



Original Research Article

Yoga-based Breathing Interventions and Their Effects on Cardiovascular Patients with Type 2 Diabetes in West Champaran, Bihar

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Abstract: **Background:** Type 2 diabetes mellitus (T2DM) is a major public health problem and is frequently associated with cardiovascular complications, which remain the leading cause of morbidity and mortality among diabetic patients. Complementary non-pharmacological interventions such as yoga-based breathing practices (pranayama) have gained attention for their potential role in improving cardiovascular and metabolic health. **Objective:** To evaluate the effects of structured yoga-based breathing interventions on cardiovascular parameters in patients with type 2 diabetes mellitus and established cardiovascular disease. **Methods:** This prospective interventional study was conducted at Government Medical College and Hospital Bettiah, West Champaran, Bihar from April 2024 to April 2025. A total of 100 patients with type 2 diabetes mellitus and cardiovascular comorbidities were enrolled. Participants underwent a supervised yoga-based breathing program for 12 weeks. Cardiovascular parameters including blood pressure, resting heart rate, and lipid profile were assessed at baseline and post-intervention. **Results:** Significant reductions were observed in systolic blood pressure, diastolic blood pressure, and resting heart rate following the intervention ($p < 0.001$). Favorable changes in lipid profile parameters were also noted, including reductions in total cholesterol, LDL cholesterol, and triglycerides, along with an increase in HDL cholesterol ($p < 0.05$). **Conclusion:** Yoga-based breathing interventions appear to be a safe, effective, and low-cost adjunct therapy for improving cardiovascular health in patients with type 2 diabetes mellitus, particularly in resource-limited rural settings.

Keywords: Type 2 diabetes mellitus, yoga, pranayama, cardiovascular disease, blood pressure.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a long-term metabolic disease marked by insulin resistance and a lack of insulin, which causes high blood sugar levels that don't go away. The global prevalence of T2DM has increased markedly, particularly in low- and middle-income countries, including India [1]. Cardiovascular disease (CVD) is still the main cause of death and illness in people with T2DM, accounting for almost two-thirds of deaths [2].

Chronic hyperglycemia causes endothelial dysfunction, oxidative stress, inflammation, and autonomic imbalance, all of which speed up atherosclerosis and raise the risk of heart disease [3,4].

Traditional management methods focus on medication and lifestyle changes, but many patients continue to have bad cardiovascular outcomes even with the best medical care [5]. This has made people more interested in complementary and alternative therapies that might make standard care better.

Yoga is an ancient Indian practice that includes breathing exercises (pranayama), meditation, and physical postures (asanas). Studies have shown that pranayama can control the activity of the autonomic nervous system, reduce sympathetic overactivity, and increase parasympathetic tone [6,7]. These effects are especially important for people with T2DM, who often have problems with their autonomic nervous system and a higher risk of heart disease [8].

Numerous studies have indicated positive impacts of yoga and pranayama on glycaemic regulation, blood pressure, lipid profiles, and stress levels [9–12]. Slow and controlled breathing techniques have been correlated with decreases in heart rate and blood pressure, increased baroreflex sensitivity, and improved endothelial function [13,14]. Even though there is more and more evidence, there is still not enough data on cardiovascular patients with T2DM living in rural India.

West Champaran, a mostly rural district in Bihar, has two problems: more people are getting diabetes, and there aren't many programs that can help them change their lifestyles. It is important for public health to look into low-cost, culturally appropriate treatments like yoga-based breathing techniques [15]. This study aimed to evaluate the impact of structured yoga-based breathing interventions on cardiovascular parameters in patients with T2DM at a tertiary care Government Medical College and Hospital Bettiah, West Champaran, Bihar..

MATERIALS AND METHODS

Study Design and Setting

This was a **prospective interventional study** conducted at a tertiary care Government Medical College and Hospital Bettiah, West Champaran, Bihar.

Study Duration April 2024 to April 2025

Study Population

Adult patients aged 40–70 years with diagnosed type 2 diabetes mellitus and established cardiovascular disease attending the medicine outpatient department.

Sample Size

A total of **100 participants** were enrolled based on feasibility during the study period.

