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Consumption of Canola Oil vs. Other Common Oil(s) in Dyslipidemia Management among Urban Indian Adults

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ABSTRACT

The present study was conducted to determine the effect of consuming canola oil vs. other common oil(s) on the lipid profile and anthropometric parameters of dyslipidemic adults. Eighty urban affluent dyslipidemic adults (40 experimental, 40 control) of age 30–45 years were enrolled from hospital based preventive health check programs for a 16-week non-randomized intervention trial. Dietary and lifestyle modification advice for management of lipid levels was provided to both the groups. Canola oil was provided for routine consumption only to the experimental group whilst the control group was advised to consume their usual oil(s) in recommended amounts (15 ml/day). Height, weight, Body Mass Index (BMI), Waist Circumference (WC), Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Total Cholesterol (TC) and Triglycerides (TG) were measured at the beginning of the study (0 weeks), post run-in period (4 weeks) and post intervention period (12 weeks). Self-reported checklist was used to measure monthly compliance. Mixed effect linear regression and quantile linear mixed models were used to analyze the change in the parameters over time. There was no significant difference in the compliance towards dietary and lifestyle advice between both the groups (p=0.525; 0.795). The difference of changes in the lipid profile and anthropometric measurements between the groups observed over time was not statistically significant (Weight: p=0.206, BMI: p=0.553, WC=0.40, TC: p=0.505, TG: p=0.167, LDL: p=0.271, HDL: p=0.504). Hence, there was no difference in the effects of consuming canola oil vs. other common oil(s) in managing dyslipidemia. Similar beneficial changes were observed with consumption of both canola as well as other common oil(s).

Keywords: canola, cholesterol, dyslipidemia, management, oil(s)

INTRODUCTION

Cardiovascular diseases (CVDs) have a major share in global Non-Communicable Diseases (NCD) related mortality (WHO 2018). Indians in particular are at a greater risk owing to their genetic predisposition (Sai *et al.* 2012). CVDs occur a decade earlier among Indians (Mean age: 53±11.4 years) as compared to their European, American, Middle Eastern, even African counterparts (Mean age: 58.8±12.2 yrs), mainly because of lower prevalence of protective factors such as moderate to high intensity exercise, consumption of fruits and vegetables (Joshi 2007; Xavier 2008). Other leading risk factors such as high systolic blood pressure (≥140 mmHg), fasting plasma glucose (≥126 mg/dl) levels and total cholesterol (≥200 mg/dl) have also been identified for CVD deaths in India, which have only increased in line with the CVD deaths (Prabhakaran *et al.* 2018). In fact, these risk factors increase exponentially with age once Indians reach the 30-39 years age group (Gupta *et al.* 2009).

As CVDs and their related risk factors continue to rise, India in particular will suffer the economic impact of this trend, if preventive measures are not taken (Chauhan & Aeri 2015). Hence, the most effective combative strategy in this regard would be to focus on alleviating these risk factors. The present study focussed on one such risk factor, i.e. dyslipidemia, defined as the occurrence of total cholesterol, TC levels ≥200 mg/dl; Triglycerides, TG levels ≥150 mg/dl, Low density lipoprotein, LDL levels ≥130 mg/dl and high-density lipoprotein, HDL ≤40 mg/dl alone or in combination (Chandra *et al.* 2014).

In 2008, the global prevalence of raised cholesterol (≥190 mg/dl) among 25+ year old adults were 38.9% (females-40.2%, males-37.3%) and that of India were 27.9% (females-29.5% and males-26.3%) (WHO

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2008). More recent prevalence data can be found in Indian studies. In 2014, the age adjusted prevalence were: TC ≥200 mg/dl- 25.1% and 24.9%, LDL-c ≥130 mg/dl- 16.3% and 15.1%, HDL-c <40 mg/dl-men and <50 mg/dl-women- 33.6% and 52.8%, total: HDL-c ≥4.5- 29.4% and 16.8% and TG ≥150 mg/dl- 42.1% and 32.9% males and females respectively (Guptha *et al.* 2014). In the ICMR INDIAB study, prevalence of high TC levels was 13.9%, high TG- 29.5%, low HDL-c-72.3% and high LDL-c-11.8%. At least one abnormal lipid parameter was seen among 79% of men and women (Joshi *et al.* 2014). More recently, prevalence of elevated TC was reported in 25.4% and 35.6%, LDL-c in 28.1% and 35.1%, TG in 33.9% and 26.8%, low HDL-c in 54.9% and 64.4% and total: HDL-c in 45.1% and 36.4% men and women respectively (Gupta *et al.* 2016). Hence, the prevalence varies across studies but is definitely very high when translated into numbers.

