Shivakumara CS, et al., J Food Sci Nutr 2022, 8: 129
DOI: 10.24966/FSN-1076/100129

HSOA Journal of
Food Science and Nutrition

Research Article

The Impact of Daily Walnuts Consumption and Lifestyle Changes on Dyslipidemia

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Abstract

The most frequent health condition linked to Cardiovascular Disease Is Dyslipidemia (CVD). This study showed how walnut consumption affected dyslipidemia patients when combined with a low-calorie diet and lifestyle modifications. A subsample of 120 people was chosen at random for intervention and divided into control (n=60) and experimental (n=60). Baseline blood lipid parameters and anthropometric measurements were assessed in both groups.A significant reduction in body weight (5.4%) and BMI (4.0%) of the experimental group was observed when compared to the control group (1.9% and 2.1%). However, for all parameters, there was a statistically significant ($p<0.05$) difference between pre-test and post-test in the experimental group, but non-significant ($p>0.05$) in the control group. Total cholesterol (11.5%), LDL cholesterol (15.3%), triglycerides (11.2%), VLDL cholesterol (9.0%), and enhanced HDL cholesterol (6.0%) were all significantly lower ($p<0.05$) in the experimental group.

Practical applications

This study showed that consuming 30g of walnuts per day and changing one's lifestyle can improve blood lipid profiles and help people lose weight.

Keywords: *Cholesterol; Dyslipidemia; HDL; LDL; Lifestyle; Walnut*

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Citation: Shivakumara CS, Sunil L, Satish A, Devi CU (2022) The Impact of Daily Walnuts Consumption and Lifestyle Changes on Dyslipidemia. J Food Sci Nutr 8: 129.

Received: February 02, 2022; **Accepted:** February 22, 2022; **Published:** February 28, 2022

Introduction

Cardiovascular Disease (CVD) is one of the top causes of death and disability in affluent countries and a primary cause of death and disability in developing countries. In India alone, it is estimated that 31.8 million people have Coronary Artery Disease (CAD) [1]. Furthermore, CVD is more common in Indian adolescents than in developed countries, with 52 % of CVD fatalities occurring before the age of 70 and 10% of heart attacks occurring in those under the age of 40. Dyslipidemia has been linked to the pathophysiology of CVD and is a crucial, modifiable risk factor for cardiovascular disease. The dyslipidemia pattern in Asian Indians is different, with lower HDL cholesterol, greater triglyceride levels, and higher amounts of tiny dense LDL cholesterol [2,3]. The most common treatment for high cholesterol is statin medicine, which lowers LDL cholesterol levels. Statin medication has also been associated with a considerable reduction in the risk of heart attacks and strokes [4]. According to research, lowering LDL cholesterol levels by 20% with statin therapy can reduce the risk of cardiovascular disease by 23-36 % [4]. Unfortunately, statins can have adverse side effects in certain people, such as unpleasant myalgias, making it difficult to take them. As a result, a growing number of individuals and healthcare professionals are seeking for new approaches to lower LDL cholesterol levels, such as functional foods and nutritional supplements. Nut consumption and CVD risk have continuously been inverse connection and dose-dependent effects in epidemiological studies.

Nuts have a unique nutritional profile and are high in polyunsaturated fatty acids, fiber, minerals, vitamins, and other bioactive substances. Consumption of nuts regularly has been linked to a reduction in cardiovascular risk factors such as dyslipidemia, type 2 diabetes, metabolic syndrome, and the risk of Coronary Heart Disease (CHD) [5]. Although most nuts are high in Monounsaturated Fatty Acids (MUFA), walnuts have the highest concentration of alpha-linolenic acid, which gives them extra anti-atherogenic effects [6,7]. Walnuts have a particular feature that sets them apart from other nuts, making them a fascinating target for research.

Walnut (*Juglans regia L.*) is a vital tree nut that belongs to the *Juglandaceae* family of angiosperms. It is a good source of essential fatty acids and tocopherol, which helps to prevent cancer and coronary heart disease [8]. People are more conscious of diets high in antioxidants and polyphenols as the prevalence of diabetes, cancer, cardiovascular difficulties, and other ailments have increased. Walnuts are high in polyphenols (particularly ellagic and gallic acid), tocopherol (vitamin E), ellagitannins (tannins), and substances with powerful antioxidant action, such as melatonin, which lowers the risk of heart disease [9]. In hypercholesterolemic and diabetic people, it has also been proven that eating 2-3 portions of walnuts per day lowers total cholesterol and low-density lipoprotein cholesterol and improves endothelial function [10-12]. In another study, the protective effect of walnut against coronary heart disease was presented scientifically [10].

