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Ayurveda Body–Mind Constitutional Types and Role of Yoga Intervention Among Type 2 Diabetes Mellitus Population of Chandigarh and Panchkula Regions

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Abstract

Background: Type 2 diabetes needs a better understanding of etiological factors and management strategies based on lifestyle and constitutional factors, given its high association rate with many cardiovascular, neurological disorders, and COVID-19 infection.

Purpose: The present study was undertaken to investigate the effect of Diabetes-specific integrated Yoga lifestyle Protocol (DYP) on glycemic control and lipid profiles of diabetic adults. Along with the DYP intervention, the individuals residing in Chandigarh and Panchkula union territories in the northern part of India were assessed for Ayurveda-based body–mind constitutional type. Ayurveda describes body–mind constitution as "*prakriti*," which has been discussed from two angles, namely physiological and psychological as body and mind are correlated.

Methods: Cluster sampling of waitlist control study subjects was used as the sampling method for the study. A total of 1,215 registered subjects (81 diabetic) responded in randomly selected clusters in Chandigarh and Panchkula. Ayurveda physicians did Ayurveda body–mind constitutional assessment called *prakriti assessment* (physiological body–mind constitution assessment) in 35 participants (23 diabetic, 12 prediabetic) as a part of the study.

Results: A group of 50 subjects was randomly selected for yoga intervention out of 81 diabetes mellitus adults, and 31 subjects were enrolled as waitlist controls. A significant decrease in the glycosylated hemoglobin levels from 8.49 ± 1.94% to 7.97 ± 2.20% in the intervention group was noticed. The lipid profiles of the DYP intervention and control groups were monitored. Three-month follow-up results of lipid profile diagnostic tests in intervention and control groups showed a significant difference between the two groups ($P < 0.05$). Most diabetic and prediabetic individuals were found to have *pitta dosha* (*pitta* controls all heat, metabolism, and transformation in the mind and body) as dominant constitution type.

Conclusion: The study results demonstrated significant positive effects of yoga in diabetic individuals. This study has indicated the evidence for the safety and efficacy of the validated DYP for community-level interventions to prevent maladies like brain damage and stroke.

Keywords

Diabetes-specific integrated Yoga lifestyle Protocol (DYP), Diabetes mellitus (DM), Glycosylated hemoglobin (A 1 c), Lipid profile, *Prakriti*

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Introduction

Diabetes mellitus (DM) is a metabolic disorder, and it has become an epidemic with about 463 million people (20 to 79 years) affected as per 2019 estimates, which represents 9.3% of the total world's population. It has an expected prevalence of 700 million by 2045 globally.[1] The International Diabetes Federation 2019 report revealed that 1 in every 11 adults (20 to 79 years age) has diabetes, and 79% of them belong to low- and middle-income countries. The high mortality rate (4.2 million in 2019) associated with DM has been a growing concern and has created a global pandemic.[2] The most affected nations are China, India, and the USA. In India alone, there are approximately 77 million individuals who are affected by diabetes. The total global health expenditure on DM is nearly about USD 760 billion (10% of total healthcare expenditure).[3] The total number of deaths is alarming in different regions such as South-East Asia (1,150,300), Europe (465,900), Middle East and North Africa (418,900), North America and the Caribbean (301,700), South and Central America (243,200; 9.4%), and Western Pacific (1,265,100).[1] In a developing country like India, where there is a shortage of resources, it is expected that the number of DM patients will increase by 134.2 million by the end of 2045.

The apex body in India for biomedical research, the Indian Council of Medical Research (ICMR), conducted a phase I study and projected that there are 62.4 million individuals affected by diabetes, and 77.2 million people have been living with prediabetic conditions in India.[4]

The current global prevalence and mortality rate associated with DM indicate the burgeoning socioeconomic burden on society. Complications of diabetes range from microvascular, such as neuropathy, nephropathy, and retinopathy,[5] to macrovascular complications involving cardiovascular diseases and others.[6] American Diabetes Association classified diabetes into type 1 (insulin-dependent), type 2 (noninsulin-dependent), gestational DM, and diabetes from other causes.[7] Metformin is the most common antidiabetic agent but is associated with increased homocysteine levels and vitamin B12 deficiency because of vitamin B12 malabsorption on prolonged use.[8]