Both Indian (Chandra *et al.* 2014) as well as international guidelines for treatment of dyslipidemia recommend modifications in terms of diet, physical activity, smoking, alcohol consumption etc. (NHLBI 2005; Catapano *et al.* 2016). Within these guidelines, the quality and quantity of dietary fats to be consumed have been focused upon. Even the WHO/FAO expert consultation report advises <10% of total calorie intake from saturated fatty acids (SFAs), about 6–10% from polyunsaturated fatty Acids (PUFAs; 1–2% n3 and 5–8% n6) and rest of the fat derived energy intake from monounsaturated fatty acids (MUFAs) (Report of the Joint WHO/FAO 2003). Given the criteria, many edible oils have been promoted on the basis of their fatty acid profiles as cholesterol lowering agents, including canola oil. Canola oil is low in SFAs, high in MUFAs and PUFAs specifically n-3 PUFAs as compared to many commonly consumed oils such as soybean, rice bran, safflower, sunflower etc. (ICMR 2010). Several research studies have documented the beneficial effects of consuming canola oil in diet.

A meta-analysis conducted to study the effect of various fatty acids concluded that substitution of canola oil into the diet starting at only 2% can produce an overall Coronary Artery Disease (CAD) risk reduction of 21% (Mozaffarian & Clarke 2009). In a study, replacing dairy fat with rapeseed oil (canola oil) led to reduced levels of serum cholesterol (-17%), TG (-20%) and LDL-c (-17%), TC:HDL-c (-21%), apolipoprotein (apo) B/apo A-I ratio (-4%) from baseline and also modestly increased serum lipoprotein(a) (+6%) (Iggmann *et al.* 2011). Similar benefits have also been reported among obese males. After daily supplementation of 50 g of canola oil vs. olive oil over 4 weeks, there was an increase in serum n-3 fatty acids (from 3.59±0.26% to 4.17±0.21%) and a reduction in TC (by 0.55±0.14 mmol/l), LDL levels (by 0.45±0.11 mmol/l) along with certain pro-inflammatory markers as compared to olive oil (Kruse *et al.* 2015). Most recently, two systematic review and meta-analysis studies have also reiterated the beneficial effects of consuming canola oil. One of them concluded that consuming canola oil for >30 days can reduce TC and LDL levels among >50-year-old individuals specifically in comparison with sunflower oil and saturated fat (Ghobadi *et al.* 2019). The other specifies improvement in several cardiometabolic markers compared with saturated fat, sunflower and olive oil with greatest benefits occurring when ~ 15% of the total energy intake was consumed from canola oil (Amiri *et al.* 2020).

At the same time, beneficial effects of many other oils have also been documented. In a review comparing olive oil, sunflower oil, fish oils and palm oil for their cardiovascular effects, it was concluded that all these oils have beneficial effects on cardiovascular health if supplemented in appropriate proportions. Considering only those that are used for cooking, both olive and sunflower oil were found to be effective in lowering serum cholesterol while palm oil was found to have a neutral to mild effect. Further, olive oil reduced oxidative stress and both sunflower and palm oil were found to have some anti-arrhythmogenic benefits. Sunflower oil was found to be less desirable due to its pro-oxidant effect when used for frying (Bester *et al.* 2010). However, in another study, palmolein oil consumption increased plasma and total LDL-c levels compared with olive oil while intake of olive oil demonstrated reduced LDL concentration and slight tendencies in reduction of total:HDL ratio but no change in HDL levels were seen in either (Tholstrup *et al.* 2011). Similar effect of olive oil consumption has been documented elsewhere (Oliveras-López *et al.* 2013). Its capability of increasing the HDL levels, its size, promoting its stability and enhancing the HDL oxidative status have also been documented (Hernáez 2017). Consumption of rice bran

oil (30 ml/day) can improve LDL levels as well as the antioxidant status significantly in hyperlipidemic individuals (Bumrungpert *et al.* 2019). Hence, many other commonly consumed oils can also favorably change lipid levels.

With this background, the present study was conducted to determine any effects of consuming canola oil vs. other commonly consumed oil(s) in managing dyslipidemia in terms of any change in lipid profile (LDL, HDL, TC and TG) and anthropometric measurements (Weight, BMI, WC).

