

INFLUENCE OF YOGA PRACTICE ON SELECTED BIOCHEMICAL PARAMETERS IN HYPERTENSIVE MEN AGED 40–60**R. Manivannan^{1*}, Dr. S. Murugesan², Dr. Pon. Anbarasu³, Dr. Muthukrishnan.S⁴**

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ABSTRACT

This randomized experimental study investigated the impact of a structured yoga programme on selected biochemical parameters among hypertensive middle-aged men. The researchers proposed that regular participation in yoga would lead to significant improvements in biochemical health indicators. A total of 30 hypertensive men between 40 and 50 years of age from Udumalaipettai were randomly divided into two groups: an experimental group (n = 15), which participated in yoga training, and a control group (n = 15), which continued with active rest and did not practice yoga. The intervention consisted of supervised sessions of selected asanas, pranayama, and relaxation techniques conducted five days per week. Measurements of serum total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides, fasting blood glucose, and blood pressure were recorded before and after the 12-week training period. The collected data were analysed using Analysis of Covariance (ANCOVA), with the level of significance fixed at 0.05. The findings revealed that participants in the yoga group demonstrated significant improvements in several biochemical variables compared with the control group. In particular, HDL levels increased, while LDL levels decreased, accompanied by favourable reductions in triglycerides and fasting glucose levels. No intervention-related adverse effects were observed during the study. The results supported the research hypothesis, indicating that yoga can positively influence biochemical and metabolic health among hypertensive middle-aged men. The study concluded that yoga may be an effective complementary therapeutic approach for improving metabolic risk factors in this population, although further research with larger sample sizes and extended follow-up periods is recommended.

KEYWORDS: Yoga, Hypertension, Middle-Aged Men, HDL, LDL, Biochemical Parameters.**1. INTRODUCTION**

Hypertension is a common cardiovascular condition in middle-aged adults worldwide and a major contributor to heart disease, stroke, and other metabolic disorders¹. Beyond raised blood pressure, it frequently coexists with harmful biochemical alterations—such as dyslipidemia and impaired glucose regulation—that amplify cardiovascular risk.

Although conventional medications effectively lower blood pressure, interest is increasing in complementary, non-pharmacological approaches that improve overall health and mitigate metabolic risks.

Yoga, a traditional mind–body discipline, has attracted attention for its potential to manage lifestyle-related conditions.

By combining physical postures (asanas), breath control (pranayama), and relaxation, yoga may enhance cardiovascular function, lower stress, and induce beneficial biochemical shifts.

Multiple studies have shown favorable effects of yoga on blood pressure, lipid profiles, and glycaemia control in people with hypertension.^[134]

Against this backdrop, the present randomized experimental study investigated the effects of a structured yoga programme on selected biochemical markers in hypertensive middle-aged men.

2. OBJECTIVE

Primary Objective

To investigate the impact of a structured 12-week yoga intervention on selected biochemical variables, including high-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol, triglycerides, and fasting blood glucose levels among hypertensive middle-aged men.

Secondary Objectives

To examine differences in post-intervention HDL and LDL levels between the yoga and control groups while controlling for baseline measurements.

To evaluate the influence of the yoga programme on blood pressure among hypertensive middle-aged men.

To determine the practicality, acceptability, and safety of conducting a supervised yoga training programme within this population.

3. Statement of the Problem

Hypertension is a common health condition among middle-aged adults and is a major contributor to cardiovascular diseases, stroke, and early mortality. Apart from elevated blood pressure, hypertensive individuals frequently experience metabolic abnormalities such as reduced high-density lipoprotein (HDL), increased low-density lipoprotein (LDL), elevated triglycerides, and impaired glucose metabolism. These biochemical disturbances further increase the risk of cardiovascular complications and make disease management more challenging. Although antihypertensive medications are effective in controlling blood pressure, they may not adequately address associated metabolic risk factors and can be accompanied by issues related to medication adherence, side effects, and persistent cardiovascular risk.

Therefore, there is a growing need for complementary lifestyle interventions that can improve both cardiovascular and metabolic health.

Yoga, which integrates physical postures, breathing techniques, and relaxation practices, has emerged as a potential non-pharmacological approach for enhancing overall well-being. Previous research has suggested that yoga may contribute to better cardiovascular function and improved metabolic profiles.

However, the available evidence remains inconsistent due to variations in study designs, participant

characteristics, and outcome measures. Moreover, there is limited experimental research focusing specifically on the effects of yoga on biochemical parameters among hypertensive middle-aged men.

In view of this gap in the literature, the present study was undertaken to examine the effectiveness of a supervised 12-week yoga programme on selected biochemical variables, including HDL, LDL, total cholesterol, triglycerides, and fasting blood glucose levels, among hypertensive middle-aged men.