Despite the proven benefits of oral drugs and/or insulin, there are several adverse drug reactions, metabolic complexities in patients, and economic ramifications that cannot be overlooked. DM, being a chronic disease, requires long-term compliance with the medications. A meta-analysis report indicated that exercise, both aerobic and resistance, positively increased insulin sensitivity, improved glycemic level, and decreased cardiovascular risks in diabetic patients.[9] However, many studies have indicated that people with restricted joint mobility and those who are either overweight or lead the sedentary lifestyle are unable to participate in the conventional physical exercise regimen despite being aware of the benefits of exercise in managing diabetes. There are several studies that have documented the benefits of yoga on DM and indicate practicing evidenced-based yoga could be possible cost-effective interventions suited particularly to those who have difficulty engaging in physical exercise, remaining active, and utilizing community resources for the management of DM.[10]

Yoga is a mind–body practice that originated from ancient India and focused on the sequence and combination of different *asanas* (postures) synergizing with breath and mind control.[11,12] These *asana*/postures are not merely practicing physical movements but exert a coordinated positive impact on health and lifestyle.[13] Yoga, through the neuroendocrine mechanism, has been proven to be associated with the decrease in the glycemic status[14] and lipid profile of the individuals.[15]

Prakriti (*Pra* = primary, *Kriti* = creation), or human being's physiological personality, is an essential Ayurveda construct that explains an individual's biological variability that is distinguishable based upon genetic specificity and epigenetic effects.[16] Accordingly, a person's *prakriti* is determined by the dominance of one or more of the three *doshas* (*vata, pitta*, and *kapha*). *Dosha* is considered a condition in the body caused by certain substances, and different combinations of its elements interfere with physiological activities. *Vata* refers to wind, energy, or all movements inside the body; *pitta* designates bile and its functioning; and *kapha* refers to phlegm and other problems in nose, ear, and throat in modern science, and their balance and imbalance refer to different Ayurveda personalities. An individual's physiological strengths and weaknesses, mental status, and susceptibility to various illnesses can be explained by the *prakriti* type of an individual.[17] Several Ayurveda texts give directions for a personalized healthy living based upon one's *prakriti* type. Therefore, a unique aspect of this study was the inclusion of an analysis of *prakriti* type on a small subset of individuals in a randomized waitlisted controlled research on yoga for the primary prevention of diabetes in Chandigarh and Panchkula in India.

Methodology

Subjects

This study was a part of a multicenter randomized control pan-India study with the primary goals of the prevention of diabetes. The results of the larger study have been published.[18,19] In the present study, the data of yoga interventions conducted in Chandigarh and Panchkula have been included for analyses considering homogeneity in the population of the identified areas. A total of 1,215 individuals were screened for identifying the high-risk diabetic population using the Indian Diabetes Risk Score (IDRS). The survey conducted the door-to-door survey in the randomly selected rural and urban clusters by trained field volunteers. Of these, a total of 444 participants were identified at high risk on IDRS (>60) and were invited for detailed assessments. There were 154 participants with glycosylated hemoglobin (A1c) level greater than 6.5%, who were identified as the diabetic group. The prediabetic group constituted 142 participants whose A1c was between 5.7% and 6.4%, whereas 148 participants with A1c less than or equal to 5.6% were considered a healthy

population. All 154 diabetic group participants (both males and females) were requested to participate in the free Diabetes-specific integrated Yoga lifestyle Protocol (DYP) intervention camps organized by the Indian Yoga Association. Because of time constraints, 73 subjects denied participating in yoga interventions. Of the remaining 81 participants, 50 subjects received yoga intervention, and 31 subjects constituted waitlist control clusters, following four levels of randomizations. The follow-up period was three months, and the waitlist control group was trained with the same DYP after the collection of the data (Figure 1). Both the intervention and the control groups were on the antidiabetic medications.

