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Original Article

# Effect of yoga training on lipid metabolism in industrial workers with reference to body constitution (*Prakriti*)

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ABSTRACT

*Introduction:* The progressive increase in dyslipidemia and physical inactivity are considered to be major risk factors for the onset of non communicable diseases. Awareness of body constitution plays a vital role to regularise optimum health. The present study was planned to evaluate the effect of yoga practices on lipid metabolism with reference to specific body constitution (*Prakriti*).

*Methods:* A *self-as-control* study was conducted on 36 male healthy volunteers between age group of 30–58 years. Their *prakriti* analysis was done using standardized, validated questionnaire and were divided into *Vata-Pitta* (n = 16) and *Pitta-Kapha* (n = 20) groups. The assessment of lipid profile was done in fasting blood samples before and after 12 weeks of yoga training. Data were analyzed using paired t-test and independent t-test.

*Results:* After yoga intervention, the result of within group comparison revealed that in *Vata-Pitta* (V-P) group, significant decrease in the levels of TC, LDL ($p < 0.001$) and significant increase in HDL ($p < 0.01$) was observed. While, *Pitta-Kapha* (P-K) group showed significant decrease in TC ($p < 0.001$), TG ($p < 0.01$), LDL ($p < 0.001$) and VLDL ($p < 0.05$) levels. Further, the results between groups revealed that P-K group has significantly higher baseline levels of TC, TG and VLDL as compared to V-P group ($p < 0.05$).

*Conclusion:* The study concludes that yoga practices can effectively regulate lipid metabolism and total body energy expenditure with reference to specific constitutional type (*Prakriti*) that may act as a tool to assess magnitude of metabolic functions.



## 1. Introduction

Non Communicable Diseases (NCDs) such as Cardio Vascular Diseases (CVD), Type-2 diabetes, obesity, cancer etc. are recognised as Global burden towards morbidity and mortality.[1] The major global death rates in NCDs comprises of CVDs and Type-2 diabetes as a main leading cause where, one fourth of them will occur before the age of 60.[2] Dyslipidemia and physical inactivity are the established risk factors for the onset of NCD[3,4] and high cholesterol levels seem to cause 2.6 million deaths annually.[5] Apart from this, industrial or factory workers are more prone towards ill effects of air pollutants[6] that lead to hyper lipidemia, which seems to have a possible association with cardiovascular morbidity and mortality.[7,8] Several reports are evident towards reversal of cardiovascular and their associated multiple risk disorders through the modification of serum lipid profile.[9,10] However, lifestyle modification for lowering the cholesterol levels has been given a prime importance.[11] The crux of ancient Indian traditional sciences such as Yoga and Ayurveda mainly focus on healthy lifestyle to balance body – mind functions. There are several scientific reports that reveal the beneficial effects of yoga or physical activity towards improvement of lipid metabolism, as well as, reduction in obesity.[3,12] The Ayurvedic concept of *prakriti* or body constitution plays a vital role towards regulation of optimum health, that has shown a strong association with many psycho-physiological and biochemical parameters.[13,14] Since, there have been several limitations to prevent the progression of metabolic disorders, due to individual metabolic variability,[15] hence this study hypothesizes that intervention of

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yoga practices would regulate lipid metabolism with reference to specific *prakriti.*

## 2. Materials and methods

### 2.1. Subjects

In this *self-as-control* study design, 65 healthy male volunteers aged between 30–58 years were enrolled from Nagargaon Industrial estate, Lonavla. Among them, 5 subjects dropped out due to the lack of interest and time. The study was approved by Institutional Ethics Committee (IEC) of Kaivalyadhama Yoga Institute, Lonavla (Kdham/SRD/IEC-04) and was initiated at Scientific Research Department of the institute with written consent of the subjects duly taken. The health fitness examination of the participants was done by residential medical officer of the institute. The participants who are normal, healthy with no background of yoga practice were selected for study and those suffering from diabetes, cardiovascular disorders, physical or mental disabilities, were excluded. The 60 subjects were randomized and assessed to categorize for *prakriti* groups. Among them, 58 subjects with *prakriti* having dual dominant *doshas* such as *Vata-Pitta* (n = 25), *Pitta-Kapha* (n = 23) and *Vata-Kapha* (n = 10) were included for the study, while, remaining 2 subjects with *prakriti* having single dominant *doshas* were excluded. They were allocated for 12 weeks of yoga training. However, in post test, 20 subjects dropped out due to their absence and 36 subjects of *Vata-Pitta* (n = 16) and *Pitta-Kapha* (n = 20) groups were recruited for the study, while, *Vata-*

