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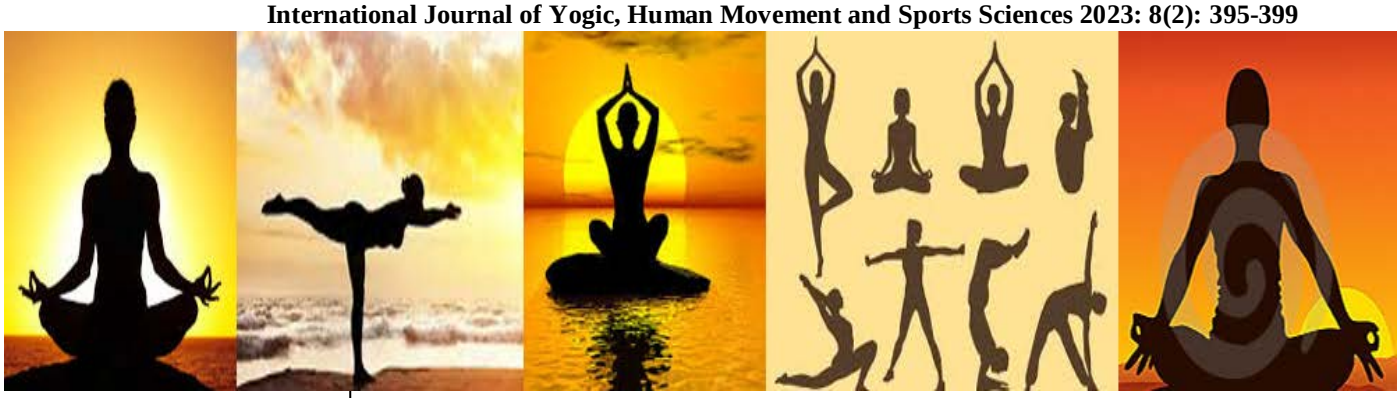

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R Poornima
Research Scholar, Department of Yoga School of Ancient Indian Studies, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu, India

Dr. Natarajan
Associate Professor, Department of Yoga School of Ancient Indian Studies, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu, India

Dr. CV Jayanthi
Assistant Professor, Department of Yoga School of Ancient Indian Studies, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu, India

Corresponding Author:
R Poornima
Research Scholar, Department of Yoga School of Ancient Indian Studies, Vels Institute of Science, Technology & Advanced Studies, Chennai, Tamil Nadu, India

Impact of selected yoga practices on lipid metabolism in pre-hypertensive male adults

R Poornima, Dr. Natarajan and Dr. CV Jayanthi

Abstract
Yoga, a holistic practice encompassing physical postures, breathing exercises, meditation, and relaxation techniques, serves as a valuable therapeutic approach for individuals with pre-hypertension. This study aimed to evaluate the effectiveness of a 20-week yogic protocol-incorporating Asana, Pranayama, and Relaxation in enhancing overall physical function and lipid profile among pre-hypertensive males. Elevated levels of high-density lipoprotein (HDL), low-density lipoprotein (LDL), and blood pressure are significant risk factors for coronary heart disease, along with obesity.
Thirty subjects were recruited and randomly assigned to either the yoga group (YG) or the control group (CG). The yoga group engaged in sessions five days a week for 20 weeks. Post-intervention, noteworthy reductions in blood pressure, LDL levels, and considerable changes in HDL levels were observed due to the consistent practice of Yoga.