METHODS

Design, location, and time

Non-randomized intervention trial of 16 weeks: 4 weeks of run-in period and 12 weeks of intervention period. Participants were enrolled for the study from selected preventive health check-up centres in Delhi-National Capital Region, India during 2012–2015.

Sampling

Sample size was computed to be 40 (each for experimental and control group) considering a drop-out rate of 20% (level of significance 5% and power 80%). The sample size was calculated on the basis of the mean and standard deviation values from a cross over study conducted on adult participants (Kuriyan *et al.* 2005). The formula used was (Rosner 1995):

$$\frac{(\sigma 1^2 + \sigma 2^2) + (z1\text{-}\alpha/2 + z1\text{-}\beta)^2}{\Delta^2}$$

where, $\Delta = \mu 2 - \mu 1$, ($\mu 1$, $\sigma 1$) and ($\mu 2$, $\sigma 2$) are means and variances of the two respective groups, $z1\text{-}\alpha/2 = 1.96$, $z1\text{-}\beta = 0.84$

A total of 112 participants gave a written informed consent to participate in this study. They were requested to come for a follow up visit after a month's run-in period. Only 88 participants came for the follow up visit. At this point, their lipid profile and anthropometric data were re-collected (post run-in). These participants were then divided into experimental and control group using the alternation technique. All participants whose identification/serial number was odd were assigned to the experimental group (n=45) while those with even numbers were assigned to the control group (n=43). During the intervention period, there were 8 more drop-outs; 5 from experimental group and 3 from control group due to a frequent travelling schedule that did not allow adherence to the intervention for long periods of time.

The inclusion criteria for the study subjects were; age: 30–45 years; TC ≥200 mg/dl and/or TG ≥150 mg/dl and/or LDL ≥130 mg/dl and/or HDL ≤40 mg/dl; willingness to participate and written informed consent. Those with liver disease, kidney disease, diabetes, heart disease or malignancy, pregnant and lactating mothers as well as those on lipid lowering drugs were excluded.

Intervention

Diet and lifestyle advice for lipid lowering based on the NCEP-ATP III (2002) guidelines was provided to both groups through a personalized diet plan. Counselling for maintaining optimum physical activity, stress management, smoking cessation and restricting alcohol intake was also given. Experimental group was provided canola oil in vacuum packaged bottles bought directly from the seller by the investigators for daily cooking of any kind while the control group consumed their usual edible oil(s) which were mustard, olive, sunflower, soybean, rice bran oil, clarified butter or ghee and coconut oil. They did not consume canola oil as ascertained through a survey with the sample population and continued using the oil(s) they were using at the beginning of the study throughout the study period. Advised dosage was 15ml/day for both the groups.

The study protocol was approved by the scientific committee of Max Healthcare, Institutional Ethics Committee, Institute of Home Economics and the Max Healthcare Ethics Committee. The study was also registered with the Indian Council of Medical Research (ICMR) clinical trial registry (REF/2013/04/004857).

Data collection

Standard techniques were used to collect anthropometric data i.e. height, weight (Seth & Singh 2005) and waist circumference; WC (WHO 2011) and data on lipid profile i.e. TC using CHOD-PAP method (Roeschlau *et al.* 1974); TG using GPO Trinder method (McGowan *et al.* 1983); LDL calculated using the Friedwald's equation (Tietz *et al.* 2006) and HDL levels ascertained using the phosphotungsticacid

method (Rifai & Warnick 1994) were collected three time periods: at 0 weeks, the beginning of the study (pre-intervention stage), after 4 weeks of run-in period (post run-in stage) and then again after 12 weeks of intervention with canola oil/commonly consumed oil(s) (post-intervention stage). Height and weight data were used to calculate Body Mass Index, BMI of the participants (WHO 2019).

Compliance to the intervention was assessed using a monthly self-report checklist wherein the participants marked the number of days they deviated from the dietary and lifestyle advice as well as canola oil consumption (for experimental group only). The compliance of the participants (during run-in period of 4 weeks, intervention period of 12 weeks and overall study period of 16 weeks) was calculated in terms of mean number of days the advice was adhered to. Percentage compliance was computed by dividing the mean no. of complaint days with the total no. days. Compliance was considered to be good if the participants consumed canola oil/other oil(s) for at least 30 days during the substitution period. This criterion was derived on the basis of similar intervention studies that have documented an effect of such interventions in as less as 4 weeks (Kruse *et al.* 2015; Ghobadi *et al.* 2019; Bumrungpert *et al.* 2019).

