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How Yoga And Calisthenics Can Boost Good Cholesterol In People With Borderline Type 2 Diabetes: A Study

Suma Joseph[1*], Nidhu Neena Varghese[2], Anjaly Scaria[3], Drisya. S.[4], Tony Thomas Podimattom[4], Shafeeq V. A[5], Chinsu Joy[6], George Abraham[7]

[1*]Professor & Principal, Mount Carmel College of Teacher Education for Women, Kottayam, Mahatma Gandhi University, Kerala, India.
[2]Assistant Professor, M.Ed. Department, Mount Carmel College of Teacher Education for Women, Kottayam, Mahatma Gandhi University, Kerala, India.
[3]Post Graduate Teacher of Physics, St. Antony's Senior Higher Secondary School, Fatehgarh, Farrukhabad, Uttar Pradesh, India
[4]PhD Research Scholar, School of Physical Education and Sports Sciences, Mahatma Gandhi University, Kottayam, Kerala, India.
[5]Associate Professor,Department of Physical Education, Govt. Arts & science College,Kunnamanagalam, Calicut University, Kerala, India
[6]Assistant Professor, Department of English, Hindustan University, Padur, Tamil Nadu, India.
[7]Professor, YMCA College of Physical Education, Chennai, Tamil Nadu, India.

***Corresponding Author:** Prof. Suma Joseph
*Professor & Principal, Mount Carmel College of Teacher Education for Women, Kottayam, Mahatma Gandhi University, Kerala, India.

Abstract
Diabetes has come to be a main fitness challenge international. In India the prevalence of diabetes is growing unexpectedly in particular inside the city population due to increasing weight problems and reduced bodily activity. The purpose of this investigation was to investigate the effects of yoga and calisthenics on good (HDL) cholesterol among people with borderline (prediabetes) type2 diabetes. Thirty male persons with borderline type 2 diabetic patients (n = 30) were randomly selected as subjects. The age of the subjects ranged from 45 to 60 years (mean age: 54 ± 4.62 years). The subjects divided into three equal groups of ten subjects each (n = 10). In which, group I underwent yogic exercises (YEG), group II underwent calisthenics exercise (CEG) with moderate intensity for six days per week for twelve weeks and group III acted as control (CG) who did not undergo any special training programme apart from their daily life. HDL cholesterol was selected as a test variable and assessed before and after the training period. The HDL cholesterol was assessed by using Boehringer Mannheim (BM)cholesterol oxidase enzymatic method. The collected data were statistically analyzed by using Analysis of Covariance (ANCOVA) and Scheffe's test was applied as post hoc test to determine the paired mean difference. From the results of the study, it was found that there was a significant improvement ($p \leq 0.05$) in HDL cholesterol level due to yoga intervention and calisthenics compared to control group. However there was an insignificant difference ($p \geq 0.05$) in between the training groups on good cholesterol (HCL – C).

Keywords*:* Yoga, calisthenics, HDL cholesterol, HDL levels, HDL functioning, type2 diabetes, moderate intensity.

Introduction
Yoga is an historical art primarily based on a harmonizing gadget of improvement for the frame, thoughts, and spirit. The continued practice of yoga will lead you to a sense of peace and well-being, and also a sense of being at one with their environment. The practice of yoga makes the frame robust and bendy; it additionally improves the functioning of the respiration, circulatory, digestive, and hormonal structures. Yoga brings approximately emotional stability and clarity of mind (Devananda, 2000). Yoga is one of the orthodox structures of Indian philosophy. It became collated, coordinated and systematized through patanjali in his classical work, the yoga sutras, which include 185 terse aphorisms. The gadget of yoga is called as it teaches the way by way of which the jivatma can be united to, or be in communion with the paramathma, and so relaxed liberation (moksa). Yoga is a complete technology of lifestyles that originated in India many hundreds of years in the past. It's far the oldest system of personal improvement within the global, encompassing body, thoughts and spirit. As a selected form of bodily hobby, yoga packages using various physical postures were proven to advantage people with a huge variety of fitness situations together with diabetes (Bijlani *et al*, 2005).
Calisthenics is a shape of electricity education the use of your very own body weight as resistance for physical games, requiring little to no equipment, to construct energy, endurance, flexibility, and coordination. Originating in historic Greece, it is a flexible exercise that specialize in herbal movements (pushing, pulling, bending) that may be performed nearly everywhere, progressing from fundamental to superior skills for ordinary physical fitness (www. google.