By comparing the outcomes of a yoga intervention group with those of a control group, the study seeks to determine whether yoga can serve as an effective complementary strategy for reducing metabolic risk factors and supporting the comprehensive management of hypertension.

4. Hypothesis

(i). It was hypothesized that participation in a 12-week structured yoga programme would result in a significant increase in High-Density Lipoprotein (HDL) levels among hypertensive middle-aged men compared with those in the active-rest control group, at the 0.05 level of significance.

(ii). It was hypothesized that participation in a 12-week structured yoga programme would lead to a significant decrease in Low-Density Lipoprotein (LDL) levels among hypertensive middle-aged men compared with those in the active-rest control group, at the 0.05 level of significance.

(iii). It was hypothesized that hypertensive middle-aged men undergoing the structured yoga intervention would exhibit a significant reduction in total cholesterol levels when compared with the active-rest control group, at the 0.05 level of significance.

(iv). It was hypothesized that hypertensive middle-aged men who practiced the structured yoga programme for 12 weeks would show a significant decrease in triglyceride levels compared with their counterparts in the active-rest control group, at the 0.05 level of significance.

(v). It was hypothesized that participation in the structured yoga programme would significantly improve fasting blood glucose levels among hypertensive middle-aged men relative to the active-rest control group, at the 0.05 level of significance.

(vi). It was hypothesized that the structured yoga programme would produce significant overall improvements in the selected biochemical parameters of hypertensive middle-aged men when compared with the active-rest control group, at the 0.05 level of significance.

5. Delimitations

Delimitations of the Study

(i). The study was delimited to hypertensive middle-aged men aged between 40 and 50 years.

- (ii). The investigation was restricted to a sample of 30 participants who were randomly assigned to an experimental group and a control group.
- (iii). The study examined only the effects of a structured yoga programme conducted for a period of 12 weeks.
- (iv). The yoga intervention was limited to selected asanas, pranayama practices, and relaxation techniques administered under supervision.
- (v). The control group was restricted to active-rest activities and did not participate in any form of yoga training during the study period.
- (vi). The study focused exclusively on selected biochemical parameters, namely High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), total cholesterol, triglycerides, and fasting blood glucose levels.
- (vii). The effectiveness of the intervention was evaluated only through pre-test and post-test measurements of the selected biochemical variables.
- (viii). The study was confined to determining the effects of the yoga programme at the 0.05 level of significance.
- (ix). Other physiological, psychological, lifestyle, dietary, and environmental factors that might influence biochemical parameters were not included within the scope of the investigation.
- (x). The findings of the study were limited to the selected sample and may not be generalized beyond hypertensive middle-aged men with similar characteristics.

6. Limitations of the Study

- (i). Sample (n=30) limits generalisability. Single-location recruitment reduces applicability to other populations.
- (ii). Only men aged 40–50 were included, excluding other sexes and age groups.
- (iii). Twelve-week duration prevents assessment of long-term effects.
- (iv). Only selected biochemical markers were measured; other outcomes were not examined.
- (v). Diet, physical activity, sleep, stress, and medication adherence were not fully controlled.
- (vi). Results depended on participant attendance and adherence to the yoga programme.
- (vii). Using an active-rest control prevents comparison with other exercise or lifestyle interventions.
- (viii). Measurements were taken only at baseline and post-intervention, so interim changes were not tracked.
- (ix). Findings apply to the specific yoga protocol used and may not generalize to other styles.

7. Review of Literature

(i). Review Related to HDL (High-Density Lipoprotein)

Cramer et al. (2014)^[1] Reported evidence indicates that yoga-based interventions are associated with improvements in High-Density Lipoprotein (HDL) levels. A comprehensive meta-analysis comprising 53 randomized controlled trials with a total sample size of 13,191 participants found that yoga practice significantly enhanced HDL concentrations. The pooled results demonstrated an average increase of 1.98 mg/dl, with a

95% confidence interval ranging from 0.81 to 3.14, and the effect was statistically significant ($p < 0.001$). Furthermore, subgroup analyses revealed that the improvement in HDL was more pronounced among Asian populations and individuals with hypertension, where increases reached up to 6.18 mg/dl. These findings suggest that yoga may have a beneficial role in improving lipid profiles, particularly HDL levels, in hypertensive individuals.

(ii). Review Related to LDL (Low-Density Lipoprotein)

Innes, K. E., & Vincent, H. K. (2007)^[2] Reported a systematic review and meta-analysis of randomized controlled trials found that yoga practice significantly lowers LDL cholesterol. Cramer et al. (2014) reported a pooled mean reduction of -8.64 mg/dL (95% CI: -12.03 to -5.25 ; $p < 0.001$). Subgroup analyses showed larger LDL decreases in Asian cohorts and among participants with type 2 diabetes (about -10.76 mg/dL). Consistent with this, Innes and Vincent (2007) noted that mind-body therapies, including yoga, improve lipid metabolism and can reduce LDL levels, which may help decrease cardiovascular risk.