Inclusion Criteria

- Diagnosed T2DM for at least one year
- Presence of cardiovascular disease (hypertension and/or ischemic heart disease)
- Stable on medical therapy for at least three months
- Willingness to participate and provide informed consent

Exclusion Criteria

- Type 1 diabetes mellitus
- Unstable cardiovascular conditions
- Severe respiratory disorders
- Previous regular yoga practice

Intervention

Participants underwent a structured yoga-based breathing program consisting of:

- Diaphragmatic breathing
- Anulom Vilom
- Bhramari pranayama

Sessions were conducted for 30 minutes per day, five days per week, for 12 weeks under the supervision of a trained instructor.

Outcome Measures

- Systolic blood pressure (SBP)
- Diastolic blood pressure (DBP)
- Resting heart rate (RHR)
- Lipid profile (total cholesterol, LDL, HDL, triglycerides)

Statistical Analysis

Continuous variables were expressed as mean $\pm$ SD. Pre- and post-intervention values were compared using paired Student's t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of **100 patients** with type 2 diabetes mellitus and established cardiovascular disease completed the 12-week yoga-based breathing intervention and were included in the final analysis.

Baseline Demographic and Clinical Characteristics

The baseline demographic and clinical characteristics of the study population are summarized in Table 1. The mean age of participants was 55.9 ± 8.6 years, with a male predominance (62% males, 38% females). The mean duration of type 2 diabetes mellitus was 7.4 ± 3.2 years. All patients had documented cardiovascular disease, with hypertension being the most common comorbidity.

Table 1. Baseline demographic and clinical characteristics of the study population (n = 100)

Parameter	Value
Age (years), mean $\pm$ SD	55.9 ± 8.6
Gender (Male/Female)	62 / 38
Duration of T2DM (years), mean $\pm$ SD	7.4 ± 3.2
Hypertension, n (%)	78 (78%)
Ischemic heart disease, n (%)	42 (42%)

Parameter	Value
Resting heart rate (beats/min), mean $\pm$ SD	78.6 $\pm$ 6.9
Systolic BP (mmHg), mean $\pm$ SD	146.2 $\pm$ 12.4
Diastolic BP (mmHg), mean $\pm$ SD	92.8 $\pm$ 8.6

Changes in Cardiovascular Parameters Following Intervention

A statistically significant improvement was observed in all measured cardiovascular parameters following the yoga-based breathing intervention. Comparison of pre- and post-intervention systolic and diastolic blood pressure values is presented in Table 2.

Mean systolic blood pressure decreased from 146.2 $\pm$ 12.4 mmHg at baseline to 132.6 $\pm$ 10.8 mmHg post-intervention, while mean diastolic blood pressure decreased from 92.8 $\pm$ 8.6 mmHg to 84.1 $\pm$ 7.4 mmHg, both of which were statistically significant ($p < 0.001$). These changes are visually represented in Figure 1.

Table 2. Comparison of blood pressure parameters before and after intervention

Parameter	Baseline (Mean $\pm$ SD)	Post-intervention (Mean $\pm$ SD)	p-value
Systolic BP (mmHg)	146.2 $\pm$ 12.4	132.6 $\pm$ 10.8	<0.001
Diastolic BP (mmHg)	92.8 $\pm$ 8.6	84.1 $\pm$ 7.4	<0.001