com/search q = what + is + calisthenics). The useful effects of bodily interest commonly include reductions in glucose level and body weight (USDHHS, 2004). As a specific form of physical hobby, yoga applications the usage of various physical postures had been shown to gain individuals with a huge range of fitness situations along with diabetes (Bijlani *et al*, 2005 and Abraham, 2014). Frequent and everyday bodily exercise boosts the immune system, and helps prevent sicknesses of affluence along with coronary heart disease, cardiovascular disorder. Systematic bodily pastime develops and keeps physical health and basic health. It's far often practiced to bolster muscles and the cardiovascular machine, and to enhance athletic competencies (Ashokan & Abraham, 2015). Common and regular bodily workout boosts the immune machine, and facilitates prevent illnesses of affluence inclusive of heart sickness, cardiovascular ailment (Ronald *et al*., 2004 and Panackal & Abraham, 2015). One important routine for humans with diabetes and for those at chance for growing diabetes is engagement in appropriate physical interest.

Type 2 diabetes mellitus (T2DM) has come to be a serious public health problem throughout the globe that is normally characterized by impaired insulin secretion and insulin resistance, and critically affects the first-rate of lifestyles of patients. People with T2DM have been subjected to many lifestyles-threatening fitness troubles, resulting in better hospital therapy fees, dwindled first-rate of lifestyles, and a higher threat of mortality (Baena-Díez *et al*., 2016). Diabetes is a metabolic ailment, which has become a prime health mission international. The unparalleled monetary development and rapid urbanization in Asian international locations mainly India has brought about shift in health problems from communicable to non-communicable illnesses (Mohan *et al*, 2001).

LDL cholesterol is a fats-like substance used to assist construct cell membranes, make some hormones, synthesize vitamin D, and shape bile secretions that aid for digestion. Lipoproteins are shipping vehicles in the circulate plasma which are composed of numerous lipids including cholesterol, phospholipids, triglycerides and proteins known as apoproteins (Kravitz & Heyward, 1993). HDL-C has an inverse dating with coronary coronary heart ailment, presenting a defensive mechanism towards the improvement of CHD (Kannel *et al*., 1983). HDL-C is considered to be the maximum effective lipid parameter for predicting CHD in people of all ages (Gordon *et al*., 1977). The number one feature of HDL-C is to transport ldl cholesterol from the tissues and blood to the liver for excretion from the body or synthesis into bile acids. Physical workout will increase the level of the "correct" HDL cholesterol in the bloodstream, which helps convey the ldl cholesterol out of the arteries. Exercise improves lipid profile and reduces CHD risk. Leon and Sanchez (2001) cautioned that better HDL cholesterol levels are associated with a decrease danger of coronary heart disorder, and that low HDL cholesterol levels are associated with an improved chance of heart ailment. This observes has attempted to discover the results of yoga and calisthenics on HDL cholesterol among kind 2 prediabetes patients.

Materials and Method

For this purpose only type-2 male diabetes patients from Chennai city, Tamil Nadu, were randomly selected as subject. Their age were ranged between 45 and 60 years. The selected thirty subjects were divided into three groups of ten each. Out of which, group I (n = 10) underwent yogic practices, group II (n = 10) underwent calisthenics exercises and group III (n = 10) remained as control. The training programme was carried out for six days per week during morning session only (6 am to 8 am) for twelve weeks. HDL cholesterol was selected as criterion variable for this study and it was assessed by cholesterol oxidase enzymatic method using Boehringer Mannheim Kit. Both experimental groups initially performed thorough warming up exercises.

Yoga classes were conducted by an experienced yoga teacher who chose the asanas in the package and adapted their execution to the needs and abilities of the participants. The experimental group was taught a series of yoga postures in groups of 10 subjects each. They were instructed to practice them daily for 1 h duration and were asked to record the number of minutes they engaged in yoga per day. Yoga treatment consisted of practice of asana (Body postures). After that group I performed the following yoga exercises. These are the exercises were given, padmasan, bhujangasan, halasan, vajrasan, eka padhasan, parivatasan, oorthavamuga bhujangasan, dhanurasana, shasangasan, veerabhadhrasan, vakhrasan, patchimoththanasan, shalabhasan, trikonasan and padhahasthasan with moderate intensity. Group II performed calisthenics such as stretching, planks, lunges, squats, burpees, sit-ups, push-ups with moderate intensity.