Keywords: Yog, metabolism, hypertension biochemical, lipid profile

Introduction
Lipid metabolism refers to the process by which the body breaks down fats and converts them into energy. This process is necessary for the body to function properly, as lipids play a crucial role in many bodily functions, including the production of hormones and the formation of cell membranes. Various enzymes and hormones regulate lipid metabolism, and any disruptions to this process can lead to health issues such as obesity, diabetes, and heart disease.
Most of the lipids that are present in the human body after consuming food are in the form of triglycerides and cholesterol. Fatty acids and membrane lipids are also types of lipids found in the body. Lipid metabolism is often described as the process of digesting and absorbing dietary fat. However, there are two sources of fats that organisms can utilize for energy, i.e., consumed dietary fats and stored fats. Vertebrates, including humans, use both sources of fat to produce energy for organs such as the heart to function properly.
Cholesterol plays a significant role in our body by serving as a precursor to various hormones like progesterone and testosterone. Additionally, it helps in controlling the fluidity of the cell membrane. On the other hand, triacylglycerols, also known as fats, are the primary form of energy storage in the human body. They are involved in lipolysis and lipogenesis processes and play an essential role in maintaining energy balance.
Blood pressure is a fundamental indicator of cardiovascular function that reflects the force of blood flow against the inner walls of blood vessels. This force is determined by several factors, including vascular resistance and cardiac workload. Knowledge of blood pressure is crucial for maintaining optimal health and preventing a range of conditions, including but not limited to heart disease, stroke, and kidney failure.
Blood pressure is a measure of two pressures, the systolic and the diastolic.
The systolic pressure (the higher pressure and the first number recorded) is the force that blood exerts on the artery walls as the heart contracts to pump the blood to the peripheral organs and tissues.
The diastolic pressure (the lower pressure and the second number recorded) is the residual pressure exerted on the arteries as the heart relaxes between beats.
Pre-hypertension is a condition in which an individual's blood pressure is higher than normal but not high enough to be considered hypertension.

Pressures are measured in millimeters of mercury (mmHg). High blood pressure is defined as pressures above 140/90 for a period of time. Prehypertension is defined as a systolic pressure from 120-139 millimeters of mercury (mm Hg) or a diastolic pressure from 80-89 mm Hg.

There can be several causes of prehypertension, including genetics, age, lack of physical activity, unhealthy diet, stress, smoking, alcohol consumption, and certain underlying medical conditions such as kidney disease, diabetes, and sleep apnea. It is important to identify the underlying cause of prehypertension and take appropriate measures to manage it in order to prevent it from progressing to hypertension.

Studies have shown that practicing yoga regularly can help reduce blood pressure, improve cardiovascular health, and reduce stress levels. Additionally, yoga can be a low-impact exercise accessible to individuals of all ages and fitness levels.

Methods

A comprehensive method is provided below, detailing the individuals involved, variables studied, training methodologies employed, and statistical techniques used. The recruitment strategy encompassed marketing efforts and public announcements across various yoga therapy clinics. Prior to data collection, individuals meeting the inclusion criteria provided informed consent. The study enrolled a total of 30 pre hypertensive male participants, categorized into two groups: The experimental group, and the control group.

Measurement of systolic and diastolic pressure, both Low-density Lipoprotein (LDL) and High-density Lipoprotein (HDL) levels was conducted using standard, sphygmomano-meter and blood sampling procedures. The Experimental group engaged in a 20-week program, involving instruction and practice of asana, such as sitting postures: Sasankasan, ustrasan, vakrasan.

Supine postures: Setubandhasan, sarvangasan with wall support.

Standing: Hand stretches, tadasan, ardha kati chakrasan.

Prone postures: Marjari asana, bhujangasana.

Restorative breathing techniques are a set of practices that focus on regulating one's breathing pattern in order to reduce stress and improve overall well-being. These techniques involve deep, diaphragmatic breathing, which can help activate the body's relaxation response and reduce feelings of anxiety and tension. Restorative breathing techniques can be practiced in a variety of settings, including meditation, yoga, and mindfulness exercises. They are simple yet effective tools that can be used to promote a sense of calm and balance in one's daily life. Breathing practices would include, dirge pranayama, nadi shodhana and bhramari.

Mudras are hand gestures used in yoga and meditation practices to channel energy flow within the body and promote healing. Each mudra has a specific meaning and purpose, and they are believed to help balance the chakras and enhance mental and physical health. Effective mudra practice for prehypertensive male adults is Hridaya mudra and prana mudra.

Affirmations are positive statements that aim to reprogram the subconscious mind, replacing negative and limiting beliefs with empowering and uplifting ones.

- My heart is strong and healthy
- All the circulations in my body are regular and normal throughout
- I thank my body with gratitude for functioning in a regular and normal manner.

Meditation is a practice that involves training the mind to induce a state of relaxation, calmness, and inner peace. Through regular meditation, one can reduce stress, improve concentration, boost emotional well-being, and gain a deeper understanding of oneself. Practice of breath awareness meditation, nadaanusandhana.

