

EFFECT OF 8 WEEKS OF YOGA ON ANTHROPOMETRY PARAMETERS IN TYPE 2 DIABETES MELLITUS: A RANDOMIZED CONTROL STUDY.

Vishakha¹, Manish Gupta², Savita Singh³, Amitesh Aggarwal⁴

¹Former Senior Resident, Department of Physiology, UCMS & GTB Hospital, Delhi.

²Assistant Professor, Department of Physiology, UCMS & GTB Hospital, Delhi.

³Former Professor & Head, Department of Physiology, UCMS & GTB Hospital, Delhi.

⁴Associate Professor, Department of Medicine, UCMS & GTB Hospital, Delhi.

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Corresponding author: Dr. Vishakha

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Abstract

Yoga by definition means controlling the modifications of mind. It is also understood as a therapy for health and fitness. Hence, yoga has proved to be of immense help in various lifestyle disorders such as Type 2 Diabetes Mellitus (Type 2 DM). Yoga is also known to reduce stress which is one of the main risk factors in the development of insulin resistance. In this study, we analysed the effect of yoga in known type 2 diabetic patients attending regular medicine Out-Patient Department (OPD) and receiving routine therapy.

Research Design and Methods:

Setting: Follow-up, randomized control study done in a tertiary care hospital.

Participants: 60 Type 2 diabetic patients, between 35-55 years of age, were randomly and equally divided into Group I (yoga) and Group II (controls), age and sex matched. Group II received only routine therapy for DM and Group I underwent yoga therapy along with the routine therapy for 8 weeks. Both groups were assessed twice (pre- and post-study).

Statistical Analysis: ANOVA (Repeated measure) followed by Tukey's test. $P < 0.05$ was considered significant. Results were expressed as mean \pm SD.

Results: After 8 weeks of yoga, Group I patients showed a significant improvement in their BMI as shown by reduced body weight.

Conclusions: Yoga can be used as an adjunct to the routine treatment for Diabetes Mellitus (DM) as it is not rigorous and so, is far superior than other forms of exercise in comparatively older subjects.

Keywords: Type 2 Diabetes Mellitus (Type 2 DM), Body Mass Index (BMI), Yoga, Pranayama.

Introduction

Yoga is known to have been developed in India during Vedic period (3000 BC to 800 BC). The word 'Yoga' is derived from the Sanskrit root 'Yuj', meaning 'to join' or 'to unite'. Earlier yoga mainly focussed on self-concentration i.e. union of one self with supreme self. At later stages, Patanjali gave greater importance to the asanas, kriyas and pranayama, called as hatha yoga. *"While Patanjali's yoga is primarily concerned with developing mental concentration in order to experience samadhi; hathayoga, or the 'yoga of force', develops a system of elaborate and difficult postures (asana) accompanied by breathing techniques (pranayama)"*¹

In recent times worldwide among population in all age groups, there have been decreased physical activity, increased sedentary lifestyle, increased social networking pressures and increased unhealthy eating practices all contributing to major physical and mental stress. All these stressors are main culprits for lifestyle disorders such as Hypertension and Diabetes Mellitus. In India as well, there

is increased prevalence of Type 2 diabetes as reported by WHO.²

Type 2 DM is the commonest form of diabetes constituting nearly 90 - 95% of the diabetic population in any country. Also called adult-onset diabetes, it consists of hyperglycemia resulting from the resistance to insulin action or inadequate insulin secretion or both. Most patients with this form of diabetes are overweight, and obesity itself causes some degree of insulin resistance. The risk of developing this form of diabetes increases with age, obesity, and lack of physical activity³.

Type 2 DM usually begins in middle life or later. At present, Type 2 DM is treated using oral anti-diabetic drugs and/or insulin along with strict diet restriction on long term basis. Regular exercise is also advised along-with routine drug therapy for diabetes. Despite the continuous treatment; there is every possibility of aggravation of the disease along-with adverse reactions and side effects of medications. Therefore, diabetes poses a major life stress that requires considerable physical, emotional, and

psychological accommodation and coping. And so, importance of mind-body therapies come into play.