DYP Intervention

The intervention group comprised of 50 subjects and were categorized as known diabetes and newly diagnosed groups based on A1c (>6.5%). They were trained by qualified yoga instructors of the Indian Yoga Association on validated DYP. The training was conducted initially in camps at local community centers for nine days following 2-h daily practice of yoga either in the morning or in the evening. The yoga practice was followed by counseling on using instruction charts and DVDs to continue yoga at home for one hour daily. The subjects were monitored once a week by the yoga instructor, and the same instructor performed a 2-h review session for three months. Attendance and feedback on daily home practice were maintained during the weekly visits as well as through phone calls and WhatsApp messages.

Control Group

The control group comprised of 31 subjects who were screened and diagnosed as DM and consented to serve as waitlist controls.

Diabetes-Specific Integrated Yoga Lifestyle Protocol (DYP)

The validated DYP was designed by the expert committee consisting of yoga scholars from the member institution of the Indian Yoga Association that included diabetologists. The protocols included lectures and materials on lifestyle and behavior change (diet, physical activity, abstinence from tobacco, and yoga-based stress coping skills) apart from *asana* (physical postures), *pranayama*, meditation, and relaxation techniques (Table 1). Table 2 shows the effect of each *asana*/procedure used in this study.[20,21]

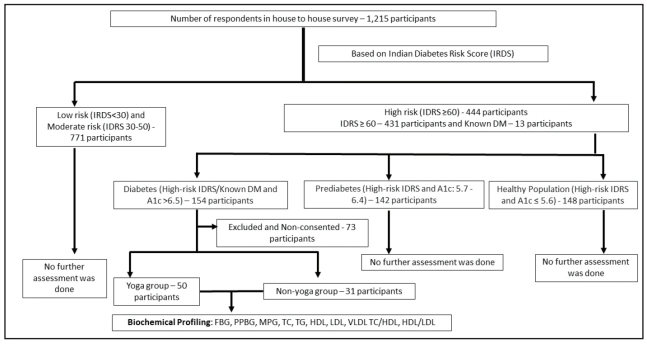

Figure 1. The Study Profile of Chandigarh and Panchkula

Table 1. Diabetes-Specific Integrated Yoga Lifestyle Protocol (DYP)

S. No.	Name of the Practice	Duration (in min)
1	Opening prayer: *Asatoma sat gamaya* (from ignorance lead me to truth) *Taaaso maajyotir–gataya* (from darkness lead me to light) *Mrtyor-maa amrtamgamaya* (from death lead me to immortality) *Om shaantih shaantih shaantih* (om peace, peace, peace)	2
2	Loosening exercises (preparatory *sukshma vyayamas* and *shithililarna* practices) *Urdha-vahastashvasan* (upward tree position; hand stretching breathing three rounds at 90°, 135°, and 180° each) *Kati-shakti vikasaka* (three rounds) (a) Forward and backward bending; (b) twisting *sarvangapushti* (developing entire body; three rounds clockwise, three rounds anticlockwise)	6
3	*Surya Namaskara* (SN) (sun salutation)10 step fast SN (fast sun salutation) six rounds 12 step slow SN (slow sun salutation) one round Modified version chair SN seven rounds	9
4	*Asanas* (pose/posture; 1 min per *asana* [pose/posture])1. Standing Position (1 min per *asana*) *Trikonasana* (extended triangle pose), *parvritta trikonasana* (revolved triangle pose), *prasarita padhastasana* (wide-legged forward bend) 2. Supine Position *Jatara parivartana-sana* (master revolved abdomen pose), *pawa-nmuktasana* (wind-relieving pose), *viparitaka-rani* (upside-down pose) 3. Prone Position *Bhujangasana* (cobra pose), *dharuasana* (bow pose), followed by *pawanmuktasana* (wind-relieving pose) 4. Sitting Position *Mandukasana* (frog pose), *vakrasana*/*ardhamatsayendrasana* (half spinal twist pose), *paschimatanasana* (seated forward bend), *ardha ushtrasana* (half camel pose) At the end, relaxation with abdominal breathing in the supine position (*vishranti*), 10 to 15 rounds (2 min)	15
5	*Kriya* (outward physical manifestation) *Ag-nisara* (abdomen churning): 1 min, *kapalab-hati* (skull shining breathing technique) (60 breaths per minute for 1 min followed by rest for 1 min)	3
6	*Pranayama* (breathing techniques) *Nadishud-dhi* (alternate nostril breathing; for 6 min, with *antarkumbhak* (internal breath retention) *and jalandhar bandh* (chin lock; for 2 s) Bhramari (humming bee breathing) 3 min	9