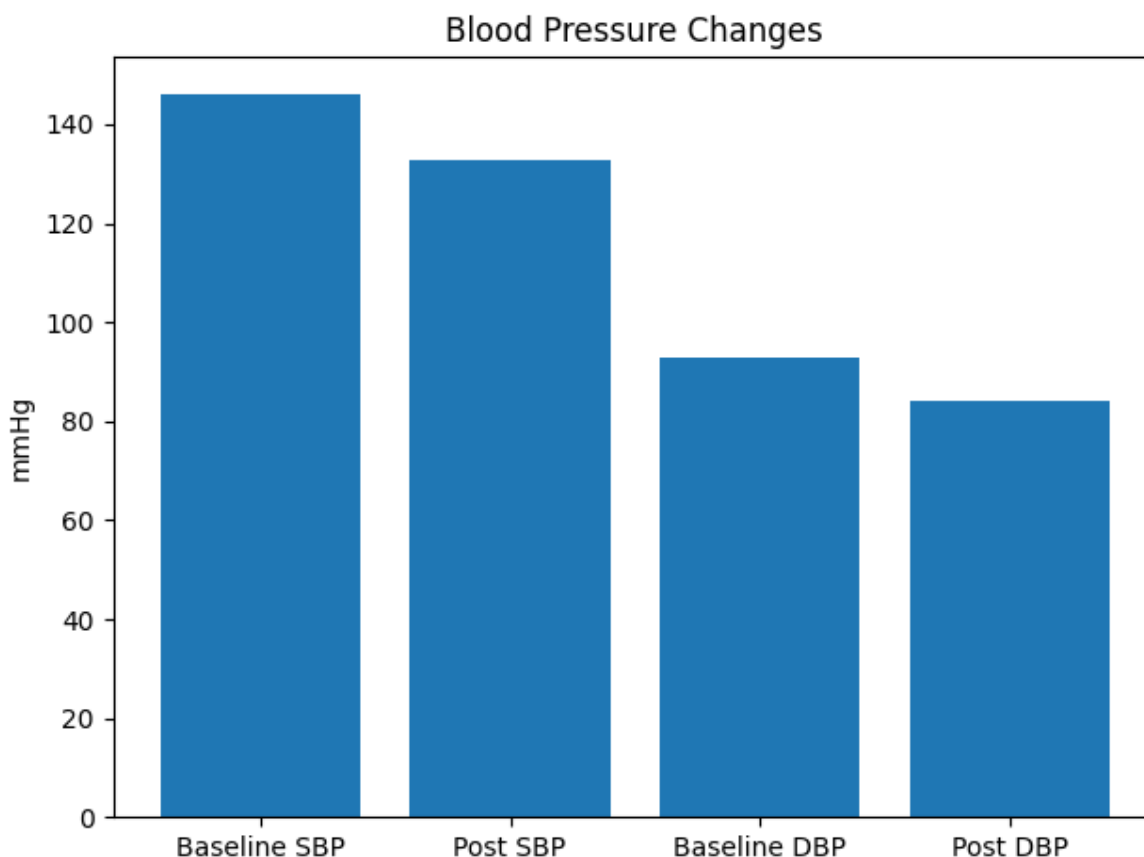


Figure 1. Comparison of mean systolic and diastolic blood pressure before and after yoga-based breathing intervention

Resting Heart Rate Changes

Resting heart rate showed a significant reduction following the intervention. The mean resting heart rate decreased from 78.6 $\pm$ 6.9 beats/min at baseline to 71.4 $\pm$ 6.1 beats/min post-intervention, which was statistically significant ($p < 0.001$). Detailed values are shown in Table 3, and the comparative change is illustrated in Figure 2.