Yoga, is one such mind - body approach which have gained momentum in recent years and its health benefits are preventive as well as curative. It is an ancient form of low-impact exercise, stretching, and breathing⁴. Asanas are body postures held for 5–20 breaths, and pranayamas are controlled abdominal and diaphragmatic breathing movements⁵. These together are used to form breathing and exercise sequences.

Also, Type 2 DM is usually present in age group when other debilitating disorders might also be present which limit the patient from performing aerobic exercises. Yoga is generally considered a safe mode of physical activity and can be modified for elderly patients as well according to the needs.

And with current scenario of COVID pandemic where social distancing and staying indoors is advised, when outdoor aerobic activities are restricted; yoga can be highly beneficial form of exercise that can be practised indoors as well.

Hence, the present study was aimed to record the effects of yoga in Type 2 DM as 'Can yoga be used as a form of exercise to optimise BMI in Type 2 diabetic patients along-with routine therapy.'

Objectives:

- To compare anthropometry parameters in Type 2 DM patients before and after yogic interventions for 8 weeks.
- To compare anthropometry parameters in Group I (medication + yoga therapy) and the Group II (only on medication) in Type 2 diabetic patients.

METHODS

Participants

Diagnosed Type 2 diabetic patients [according to revised American Diabetic Association (ADA) criteria] attending regular Medicine OPD and undergoing routine treatment [drug therapy (metformin) + diet restriction] in a tertiary care hospital were recruited for our study. Patients were between age 35 – 55 years and of BMI ≥ 23 kg/m². Patients not willing to do yoga or who were practicing yoga earlier as well; those with any other metabolic disorder like hypothyroidism; those with extreme mobility issues or smokers or/and alcoholics were excluded from our study.

Ethics statement

Ethical clearance was taken from the Institutional Ethical committee for the study. Prior to participation, the purpose of the study was explained to all the subjects and their informed consent was taken according to the ethical principles of the Ethical Committee of our institution.

Study design

Our study design was an Interventional Randomized Control Trial.

As shown in Fig.1, 94 subjects with Type 2 diabetes were initially assessed for eligibility. Out of those, finally 60 patients were included in the study based on inclusion and exclusion criteria. Patients were then randomly and equally divided into two parallel groups: Group I had to do yoga along-with routine therapy and Group II only received routine therapy. All subjects underwent complete physical and clinical assessment at the onset of study. Randomization was done using a randomized block technique (matched pairing for age and sex; 30 pairs were made) followed by random allocation within pairs to either Group I or Group II by sealed envelope technique. The random assignment was performed by a worker who was blind to the experimental design. Both the groups had 30 patients each.

Figure 1 depicts our study plan.

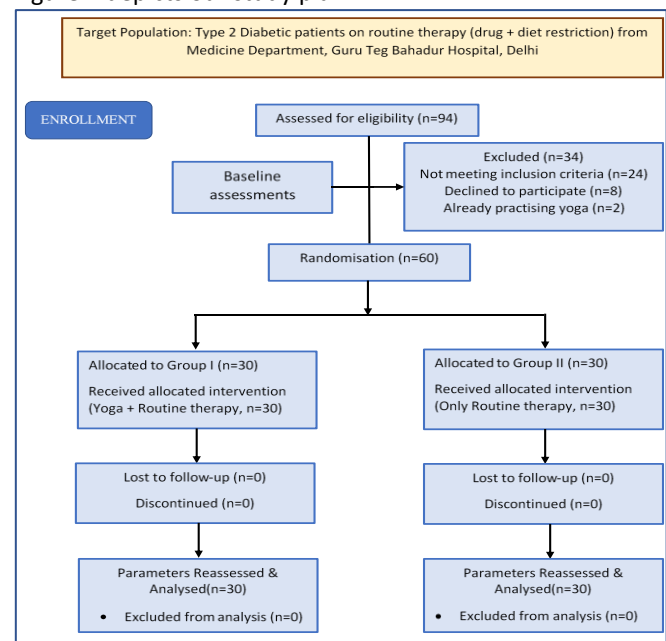


Figure 1: CONSORT flow diagram showing the progress of our study over 8 weeks.