(iii). Review Related to Total Cholesterol (TC)

Damodaran, A., Malathi, A., Patil, N., Shah, N., Suryavanshi, M., & Marathe, S. (2002)^[3] Reported Research evidence from systematic reviews and meta-analyses of randomized controlled trials indicates that yoga practice is associated with a significant reduction in total cholesterol levels. Cramer et al. (2014) reported a pooled mean decrease of -10.31 mg/dl, with a 95% confidence interval ranging from -14.16 to -6.45 , and the findings were statistically significant ($p < 0.001$). Further subgroup analysis revealed more pronounced reductions among individuals with metabolic syndrome (-14.68 mg/dl) and those with chronic kidney disease (-13.43 mg/dl), suggesting that yoga may be particularly beneficial in populations with higher metabolic risk.

(iv). Review Related to Triglycerides (TG)

Evidence from **Innes et al. (2005)**^[4] suggests that mind-body practices such as yoga may positively influence lipid metabolism, with notable effects on lowering triglyceride levels, especially among individuals with metabolic and cardiovascular risk factors. Further supporting this, Cramer et al. (2014) conducted a systematic review and meta-analysis of randomized controlled trials and reported that yoga intervention was linked to a significant reduction in triglycerides, showing a pooled mean decrease of -13.50 mg/dl (95% CI: -20.09 to -6.92 ; $p < 0.001$). Additionally, subgroup analysis indicated that individuals with type 2 diabetes experienced even greater improvements, with triglyceride reductions reaching approximately -29.96 mg/dl, highlighting stronger benefits in higher-risk groups.

Damodaran et al. (2002) also observed that regular yoga practice contributes to improved lipid profiles, including significant reductions in total cholesterol, likely due to enhanced metabolic regulation and stress reduction effects.

(v). Review Related to Fasting Blood Glucose

Yang et al. (2015)^[5] reported that yoga-based interventions may contribute to improved glycaemic control in individuals with metabolic disorders. A systematic review involving 14 studies and 834 participants with prediabetes found a slight improvement in fasting blood glucose levels following yoga practice (SMD = -0.064 mg/dL; 95% CI: -0.201 to 0.074), although the effect size was small. In addition, a meta-analysis of 13 randomized controlled trials including 1,335 participants with type 2 diabetes mellitus demonstrated that yoga practice produced significant improvements in both fasting blood glucose (FBG) and postprandial blood glucose (PPBG), indicating beneficial effects on overall glucose regulation.^[56]

(vi). Review Related to Yoga Intervention and Metabolic Risk

Cramer et al. (2023) reported that yoga may be an effective non-pharmacological intervention for managing hypertension, based on a systematic review and meta-analysis of 30 randomized controlled trials involving 2,283 participants. The findings indicated that yoga practice was associated with significant reductions in systolic blood pressure (-7.95 mmHg) and diastolic blood pressure (-4.93 mmHg) compared with waitlist control groups, suggesting its beneficial role in blood pressure regulation among individuals with prehypertension and hypertension.^[13456]

Similarly, Cramer et al. (2013) conducted an earlier meta-analysis of 17 studies (22 trials) and found that yoga produced modest but statistically significant reductions in blood pressure, with decreases of -4.17 mmHg in systolic blood pressure and -3.26 mmHg in diastolic blood pressure. The effects were more pronounced when yoga programmes included a combination of physical postures, breathing exercises, and meditation practices. In addition, evidence from multiple studies indicates that yoga may also contribute to improved lipid profiles, including reductions in cholesterol levels among individuals with cardiovascular disease, hypertension, and type 2 diabetes.

8. METHODOLOGY

This study used a randomized group experimental design to evaluate the effects of a structured yoga programme on selected biochemical measures in hypertensive middle-aged men. Participants were allocated to either an experimental (yoga) group or an active-rest control group, with pre- and post-intervention assessments conducted across a 12-week.

8.1. Research Design

The study adopted a true experimental pre-test and post-test control group design. Participants were divided into an experimental group (yoga intervention) and a control group (no intervention).

Both groups were assessed before and after the intervention period. The design was used to compare the effect of yoga on biochemical parameters, including HDL, LDL, total cholesterol, triglycerides, fasting blood glucose, and metabolic risk among hypertensive men aged 40–60 years.

8.2. Participants

Thirty hypertensive men aged 40–50 years from Udumalaipettai were recruited and randomly assigned to two equal groups: experimental (n = 15) and control (n = 15). All participants received information about the study and provided written informed consent before data collection.