Only a few investigations on the effects of walnut consumption on dyslipidemia have been conducted to date. This research aims to see how walnut consumption affects dyslipidemia patients when combined with a low-calorie diet and other lifestyle adjustments. Walnuts are unusual among nuts because they contain omega-3 fatty acids, which, when combined with a low-calorie diet and lifestyle adjustments, may reduce the risk factors for coronary heart disease.

Materials and Methods

Selection of the samples

A total of 400 samples with dyslipidemia were screened from public sector company hospitals, with males (n=306) and females (n=94) ranging in age from 30 to 60 years. A total cholesterol cut-off value of more than 200 or a Low-Density Lipoprotein Cholesterol (LDL) cut-off value of more than 130 should be used to diagnose dyslipidemia. Secondary data was chosen from available medical records with the help of physicians and cardiologists. A subsample of 120 respondents was randomly selected for intervention based on the responder's desire to engage in the study. The study was approved by the Nutri-Explore Ethics Committee (NEEC BU 010Ph.D./Project/2015-16). According to the Indian Council of Medical Research (ICMR) norms, the study is ethical and discreet.

Inclusion and exclusion criteria

Adult males and females between the age of 30 and 60 with a high lipid profile met the study's inclusion criteria. Adult males and females between the ages of 30 and 60 years old with other health difficulties such as renal dysfunction, cancer, hepatic disease, previous heart surgery, and patients with cerebrovascular damage were excluded from the study. The samples are chosen depending on the intervention study's inclusion and exclusion criteria. 120 people were selected at random from the primary samples as subsamples. The sample was also chosen based on the respondent's willingness to participate in the study, and they were divided into control and experimental groups.

Control and experimental groups

The control group consisted of n=60 subjects who were told to follow a low-calorie diet through diet counseling and 30 to 45 minutes of physical exercise without walnut for 90 days. The experimental group consisted of n=60 participants who were told to follow a low-calorie diet through diet counseling and 30 to 45 minutes of physical exercise with walnuts during 90 days.

Nutritional Assessment

A standardized questionnaire was used to measure nutritional status in all subsamples before and after the intervention. All participants measured total cholesterol, LDL cholesterol, HDL cholesterol, VLDL cholesterol, triglycerides, total cholesterol/HDL ratio, and LDL/HDL ratio.

Dietary recommendation

All intervention participants recommended the nutritional intervention based on therapeutic lifestyle changes and nutrient intake monitoring. The calories were divided among the macronutrients based on therapeutic lifestyle changes specific dietary recommendations (NCEP Adult Treatment Panel (ATP) III guidelines) based on their age, BMI, physical activity, dietary pattern, and nutritional demands.

Walnut intervention

For 90 days, all subjects in the experimental group were told to consume 30g of walnuts divided into two intervals: 15g in the morning and 15g in the evening, along with a low-calorie diet and 30 minutes of physical exercise. The intervention subjects were given shelled walnut with a zip lock cover. Each cover has two packets containing 15g of walnuts supplied every 15 days for 90 days. The patients are instructed to store the walnuts in an airtight container to prevent oxidation. Every alternate day, the experimental subjects were checked for walnut consumption through a physical conversation over the phone.

Anthropometric and biochemical analyses were performed on all intervention participants after the intervention. Biochemical tests, post-test anthropometric indices, biochemical parameters, and nutritional intake of both the control and experimental groups were administered to the participants. These tests were compared to pre-test findings and statistically assessed to determine the efficacy of the walnut intervention program.

Using SPPSS version 20 and Office Package Windows 2010, the collected data was aggregated, categorized, tabulated, and analyzed. Mean, standard deviation, chi-square test, paired 't-test, standard 't-test, and correlation coefficient were all utilized to examine the data. All of the data was presented in a statistically significant way at the 5% level (p-value 0.05).

Results

Anthropometric measurements and blood lipid profile parameters (including cholesterol, Low-Density Lipoprotein Cholesterol (LDL), High-Density Lipoprotein Cholesterol (HDL), Very Low-Density Lipoprotein Cholesterol (VLDL), Triglycerides (TG), LDL/HDL ratio, and total cholesterol/HDL ratio) of participants in the control group (only regulated diet) and experimental group (regulated diet with walnut consumption) were compared between the two groups.

