtained and CTRI registration was done for his study (CTRI /2021/04/032940). The non-randomly selected volunteers ≥23 ±5years old (n = 35) were divided into body constitution (*Prakriti)* groups and evaluated for the body constitution (*Prakriti*) using a questionnaire, IMT (intimae medial thickness), LD(luminal diameter) of the radial artery were measured by B-mode ultrasonography.

P*rakriti* evaluation:

The body constitution (*Prakriti*) of the healthy volunteers was assessed using a validated questionnaire based on physical, physiological, and psychological characteristics by an expert Ayurveda physician (Rastogi, 2012; Ghodke *et al.*, 2011). The *Prakriti* features were given a score of one each and the total % (percentage) was considered, if any specific *Prakriti* was allotted a score ≥of 60 %, then dominance of single *dosha* was considered. If there is a predominance of two *dosha* score of each ≥40% then the combination of two *dosha* was considered. The volunteers were recruited only after 80% concordance of questionnaire results with clinical evaluation by Ayurveda physician (Table 1).

Participants screening and study population:

Total of 40 healthy volunteers was screened for Prakriti assessment and USG for distal radial artery.

Inclusion criteria: Healthy volunteers of both male

and female gender ≥23±5years, whose Prakriti assessment was done without any bias, whose distal radial artery parameters were obtained with USG were included in the study.

Exclusion criteria: The volunteers whose blood vessel wall had very thin consistency, which got compressed in B-mode ultrasonography, and unhealthy volunteers with or without medications were excluded from the study.

Ultrasound Doppler to obtain DRA (distal radial artery) Pulse data:

The apparently healthy volunteers fulfilling the inclusion criteria were asked to relax for 10 minutes and later pulse examination was done using 3hz B-mode ultrasonography probe at 3 sites on the distal radial artery. The standard three finger examination method (index finger for *vata sthana*, middle finger for *pitta sthana*, ring finger for *kapha sthana*) explained in the classics was followed which states that the pulse data must be collected from the three consecutive sites from 2.1 ± 0.5cm (1 *angula*) (Shirodkar, Mehmod, 2014) from the wrist joint representing *vata* (the distal part near the wrist joint examined by index finger), *pitta* (middle finger), *kapha sthana*(ring finger). As per the classical guidelines male volunteers radial pulse was examined in the right hand and female volunteers pulse was examined in the left hand. The volunteers were palpated manually for pulse parameters like pulse rate, pulse rhythm, blood vessel consistency (elastic thin, elastic soft with a medium consistency, and elastic thick and broad in palpation). The volunteer's distal radial arterial pulse data namely IMT, LD (luminal diameter) was captured through a B-mode ultrasound Doppler probe by an expert radiologist. The probe was specially positioned transversely such that individual data from 3 consecutive sites can be captured. The data obtained was statically analyzed using the chi-square test of independence for testing the association between the IMT, LD (luminal diameter) of distal radial artery and body constitution (*prakriti*) of the same individual.

Statistical analysis:

The observed data was statically analysed using SPSS software. The Pearson's Co-relation test was used to study the co-relation of IMT and LD of the distal artery in a 2X2 table. Further Chi-square test of independence was used to study the association of different body constitution with IMT and LD of the distal radial artery. One-way ANOVA test was used to test the difference between the means of luminal diameters and means of IMT (intima-media-thickness) in between different groups of *prakriti.*

OBSERVATIONS

Distribution of volunteer's in different body constitution (*prakriti)*:

Total 35 volunteers fulfilled the inclusion criteria were distributed in 7 categories of prakriti 6% vataja, 11 % in pittaja, 11% in kaphaja, 11% in vatapittaja, 26% in vatakaphajaprakriti, 22% in pittakaphaja and 11% samadhatuja prakriti. (Table 2)

Among 35 volunteers selected for the study the intimae medial thickness (IMT) of distal radial artery for *vata prakriti* is 0.05±0 mm, *pitta prakriti* is 0.03±0 mm, *kapha prakriti* is 0.05±0.014 mm. *Vatapitta prakriti* has 0.107±0.09 mm, *Vatakapha prakriti* has 1.6±0.083 mm, *Pittakapha prakriti* has 0.313±0.006 mm, *Samadhatuja Prakriti* has 0.350 ± 0.012 mm.

Among 35 volunteers selected for the study the luminal diameter (LD) of distal radial artery for *vata prakriti* is 1.450±0.049 mm, *pitta prakriti* is 1.750±0.010 mm, *kapha prakriti* is 1.70±0.03 mm. *Vatapitta prakriti* has 4.15±0.048 mm, *Vatakapha prakriti* has 1.6±0.083 mm, *Pittakapha prakriti* has 2.313±1.5 mm, *Samadhatuja Prakriti* has 2.0 ±0.189 mm.