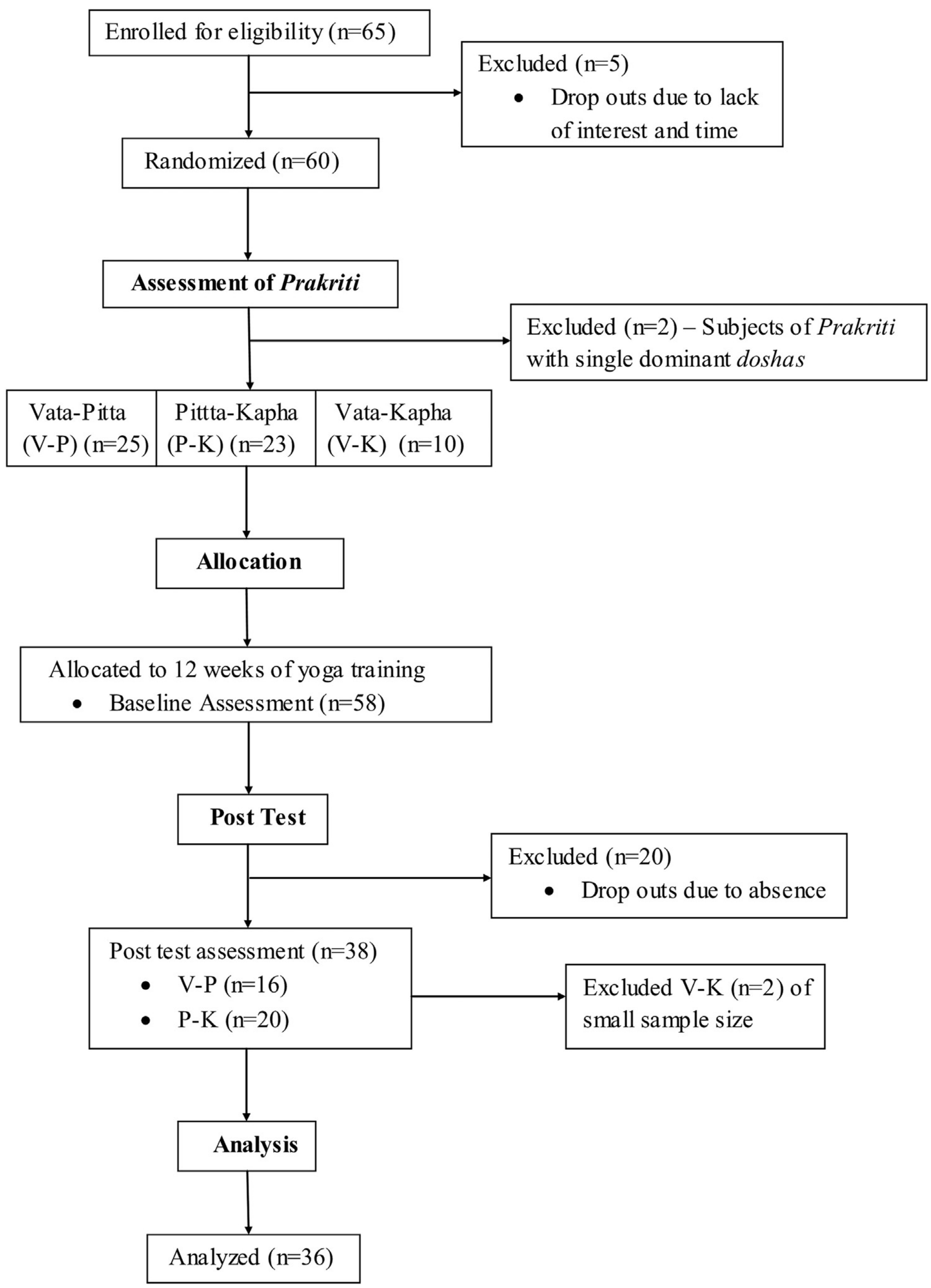


**Fig. 1.** Flow diagram of Subjects' enrolment procedure.

*Kapha* (n = 2) group with small sample size was excluded. The fasting blood samples were collected before and after 12 weeks of yoga training to evaluate the effect of yoga practice on lipid profile of the participants. The selection criteria of subjects enrolment is described in Fig. 1.