Table 1 shows the body mass index of the study participants. When compared to the control group(Bodyweight, 1.9 % and BMI, 2.1%), the experimental group saw a significant drop in body weight (5.4%) and BMI (4.0%). The effectiveness of the intervention group establishes statistically significant weight (t=7.96*) and BMI (t=8.02*) reductions. The changes in the waist-hip ratio of respondents before and after the intervention revealed a reduction in waist circumference (3.3%), hip circumference (2.3%), and waist-hip ratio (2.1%) among the experimental group's respondents in the post-test as compared to the pre-test. However, for all parameters, a statistically significant ($p<0.05$) difference was seen between the pre-test and post-test of the experimental group but not for the control group ($p>0.05$). According to the post-test data, the experimental (3cm & 2.2cm) and control groups (1cm & 1.1cm) had a mean reduction in waist and hip circumference. Furthermore, a reduction in the waist (t-5.81) and hip (t-6.64) circumferences were found, which was very significant in the experimental group and non-significant in the control group. The experimental group had a more significant mean difference in waist-hip ratio than the control group. As a result, waist circumference was given greater attention in this investigation. The experimental group's waist circumference was likewise significantly reduced following the intervention, according to the findings.

Table 2 shows that adding 30 g walnuts per day to a low-calorie diet for 90 days resulted in a significant reduction ($p<0.05$) in total cholesterol (11.5%), LDL cholesterol (15.3%), triglycerides

Variables	Control (n=60)		Reduction (%)	Paired 't' Test	P-value	Experimental (n=60) (Walnut-30 g/day)		Reduction (%)	Paired 't' Test	P-value
	Pre-test	Post-test				Pre-test	Post-test			
Gender Male/ Female	40 (67%)/20 (33%)					37 (62%)/23 (38%)				
Age (Years)	44.3±7.45					43.7±6.59			1.14 NS	0.2551
Weight (kg)	70.9±11.5	69.5±10.4	1.9	4.61*	0.022	70.6±11.0	66.8±9.5	5.4	7.96*	0.008
Body mass index	26.2±3.5	25.7±3.1	2.1	1.89NS	0.100	36.0±3.2	24.6±2.7	4.0	8.02*	0.008
Waist (cm)	91.7±8.5	90.7±7.8	1.1	1.90NS	0.100	91.0±8.0	88.0±7.2	3.3	5.81*	0.014
Hip (cm)	97.5±9.2	96.4±8.8	1.1	1.94NS	0.097	96.5±8.6	94.3±7.7	2.3	6.64*	0.011
W/H ratio	0.94±0.1	0.94±0.1	0.1	0.26NS	0.409	0.95±0.1	0.93±0.1	2.1	3.87*	0.031

Table 1: Anthropometric measurements of the intervention group.

Note: * Significant at 5% level, NS: Non-significant, t (0.05, 59 df)=1.96

Variables	Control (n=60)		Reduction (%)	Paired 't' Test	P-value	Experimental (n=60) (Walnut-30 g/day)		Reduction (%)	Paired 't' Test	P-value
	Pre-test	Pre-test				Pre-test	Post-test			
Total cholesterol	219.6±20.1	212.0±16.6	3.5	1.84NS	0.010	213.7±17.0	189.1±18.4	11.5	16.43*	0.002
LDL cholesterol	140.9±19.1	134.7±17.9	4.4	1.92NS	0.098	136.9±18.3	116.1±15.4	15.3	11.82*	0.003
HDL cholesterol	43.4±7.8	43.7±7.8	5.7	0.93NS	0.226	43.0±7.6	45.6±7.4	6.0	4.20*	0.027
Triglycerides	179.8±66.4	167.3±55.8	6.9	1.94NS	0.097	158.4±46.7	140.6±44.6	11.2	5.28*	0.017
VLDL	33.3±14.1	29.8±9.3	10.2	1.91NS	0.099	39.8±9.3	26.2±8.8	9.0	4.23*	0.026
LDL/HDL Ratio	3.40 ± 0.8	3.23 ± 0.8	5.0	1.88NS	0.010	3.27±0.8	2.57±0.4	21.4	9.04*	0.006
Total Cholesterol /HDL Ratio	5.14±1.0	4.96±0.9	3.5	1.74NS	0.113	5.10±1.0	4.20±0.7	17.6	11.62*	0.003

Table 2: Lipid profile of the respondents before and after the study.