(*Table 1 continued*)

(*Table 1 continued*)

S. No.	Name of the Practice	Duration (in min)
7	Meditation (for stress relief, deep relaxation, and silencing of mind) cyclic meditation	15
8	Resolve (I am completely healthy)	1
9	Closing prayer: *Sarvebhavantu Sukhina* (let all be happy) *Sarve Santu Nirāmayaah* (free from diseases) *Sarve Bhadrani Paāyantu* (let all align with reality) *Maa Ka Scid-Duhkha-Bhag-Bhavet* (let no one suffer from miseries) *Om Šāntih Šāntih Šāntih* (om peace, peace, peace)	1
	Total duration	60

Table 2. The Effect of Each *Asana* or Practice/Procedure

S. No.	*Asana*/Practice/Procedure		Effect
1.	*Surya Namaskara*		Subcutaneous tissue fat is removed because of extensive muscle workouts; harmonizing effect at *prana* level.
2.	*Asana*	Standing position	Limbs, buttocks, and abdominal region fat reduction; *apana* opening.
		Sitting position	Abdominal region fat reduction; *apana* opening.
		Supine position	Abdominal region fat reduction; *apana* dislodgement.
		Prone position	Fat reduction at buttock and shoulder level; *prana* balancing.
3.	*Kriya*		Developing deep internal awareness; *Titiksha,* stamina building; activating and revitalizing the organs; toning up their functions; desensitization; development of deep internal awareness; releases locks and vital life force in the body.
4.	Relaxation		Alertful rest through stress reduction (sympathetic activity decreased).
5.	*Pranayama*		Regulation of breath; removes the random agitations in *prana* flows; dominant parasympathetic activity; stress reduction.
6.	Meditation		Mental alertness increases and so does physiological relaxation with the reduced heart rate.

Assessments

Biochemical Analyses

Fasting blood sugar (FBG), postprandial blood glucose (PPBG), A1c, and lipid profile were assessed from the blood samples using standard laboratory procedures in an NABL accredited lab.[22] The blood samples were collected after 10 to 12 hours of overnight fasting and also 2 hours after breakfast, on day 1 and on day 90.

Prakriti Analysis

Out of the total number of participants from the door-to-door survey, 23 diabetic subjects and 12 prediabetic subjects, and 5 normal subjects consented and were evaluated for the *prakriti* analysis by *Ayurveda acharyas*, senior physicians of the Indian system of medicine. There were three methods of examining a person (*pareeksha*), namely *darshana* (inspection), *sparshana* (palpation), and *prashna* (history taking) *pareeksha*. Each of the three types of *pareeksha* has 10 items with 3 choices for each of the three *doshas* (health constitutional traits), namely *vata, pitta*, and *kapha.*[17] Thus, each item had 10 scores constituting a total score of 30.

The score for each *dosha* was calculated based on the cumulative score of *doshas* from the three types of *pareeksha*. Based on this result, the characterization resulted in six different constitutional types—*vata-pitta, vata-kapha, pitta-kapha, pitta-vata, kapha-vata*, and *kapha-pitta*. The cumulative score of one *dosha* being greater than 20 (*darshana* + *sparshana* + *prashna*) was defined as a single dominant *dosha* (*vata, pitta, or kapha*) constitutional type. If the total score on any *dosha* did not reach 20, it was characterized as belonging to one of the combined personalities based on the order of the scores (Table 3). The questionnaire that is mentioned in Table 3 and being used for assessing the *prakriti* of an individual is a structured nonstandardized questionnaire.

Data Analysis

The biochemical data generated from the treatment and control subjects, before and after the intervention, was recorded in the Microsoft Excel version 10. The statistical analyses were performed using the SPSS software version 21.0. The recorded data was compared using a paired *t*-test following the normal distribution curve. A *P*-value of less than .05 was set as the significance level.

Results

Baseline Characteristics

All 81 (50 yoga and 31 control) subjects recruited in the study had diabetes and were on antidiabetic medications. Table 4 shows the characteristics of yoga and control group subjects.