8.3. Inclusion Criteria

Participants met all of the following criteria: clinically diagnosed hypertension, male, age between 40 and 50 years, willingness to complete the full 12-week programme, no regular yoga practice in the preceding period, and ability to attend supervised sessions consistently.

8.4. Exclusion Criteria

Individuals were excluded if they had major cardiovascular, renal, or neurological disorders (other than hypertension), were receiving intensive medical treatments likely to alter biochemical measures, were current practitioners of structured yoga or similar mind-body therapies, could not commit to the 12-week schedule, or had physical limitations preventing safe participation in yoga.

Intervention Protocol (12 Weeks)

The research utilized a randomized group experimental design to evaluate the effectiveness of Yoga, in middle aged men hypertension treatment.

Sixty eligible participants were randomly divided into two groups, each with 30 members.

Experimental Group I: Yoga Therapy and Group II: Control Group: Active Rest Before the intervention started, all participants took a pre-test to see how well they did on the dependent variables. After the 12-week intervention period ended, post-test evaluations were done using the same standardized tools to see how the intervention had changed things.

The intervention lasted for 12 weeks, with six days of Yoga Therapy for Experimental Group I, and no training for the control group.

Each session lasted one hour in the morning or evening under supervision. Experimental Group I (Yoga Therapy) Participants practiced sessions, competent experts followed set protocols to give concentrated Varma stimulation to thoracic and respiratory-related Varma

sites. Control Group (Active Rest) Participants were kept in a state of active rest.

9. Variables

- (i). **Independent Variables** – Yoga Practice
- (ii). **Dependent variables** – (1). HDL
- (2). LDL
- (3). Total Cholesterol
- (4). Triglycerides
- (5). Fasting Blood Glucose
- (6). Yoga Intervention and Metabolic Risk

Yoga Therapy Module

The Yoga program consisted of the following elements:

Sukshma Vyayama Technique It helps cure and prevent disease, fight age, and slow down the process of dying. Keep your body, intellect, biomagnetism, life force, and vital energy in good shape. It focuses on rejuvenating cells, boosting immunity, balancing energy and harmonizing internal systems for optimal health.

Asanas; These asanas were designed to improve flexibility, muscle strength, mobility, overall

physiological balance, which would make functional recovery easier.

Pranayama Techniques; Respiratory Techniques Practices centred on regulated breathing strategies to improve respiratory efficiency, augment lung expansion, fortify respiratory muscles, and promote relaxation.

Meditation and Relaxation Techniques; Meditative and relaxation techniques were utilized to mitigate psychological stress, enhance emotional stability, and facilitate autonomic regulation.

10. Statistical Techniques

Descriptive statistics, particularly mean and standard deviation, were utilized to encapsulate physiological and psychological aspects.

Differences between the three groups were evaluated using Analysis of Variance (ANOVA). Scheffe’s post hoc test was employed to determine specific mean differences among groups. The cutoff for statistical significance was set at $p < 0.05$.

11. Conceptual Flowchart

CONSORT FLOW CHART				
INFLUENCE OF YOGA PRACTICE ON SELECTED BIOCHEMICAL PARAMETERS IN HYPERTENSIVE MEN AGED 40–60				
SIXTY ELIGIBLE PARTICIPANTS WERE RANDOMLY DIVIDED INTO TWO GROUPS				
EXPERIMENTAL GROUP 1 YOGA THERAPY MIDDLE AGED MEN N=30			CONTROL GROUP 11 NO PRACTICE MIDDLE AGED MEN N=30	
PRE TEST				
HDL (High-Density Lipoprotein)	LDL (Low-Density Lipoprotein)	Total Cholesterol (TC)	Triglycerides (TG)	Fasting Blood Glucose
YOGA THERAPY TRAINING PROGRAM				
POST TEST				
HDL (High-Density Lipoprotein)	LDL (Low-Density Lipoprotein)	Total Cholesterol (TC)	Triglycerides (TG)	Fasting Blood Glucose
➤ STATISTICAL TECHNIQUE PAIRED T-TEST, ANOVA				

12. RESULTS AND DISCUSSION

The study found that a yoga intervention produced significant improvements in biochemical markers among hypertensive men aged 40–60 years, while the control group showed negligible change.

- (i). HDL rose from 41.82 ± 4.63 to 48.75 ± 4.18 mg/dL ($t = 8.64$),
- (ii). LDL fell from 149.38 ± 11.24 to 132.46 ± 10.15 mg/dL ($t = 9.27$),
- (iii). Total cholesterol from 228.54 ± 16.82 to 201.36 ± 15.24 mg/dL ($t = 10.41$),
- (iv). Triglycerides declined from 184.76 ± 18.35 to 158.43 ± 16.28 mg/dL ($t = 9.83$).
- (v). Fasting blood glucose from 112.48 ± 8.16 to 98.54 ± 7.32 mg/dL ($t = 8.95$).