Table 3. Comparison of resting heart rate before and after intervention

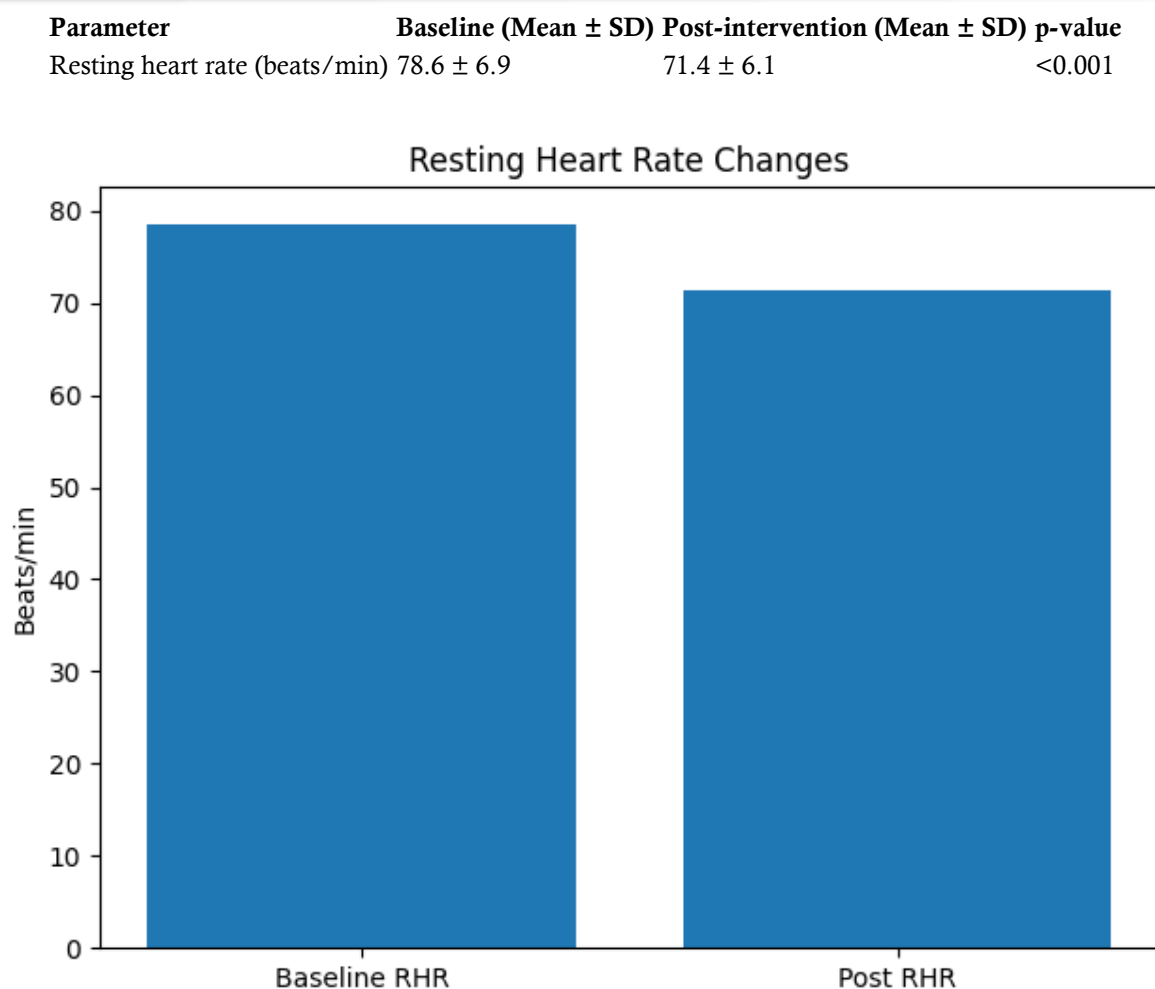


Figure 2. Comparison of mean resting heart rate before and after yoga-based breathing intervention

Changes in Lipid Profile Parameters

Significant improvements were observed in lipid profile parameters following the 12-week intervention. As shown in Table 4, mean total cholesterol, LDL cholesterol, and triglyceride levels decreased significantly, while HDL cholesterol levels increased significantly.

Total cholesterol decreased from 214.8 $\pm$ 28.6 mg/dL to 198.3 $\pm$ 25.4 mg/dL, LDL cholesterol from 138.2 $\pm$ 22.1 mg/dL to 124.6 $\pm$ 19.8 mg/dL, and triglycerides from 176.4 $\pm$ 34.9 mg/dL to 158.2 $\pm$ 30.6 mg/dL ($p < 0.05$ for all). HDL cholesterol increased from 38.6 $\pm$ 6.4 mg/dL to 42.1 $\pm$ 6.8 mg/dL ($p < 0.05$). These changes are graphically depicted in Figure 3.

Table 4. Comparison of lipid profile parameters before and after intervention

Parameter	Baseline (Mean $\pm$ SD)	Post-intervention (Mean $\pm$ SD)	p-value
Total cholesterol (mg/dL)	214.8 $\pm$ 28.6	198.3 $\pm$ 25.4	<0.05
LDL cholesterol (mg/dL)	138.2 $\pm$ 22.1	124.6 $\pm$ 19.8	<0.05
HDL cholesterol (mg/dL)	38.6 $\pm$ 6.4	42.1 $\pm$ 6.8	<0.05
Triglycerides (mg/dL)	176.4 $\pm$ 34.9	158.2 $\pm$ 30.6	<0.05