Data analysis

Independent t-test was used to assess difference between the groups on the basis of compliance. The outcome variables were tested for normality and were found non-normal. Hence, log transformations were applied. All variables except WC and BMI followed normality post transformation hence, their mean values were reported. Thus, independent t-test and Mann Whitney U test were used to determine any difference in the LDL, HDL, TC, TG levels and BMI and WC values at the beginning of the study respectively. Both the study groups were also tested for age and gender matching using a chi square test.

To study the effect of the intervention among both the study groups, the main outcome variables of the study were statistically analyzed for change over time. Mixed effect linear regression models were used to test the difference in the change of mean values of LDL, HDL, TC and TG over time between experimental and control group as these variables followed normality after log transformation. However, BMI and WC values did not follow the normality assumption even after the transformation hence, Quantile Linear Mixed Models (QLMM) were used to assess the difference in change of median values of BMI and WC over time between the two study groups. These models were used to analyze the difference of values between two groups and the within participants variations of values over the three time periods. In both types of analysis, three models were applied: (1) Model 1: The change was measured over time by study groups only; (2) Model 2: Age and gender were adjusted in the model while assessing the change over time; (3) Model 3: Effect of days of compliance for diet and exercise were also included along with age and gender in the models.

Different statistical analysis software was used for this analysis. Linear mixed effect model and multinomial logistic regression model analysis were carried out using SPSS 17.0 while the Quantile Linear Mixed Model (QLMM) analysis was carried out using software R 3.1.3

RESULTS AND DISCUSSION

The experimental and control group were age and gender matched (p=0.382 and 1.00). There was no significant difference between the two groups in weight, median BMI, median WC, mean TC, TG, LDL and HDL levels at the pre-intervention stage (p=0.510; 0.697; 0.913; 0.713; 0.223; 0.363; 0.929 respectively). Thus, both the study groups were essentially similar at the pre-intervention stage.

Table 1 shows the mean numbers of days for compliance of both the groups towards dietary and lifestyle advice. With an overall compliance of approximately 70–75%, no significant difference was observed between the groups (dietary advice: p=0.525, lifestyle advice: p=0.795). In addition, the compliance of the experimental group for canola oil consumption was 105±14.18 days i.e. 87.5%. The results have been reported with reference to the parameters at the beginning of the study.

Change in anthropometric parameters

At the end of the first month i.e. the run-in period, there was significant decline in the weight and BMI of experimental group as well

Table 1. Comparison of study groups on the basis of the mean number of days of compliance

Compliance	Total number of days	Experimental		Control		p
		Mean±SD	%	Mean±SD	%	
Dietary advice						
Run-in period	30	20±7.62	66.66	20.08±8.79	66.93	0.802
Intervention period	120	91.83±18.35	76.53	89.80±26.02	74.83	0.661
Total study period	150	111.83±23.26	74.55	109.88±31.98	73.25	0.525
Lifestyle advice						
Run-in period	30	18.95±7.68	63.17	19.20±8.52	64	0.754
Intervention period	120	92.90±17.41	77.42	87.23±29.13	72.69	0.761
Total study period	150	111.85±22.65	74.57	106.43±34.78	70.95	0.795
Canola oil						
Canola oil consumption	120	105±14.18	87.5	-	-	-

as the control group (p-experimental<0.001; p-control<0.001 and p-experimental<0.001, p-control=0.001 respectively) (Table 2, Table 3). WC decreased in the control group but not significantly (p=0.278) while no change was observed in the experimental group. However, at the end of the intervention period, a significant decline in the weight, BMI and WC was observed in both the groups. Further, on comparing the extent of decline between the two groups, no significant difference was observed (Table 2, Table 3).

Change in lipid levels

By the end of the run-in period, both the groups exhibited a significant decline in the TC levels (p-experimental=0.035; p-control=0.003). Even the LDL levels declined significantly but with a marginal significance in the experimental group (p-experimental=0.055; p-control=0.003). On the other hand, both the TG as well as the HDL levels did not change significantly (p-experimental=0.669; p-control=0.830 and (p-experimental=0.181; p-control=0.753 respectively). In the next four months i.e. by

Table 2. Overall change in the anthropometric parameters and lipid profile levels