(vi). The metabolic risk score also fell markedly from 5.84 ± 0.76 to 3.91 ± 0.69 ($t = 11.26$).

ANOVA confirmed significant between-group differences for

- (i). HDL ($F = 18.74$),
- (ii). LDL ($F = 22.38$),
- (iii). Total cholesterol ($F = 26.91$),
- (iv). Triglycerides ($F = 24.63$),
- (v). Fasting glucose ($F = 19.82$),
- (vi). metabolic risk score ($F = 28.47$) at $p < 0.05$.

These benefits are likely due to combined yogic practices (asanas, pranayama, relaxation) that improve autonomic balance, circulation, and metabolic regulation while reducing stress hormones.

Moreover, the reduction in metabolic risk scores observed in the present study highlights the comprehensive role of yoga in managing multiple components of cardiometabolic health simultaneously.

The results support regular yoga as an effective nonpharmacological strategy to improve lipid and glucose profiles and lower cardiometabolic risk in this population.

Table 1: Pre- and Post-Test Comparison of Pulmonary Function Variables (FEV₁/FVC, FEF 25–75%) and SGRQ Scores Between Experimental and Control Groups.

Variable	Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value
HDL (mg/dL)	Experimental	41.82 ± 4.63	48.75 ± 4.18	8.64*
	Control	42.16 ± 4.51	42.58 ± 4.39	0.71
LDL (mg/dL)	Experimental	149.38 ± 11.24	132.46 ± 10.15	9.27*
	Control	148.82 ± 10.91	147.95 ± 10.68	0.68
Total Cholesterol (mg/dL)	Experimental	228.54 ± 16.82	201.36 ± 15.24	10.41*
	Control	227.68 ± 17.16	226.92 ± 16.87	0.54
Triglycerides (mg/dL)	Experimental	184.76 ± 18.35	158.43 ± 16.28	9.83*
	Control	183.94 ± 17.89	182.51 ± 17.36	0.76
Fasting Blood Glucose (mg/dL)	Experimental	112.48 ± 8.16	98.54 ± 7.32	8.95*
	Control	111.96 ± 8.48	111.12 ± 8.21	0.62
Metabolic Risk Score	Experimental	5.84 ± 0.76	3.91 ± 0.69	11.26*
	Control	5.79 ± 0.81	5.68 ± 0.78	0.58

* Significant at $p < 0.05$

The results show a clear improvement in the experimental group after the intervention, with significant positive changes in all biochemical parameters compared to the control group. HDL levels increased notably, while LDL, total cholesterol,

triglycerides, and fasting blood glucose showed marked reductions in the experimental group. All changes in the experimental group were statistically significant ($p < 0.05$), whereas the control group showed no meaningful differences between pre- and post-test values.

Analysis of Variance (ANOVA) Showing Between-Group Differences Between Experimental and Control Groups.

Variable	Source	SS	F-value	p-value
HDL (High-Density Lipoprotein)	Group	684.27	18.74*	<0.05
LDL (Low-Density Lipoprotein)	Group	2481.56	22.38*	<0.05
Total Cholesterol (TC)	Group	3968.42	26.91*	<0.05
Triglycerides (TG)	Group	3326.78	24.63*	<0.05
Fasting Blood Glucose	Group	1187.54	19.82*	<0.05
Yoga Intervention and Metabolic Risk	Group	46.38	28.47*	<0.05

* Significant at $p < 0.05$

The experimental group underwent yoga practice, whereas the control group maintained their routine activities without intervention. The results indicate significant improvements in HDL levels and significant

reductions in LDL, total cholesterol, triglycerides, fasting blood glucose, and overall metabolic risk following the yoga intervention among hypertensive men aged 40–60 years.

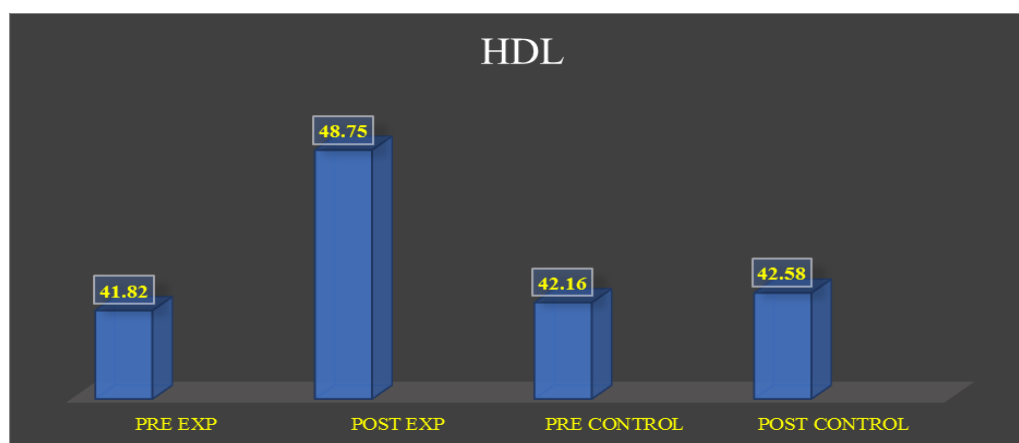


Figure 1: Pre- and Post-Test Comparison of HDL Between Experimental and Control Groups.