Relaxation techniques are methods used to achieve a state of calmness and tranquillity by reducing physical and mental tension. This technique can involve various methods such as deep breathing exercises, part-by-part body relaxation, visualization, and meditation. The aim of deep relaxation is to reduce stress, promote better sleep, and improve overall well-being. Practices of deep relaxation technique, yoga nidra.

The data gathered from the experimental and control groups before and after the experiment, focusing on Blood pressure, Lipid parameters like low-density lipoprotein and high-density lipoprotein, were evaluated to see if there were any statistically significant differences. This investigation made use of the F-ratio analysis of variance.

Statistical analysis and interpretation table

Table 1: Analysis of co-variance of the pre-test and post-test means of the yoga practices and control group in systolic blood pressure

Group	Yoga	Control	Source of variance	Sum of squares	DF	Mean square	'F' Ratio
Pre-Test Mean	132.80	130.73	Between	32.033	1	32.033	1.10
SD	4.90	5.84	Within	815.333	28	29.119	
Post-test Mean	121.73	140.53	Between	2650.800	1	2650.800	10.21*
SD	4.19	5.93	Within	740.667	28	26.452	
Adjusted Post-test mean	131.76	135.72	Between	856.350	1	856.350	8.632*
			Within	852.401	28	31.257	

S: Significant
NS: Not Significant

From the above table results proved that the pre-test mean score on Yoga practices is 132.80 and control group is 130.73. Therefore, it is inferred that the obtained calculated 'F' value is 1.10 for Pre-Test mean score. Therefore the framed research hypothesis is rejected. It is inferred that there is no significant difference between the pre-test means of the systolic blood pressure. However, the Post-test mean score of yoga group is 121.73 and the control group is 140.53. Therefore, it is evident that the obtained 'F' value 10.21 for Post-Test mean score. Therefore, the framed research hypothesis is accepted. Further, the above table taking into consideration of the adjusted post-test mean score on yoga practice is 131.76, control group is 135.72 Therefore, it is evident that the calculated 'F' value is 8.632.

Therefore, the framed research hypothesis is accepted. It is inferred that there is a significant difference between the adjusted post-test means of the systolic blood pressure.

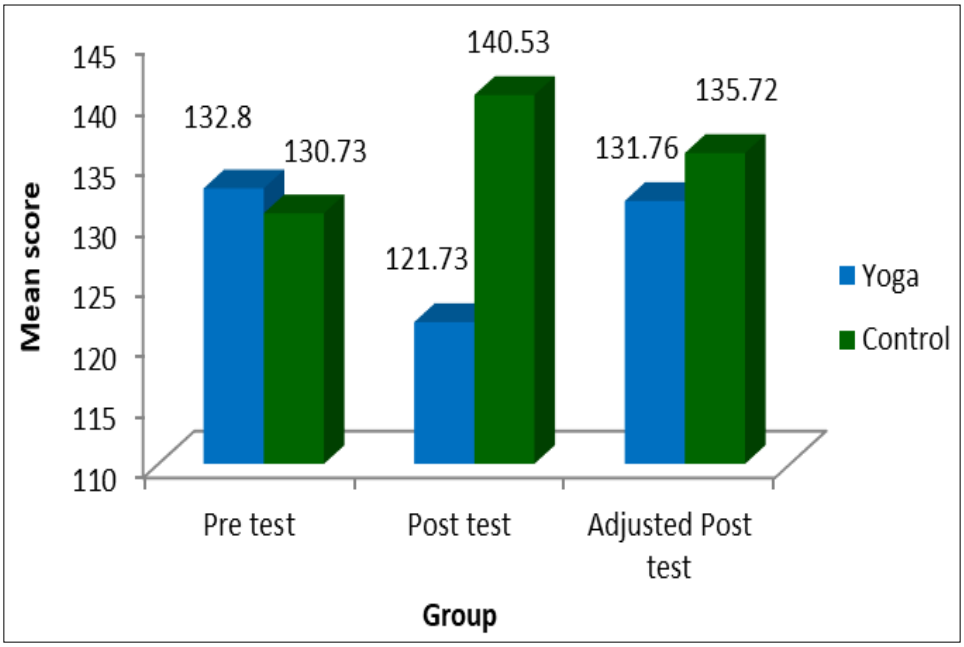

Fig 1: Graph between maximum pre-test and post-test means of the yoga practices and control group in systolic blood pressure