Table 3. Questionnaire for ***Prakriti*** (Ayurveda Personality) Analysis

Darshana Pareeksha **(Inspection)**							
S. No.	**Characteristics**	***Vata***	**Y/N**	***Pitta***	**Y/N**	***Kapha***	**Y/N**
1	Height	Short		Normal		Tall	
2	Weight	Underweight		Normal		Overweight	
3	Complexion	Brown		Wheatish		Fair	
4	Gait	Fast		Normal		Slow	
5	Voice	Harsh		Thin		Heavy	
6	Hair color	Grey		Very black		Normal	
7	Iris color	Blue/Dark brown		Black		Brown	
8	Activities	Fast		Normal		Slow	
9	Personal grooming	Unmanageable		Normal		Manageable	
10	Body parts	Short		Normal		Big	
Sparshana Pareeksha **(Palpation)**							
S. No.	**Characteristics**	***Vata***	**Y/N**	***Pitta***	**Y/N**	***Kapha***	**Y/N**
1	Skin	Dry		Normal		Oily/Moist	
2	Pulse	Uncertain/Fast		Normal		Normal/Slow	
3	Hair	Dry		Wheatish		Oily/Moist	
4	Muscle	Thin		Normal		Fat	
5	Nails	Dry		Thin		Oily/Moist	
6	Tendon reflex	Fast		Very black		Slow	
7	Pain on pressing	Maximum		Black		Low	
8	Tongue	Dry/Pale		Normal		Moist/Thick	
9	Bones	Thin, fragile		Normal		Thick and strong	
10	Pulse	Leech, snake		Normal		Pigeon/Swan	
Prashna Pareeksha **(History Taking)**							
S. No.	**Characteristics**	***Vata***	**Y/N**	***Pitta***	**Y/N**	***Kapha***	**Y/N**
1	Favorite juice	Sweet		Salty		Bitter	
2	Sleep	Less		Normal		Over	
3	Favorite season	Rainy		Winter		Summer	
4	Favorite color	Brown or grey		Red and dark		White or light	
5	Dreams	Vacuum places, sky		Fire		Hilly areas	
6	Voice (quality of speech)	Dry		Thin and sweet		Heavy and sweet	
7	Appetite	Irregular		Excessive		Moderate	
8	Temperament	Firm in decisions		Angry in decisions		Constant in decisions	
9	Feeling of pain	Highly tolerant		Moderately tolerant		Low tolerance	
10	Power	Less		Normal		High	

Note: Scoring key: yes 1; no 0. Total possible score 10 × 3 = 30. *Vata* personality ≥20 in *vata* total score; *pitta* personality ≥ 20 in *pitta* total score; *kapha* personality ≥ 20 in *kapha* total score.

Result: No. of diabetic subjects: *pitta* = 20; *pitta-kapha* = 2; *vata-pitta* = 1.

Table 4. Baseline Characteristics of Both the Treatment and the Control Subjects

Demographic Details	Yoga	Control
Sample size (n = 81)	50	31
Age (years) M ± (SD)	58.86 ± 24.73	53.31 ± 7.71
Height (cm) M ± (SD)	67.98 ± 11.51	70.40 ± 13.55
Weight (kg) M ± (SD)	26.51 ± 4.18	28.51 ± 5.11
BMI M ± (SD)	97.42 ± 9.14	99.78 ± 11.34
Hip circumference (cm) M ± (SD)	96.26 ± 10.60	97.51 ± 11.55
Waist circumference (cm) M ± (SD)	67.98 ± 11.51	70.40 ± 13.55

Effect of DYP on A1c and Mean Plasma Glucose (MPG)

The intervention group was receiving antidiabetic medications and participated in the DYP, whereas the control group was on antidiabetic medicines only. The A1c levels in the treatment group, after completion of the yoga intervention, showed a significant ($P < 0.01$) decrease from 8.49 ± 1.94% to 7.97 ± 2.20%. In the control group, there were no significant changes. Furthermore, the mean blood glucose (MBG) level decreased significantly ($P < 0.01$) in the intervention group from 197.02 ± 55.81 to 182.10 ± 63.17. In the control group, there was a nonsignificant change from 200.26 ± 52.87 to 186.69 ± 61.12 (Table 5).