RESULTS

Association between different body constitution (prakriti) and Distal Radial arterial diameter

Among 35 healthy volunteers 2 volunteers of *vataja prakriti* had average diameter of 0.14cm, 4 volunteers *pittaja prakriti* had average diameter of 0.57cm, 4 volunteers *kaphaja prakriti* had average diameter of 0.15cm, 4 volunteers *vatapittaja prakriti* had average diameter of 0.41cm, 9 volunteers *vatapittaja prakriti* had average diameter of 0.16cm, 8 volunteers *pittakaphaja prakriti* had average diameter of 0.23cm, 4 volunteers *samadhatuja prakriti* had average diameter of 0.17cm. (Table 3).

The Pearson chi-square test of independence for analysing the association between palpatory blood vessel consistency type and arterial diameter on USG is 0.35 with degree of freedom 180 at 5% level of significance. The obtained chi-square value is less than the α-value, hence shows significant results. Thus rejecting the null hypothesis. This shows there is association between the body constitution (*prakriti*) and distal radial arterial luminal diameter on USG (Fig. 1)

Association between Prakriti and IMT(intima media thickness) of distal radial artery

Among 35 healthy volunteers, 2 volunteers of *vataja prakriti* had an average IMT of 0.05mm, 4 volunteers *pittaja prakriti* had an average IMT of 0.03mm, 4 volunteers *kaphaja prakriti* had an average IMT of 0.05mm, 4 volunteers *vatapittaja prakriti* had an average IMT of 0.1mm, 9 volunteers *vatakaphaja prakriti* had an average IMT of 0.08mm, 8 volunteers *pittakaphaja prakriti* had an average IMT of 0.03mm, 4 volunteers *samadhatuja prakrati* had average IMT of 0.03mm. (Table 4)

The Pearson chi-square test of independence for analysing the association between palpatory blood vessel consistency type and arterial diameter on USG is 0.153 with degree of freedom 156 at 5% level of significance. The obtained chi-square value is less than the α-value, hence shows significant results. Thus rejecting the null hypothesis. This shows there is association between the prakriti type and arterial intima media thickness (IMT) in USG (Fig.2)

Co-relation between luminal diameter (LD) and intima medial thickness (IMT) of distal radial artery.

Pearsons's Co-relation shows low positive co-relation (r = 0.254) between the luminal diameter (LD) and intima medial thickness (IMT) of distal radial artery.

Testing difference between and within the groups:

A one-way ANOVA revealed that there was not a statistically significant difference in [luminal diameter of DRA] between at least two groups of F [between groups df(degree of freedom) =6, within groups df= 28] = [F- 1.099, p = 0.05). The one-way ANOVA for IMT of DRA revealed that there was not a statistically significant difference in [IMT of DRA] between the at least two groups F (between groups df =26, within groups df= 32) = [F- 2.919, p = 0.05). Thus One way ANOVA shows no difference seen in LD, IMT of distal radial artery with different *prakriti*.

Table. 1. *Prakriti* evaluation questionnaire (Rastogi, 2012)

Body Constitution			
	*Vata d*ominant	*Pitta* dominant	*Kapha* dominant
Inspection (*Darshana Pariksha*)	1.Emaciated, 2.Short body frame 3.Cracked skin 4.Tendency of Tremors and shivering 5.Prominent veins and Tendons	1. Clear skin, early wrinkles 2. Yellowish tinged 3.Delicate body 4. red marks, pimples, 5.Black moles	1. Compact body 2.Well built, plump 3.Clear skin 4. Though joints 5.Firm thick curly hairs
Palpation (*Sparshana Pariksha*)	6. Very dry skin, 7. Dry dusty hairs	6. Soft muscles 7. Coppery soft hairs	6. oily, smooth skin 7. cold temperature
Interrogation (*Prashna Pariksha*)	8. Dry Voice 9. Low pitch voive 10. Obstructed voice 11. Less sleep 12. Less appetite 13. Irregular eating 14.Quick movements 15.Talkative 16. Less memory 17. Quick to understand 18. Less stress tolerance 19.Restless 20.Cracking in joints	8.High pitch voice 9. Increased sweating, 10. Increased urine 11.Increased fluid intake 12. High appetite 13. Voracious eater 14. Moderate sleep 15. Hostile debator 16. Quick temper 17.Moderate spiritual 18. Moderate materialistic 19.Very aggressive Low tolerance 20.Foul smell	8. Pleasant voice 9.Soft voice 10.Minimum sweating 11.Sticky sweating 12. Slow movements 13.Slow eaters 14. Less thirst 15. Less appetite. 16.slow to begin 17. Excessive Paitence 18.Determined 19. High stress tolerance 20. Calm

Table 2. Distribution of volunteer's in different body constitution (*prakriti*)