Table 2: Analysis of co-variance of the pre-test and post-test means of the yoga practices and control group in diastolic blood pressure

Group	Yoga	Control	Source of variance	Sum of squares	DF	Mean square	'F' Ratio
Pre Test Mean	92.66	89.93	Between	56.033	1	56.033	4.14*
SD	2.60	4.49	Within	378.267	28	13.510	
Post-test Mean	84.40	92.40	Between	480.000	1	480.000	39.85*
SD	3.13	3.77	Within	337.200	28	12.043	
Adjusted Post-test mean	91.30	88.40	Between	364.206	1	364.206	20.45*
			Within	412.089	28	22.591	

S: Significant
NS: Not Significant

From the above table, the pre-test mean score of the yoga group is 92.66, control group is 89.93. Therefore, it is evident that the obtained 'F' value 4.14 for the Pre-Test mean score. Therefore, the framed research hypothesis is accepted. It is inferred that there is a significant difference between the pre-test means of the yoga practices on levels of diastolic blood pressure. Also, the Post-test mean score of the yoga group is 84.40, control group is 92.40. Therefore, it is evident that the obtained 'F' value 39.85 for the Post-Test mean score. Therefore, the framed research hypothesis is accepted. Further, the above table takes into consideration the adjusted post-test mean score of the yoga group is 91.30, control group is 88.40. Therefore, it is evident that the obtained 'F' value is 20.45.

Therefore, the framed research hypothesis is accepted. It is inferred that there is a significant difference between the adjusted post-test means of the yoga practices on levels of diastolic blood pressure.

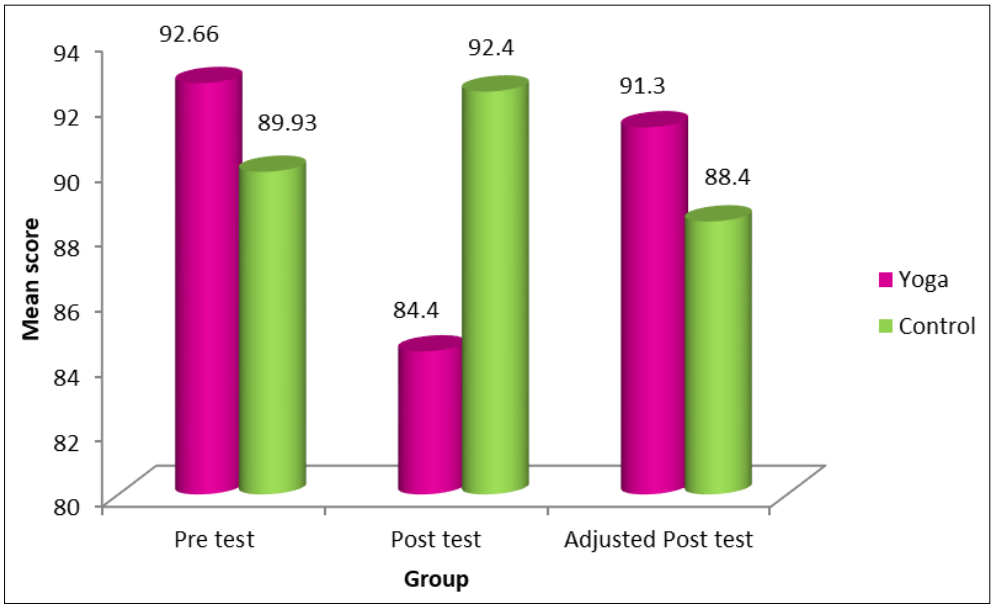

Fig 2: Graph between maximum pre-test and post-test means of the yoga practices and control group in diastolic blood pressure

Table 3: Analysis of co-variance of the pre-test and post-test means of the yoga practices and control group in HDL-C