The study was conducted in the Department of Physiology and Medicine, UCMS and GTB Hospital, Delhi.

Assessments

Assessment of height was done by using Stadiometer from Indosurgicals Pvt Ltd. It had a vertical ruler and a sliding horizontal headpiece which is adjusted to rest on top of the head and then height is noted. Weight was measured by weighing scale from Indosurgicals Pvt Ltd. Body Mass Index (BMI) was calculated using height and weight of the subject as "Weight(kg)/height(m²)". Body Surface Area (BSA) was calculated with the formula "square root of product of weight (kg) times height (cm) divided by 3600".

Assessment of anthropometry parameters was done before and after 8 weeks of study in both the groups.

Intervention

Group I subjects underwent regular supervised yogic regimen which included mainly asana and pranayama for 6 times a week, done for 8 weeks for an average of 40 - 45 minutes daily along with oral Anti Diabetic Drugs and diet restriction. Group II received only routine therapy in the form of medication and diet restriction. Yoga was done under expert guidance of highly trained yoga specialists in the yoga center in Physiology Department of UCMS, Delhi under Central Council for Research in Yoga and Naturopathy. Yoga was performed in quiet and clean surroundings from 11:30 am – 12:30 pm. Subjects were instructed to keep a time gap of minimum 4 hours for performing yoga after meals. They were instructed to carry some eatables like biscuits in case of any hypoglycaemic episode during the session. Strict compliance of every patient was recorded by maintaining regular attendance.

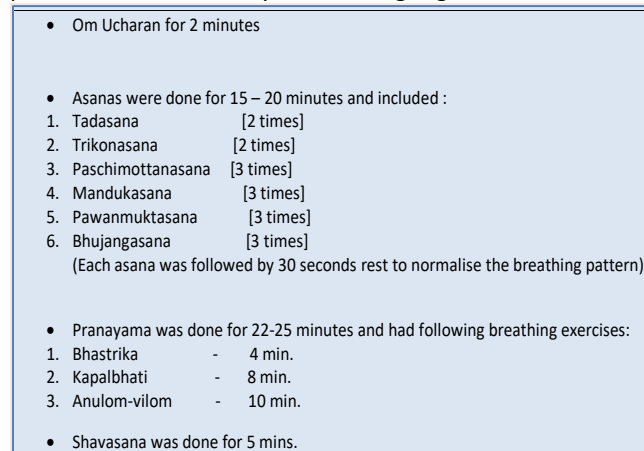


Figure 2: shows yogic regimen followed by Group I subjects.

• **Udgitha (Om ucharan):** Subject sat in sukhasana with eyes closed and the mind concentrating over the forehead; inhaled slowly, deeply and chanting Om while exhaling. This was done 11-15 times.

• Asana:

1. **Tadasana (Palm tree Pose):** Subjects were asked to stand straight with the feet together, keeping the whole body balanced and absolutely erect on toes, raised arms overhead and interlaced fingers and turned palms upward. Breathing is maintained throughout. The duration of each cycle is around 15 seconds.

Figure 2. Yogic regimen followed by Group I subjects. The person stretched shoulder, bent towards the left so as to hold the left ankle with the left hand to form a triangle, straightened the right arm and raised it towards

the head so as to touch the right ear with it. The process was repeated on the right side as to complete a cycle. The duration of each was 15 seconds.

3. **Paschimottanasana (Front Leaning Pose):** Subjects sat on ground, stretched the legs straight ahead and joined them. Held the toes with the respective hands, placed the head on the knees by bringing the chest forward and retained the breath normally as long as possible. When the person felt like inhaling, subject lifted the head slightly, inhaled slowly and again placed the head on the knees. Duration ranged from ¼ minute to 1 minute for each breath and increased by adding ¼ minute per week.