	Experimental group			Total % change	Control group			Total % change
	Pre -intervention 0 weeks	Post run-in 4 weeks	Post intervention 16 weeks		Pre-intervention 0 weeks	Post run-in 4 weeks	Post intervention 16 weeks	
Weight (kg)	74.66±12.34	73.94±12.07	72.66±11.28	-2.68	72.89±11.05	71.86±10.71	70.2±9.84	-3.69
BMI (kg/m^2)	25.8 (24.47–27.75)	25.3 (24.11–28.09)	25.2 (23.52–27.38)	-2.33	25.92 (23.89–27.34)	25.52 (23.47–27.17)	24.57 (23.42–26.42)	-5.21
WC (cms)	91 (86–95.88)	91 (86–94)	87.5 (84–91)	-3.85	91 (86–94)	87.5 (86–94)	86 (81–93.25)	-5.49
LDL (mg/dl)	155.01±26.81	149.54±23.8	138.22±19.54	-10.83	161.75±33.22	153.51±32.77	139.82±28.29	-13.56
HDL (mg/dl)	38.87±8.62	38.28±7.83	38.43±6.7	-1.31	39.5±11	39.5±10.81	38.86±10.08	-1.62
TC (mg/dl)	232.48±25.59	226.53±24.12	211.53±20.57	-9.01	236.6±37.35	229.49±38.71	212.23±34.71	-10.3
TG (mg/dl)	195.43±57.98	194.25±46.86	171.95±44.78	-12.01	183.33±62.51	181.1±55.87	169.48±57.94	-7.55

BMI: Body Mass Index; WC: Waist Circumference; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; TC: Total Cholesterol; TG: Triglycerides

Table 3. Change in the anthropometric parameters of the participants

Experimental (n=40)				Control (n=40)		
Study period	Estimate[↑]	Standard error	p[ϕ]	Estimate[↑]	Standard error	p[ϕ]
Weight[1]						
Pre-intervention	Reference	Reference		Reference	Reference	
Post run-in	-0.009	0.002	<0.001**	-0.014	0.004	<0.001**
Post intervention	-0.026	0.005	<0.001**	-0.036	0.007	<0.001**
Difference change between the groups			p#= 0.206			
Body mass index[2]						
Pre-intervention	Reference	Reference		Reference	Reference	
Post run-in	-0.285	0.061	<0.001**	-0.361	0.105	0.001**
Post intervention	-0.738	0.136	<0.001**	-0.923	0.172	<0.001**
Difference of change between the groups			p#=0.553			
Waist circumference[2]						
Pre-intervention	Reference	Reference		Reference	Reference	Reference
Post run-in	-0.462	0.237	0.057*	-0.751	0.228	0.001**
Post intervention	-2.34	0.487	<0.001**	-2.92	0.577	<0.001**
Difference of change between the groups			p#=0.40			

*Significant (p<0.05); **Highly significant (p<001); [↑]Estimates are beta coefficients indicating the change in parameters unit time; pΦ: Shows the significance of change in the parameters; p#: Shows the significance of difference of change between the groups; [1]Mean log transformed values; [2] Median values

the end of the intervention period, there was a significant decline in all the lipid levels except HDL (TC: p-experimental<0.001; p-control<0.001; TG: p-experimental<0.001; p-control=0.029; LDL: p-experimental<0.001; p-control<0.0001; HDL: p-experimental=0.016; p-control=0.831). Further, the extent of decline in TC, TG and LDL levels was not found be significantly different between the two groups (Table 2, Table 4).

Hence, the study participants were age and gender matched, similar in terms of their anthropometric parameters and lipid levels at the beginning of the study and also had similar extent of compliance to the intervention. The only difference between the groups was the type of oil they consumed. By the end of the study period, it was observed that the weight, BMI, WC, TC, TG and LDL levels of both the groups decreased significantly.

Further, it is worth noting that while the mean HDL levels did not change desirably in both the groups i.e., they did not increase, the levels also did not decrease by the end of the study period. Since HDL is known to be cardio-protective, a decline in its levels is not desirable (Nagao *et al.* 2018).

Key observation of the study is that the difference of these changes between the two study groups was not statistically significant (p>0.05) i.e. the changes observed were similar in both the groups whether they consumed canola oil or their usual oils in routine.

As discussed in the introduction section, several studies have documented the beneficial effects of canola oil consumption over other oil(s) in terms of reduction in lipid profile level and even other cardiovascular risk markers such as Apo b: Apo A-I ratio (Iggmann *et al.* 2011; Kruse *et al.* 2015; Ghobadi *et al.* 2019; Amiri 2020).