The meta-analysis only examined continuous outcome variables, and each mean difference was weighted according to the inverse variance method. When the same outcome was measured by different scales, the mean difference was standardized by dividing it by the within-group standard deviation, the results were then weighted and the average is taken standardized mean difference. And the data were analyzed by using analysis of covariance (ANCOVA). If the 'F' value was found to be significant for adjusted post-test mean, Scheffe's test was used as post hoc test to determine the significant difference between the paired mean. The p-value was set at 0.05 to be statistically significant.

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Results

Table I. Analysis of covariance for HDL - c of experimental groups and control group

Test		YEG	CEG	CG	SOV	SS	df	MS	F
Pre test	Mean	44.67	43.56	41. 91	B	2.23	2	1.14	1. 37
	S.D.	2.83	3.12	3.17	W	267.34	27	8.84	
Post test	Mean	49.65	51.03	42.41	B	387.92	2	164.28	12.72*
	S.D.	3.52	3.27	3.19	W	271.27	27	9.31	
Adjusted Post test	Mean	50.04	51.82	42.43	B	341.34	2	156.38	14.82*
					W	228.24	26	8.79	

*Significant F = (df 2, 27) (0.05) = 3.35; ($p \leq 0.05$) F = (df 2, 26) (0.05) = 3.37; ($p \leq 0.05$)

The table I showed that the pre test mean values on HDL cholesterol for yoga group, calisthenics group and control group are 44.67, 43.56 and 41.91 respectively. The obtained *F* ratio of 1.37 for pretest which was lower than the required table value 3.35 with df 2 and 27 at 0.05 level of confidence. The post test mean values for yoga group, calisthenics group and control group are 49.65, 51.03 and 42.41 respectively. The obtained *F* ratio of 12.72 for posttest which was higher than the required table value 3.35 with df 2 and 27 at 0.05 level of confidence. The adjusted post test mean values on HDL cholesterol for yoga group, calisthenics group and control group are 50.04, 51.82 and 42.43 respectively. The obtained *F* ratio of 14.82 for adjusted posttest which was higher than the required table value 3.37 with df 2 and 26 for significance at 0.05 level of confidence on HDL cholesterol.

Hence, the results of the study showed that there was a significance difference exists between yoga group, physical training group and control group on HDL cholesterol. Further to determine which of the paired means has a significant improvement, Scheffe's test was applied as post-hoc test. The result of the follow up test was presented in Table II.

Table II. Scheffe's post hoc test for mean difference between groups of HDL - c

YEG	CEG	CG	MD	CI
50.04	51.82		1.78	
50.04		42.43	7.61*	3.85
	51.82	42.43	9.43*	

*Significant, $p \leq 0.05$

Table II showed that the adjusted post test mean difference on HDL cholesterol between yoga group and control group and calisthenics group and control group are 7.61 and 9.43 respectively. These values are higher than the required confidence interval value of 3.85, which shows significant difference at 0.05 level of confidence. The results of the study showed that there was a significant difference between experimental groups and control group. It also showed that there was an insignificant difference between two experimental groups. The pre, post and adjusted post test mean values of experimental groups and control group on HDL cholesterol was graphically represented in the figure 1& 2.