Effect of DYP on Lipid Profile

A comparison of lipid profile parameters after three months of DYP in the intervention group showed statistically significant differences in the total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), high-density lipoprotein (HDL), and very-low-density lipoprotein (VLDL) levels. In contrast, in the control group, no statistically significant results are seen (Table 5).

When compared between the intervention and the control groups, no statistically significant difference was noted (Table 5).

Prakriti Analysis

Based on *darshana, sparshana*, and *prashna pareeksha*, total scores on *vata, pitta*, and *kapha* were obtained.

Table 5. The Pre and Postbiochemical Parameters in the Interventional Group and the Control Group

	Intervention Group				Control Group				
Variables	Number of Participants	Preintervention Mean ± SD (SE)	Postintervention Mean ± SD (SE)	P-Value	Number of Participants	Preintervention Mean ± SD (SE)	Postintervention Mean ± SD (SE)	P-Value	Between Group P-Value
Fasting blood glucose (FBG)	50	167.46 ± 58.22	169.01 ± 84.6	<0.02	31	176.51 ± 64.09	173.00 ± 73.39	0.25	0.80
Postprandial blood glucose (PPBG)	28	259.14 ± 92.46	231.53 ± 128.13	<0.01	28	259.25 ± 96.89	224.50 ± 111.37	<0.01	0.96
A1c	50	8.49 ± 1.94	7.97 ± 2.20	<0.01	31	8.60 ± 1.84	10.22 ± 1.66	0.49	0.03
Mean plasma glucose (MPG)	50	197.02 ± 55.81	182.10 ± 63.17	<0.01	31	200.26 ± 52.87	186.69 ± 61.12	<0.01	0.13
Total cholesterol (TC)	50	175.16 ± 47.88	186.02 ± 37.80	<0.01	31	181.22 ± 41.05	176.83 ± 47.88	<0.01	0.40
Triglycerides (TG)	50	169.68 ± 109.38	192.92 ± 128.23	<0.01	31	196.19 ± 99.62	212.77 ± 100.35	<0.01	0.60
High-density lipoprotein (HDL)	49	43.83 ± 9.35	45.36 ± 10.94	<0.01	31	41.64 ± 10.82	42.16 ± 11.69	<0.01	0.30
Low-density lipoprotein (LDL)	49	99.91 ± 33.60	102.10 ± 30.53	<0.01	31	98.51 ± 38.07	92.16 ± 41.22	<0.01	0.26
Very-low-density lipoprotein (VLDL)	46	31.15 ± 15.41	34.40 ± 17.58	<0.01	17	31.82 ± 9.67	36.9 ± 13.80	<0.04	0.25
Chol/HDL ratio	50	4.08 ± 1.54	4.30 ± 1.42	<0.01	31	4.52 ± 1.13	4.32 ± 1.01	<0.01	0.13
HDL/LDL ratio	50	2.30 ± 0.95	2.33 ± 0.83	<0.01	31	2.49 ± 0.89	2.19 ± 0.78	<0.01	0.12

Ayurveda physicians categorized the participants as *pitta, pitta-kapha*, and *vata-pitta* in the study sample. In 23 diabetic people, 87% of people (20 people) scored high in *pitta* total score (>17) and 25% scored high in *pitta-kapha* scores (11, 12). Among 12 prediabetic subjects, 75% scored high in *pitta* total score (<17) and 25% scored high in *pitta-kapha* scores (11, 12; Table 6).

The statistical analysis results of the studied population indicated that diabetic and prediabetic subjects were more of *pitta prakriti* than the *vata-pitta*. However, the association between *prakriti* scores and the status of diabetes (based on A1c levels) was not significant.

Discussion

There is a growing body of evidence that supports yoga as a cost-effective adjunct therapy for DM. With regard to practicing DYP, each practice/procedure has its clinical significance, which helps in the control of DM as an adjuvant to the medications in a more effective way (Table 2 shows the significance of each *asana*/practice/procedure). This study investigated the influence of practicing DYP in diabetic patients for a period of three months. The biochemical analysis results of these patients showed a statistically significant reduction in A1c and MBG levels after the intervention of DYP. The results of this study support the beneficial effect of early yoga interventions corresponding to the evidence in the literature. The nonsignificant differences in the control group indicate the effectiveness of the intervention protocols of the study.