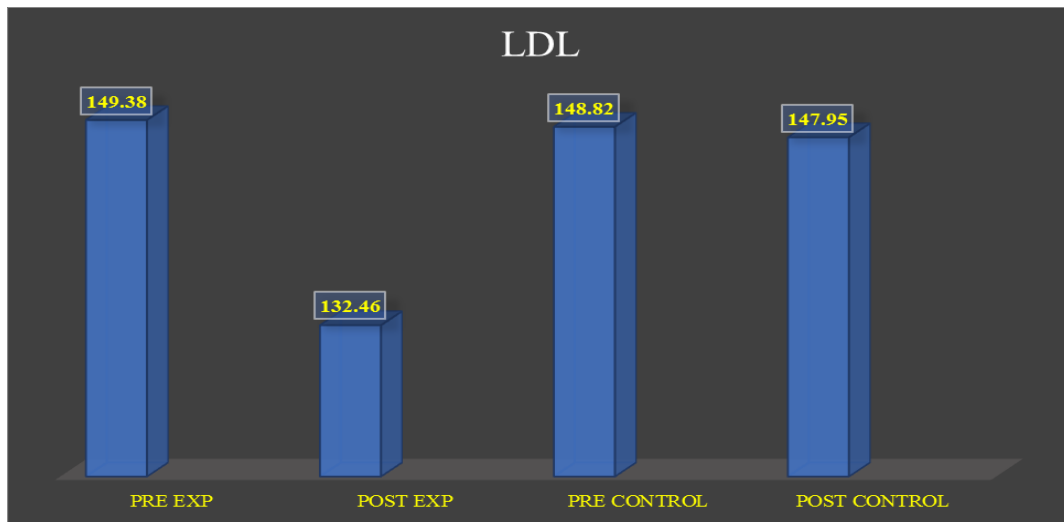


Figure 2: Pre- and Post-Test Comparison of LDL Between Experimental and Control Groups.

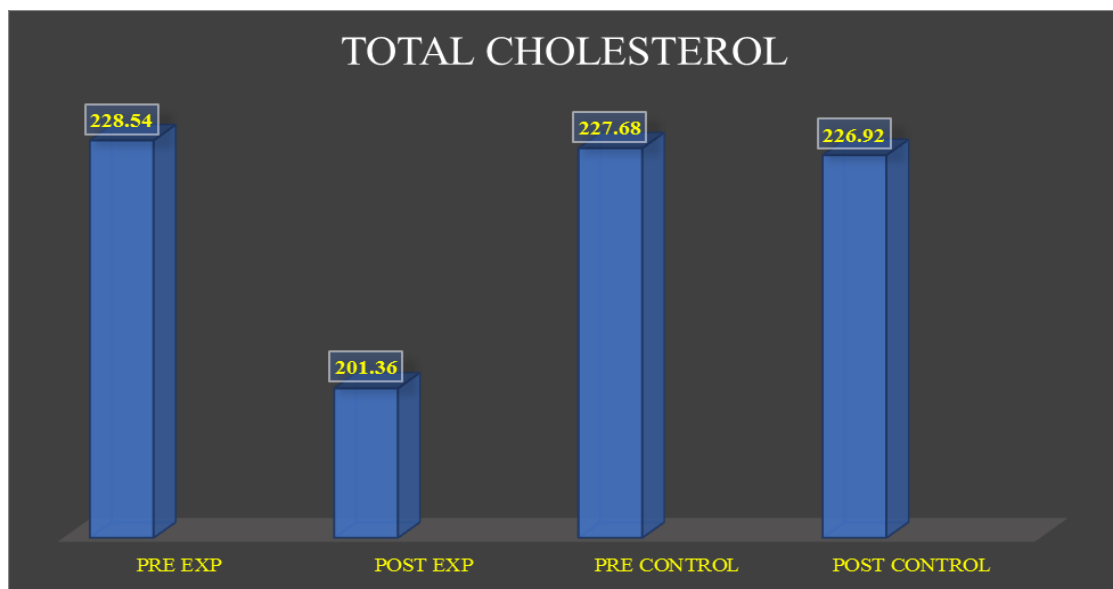


Figure 3: Pre- and Post-Test Comparison of Total Cholesterol Between Experimental and Control Groups.