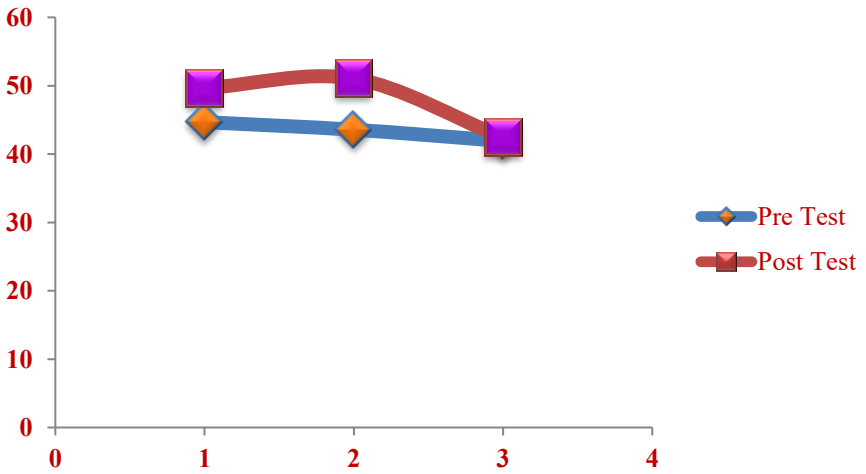

Figure 1: The pre and posttest mean values of experimental groups and control group on HDL Cholesterol

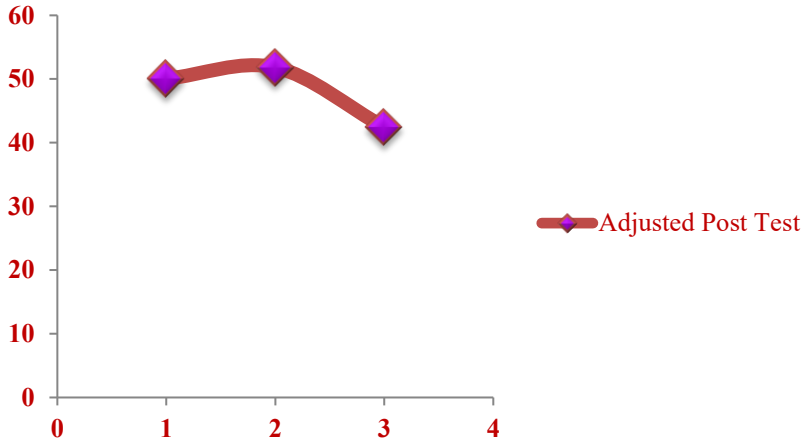

Figure 2: The improvement of the mean values of experimental groups on HDL Cholesterol

Discussion

Diabetes Mellitus is one of the many diseases that are precipitated by excessive stress and strain associated with modern life style. Moreover, an emerging issue is the recent increase in diagnosis of Type-2 DM. This study investigated to implementing yoga program and calisthenics among adults at borderline (prediabetes) type 2 diabetes patients. The results indicated that the yoga program and calisthenics are feasible and acceptable to the population.

Research consistently shows that structured yoga programs, which often include physical postures (asanas) can lead to modest yet significant increases in HDL cholesterol. One meta-analysis noted an average increase of nearly 2 mg/dL in HDL-C across various studies. Three month comprehensive yoga based program causes significant elevation of Serum HDL cholesterol levels (Schmidt *et al*., 1997). An integrated course of yoga training was given for four days followed by practice at home showed a regular decrease in all lipid parameters and increase in Serum HDL cholesterol (Mahajan *et al*., 1999). Yogic exercises causes rise in Serum HDL cholesterol levels (Bijlani *et al*., 2005).

Yoga practice is also proved to affect mental balance of an individual allaying apprehension, stress and bringing about hormonal balance and feelings of wellbeing. This sense of wellbeing is attributed to its ability to increase endogenous melatonin secretion. This can explain the probability of greater compliance with its practice even in long-term and its use as an effective intervention in control of the disease. Certain yoga asanas, if practiced regularly, are known to have beneficial effects on human body. Many research studies reported that yoga programme significantly increased HDL cholesterol in patients with type 2 diabetes mellitus (Singh *et al*., 2001 and Aljasir *et al*., 2010).

Malhotra reported significant improvement in glycaemic control and lipid profile in type 2 diabetic patients exposed to yoga exercise where there was significant improvement in HDL concentrations (Malhotra *et al*., 2005). Mercuri *et al*. (2003) reported significant improvement in HDL concentrations within three months of yoga exercise in type 2 diabetic patients. Innes et al. (2007) clearly indicated that continuous yogasana practice increase good cholesterol level and it helps to reduce the diabetics. The yoga package was designed after extensive literature review by yoga specialists and was a perfect combination of asana and breathing exercises targeted at the disease under study. Excellent compliance of study sample and there were no drop outs. Experimental group patients voluntarily reported to Holistic medicine department and were self-motivated for the practice of yoga.