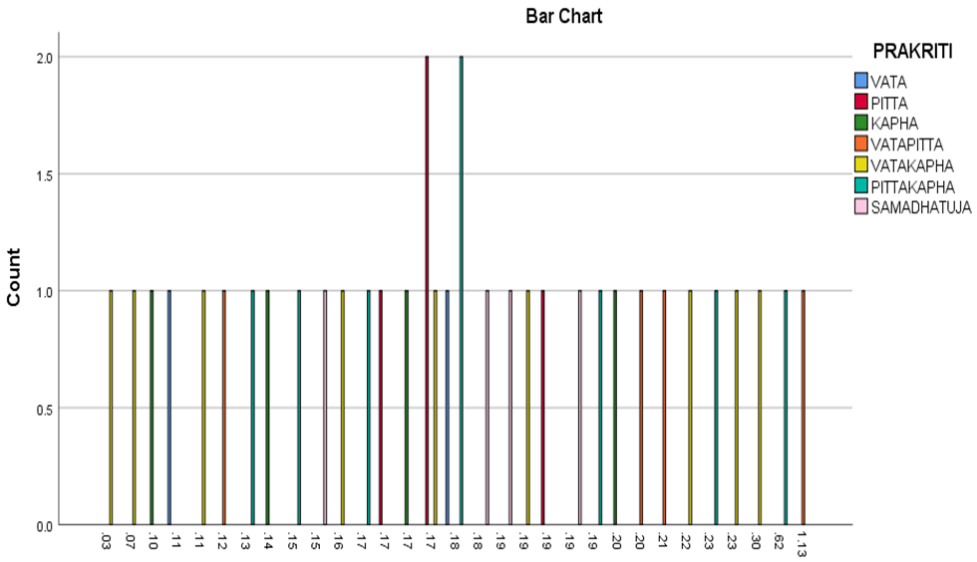
Body constitution(prakriti)	No. of volunteers	Mean LD* ±SD[#]	Mean IMT[1] ±SD
Vata prakrati	2	1.450±0.049 mm	0.050±0.000 mm
Pitta prakrati	4	1.750±0.010 mm	0.030±0.000 mm
Kapha prakriti	4	1.700±0.030 mm	0.050±0.014 mm
Vatapitta prakrati	4	4.150±0.048 mm	0.107±0.090 mm
Vatakapha prakriti	9	1.600±0.083 mm	0.830±0.070 mm
Pittakapha prakriti	8	2.313±1.500 mm	0.313±0.006 mm
Samadhatuja prakriti	4	2.000±0.189 mm	0.350±0.012 mm

*LD-luminal Diameter, [#]-S.D- standard deviation, [1]- IMT-intima-media thickness

Figure1. USG distal radial artery

Table 3. Chi-square test to check the association b/w Prakriti and LD.

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	186.991[a]	180	0.345
Likelihood Ratio	121.281	180	1.000

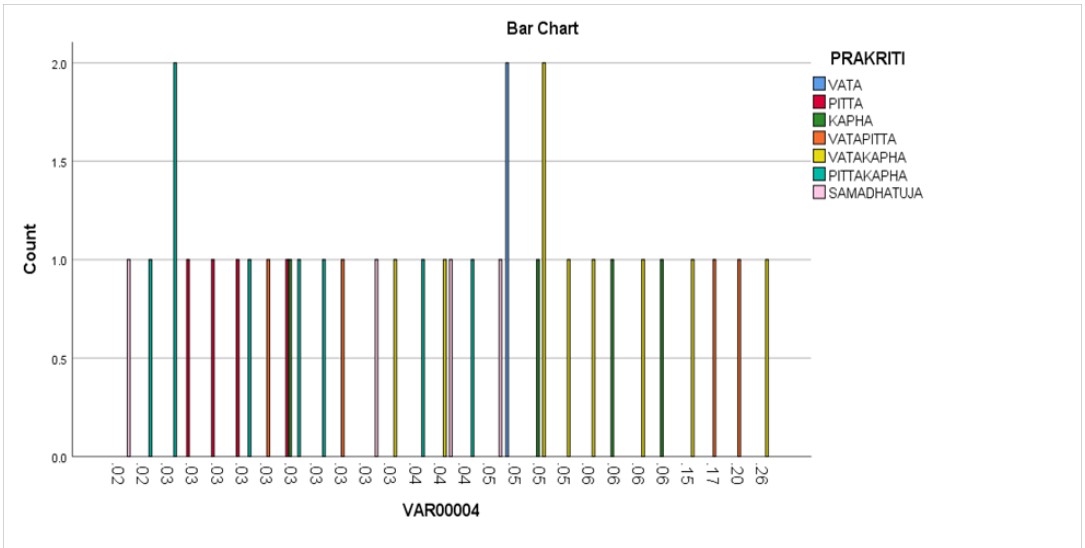


Graph 1: Association b/w Prakriti and LD.