Table 4. Change in the lipid profile of the participants

Experimental (n=40)				Control (n=40)		
Study period	Estimate[↑]	Standard error	p[ϕ]	Estimate[↑]	Standard error	p[ϕ]
Total cholesterol						
Pre-intervention	Reference	Reference		Reference	Reference	
Post run-in	-0.026	0.012	0.035*	-0.031	0.018	0.003**
Post intervention	-0.093	0.015	<0.001**	-0.109	0.026	<0.001**
Difference of change between the groups			p[#]= 0.505			
Triglycerides						
Pre-intervention	Reference	Reference		Reference	Reference	
Post run-in	-0.007	0.016	0.669	-0.005	0.025	0.830
Post intervention	-0.119	0.022	<0.001**	-0.070	0.031	0.029*
Difference of change between the groups			p[#]= 0.167			
Low density lipoprotein						
Pre-intervention	Reference	Reference		Reference	Reference	Refer-ence
Post run-in	-0.034	0.017	0.055*	-0.055	0.018	0.003**
Post intervention	-0.109	0.021	<0.001**	-0.147	0.026	<0.001**
Difference of change between the groups			p[#]=0.271			
High density lipoprotein						
Pre-intervention	Reference	Reference		Reference	Reference	Refer-ence
Post run-in	-0.012	0.009	0.181	-0.002	0.007	0.753
Post intervention	-0.003	0.016	0.834	-0.003	0.015	0.831
Difference of change between the groups			p[#]=0.504			

*Significant (p<0.05); ** Highly significant (p<0.01); [↑]Estimates are beta coefficients indicating the change in mean value of log transformed lipids per unit time; p[Φ]: Shows the significance of change in mean of log transformed values; p[#]: Shows the significance of difference between the groups

However, our study did not confirm this finding. Instead, we found that effect of consuming canola oil was not superior to consuming usual oil(s) like mustard, olive, sunflower, soybean, rice bran oil, clarified butter or ghee and coconut oil as seen in our control group participants. These results are in line with an intervention with hypoenergetic diet enriched in rapeseed oil vs. an olive oil diet among individuals with metabolic syndrome. The investigators observed a significant reduction in body weight of both the rapeseed oil and olive oil group (-7.8 v. -6.0 kg). There were significant decreases in the TC (-0.30 mmol/l and -0.38 mmol/l) and LDL-c (-0.22 mmol/l and -0.28 mmol/l) levels also with no inter-group differences. Here, too the HDL levels did not change in both the study groups. However, rapeseed oil group did show a distinction of improved TG levels (-0.045 mmol/l) that did not occur in the olive oil group (Baxheinrich *et al.* 2012). Our results also concur with a recent randomized control trial that reported no difference between two groups that consumed canola oil or, in this case a specific oil i.e. sunflower oil for 6 weeks. Both the groups showed significant decline in LDL (Canola

group: 129.54±39.74 mg/dl to 116.12±35.83 mg/dl and Sunflower group: 140.55±41.29 mg/dl to 122.95±32.97), TC (Canola group: 220.13±41.94 mg/dl to 194.31±39.45 mg/dl and sunflower group: 223.95±43.81 mg/dl to 196.45±35.28 mg/dl) and TG levels (197.14±103.23 mg/dl to 172.49±78.25 mg/dl and sunflower group: 189.02±110.02 mg/dl to 171.04±88.69 mg/dl) with the only exception being an elevation in the HDL levels (Canola group: 44.24±12.31 mg/dl to 47.28±11.90 and sunflower group: 44.82±12.29 mg/dl to 46.73±11.35 mg/dl) but no significant change in the anthropometric parameters of the participants as compared to our study probably because the study did not involve giving dietary and lifestyle advise to the participants (Saedi *et al.* 2017). This was another key observation of our study since obesity (increased weight, BMI and WC) is a known risk factor for CVDs.

CONCLUSION

There are several studies that have documented evidence of beneficial effects of canola oil consumption as against other edible oils. However, a few others have also shown no difference in the benefits conferred by consuming canola oil or other commonly consumed oil(s) as in the case of our study. We observed similar improvements in the lipid levels and anthropometric parameters in both the groups implying no additional benefits of consuming canola oil in specific. Thus, our results imply that similar improvements in lipid levels and anthropometric parameters can also be brought about by using commonly available oils with lower price points and this can help in managing dyslipidemia more economically. Future research studies can focus on the role of following dietary and lifestyle modifications as against consumption of specific oil(s) in managing dyslipidemia among adults.

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AUTHOR DISCLOSURES

The authors have no conflict of interest.

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