Note: * Significant at 5% level, NS: Non-significant, t (0.05, 59 df)=1.96

(11.2%), VLDL cholesterol (9.0%), and improved HDL cholesterol (6.0%) in the experimental group. The lipid profile characteristics of the responders in the control group were non-significantly reduced ($p>0.05$), and the HDL cholesterol did not improve. Most respondents from both groups had borderline high total cholesterol, LDL cholesterol, and triglycerides in the post-test. The pre-test shifted to a desirable level of total cholesterol (70.0%), LDL cholesterol (71.7%), and normal triglycerides (61.7%), which is highly significant at the 5% level ($p<0.05$) for the experimental group. In contrast, there was a change in the control group but was statistically non-significant ($p>0.05$). The results of the lipid profile ratio of the respondents showed that there was a significant ($p<0.05$) drop in the LDL/HDL ratio (21.4%) and total cholesterol/HDL ratio (17.6%) among the experimental group as compared to a non-significant control group (5.0% and 3.5%). When compared to the control group, the majority of respondents in the moderate risk category changed to the low-risk category in the experimental group, exhibiting significant ($p<0.05$) differences in both parameters (Table 2).

During the intervention period, both the control and experimental groups were given individualized structured diet counseling with a low-calorie diet based on the Therapeutic Lifestyle Changes diet (TLC) depending on their height, weight, and age. Table 3 shows the nutritional consumption of male responders. The pre-test consumption of calories, carbohydrate, total fat, and saturated fats in the control and experimental groups was higher than the post-test intake. In the post-test, the statistically non-significant macronutrient intake was on par with the recommendations according to the therapeutic lifestyle modifications diet (Table 3).

The connection between walnut intake and anthropometric indices with the lipid profile is shown in Table 4. According to the data, BMI appears to correlate with HDL cholesterol ($r=+0.518$) positively. Total cholesterol, LDL cholesterol, triglyceride, VLDL cholesterol, total cholesterol: HDL ratio, and LDL: HDL ratio, on the other hand, showed a negative connection that was statistically significant at the 5% level ($p<0.05$).

In addition, the Waist/Hip (W/H) ratio was found to have a favorable correlation with HDL cholesterol ($p=+0.407$). Total cholesterol, LDL cholesterol, triglyceride, VLDL cholesterol, total cholesterol: HDL ratio, and LDL: HDL ratio, on the other hand, showed a negative connection that was statistically significant at the 5% level ($p<0.05$). On the other hand, Walnut consumption has a significant negative correlation with BMI ($r=-0.613$) and W/H ratio ($r=-0.376$). The walnut and lipid profile association results demonstrated that walnut consumption has a valuable link with HDL cholesterol. Total cholesterol, LDL cholesterol, triglyceride, VLDL cholesterol, total cholesterol: HDL ratio, and LDL: HDL ratio all had a negative connection that was statistically significant at the 5% level ($p<0.05$).

Nutrients	Control (n=60)		't' Test	P-value	Experimental (n=60)		't' Test	P-value
	Pre-test	Post-test			Pre-test	Post-test		
Energy (kcal)	1998±135	1832±146	32.81*	0.0005	2198±152	2018±163	35.32*	0.0004
Protein (g)	65±5.2	68.5±5.6	36.89*	0.0004	68±5.6	75.7±6.1	42.58*	0.0003
CHO (g)	320±23.1	274.1±22.6	35.84*	0.0004	350±24.4	292±23.6	44.20*	0.0002
Total Fat (g)	55±4.3	50.7±4.2	22.66*	0.0010	64±5.1	60.5±4.9	23.66*	0.0009
Saturated Fat (g)	13±1.7	3.04±0.3	39.37*	0.0003	15±2.2	3.63±0.3	36.60*	0.0004
Monounsaturated Fatty Acids (g)	7±0.5	10±0.8	15.81*	0.0021	10±0.9	18.85±1.2	31.36*	0.0005
Polyunsaturated Fatty Acids (g)	3.8±0.3	4.98±0.4	12.44*	0.0034	13.6±1.8	25.72±2.5	31.44*	0.0005

Table 3: Macronutrients intake of control and experimental groups.

Note: * Significant at 5% level, NS: Non-significant, t (0.05, 59 df)=1.96

Sl. no	Lipid profile	The correlation coefficient (r)		
		BMI	W/H ratio	Walnuts
1	Total Cholesterol	-0.407*	-0.381*	-0.561*
2	HDL Cholesterol	+0.518*	+0.407*	+0.493*
3	LDL Cholesterol	-0.415*	-0.365*	-0.516*
4	Triglyceride	-0.432*	-0.314*	-0.407*
5	VLDL Cholesterol	-0.354*	-0.295*	-0.613*
6	Total Cholesterol: HDL ratio	-0.483*	-0.507*	-0.315*
7	LDL: HDL ratio	-0.502*	-0.451*	-0.476*
8	Walnut	-0.613*	-0.376*	

Table 4: Relationship between walnut intake and anthropometric indices with lipid profile.