Table 4. Chi-square test to check the association b/w Prakriti and IMT

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	174.109[a]	156	0.153
Likelihood Ratio	112.963	156	0.996

[Δ] Intima media thickness



Graph 2: Association b/w Prakriti and IMT

DISCUSSION

In the present study, distal radial artery dimensions were observed using B–mode ultrasonography. The correlation of luminal diameter (LD) and intimae media thickness (IMT) of the artery was studied and further, the association between body constitution *(Prakriti)* and DRA luminal diameter (LD) and intima-media thickness (IMT) was analysed in this study. Earlier studies by Norimastu *et al.* (2019) on measurement of distal radial artery (DRA) with ultrasonography stated that the distal radial artery (DRA) vessel diameter in the anatomical snuffbox (2.6 ± 0.5 mm) was significantly smaller than that of the proximal radial artery (PRA) which is the conventional puncture site (3.1 ± 0.4 mm) of the radial artery (Norimatsu *et al.*, 2019). Some difference in vessel luminal diameter between the DRA and PRA was 0.5 ± 0.4 mm, and the DRA/PRA ratio was 0.8 ± 0.1. Although the vessel diameter of the DRA was positively correlated with that of the PRA ($r = 0.66$, $p < 0.0001$). Takayuki et al 2019 studied the ultrasonography of the distal radial artery (DRA) on male and female volunteers before angiography on 120 patients. In male patients, the conventional puncture (CRA) site of the radial artery had diameters of 2.62 ± 0.60 mm and DRA was 2.04 ± 0.43 mm. In females, these diameters at CRA were 2.44 ± 0.51 mm and DRA was 1.96 ± 0.44 mm (Takayuki *et al.*, 2019).

Tarif *et al.* (2010) studied the size of the radial artery with a mean diameter of the right artery of 2.3±0.4mm and a left radial artery was 2.2±0.4mm. The factors which influence the size of radial artery dimensions like male sex, diabetes mellitus, and smoking were enlisted. The other factors like body size parameters height, weight, body mass index have low positive correlation with the radial arterial dimensions ($r=0.28$, $r-= 0.07$, $r=0.30$) respectively (Tarif *et al.*, 2010). The present study focuses on the association between the body constitution and IMT, LD of the Distal Radial artery. The mean luminal diameter observed in *vataja Prakriti* with small and narrow blood vessel (*alpa)* was smaller (1.450 ± 0.495 mm) than the *pittaja* body constitution with medium blood vessel diameter (2.050±0.1mm), *kaphaja*

constitution with broad blood vessel lumen didn't show marked results (2.0± 0.3mm). Among all the *vatapittaja* body constitution had a more luminal diameter of 4.15±0.47mm, *vatakaphaja* body constitution was 1.64±0.83mm, *pittakaphaja* constitution was 2.3±0.15mm and s*amadhatuja* constitution had 1.8±0.189mm.

The mean intima-media thickness (IMT) in *vataja* body constitution which is believed to have narrow blood vessels had 0.05±0 mm of thickness, *pittaja* body constitution with soft elastic blood vessels had IMT of 0.03±0 mm, *kaphaja* constitution with thick elastic blood vessel had thicker IMT of 0.05± 0.014 mm, v*atapittaja* body constitution had 0.107±0.09 mm, *vatakaphaja* body constitution had 0.83±0.07 mm, p*ittakaphaja* constitution was 0.313±0.006 mm and *samadhatuja* constitution had 0.350±0.012 mm. Among the observed values, the *vatakaphaja* body constitution was 0.83±0.07 mm had increased thickness. Earlier studies have shown that obese volunteers had increased IMT and decreased pulse wave velocity as felt in *kaphaja naadi* (pulse) (Dangardt, 2008). The One-way ANOVA has shown no significant difference in luminal diameter, IMT of DRA in different *prakriti.* But as per the observation the values of F (ANOVA) for IMT are nearing significance, which shows that there may be some difference seen in IMT of distal radial artery between the *prakriti.* Thus the further scope of study is to conduct the same study with more sample size.

CONCLUSION

The study had observed that high resolution ultrasonography is the convenient tool that can be adapted to study the IMT and LD of the distal radial artery. Further the observations have shown that *vatapittaja* body constitution had more luminal diameter of 4.15±0.47mm, v*atakaphaja* body constitution was 0.83±0.07mm had increased intimae media thickness (IMT). One way ANOVA shows *prakiti* (body constitution of an individual) had a no significant role in judging the luminal diameter, intima-media thickness of the distal radial. As per the observations of the present study, there is a scope of difference of IMT (intima-media thickness) between the *prakriti*, which can be further scope of study with more sample size.

CONFLICTS OF INTEREST

The authors declare that they have no potential conflicts of interest.

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