Group	Yoga	Control	Source of variance	Sum of squares	DF	Mean square	'F' Ratio
Pre Test Mean	35.83	36.19	Between	1.019	1	1.019	0.343
SD	1.60	1.83	Within	83.218	28	2.972	
Post-test Mean	36.92	35.73	Between	10.549	1	10.549	4.24*
SD	1.62	1.52	Within	69.670	28	2.488	
Adjusted Post-test mean	33.01	36.32	Between	12.637	1	12.637	6.17*
			Within	74.569	28	5.691	

S: Significant
NS: Not Significant

The above table result reveals that the pre-test mean score on yoga practices is 35.83, control group is 36.19. Therefore, it is observed that the obtained 'F' value 0.343 for the Pre-Test mean score. Therefore, the framed research hypothesis is rejected. It is inferred that there is no significant difference between the pre-test means of the HDL-c. Also, the Post-test mean score on the yoga group is 36.92, control group is 35.73. Therefore, it is evident that the obtained 'F' value 4.24 for the post-test mean score. Therefore, the framed research hypothesis is accepted. Further, the above table taking into consideration the adjusted post-test mean score on yoga practices is 33.01, control group is 36.32. Therefore, it is evident that the obtained 'F' value is 6.17.

Therefore, the framed research hypothesis is accepted. It is inferred that there is a significant difference between the adjusted post-test means of the HDL-C.

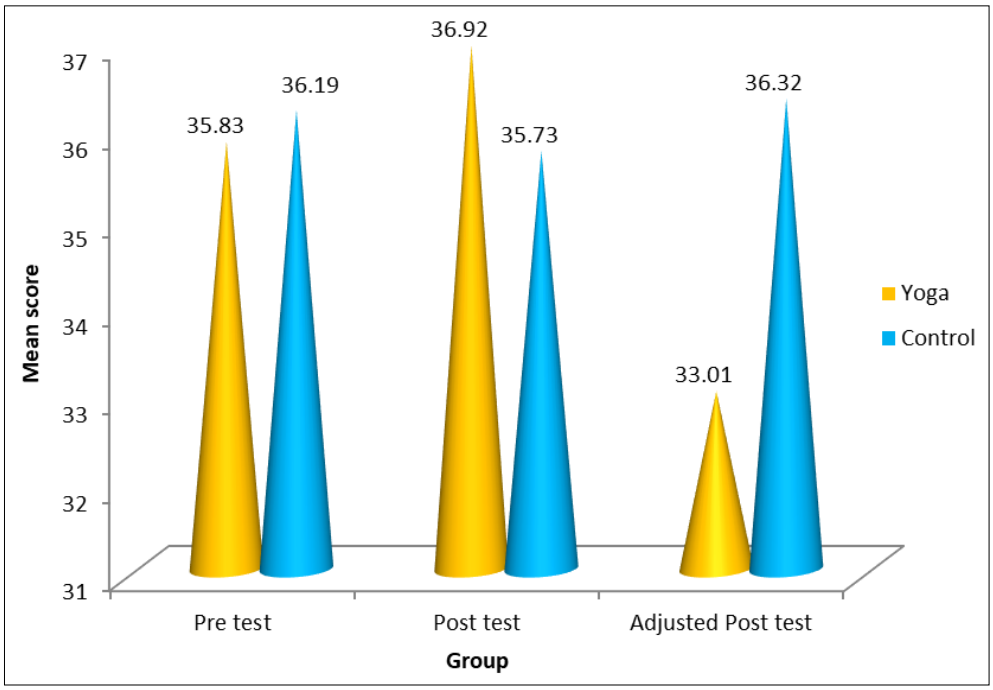

Fig 3: Graph between maximum pre-test and post-test means of the yoga practices and control group in HDL-C

Table 4: Analysis of co-variance of the pre-test and post-test means of the yoga practices and control group in LDL-C

Group	Yoga	Control	Source of variance	Sum of squares	DF	Mean square	'F' Ratio
Pre-Test Mean	187.0	185.93	Between	8.533	1	8.533	1.193
SD	1.64	2.25	Within	108.933	28	3.890	
Post-test Mean	183.0	185.66	Between	53.333	1	53.333	4.401*
SD	1.69	4.62	Within	339.333	28	12.119	
Adjusted Post-test mean	186.46	182.33	Between	38.460	1	38.460	7.153*
			Within	376.184	28	26.880	