Evidence for the benefits of physivcal activity includes its effects shown to increase the high-density lipoprotein (HDL) (Scheers *et al*., 2008 and Eble *et al*., 2009). Many previous studies have shown exercise is beneficial and increases HDL (Dimitriou *et al.,* 2007 and Wing *et al,* 2004) in men. General physical exercise, which includes activities like calisthenics, is a cornerstone of diabetes and cholesterol management and has been shown to raise HDL levels and improve the overall lipid profile. On the basis of hypoglycemic drug therapy, combined with aerobic exercise intervention, patients with type 2 diabetes can effectively improve the control rate of clinical observation indicators (Daqing, 2017 and Weidan & Zhichao, 2018).

Calisthenics is one of the three basic diabetes therapies, and it relates to diabetic patients' long-term scientific and regular exercise. It has been proven that exercise has a better hypoglycemic effect (Kocaranik *et al*., 2017 and Asaithabi *et al*., 2012). Aerobics training can improve the immune function and condition of patients with type II diabetes by affecting hemoglobin (Xiaofang, 2010). Mackinnon and Hubinger, (1999), concluded that exercise training increase the level of HDL-C in blood. Thirty minutes per day of exercise, like jogging, has sustained beneficial effects on HDL metabolism. No previous studies have attempted to compare the responses of HDL cholesterol to yoga programme and physical exercise in male diabetic patients. Therefore, the present study was designed to determine the yogi and physical training on HDL cholesterol of type-2 male diabetic patients. According to the American Diabetes Association, moderate-intensity aerobic exercise plays a pivotal role in managing diabetes-induced metabolic disorders (American Diabetes Association, 2019).

Direct supervision of the patients was not possible for the entire period of the stud. Dietary data were not recorded, which were the limitations of this study. Long-term study was not possible due to threat of non-compliance of the patients. In conclusion, while specific calisthenics studies have shown limited direct impact on HDL-C, incorporating them as part of a comprehensive exercise plan that includes sufficient calisthenics can contribute to overall better lipid profiles with borderline type2 diabetes.

Conclusion

This study has confirmed the useful role of yoga and calisthenics training in the control of diabetes mellitus. High density lipoprotein cholesterol level increased significantly. There was a lowering of drug requirement and the incidence of acute complications like infection and ketosis was significantly reduced. Prevailing evidence supports the concept that yoga exercise and physical activity can help to increase the HDL level among type-2 diabetic patients. The presented data suggest the favorable effects of calisthenics on lipid and lipoprotein profiles. The impact of calisthenics exercise on HDL function depends on several factors, including exercise type, intensity and duration. Regular physical activity improves vascular function (e.g., endothelium-dependent vasodilation) via the effect on vascular structure and vascular cell functions. The effects of repeated acute physical activities with moderate intensity may produce significant changes. The frequent repetitions of single sessions may result in lasting adaptations.

Therefore, yoga can be regarded as an effective complementary treatment to T2DM for the short term (i.e., 12 weeks). Future research is needed to highlight high-quality trials with standardized yoga plans to verify the long-term reductive effect of yoga on T2DM-related indicators. The findings of this study suggested that yoga treatment can improve the indices of blood glucose and lipid profile in patients with T2DM. Calisthenics exercises are an excellent way to start your fitness journey or even switch up an existing workout routine. And as we can do calisthenics at home without equipment, we can say goodbye to a sedentary lifestyle and hello to a healthier heart and toned muscles.

Future studies focusing on exercise-related improvements in HDL function should be based on standardized methodologies and require better characterization of patients from diverse populations since medications, diet and concomitant diseases may affect the final result. In summary, the result of the study indicated that there was significant improvement on HDL levels of male type -2 diabetic patients due to twelve weeks of yoga and calisthenics. To conclude, employing calisthenics to treat hypoglycemia has a considerable effect based on routine nursing intervention, which not only considerably improves patients' self-care ability in life, but also can reduce the blood sugar of patients, have obvious effects on weight and blood lipid, and improve the quality of life of patients, and make healthy citizens.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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