4. **Mandukasana (Frog pose):** Subjects first sat in the vajrasana (or kneeling pose), put left palm on their navel area and the right palm over the left one, inhaled deeply. Exhaled and bent forward and took suitable stretch on their naval region through your palms. This pose was held for about 1 minute with slow inhaling and exhaling.

5. **Pawanmuktasana (Wind Relieving Pose):** Subjects lied supine on ground, ensuring their feet were together, and arms placed beside body. As they exhaled, knees were brought towards their chest, and pressed thighs on their abdomen. Clapsed hands around legs. Held asana while breathing normally. Duration varied from 1/2 to 1 minute.

6. **Bhujangasana (Cobra Pose):** Subjects lied in prone with face downwards and placed palms on the sides, just below the shoulders, inhaled, retained breath and raised their head, neck, chest and waist, i.e. from navel upwards. Kept body beneath the navel fully on the ground. Kept in the position for at least 10 seconds and then lowered the head while exhaling. The cycle repeated for 3-7 times.

• Pranayama

1. **Bhastrika:** Subject were made to sit erect in padmasana, and asked to exhale and inhale completely, slowly and continuously for 2 min.

2. **Anulom – Vilom:** Subjects were made to sit erect in padmasana and asked to close the right nostril with the thumb of the right hand; then inhaled slowly, steadily and deeply as long as possible through left nostril. Now the left nostril was closed with the middle finger and the breath released through the right nostril. Again, breathed in through the right nostril and breathed out through the left nostril. This completed one cycle. This was done for 10 min.

3. **Kapalbhati:** Subjects were made to sit erect in Padmasana. They were instructed to do a series of forceful expulsion of the breath by contracting the abdomen in a rapid and vigorous inward thrust. The expulsions followed one another in quick succession, there being only a passive inhalation in between any two expulsions. This was done for 10 min.

• **Shavasana:** In this, the subjects were made to lie in supine position with the hands and legs apart. Slightly

stretched the body and allowed the whole body to relax while concentrating on breathing.

- **Diet:** The advice was given to focus on vegetarian diet with restriction on oil and foods with high glycaemic index; and more emphasis was given on green leafy vegetables, fruits and to have meals regularly and on time.

Statistics:

Data analysis was done using IBM SPSS Statistics 20 software (by IBM Corporation, USA). Two factors: repeated

measure ANOVA followed by Tukey's test at 5% level of significance were used. Hence, Probability value (p-value) ≤ 0.05 was considered significant. Results were expressed as Mean \pm Standard Deviation (SD).

RESULTS

- Comparison of demographic factors (age and sex) was done at the beginning of the study. Group I and Group II subjects were age and sex matched [Table 1]

Table 1: Comparison of age and sex between Group I and Group II.

	Age (years) (Mean \pm SD)	Sex (M/F)
Group I	44.533 \pm 5.178	15F/15M
Group II	45.4 \pm 5.315	13F/17M
p-Value	0.525	0.612

Intragroup Comparison (pre & post study): On analysis, all anthropometry parameters including weight, BMI and BSA showed a statistically significant reduction in the group that underwent yoga i.e. Group I. However, Group II subjects showed slight non-significant increase in weight at the end of study and hence, increased BMI and BSA. Table 2.1 and Table 2.2 shows comparison in Group I and Group II respectively at the onset and after 8 weeks of our study.

Table 2.1: Comparison of anthropometric parameters in Group I before and after 8 weeks.

Group I	Height (cm) (mean \pm SD)	Weight (kg) (mean \pm SD)	BMI (kg/m ²) (mean \pm SD)	BSA (m ²) (mean \pm SD)
Pre-Study	164.77 \pm 7.361	67.33 \pm 7.730	24.70 \pm 0.889	1.74 \pm 0.139
Post-Study	164.77 \pm 7.361	65.57 \pm 8.110	24.04 \pm 1.012	1.72 \pm 0.147
P - value	---	<0.001	<0.01	<0.001
Tukey's Significance	---	Significant	Significant	Significant

Table 2.2: Comparison of anthropometric parameters in Group II before and after 8 weeks.