### 2.2. Prakriti analysis[16]

The *prakriti* analysis was done using a standardized and validated questionnaire, based on the descriptions from various Ayurvedic texts. It comprises 37 objective questions related to physical characteristics, physiological habits and psychological make-up of an individual. Each *dosha* namely *Vata* (V), *Pitta* (P) and *Kapha* (K) carries three options. On the basis of responses given by a person in each column of V, P, K followed by interview and physical examination by an *Ayurvedic* physician, the dominance of specific *prakriti* was identified. The responses were computed to obtain final percent score. The percent score of particular *dosha* with >50% was considered as predominant *dosha*, while score between 25%–35% was categorized as secondary *dosha* in *prakriti*. The volunteers were classified as three groups namely *Vata-Pitta, Pitta-Kapha* and *Vata-Kapha*. While designating *prakriti*, individuals of *Vata-Pitta* or *Pitta-Vata*, *Pitta-Kapha* or *Kapha-Pitta* and *Vata-kapha* or *Kapha-Vata* were considered to be equivalent.

### 2.3. Lipid profile assessment[17]

The biochemical assessment of lipid profile included Total Cholesterol (TC), Low Density Lipoprotein (LDL), Very Low Density Lipoprotein (VLDL), Triglyceride (TG) and High Density Lipoprotein (HDL). The subjects were advised to come with fasting overnight and 5 ml of blood samples from each one were collected from ante cubital vein using a tourniquet with all aseptic conditions. The separation of serum samples from blood were done by centrifugation at 1000 g for 10 min using Vacutainer blood collection tubes (Becton Dickinson), after the blood was allowed to clot at room temperature for 30 min. The determination of TC, TG and HDL were done by the enzymatic method, while LDL and VLDL were done by using Friedwald's equation. The enzymatic assessment was done by using biochemical assay kits, prescribed for the analyzer Statfax-2000 (Awareness technology, USA).

### 2.4. Yoga intervention

The yoga training was imparted daily for an hour with duration of 12 weeks excluding holidays. The yoga schedule was prepared as per the tradition of Kaivalyadhama Yoga Institute, Lonavla, and the sessions of yoga were conducted by yoga expert appointed by the institute. The yoga training module is described in Table 1.

### 2.5. Statistical analysis

Statistical analysis was done using SPSS (Statistical Package for the Social Sciences), version 20.0 statistical software. Data were analyzed using paired t-tests and descriptive statistical method. Independent t-test was used for between groups comparison at baseline. The pre-post mean values ± SD of variables are presented in Table 3.

## 3. Results

The demographic data of subjects are described in Table 2. It has been found that Weight and BMI of *Pitta-Kapha* group was significantly higher as compared to *Vata-Pitta* group ($p < 0.001$). After yoga intervention, the result of within group comparison revealed that *Vata-Pitta* (V-P) group showed significant decrease in the levels of TC and LDL ($p < 0.001$), while significant increase was observed in HDL ($p < 0.01$). The change in levels of TG and VLDL was not significant ($p > 0.05$). In *Pitta-Kapha* (P-K) group, there was significant decrease in TC ($p < 0.001$), TG ($p < 0.05$), LDL ($p < 0.001$) and VLDL ($p < 0.05$) levels with no significant change in HDL ($p > 0.05$). Further, the results between groups revealed that P-K group has significantly higher baseline levels of TC, TG and VLDL as compared to *Vata-Pitta* group ($p < 0.05$). The trend of results is schematically presented in Table 3 and Fig. 2.

**Table 1**
Yoga training module.

| Name | Duration |
|---|---|
| Shavasana | 2–5 min adding 1 min per week |
| Ardha Halasana (half-plough pose) | 5 s initially, adding 5 s per week until forty five seconds |
| Viparita karani (inverted pose) | " |
| Matsyasana (fish pose) | " |
| Naukasana (boat pose) | " |
| Setubandhasana (bridge pose) | " |
| Bhujangasana (cobra pose) | " |
| Ardha shalabhasana (half locust pose) | " |
| Shalabhasana (locust pose) | " |
| Dhanurasana (bow pose) | " |
| Vakrasana (twisted pose) | " |
| Gomukhasana (cow face pose) | " |
| Paschimatanasana (forward bending pose) | " |
| Supta vajrasana (reclining adamant pose) | " |
| Ushtrsana (camel pose) | " |
| Chakrasana (wheel pose) | " |
| Utkatasana (chair pose) | " |
| Vrikshasana (tree pose) | " |
| Tadasana (mountain pose) | " |
| Anulom- Vilom | 5–10 min per day |
| Bhramari | 10 times per day |
| Ujjayi | 11 times per day |
| Kapalabhati | 5–10 min per day |
| Om Chanting | 5 min per day |