S: Significant
NS: Not Significant

The table 4 result proved that the pre-test mean score of the yoga group is 187.0, the control group is 185.93. Therefore, it is observed that the obtained 'F' value 1.193 for the Pre-Test mean score. Therefore, the framed research hypothesis is rejected. It is inferred that there is no significant difference between the pre-test means of the LDL-C. Also, the Post-test mean score on yoga practices is 183.0, control group is 185.66. Therefore, it is evident that the obtained 'F' value 4.401 for the Post-Test mean score. Therefore, the framed research hypothesis is accepted. Further, the above table taking into consideration the adjusted post-test mean score on yoga practices is 186.46, control group is 182.33. Therefore, it is evident that the obtained 'F' value is 7.153.

Therefore, the framed research hypothesis is accepted. It is inferred that there is a significant difference between the adjusted post-test means of the LDL-C.

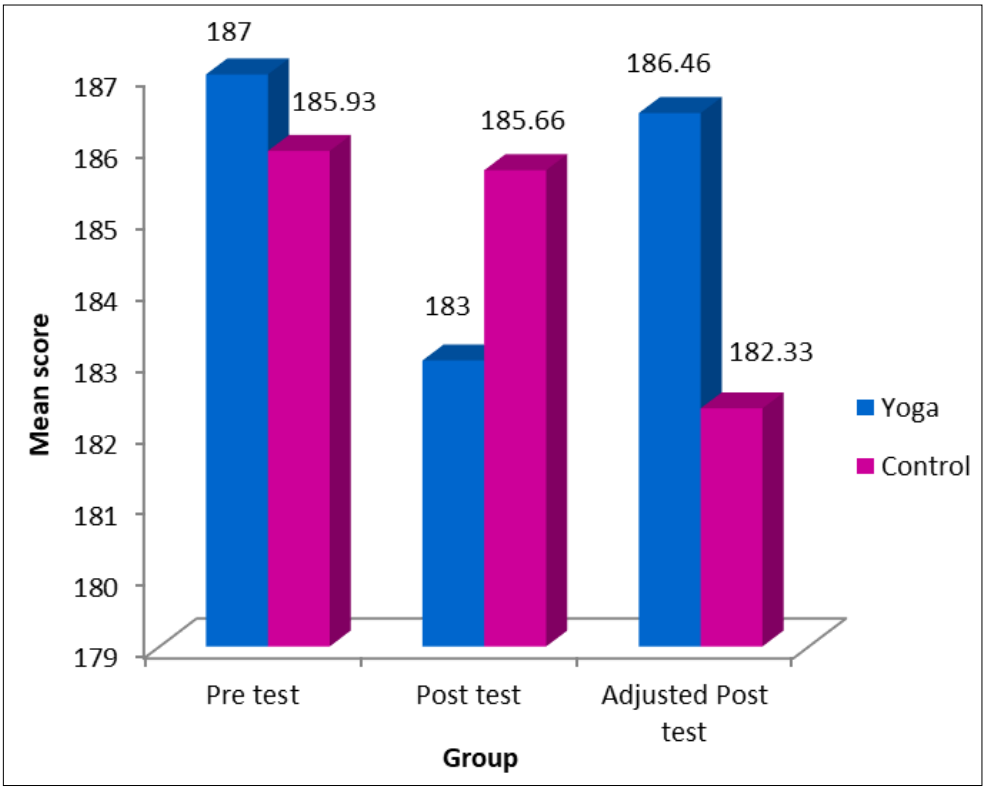

Fig 4: Graph between maximum pre-test and post-test means of the yoga practices and control group in LDL-C

Conclusion

The present study contributes to establishing the scientific basis and confirming several positive effects of practicing yoga, particularly in Asana and Pranayama. Noticeable improvements were observed in the measured parameters. Participants engaging in Pranayama for 20 weeks exhibited a significant decrease in LDL levels, an increase in HDL, and alterations in Blood Pressure. Yoga practices such as Asana and Pranayama offer potential benefits for various cardiovascular risk factors, including obesity, hypertension, and dyslipidemia, along with addressing stress-related mental issues and respiratory disorders.

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