Group II	Height (cm) (Mean \pm SD)	Weight (Kg) (Mean \pm SD)	BMI (kg/m ²) (mean \pm SD)	BSA (m ²) (mean \pm SD)
Pre-Study	165.07 \pm 7.339	66.97 \pm 8.126	24.46 \pm 1.055	1.738 \pm 0.145
Post-Study	165.07 \pm 7.339	67.03 \pm 7.739	24.51 \pm 1.152	1.740 \pm 0.139
P - value	---	0.797	0.324	0.687
Tukey's Significance	---	Non- Significant	Non- Significant	Non- Significant

Intergroup comparison (Group I vs Group II): At the onset of study, there was no significant difference in anthropometric parameters of subjects of Group I and Group II as shown in Table 3.1. On the other hand, when we compared these anthropometric parameters in two groups at the end of study, the difference was found to be statistically significant as shown in the data below as given by Table 3.2.

Table 3.1: Comparison of anthropometric parameters between Group I and Group II at the onset of study

	Height (cm) (mean \pm SD)	Weight (kg) (mean \pm SD)	BMI (kg/m ²) (mean \pm SD)	BSA (m ²) (mean \pm SD)
Pre-Study				
Group I	164.77 \pm 7.361	67.333 \pm 7.730	24.703 \pm 0.89	1.741 \pm 0.139
Group II	165.07 \pm 7.339	66.967 \pm 8.126	24.464 \pm 1.055	1.738 \pm 0.145
p - value	0.875	0.859	0.347	0.431
Tukey's Significance	Non- Significant	Non- Significant	Non- Significant	Non- Significant

Table 3.2: Comparison of anthropometric parameters between Group I and Group II after 8 weeks.

Post Study	Height (cm) (Mean \pm SD)	Weight (Kg) (Mean \pm SD)	BMI (kg/m ²) (mean \pm SD)	BSA (m ²) (mean \pm SD)
Group I	164.77 \pm 7.361	65.57 \pm 8.110	24.04 \pm 1.012	1.72 \pm 0.147
Group II	165.07 \pm 7.339	67.03 \pm 7.739	24.51 \pm 1.152	1.74 \pm 0.139
p-value	0.822	<0.05	0.120	<0.01
Tukey's Significance	Non- Significant	Significant	Non- Significant	Significant

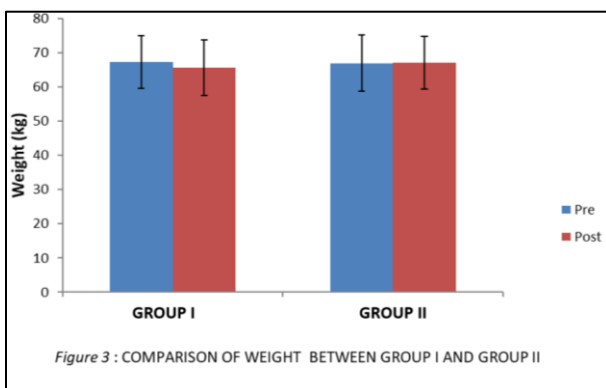
Discussion

Yoga has been known as a non-medicinal cure for various disorders since ages. The purpose of yoga is to build strength, awareness and harmony in both the mind and body.

Furthermore, yoga is known to reduce stress by various mechanisms such as enhanced vagal activity⁶ or down-regulation of Hypothalamic-Pituitary Axis and Sympathetic Nervous System, both of which have shown to prevent the release of stress hormone cortisol and catecholamines⁷. It can be especially helpful in illnesses with stress as a risk factor. In addition to this, various postures and breathing techniques in yoga can be adapted according to the person's health condition and any specific requirement.