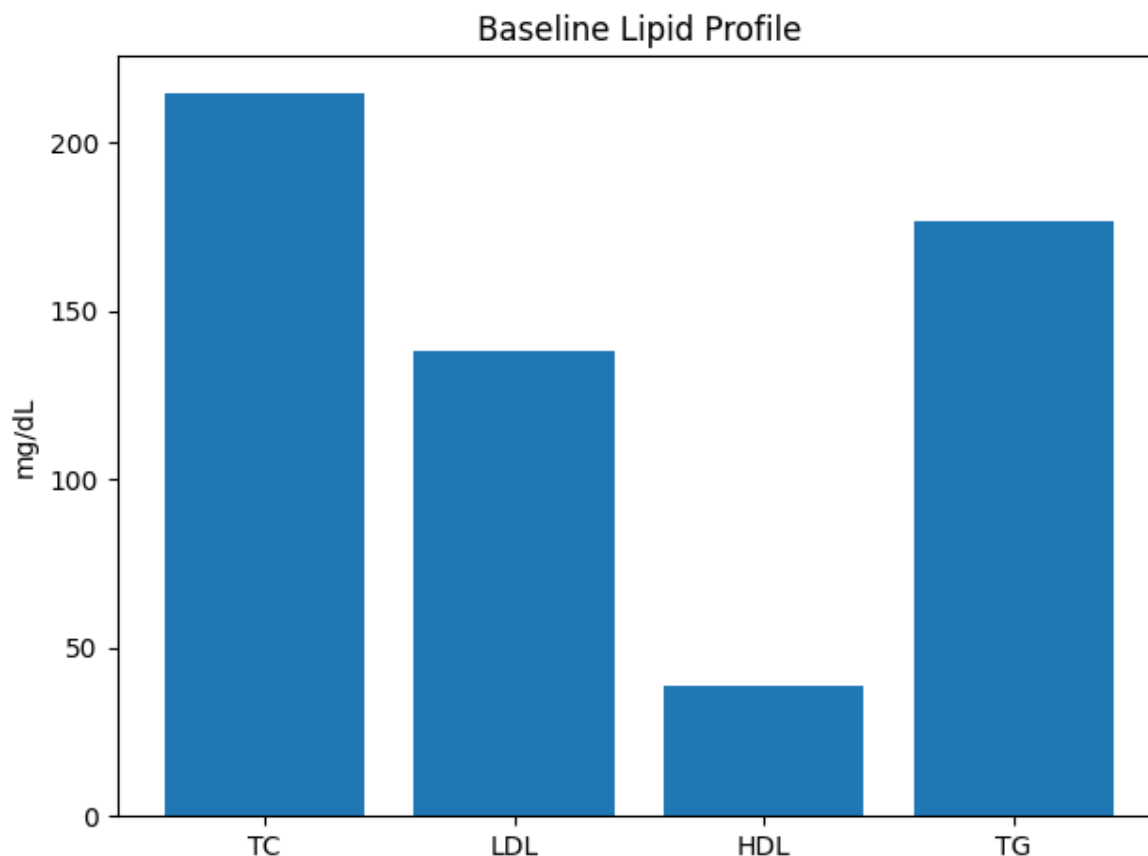


Figure 3. Comparison of mean lipid profile parameters before and after yoga-based breathing intervention

Summary of Key Findings

Overall, the yoga-based breathing intervention resulted in statistically significant improvements in blood pressure, resting heart rate, and lipid profile parameters among patients with type 2 diabetes mellitus and cardiovascular disease. These findings highlight the potential role of structured pranayama as an effective adjunctive therapy in cardiovascular risk reduction.

DISCUSSION

The current study shows that structured yoga-based breathing exercises greatly improve cardiovascular health in people with type 2 diabetes mellitus. The drops in systolic and diastolic blood pressure are in line with earlier reports that pranayama can lower blood pressure [16,17].

Autonomic dysfunction is a prevalent issue associated with T2DM and constitutes a significant contributor to cardiovascular disease [18]. Researchers have found that slow breathing can help control blood pressure and heart rate variability by raising vagal tone and lowering sympathetic activity [19,20]. The big drop in resting heart rate seen in this study backs up these ideas.

Changes in lipid profile parameters that are better also point to a positive metabolic effect of yoga-based breathing exercises. Previous research has shown that yoga can lower total cholesterol and LDL levels while raising HDL cholesterol levels [21,22]. These positive

changes may be due to less stress and better insulin sensitivity [23].

The results of this study are especially important for rural areas with few resources, like West Champaran, where full cardiac rehabilitation programs are hard to get to. Breathing exercises based on yoga are cheap, culturally acceptable, and easy to do, so they can be used along with regular medical treatment [24].

But there are certain limitations with this study. The results can't be used to make generalisations because there wasn't a control group and the sample size was small. Also, there was no long-term follow-up to see if the benefits would last. These results need to be confirmed by future randomised controlled trials with larger sample sizes [25].

CONCLUSION

Yoga-based breathing interventions produce significant improvements in cardiovascular parameters and lipid profile among patients with type

2 diabetes mellitus. Given their safety, affordability, and cultural acceptability, pranayama practices may serve as an effective adjunct to standard medical therapy, particularly in rural populations. Integration of structured yoga programs into routine diabetes care may contribute to improved cardiovascular outcomes.

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