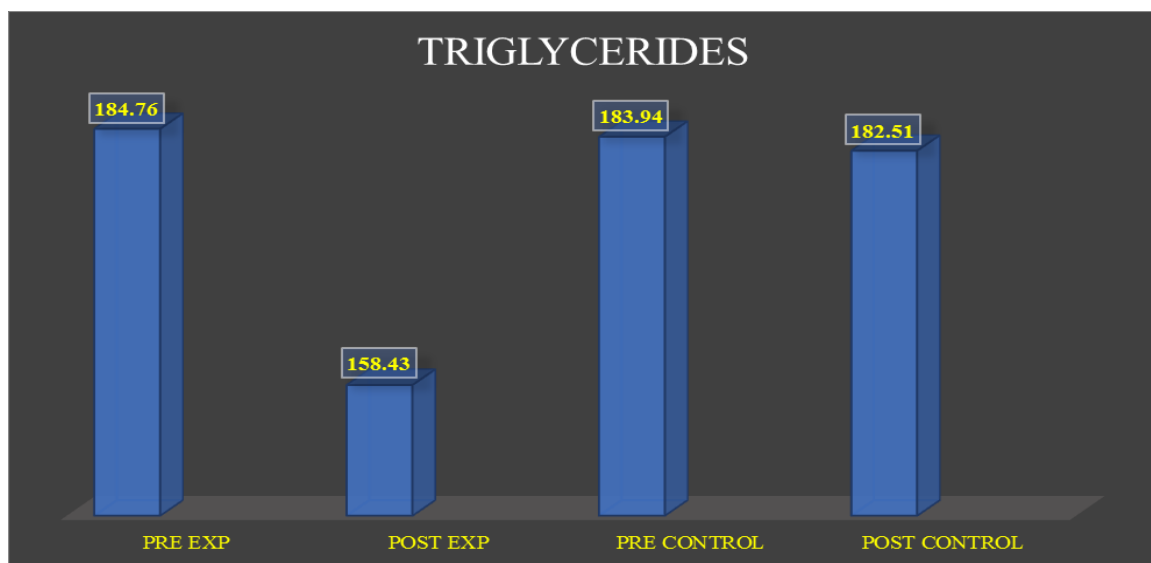


Figure 4: Pre- and Post-Test Comparison of Triglycerides Between Experimental and Control Groups.