**Table 2**
Demographic data of subjects as per *prakriti.*

| Variables | *Vata-Pitta* | *Pitta-Kapha* |
|---|---|---|
| n | 16 | 20 |
| Age, years (Mean ± SD) | 42.68 ± 7.84 | 40.65 ± 8.25 |
| Height, cm (Mean ± SD) | 164.93 ± 5.35 | 164.3 ± 4.23 |
| Weight, kg (Mean ± SD) | 56.40 ± 6.96 | 66.15 ± 8.86* |
| BMI (Mean ± SD) | 20.66 ± 2.19 | 24.8 ± 2.8* |

SD: Standard Deviation, BMI: Body Mass Index.
*$p < 0.001$, t = 4.96 as compared to *Vata-Pitta.*

## 4. Discussion

This study has been taken to find out the yoga practice effect on lipid metabolism in subjects of specific *prakriti*. The participants included in the study were industrial workers who are directly exposed towards air pollutants. Many studies reported that occupational exposure to air pollutants is at more health risk than any other means[18,19] leading to potential increase in dyslipidemia, metabolic syndrome and other chronic disorders.[20,21] Further, in population based study, people exposed to ambient air pollution found to have higher levels of TG and reduced HDL.[22] The lipoproteins are considered as one of the source for modulation of metabolism.[23] In Ayurveda, each individual is characterised with unique body constitution or *prakriti* that represents biological specificity at cellular level.[24] The constituents of *prakriti* (*tridosha*) as functional units at cellular level, reflects metabolic variability

**Table 3**
Pre-post test results on lipid profile with 12 weeks of yoga training as per *Prakriti*.

| Lipid Profile | *Vata-Pitta* (V-P) | | t-Value | *Pitta-Kapha* (P-K) | | t-Value | V-P vs P-K at baseline (t-value) |
|---|---|---|---|---|---|---|---|
| | Pre (Mean ± SD) | Post (Mean ± SD) | | Pre (Mean ± SD) | Post (Mean ± SD) | | |
| TC | 167.06 ± 21.32 | 158.13 ± 18.38 | 4.75*** | 185.8 ± 26.56 | 174.2 ± 25.90 | 4.92*** | 2.34* |
| LDL | 106.08 ± 17.66 | 96.65 ± 14.49 | 4.73*** | 115.69 ± 19.07 | 106.72 ± 19.38 | 3.63*** | 1.56 |
| VLDL | 21.66 ± 7.98 | 22.03 ± 7.60 | 0.41 | 29.46 ± 12.55 | 27.1 ± 11.8 | 2.21* | 2.26* |
| TG | 108.31 ± 39.90 | 110.19 ± 38.02 | 0.41 | 147.3 ± 62.78 | 135.4 ± 59.13 | 2.21* | 2.26* |
| HDL | 39.31 ± 3.05 | 40.63 ± 2.03 | 2.83** | 40.65 ± 3.78 | 40.95 ± 3.06 | 0.84 | 1.17 |

SD = Standard Deviation, TC = Total Cholesterol, LDL = Low Density Lipoprotein, VLDL = Very Low Density Lipoprotein, TG = Triglyceride, HDL = High Density Lipoprotein.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

such as *vata* as varied, *pitta* as fast and *kapha* as slow in metabolism.[25] Based on the dominance of *tridosha* with distinct proportions, the *prakriti* is categorized as seven types with single, dual or equilibrium combination.

Several studies with lifestyle intervention such as yoga, exercise etc., reveal beneficial effects towards restoration and regulation of lipid metabolism.[3,12,26] These findings have a fair corroboration from the results of present study, where in, 12 weeks of yoga training showed significantly decreased levels of TC and LDL in both V-P and P-K group along with TG, VLDL levels in P-K group and enhanced HDL in V-P group (Table 3). This could infer that through yoga practice, there will be activation of Carnitine Palmitoyl Transferase (CPT) system and sterol regulatory element binding proteins, which have a major role in fatty acid metabolism.[10,27] The presence of *Pitta* (P) in both V-P and P-K group suggests higher baseline energy expenditure with more mitochondrial activity.[28] Previous study reported that people with dominant *Kapha dosha* (K) exhibit more risk towards metabolic syndrome like cardiovascular disorders, dyslipidemia and obesity.[29] This could be due to increased visceral adipose tissue that further elevates TG-VLDL secretion and impairs glucose tolerance, insulin resistance etc.[10,21,22] In this direction, it can be inferred that in P-K group, an observed higher levels of TC, TG and VLDL as compared to V-P group ($p < 0.05$) is due to the presence of K with more adipose tissue mass and energy storage. However, after yoga practice in P-K group, adipose tissue lipolysis can occur through increased blood flow that facilitates greater transport of catecholamine,[27] where, from Ayurvedic viewpoint, the catecholamine is co-related with P.[30] It is evident that subjects with V-P body constitution posses lesser BMI[16] where, the same is reflected in present study (Table 2) as compared to P-K. Further, an enhanced post HDL level in V-P group may be due to *Vata dosha* (V) which is known to have higher HDL[13] and the circulatory effect of V[28] could lead to greater activation of malonyl CoA-regulated CPT system towards fatty acid mobilization.