Yoga and glycemic control have been studied earlier among adults with DM patients. In a meta-analysis, Thind et al., studied the effects of yoga interventions among adults with type 2 DM. They found that yoga participants had significantly decreased levels of A1c, FBG, and PPBG compared to controls,[23] suggesting the biochemical effects of yoga on the glycemic control of DM in the adult population. In our study, it was also noted that the MBG along with A1c decreased and were statistically significant after DYP intervention in diabetic patients. However, in that meta-analysis, most of the included studies had a nonuniform protocol, and different studies used different yoga protocols. In the present study, DYP, a protocol designed specifically for diabetic patients, was used for the specified period of three months. This is consistent with current reports that showed the yoga group had significantly decreased FBG, PPBG, A1c, and lipid profile.[24] However, our study did not examine glycemic control based on duration, other comorbidity conditions, or DM with other complications.

Table 6. *Tridosha* Characterization in the Subjects

Diabetes Category		*Pitta*	*Pitta-Kapha*	*Vata-Pitta*	Total
Prediabeticsubjects	*N*	9	3	0	
	%	75.0%	25.0%	0.0%	12
Diabetic subjects	*N*	20	2	1	
	%	87.0%	8.7%	4.3%	23

Despite the known benefits of long-term adherence to physical exercises, such as jogging, walking, swimming, and other outdoor exercises, patients have reported several barriers to commitment.[25] It is pertinent to note that diabetic patients often have abnormal lipid profiles because several steps in lipid metabolism are regulated by insulin,[26] and hence the lipid metabolism **follows a typical pattern called diabetes dyslipidemia.**[27] Dyslipidemia in individuals with diabetes is a major risk factor for cardiovascular disease, and its prevention requires a holistic approach that will control both glycemic and lipid profile abnormality. Studies have shown that regardless of the treatment types, good glycemic control is associated with improved lipid profiles. For example, Shantakumari et al., studied the effect of **yoga on dyslipidemia among type 2 DM patients for three months and found improvement in TC, TG, and LDL.**[26] Our study investigated the influence of practicing DYP on lipid profiles among **diabetic patients for three months and found statistically significant results similar to those found in the literature. Another study has shown significantly reduced levels of TC and TG after 12 weeks of postyoga practices, but in that study, yoga training regimens recommended for weight reduction were also used (three sets of specific yoga protocol, which was changed every month).**[29] In our study, the mean age (years) of the study participants was 58.86 years in the yoga group. Ferrara et al., indicated that TC and LDL levels show an increasing trend until the age of 65 years, and the levels fall progressively after 65 years.[30] Another study analyzed the correlation between age and plasma TG levels among men and found a strong correlation between aging and increased fasting TG plasma concentration,[32] suggesting the influence of aging on lipid profiles. The findings in our study provide evidence that DYP can help in glycemic control; however, it should be standardized to cover both diabetes and hyperlipidemia because they can increase the risk of many diseases such as cardiovascular diseases and stroke. This may require the development of new protocols for the management of DM.

Diabetes in Ayurveda is considered as *kapha* dominant metabolic disorder where "*agni"* (digestive power) both at the gastrointestinal level and at the tissue level is disturbed. This eventually leads to a state of improper digestion. The imbalance in digestion and metabolism is associated with disturbed glycemic control and lipid profile. This can be of three types according to the predominant *dosha* in causative factors, that is, *vata* type, *pitta* type, and *kapha* type. In a study reported by Govindaraj et al., the genome-wide analysis correlates with *prakriti* analysis.[32] *Prakriti* analysis basically describes the biological specificity operating at cellular and genomic level.[33]

Tridosha balance and *prakriti* analysis being the core philosophy of the Ayurveda system of medicine are shown to be linked with chronic diseases, metabolic pathways, and genotypes, which throws light on its potential applicability of the concepts in personalized medicine and personalized preventive healthcare.[17] For example, in a diabetic patient, a better understanding of a complex interaction between an individual's *prakriti* and genomic pathways may enable instituting personalized prevention and management strategies that can lower the susceptibility of an individual to high-risk vulnerabilities. Each of the *doshas* in the *prakriti* has a set of metabolic tendencies that determine an individual's mind and bodily reactions to a confronted stimulus. The disturbances in equilibrium of any *doshas* can cause certain diseases, depending on the *prakriti* of the person.