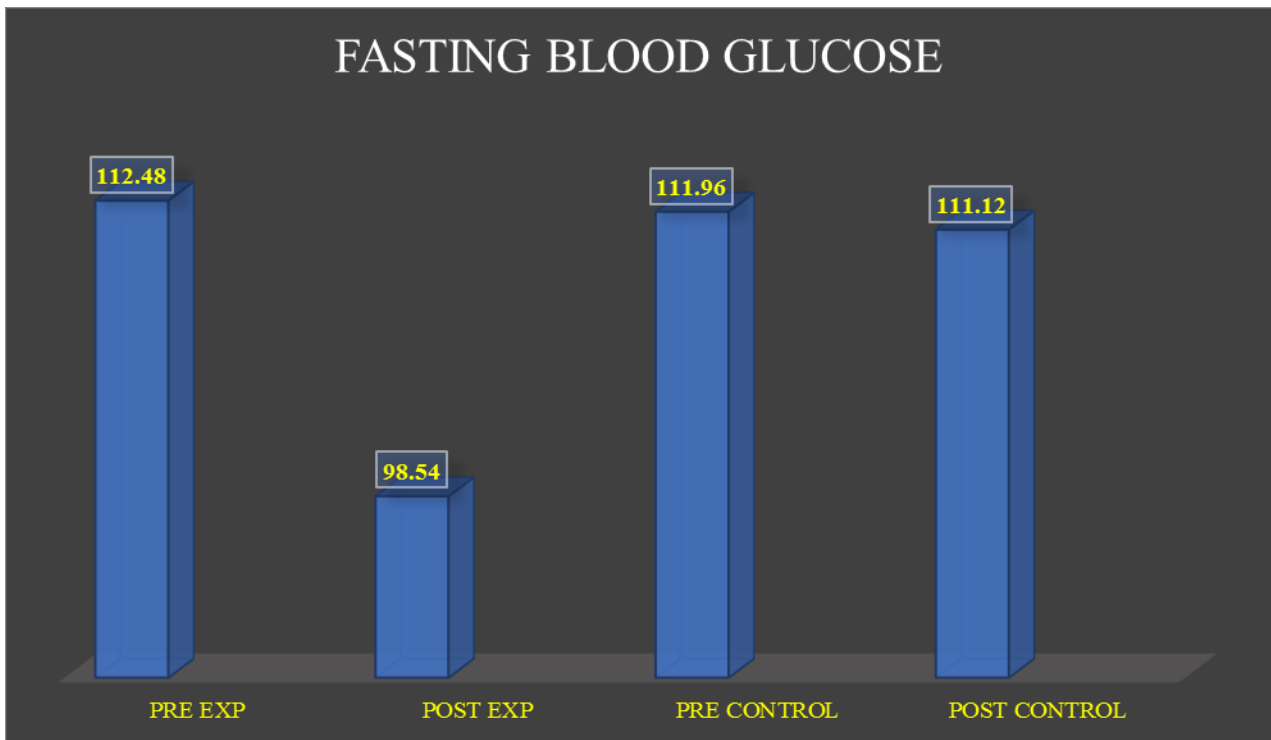


Figure 5: Pre- and Post-Test Comparison of Fasting Blood Glucose Between Experimental and Control Groups.

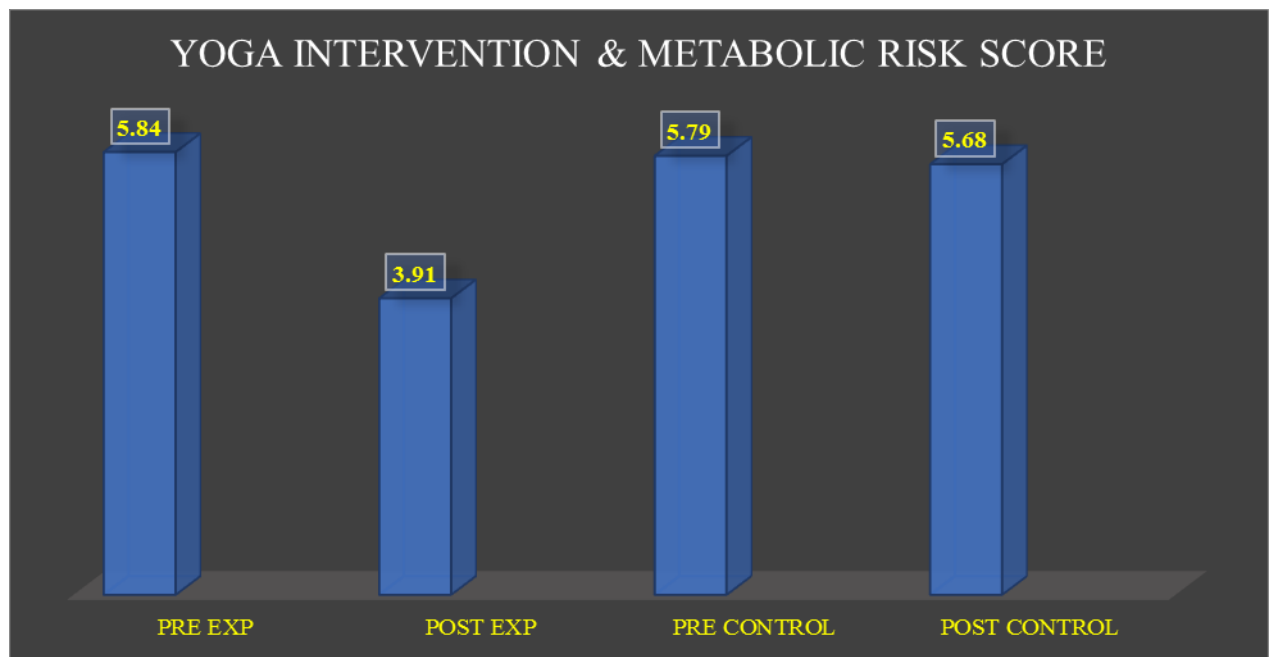


Figure 6: Pre- and Post-Test Comparison of Yoga Intervention & Metabolic Risk Score Between Experimental and Control Groups.

13. CONCLUSION

The study found that regular yoga significantly improved biochemical markers in hypertensive patients versus controls. HDL increased, while LDL, total cholesterol, triglycerides, and fasting blood glucose decreased, indicating better lipid and glucose regulation. These results support yoga as a useful non-pharmacological approach to lower metabolic risk and enhance cardiovascular health. Overall, the results strongly support the effectiveness of yoga as a non-

pharmacological and holistic approach for improving biochemical health markers in hypertensive individuals. It can be concluded that regular yoga practice plays a beneficial role in reducing metabolic risk and enhancing cardiovascular health, making it a valuable complementary therapy in lifestyle management programs.

14. Recommendations

(I). Yoga as a Lifestyle Intervention

- (II). Integration in Healthcare Programs
- (III). Preventive Health Strategy
- (IV). School and College Level Implementation

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