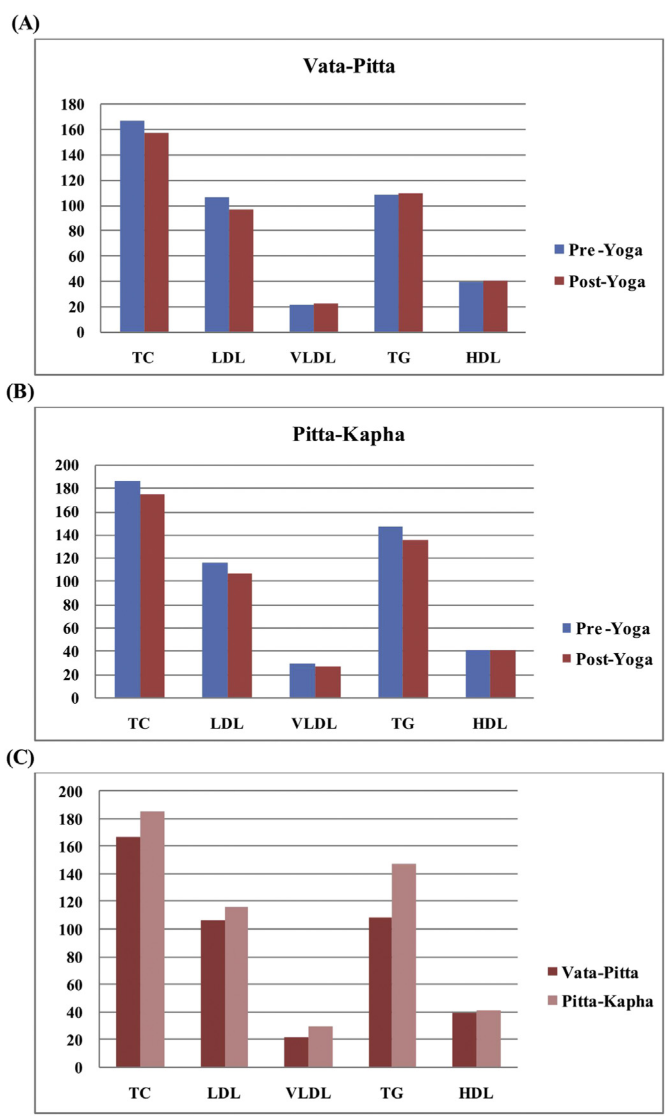


**Fig. 2.** Yoga training effect on lipid profile as per *prakriti* groups: A) *Vata-Pitta* (V-P), B) *Pitta-Kapha* (P-K) C) Baseline lipid profile comparison between V-P and P-K.

The findings of study suggests that yoga practices can improve lipid metabolism in specific constitutional types where, P-K group need yoga practices of moderate intensity as compared to V-P group, to improve lipid metabolism with balanced ratio of low to high density lipoproteins. This is of importance, as it would be beneficial to differentiate mode of yoga intervention as per the constitutional type as well as, people exposed with occupational hazards particularly, industrial workers are at more risk of developing NCD and metabolic syndrome. Although, present study had small sample size, the obtained results are promising. Further studies are recommended on large sample size and on subjects of other *prakriti* types such as Vata-Kapha as well as of single dominant *doshas* to explore the beneficial effects of yoga.

## 5. Conclusion

The study concludes that yoga practices can effectively regulate the lipid metabolism and total body energy expenditure with reference to specific body constitutional type (*Prakriti*) that may act as a tool to assess magnitude of metabolic functions.

## Conflict of interest

None declared.

## Source of support

Nil.

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