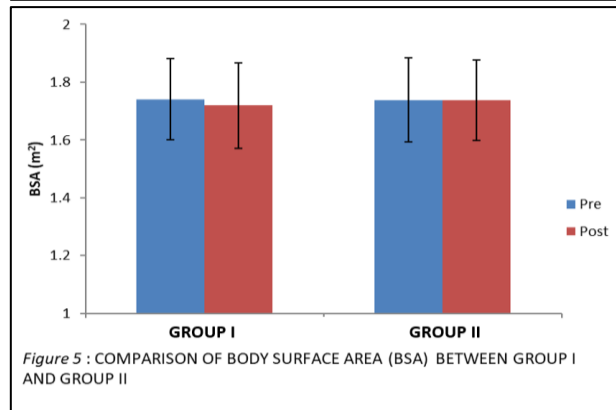
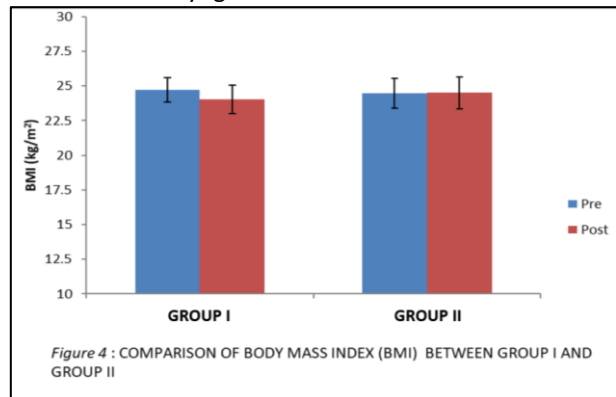
Type 2 diabetes is one such chronic illness where its aetiology, progression or complications are a result of increased stress. The increasingly altered dietary habits and sedentary lifestyle in Asian countries, particularly in India has led to a shift in health problems from communicable to non-communicable diseases⁸. Of all the non-communicable diseases, diabetes and cardiovascular diseases lead the list⁹.

In our study, 8 weeks of yogic intervention have brought a significant reduction in the weight of the subjects. Subjects who were not practicing yoga, though were receiving routine therapy for diabetes showed a slight increase in their BMI and BSA (Figure 3, Figure 4, Figure 5)



Many studies reporting improvement in anthropometric characteristics included investigations targeting adults with diabetes^{10,11}. Malhotra et al showed reduction in weight and even distribution of fat in the body space in diabetic patients. There was significant decrease in lean body mass

with a significant change in weight of normal healthy volunteers after yoga asanas¹¹.



Now, exercise has long been recognized as an essential component of diabetes management. It is perhaps known to be the best therapy for prevention of both Type 2 DM and its progression. Exercise acts by increasing insulin sensitivity¹², and exercise done on regular basis has been documented to strengthen body's immune responses. However, with space restriction and at times bodily requirements especially in age related disorders not everyone can get involved in aerobic exercises.

Yoga asanas are static stretching postures which emphasize on the stimulation of the organs and glands by easy bending and extensions and do not over-stimulate muscles¹³. Yogic exercises require low amount of oxygen consumption and produce high oxygen tension in the blood leading to delay of fatigue as suggested by Raju et al¹⁴.

Regular yoga practice can influence weight loss, but not in the "traditional" sense of losing weight. Weight loss is attributed to energy deficit created in our body when energy intake is less than energy output. In fact, yoga might not burn as many calories as any other aerobic exercise, however, yoga increases one's mindfulness and the way one relates to their body¹⁵. So, yoga makes individuals more aware of their eating habits and to seek out for foods that are nutritious and healthier. Additionally, increased mental stress have been linked to overeating in many individuals and yoga since, help to combat stress can result in optimum food intake.

However, our study was conducted within limited time frame and with small sample size. Had there been more subjects involved and increased duration of yoga we could have inferred much clearer findings. In future, more beneficial effects of yoga on other illnesses can be explored.

Conclusion: Can yoga be as a substitute for exercise in diabetes? Since yoga is a form of mind-body exercise and we have found reduction in weight in yoga group corroborating with our hypothesis, it can be used as an adjunct to present therapy for weight and stress management in diabetes. Also, with present situation of restriction on outdoor activities, yoga and meditation can be easily practiced in a limited space and is much better done in seclusion.

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