Note: r=(0.05, 58df)=0.279; *Significant at 5% level

Discussion

This study aimed to see how daily walnut eating and lifestyle changes affected patients with dyslipidemia. Despite the fact that there are numerous medicinal therapy options for dyslipidemia (low HDL, raised LDL, and TG levels), healthy lifestyle adjustments are strongly advised at all stages of treatment [13]. Most of the studies have revealed that daily intake of walnuts reduces triglycerides, apolipoprotein levels, total cholesterol and improves the HDL and LDL levels [14,15]. Furthermore, studies from the Food and Drug Administration (FDA) found that eating 42.5 g of walnuts per day, together with a low-saturated-fat and cholesterol diet, can help avoid chronic heart disease. Our findings also revealed that 90 days of walnut supplementation, along with a structured diet, counseling, physical activity, could considerably lower the individual's plasma lipid profile by lowering the total cholesterol/HDL ratio and the LDL/HDL ratio.

In the present study, consuming 30g of walnuts per day along with the low-calorie diet showed a significant reduction in the total cholesterol (11.5%), LDL cholesterol (15.3%), triglycerides (11.2%), VLDL cholesterol (9.0%), and improved HDL cholesterol (6.0%) among the experimental group. Whereas in the control group, there was a non-significant reduction. The lipid profile ratio revealed that the experimental group had a significant ($p<0.05$) reduction in the LDL/HDL ratio (21.4%) and total cholesterol/HDL ratio (17.6%) when compared to a non-significant control group (5.0 % and 3.5 %). The addition of 30g of walnuts to the diet every day for two months resulted in a considerable increase in HDL cholesterol (6.3 mg/dl). In male and female patients aged 18 to 65 years, consuming a specified amount of walnuts without the shell on a daily basis can enhance good cholesterol (HDL-cholesterol) [16].

The walnut group showed significantly better improvements in the HDL cholesterol to total cholesterol ratio and HDL than the control groups in a study adding 30g of walnuts with a reduced-fat or modified fat diet [17]. Our findings also revealed that eating 30 g of walnuts per day and following a low-calorie diet for 90 days improved lipid profile ratios and lowered the risk of heart disease. Even though walnuts have a high energy content, a walnut-enriched reduced-energy diet can aid weight loss than a regular reduced-energy-density diet due to behavioral weight loss intervention. While both dietary methods improved cardiovascular disease risk factors, the walnut-enriched diet had a more significant effect on LDL cholesterol [18]. The walnut was added as part of a low-energy diet combined with lifestyle changes in the current study, and it was shown that the experimental group had a substantial reduction in body weight (5.4%) and BMI (4.0%) when compared to the control group (1.9% and 2.1%). In the post-test compared to the pre-test, there was a substantial reduction in waist circumference (3.3%), hip circumference (2.3%), and waist-hip ratio (2.1%) among the respondents of the experimental group. Nut consumption has not been linked to weight gain in numerous epidemiological and clinical research [19-21]. This is most likely owing to the nut's satiety-inducing effects, as well as the poor absorption of caloric energy from nuts [11].

In the present study, the experimental group was given 30 g of walnut for 90 days and 30 minutes of brisk walking, which was suggested for both the control and experimental groups. Walnuts accounted for 44% of total calories and 20% of total fat. Walnuts also contained 2.4% SFA, 7.8% MUFA, and 19.5% PUFA. The findings show a drop in BMI and W/H ratio and decrease in total cholesterol, LDL cholesterol, triglycerides, VLDL cholesterol, total cholesterol: HDL ratio, and LDL: HDL ratio, as well as an increase in HDL cholesterol. Furthermore, walnut consumption lowers BMI and W/H ratio. This could be the reason for the reduction in the lipid profile of the respondents, along with the structured diet counseling and practicing a low-fat diet.

The study concluded that dietary changes are essential for preventing dyslipidemia, a well-known independent CVD risk factor. This study found that taking 30 g of walnuts for 90 days and structured diet counseling and physical exercise significantly reduced the patients' plasma lipid profile by lowering the total cholesterol/HDL ratio and the LDL/HDL ratio. The consumption of 30 g of walnuts per day, combined with a lifestyle change, improves the subjects' lipid profile and helps them manage their body weight. Weight management and lifestyle adjustments, such as excellent dietary practice with the consumption of plant-based foods, daily physical activity, and stress management, are essential for effectively preventing non-communicable diseases and enhancing the quality of life for the general population.

Funding

The authors declare that no funding is involved in this study

Declaration of Competing Interest

All authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgment

The authors wish to express their thanks to the Chief of Medical Services of Bharat Electronics Limited, Hindustan Aeronautics Limited, and BEML Limited company's hospitals Bangalore, Karnataka complete this research.

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