In our retrospective *prakriti* analysis, based upon the established scoring system, we assessed the types of *prakriti* which were more prone to DM in this population. *Prakriti* analysis in the diabetic population of Chandigarh and Panchkula showed *pitta prakriti* preponderance based on our nonstandardized structured questionnaire. This was inconsistent with other studies that investigated the profiling of *prakriti* in diabetic patients, showing an association of *vata-kapha* or *vata prakriti* with diabetes.[34] This deviation may be because of a small sample size was taken in our study, however much larger sample studies are needed to make apt conclusion. A study conducted in an Indian Ayurvedic research institute found that approximately 65% of diabetic individuals had *kapha* only or *kapha-vata* or *kapha-pitta prakriti* compared to 35% comprising only *pitta* or only *kapha* or only *vata* dominant *prakriti* type.[32] Another study conducted by Mahalle et al., reported a significant association of DM, hypertension, and dyslipidemia with *vata-kapha prakriti.*[33] Every individual has a natural predominance of one *dosha* or a combination of two *doshas* that marks the uniqueness of their physical, physiological, and psychological functions. In our study, *pitta* predominance in the diabetic population could be because of the fact that *pitta prakriti* governs metabolism, thermal regulation, and homeostasis in the body, and people living in this northern territory of India may have unique features of heightened metabolism.[17] A study conducted by Tiwari et al., found that individuals with *vata-pitta prakriti* in the DM exercise group showed a statistically significant decrease in the PPBS after exercising compared to the control group. This indicates that blood sugar may be well controlled in *vata-pitta prakriti* individuals.[36]

It should be noted that diabetes is a risk factor for cardiovascular diseases, stroke, neuropathy, and retinopathy, but the *prakriti* analysis for diseases was not carried out earlier including our own published work in respect of the risk factor analysis of age-related macular degeneration,[37–40] dementia,[41] and others. However, there are studies showing that DM acts as a protective factor by delaying the motor symptoms and the cognitive functions become worse in patients with amyotrophic lateral sclerosis.[42–44] Ayurvedic practices, such as *prakriti* analysis included in this paper, should be included as a part of the research, when studying various diseases and conducting human experiments. Such integration of Ayurvedic framework with modern medicine will be useful for an integrative health and patient-centered approach.

Limitations

This study did not assess glycemic control and lipid parameters by stratifying study participants based on gender, risk factors, and diabetes-associated complications. Small sample size and sample dropouts remain the major challenge. This study also could not assess glycemic control in long-standing cases of diabetes with other comorbid conditions and did not investigate the effect on other parameters of metabolic syndrome.

Conclusion

After three months of DYP, the yoga group showed promising results in terms of glycemic control and a good lipid profile. The study findings provide promising evidence for the effect of yoga, particularly DYP, on type 2 diabetes management, providing insights into the sensitivity of the given protocol that may not be efficient in improving the lipid profile. Therefore, the protocol should be customized for both diabetes and hyperlipidemia. *Prakriti* analysis in the diabetic population of Chandigarh and Panchkula showed *pitta prakriti* preponderance. Long-term follow-ups should be performed to assess glycemic control in diabetic individuals. An extended protocol of DYP should also be structured and examined on patients with both DM and hyperlipidemia.

Author Contribution

The conceptualization of the project was done by RN, IC, HRN; the conceptualization of the manuscript was by AA, RN, HRN; the literature search was done by MSS, SJ, VS; The data acquisition was done by NK, RN, IC, SP, SB, HRN; the data analysis was by NK, RN, SP, SB; the statistical analysis was by RN, SB, SP; the manuscript preparation was by MSS, AA, RN, SJ; the manuscript editing was by MSS, VS, RN, AA; and the manuscript review was by MSS, VS, RN, AA, IC.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Statement

Ethical clearance was obtained from the ethical committee of the Indian Yoga Association (vide Res/IEC-IYA/001 dt 16.12.16) constituted as per the ICMR guidelines. Informed consent was obtained from all the participants.

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