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Effect of High Fibre and Omega-3 Rich Diet on Hypercholesterolemia Patients

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Abstract

Background: Cardiovascular diseases (CVD) are the most prevalent cause of death and disability in both developed as well as developing countries. Dyslipidemia has been found to be one of the most important contributing factors. Dietary approaches tend to lower total cholesterol, LDL cholesterol and triglyceride levels.

Methodology: Out of 50 hypercholesterolemia patients, 38 patients participated actively in the study. A high fibre and omega-3 rich diet, followed by a thorough nutritional counselling was provided to each participant. Post two months of follow up their lipid profiles were compared and studied.

Results: The study consisted of 60.5% males and 39.5% females from the age of 25years. Results of the study showed that at a 0.01 level of significance, mean LDL levels pre-diet was greater than post-diet (155.91 and 116.72 respectively) with a difference of 39.12 at a standard deviation of 19.60 and standard error mean of 3.18, mean of HDL level pre-diet was less than post-diet (46.56 and 52.13 respectively) with a difference of -5.57 and a standard deviation of 4.01 and a standard error mean of 0.65 and mean of total cholesterol pre-diet was higher than post diet (227.32 and 197.71 respectively) with the difference being 29.61 at a standard deviation of 21.76 and standard error mean of 3.53. Also, Ryan-Joiner Normality Test showed that the data followed a normal distribution.

Conclusions: When a high fibre and omega-3 rich diet is consumed regularly as part of a healthy diet, it may have beneficial effects on serum lipid levels and may help reduce any untoward cardiovascular event.

Keywords: Hypercholesterolemia; Fibre; Omega-3 fatty acids; Cardiovascular diseases

Introduction

Cardiovascular diseases, especially coronary heart disease, are important public health problems in India and many developing countries [1,2]. Dyslipidemia has been found to be one of the most important contributing factors [3]. Dyslipidemia represents one of the major risk factors for atherosclerosis affecting arteries of large and medium size and consequently causing ischemia in the brain, heart, or legs. Coronary artery disease and cerebral stroke represent the major causes of morbidity and mortality among elderly and middle aged subjects [4]. Dyslipidemia describes a number of abnormalities in lipoprotein homeostasis including hypercholesterolemia and hypertriglyceridemia. Prevalence of lipid abnormalities is higher among Asians as compared with non-Asians, as shown by some studies [5,6]. Low HDL cholesterol and high TG concentrations have been implicated as possible independent predictors of CVD [6-9] and the combination of these two conditions are called as atherogenic dyslipidemia [10].

With the changing lifestyle and as the population grows older, richer and more urbanised there has been a gradual transition from infectious to chronic diseases. Sedentary lifestyles, increased consumption of unhealthy convenient foods and high-fat foods such as fast foods have been contributing to the rising prevalence of chronic diseases like hypertension, dyslipidemia and diabetes. In 2011, anaemia followed by hypercholesterolemia was the most prevalent disease in India and it is estimated that there are almost 224 million people with high cholesterol in India.

Diet plays a vital role and has a strong influence in normalising the blood cholesterol levels. It is equally important even in people taking cholesterol-lowering medications; however, daily exercise and maintaining a healthy weight also play an important part in this process. A diet low in cholesterol and fat, especially saturated fats and high in fibre and omega-3 fatty acids is beneficial for hypercholesterolemia patients and a diet low in carbohydrates is favourable for hypertriglyceridemia individuals.Omega-3 fatty acids have significant positive effects on health and general wellbeing [11,12]. Walnuts a very important source of omega-3 fatty acids is loaded with omega -3 fatty acids, and various other bioactive compounds [13]. Other important sources of omega -3 fatty acids are flaxseed, almonds, fish etc. In 2002 the American Heart Association revised its recommendations for dietary intake of n-3 fatty acids [14]. The following were recommended:

- Individuals without documented coronary heart disease were advised to eat fish (preferably oily) twice per week plus oils and foods rich in ALA (flaxseed, canola, soy, walnuts). This comes to ≈500 mg/d compared with current intake of <100 mg/d of n-3 fatty acids.

- Individuals with documented coronary heart disease were counselled to eat 1 g/d of EPA plus DHA, preferably from oily fish, but could take EPA plus DHA supplements in consultation with a physician.

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• Individuals with hypertriglyceridemia could ingest 2-4 g/d of EPA plus DHA under a physician's care. The Food and Drug Administration (FDA) announced a qualified health claim stating a connection between omega-3 fatty acid and a reduced risk of coronary heart disease based on sufficient scientific studies documenting a positive correlation to coronary and cardiovascular health [15].

Soluble fibre can contribute to LDL reduction and is now a formal part of hyperlipidemia dietary recommendations. Fresh fruits, vegetables, legumes, cereals, oats and whole grains are good sources of soluble fibre. This type of fibre helps block cholesterol from being absorbed into the bloodstream. Most fruits and vegetables have 1-3 g of soluble fibre per serving. It is recommended that people who have high cholesterol get a total of at least 30-40 g of Fibre each day. Studies also have indicated that plant-based diets are associated with decreases in total cholesterol and LDL cholesterol of up to 15% and that eating 2-3 g of phytosterols daily reduces total cholesterol by up to 11% and LDL cholesterol by up to 15%. However, some people have slight change in lipid levels despite significant changes in fat and cholesterol intake, this disparity may be explained by genetic factors [16] or insulin resistance [17].

Therefore, with this background the present study is a small stride to assess the effect of high fibre and omega-3 rich diet on hypercholesterolemia patients. Modification in the diet was made by incorporating foods like whole grains, whole pulses, soy, whole fruits, vegetables, salads, almonds, walnuts, flax seeds, psyllium etc. and by cutting back on saturated and trans-fats, refined foods, red meat and high cholesterol. The study was conducted to study the effect of high fibre and omega-3 fatty acids rich diet on lipid profiles (LDL, VLDL, HDL and total cholesterol). The comparisons have also been made among lipid profiles pre and post intake of high fibre and omega -3 fatty acids rich diet.

Methodology

The purpose of this study was to explore the relationship and outcome expectancies of a high fibre and omega-3 rich diet on individuals diagnosed with hypercholesterolemia. Descriptive co relational study design was used to describe several variables that had been identified in theories and practice and exploring possible relationships among them in Indian adults diagnosed with hypercholesterolemia

In this study, a total 50 hypercholesterolemia patients were contacted from the 'Preventive Health Check-up' at Max Healthcare, Saket, India and were given a high fibre and omega-3 rich diet, followed by a thorough nutritional counselling. As few patients did not stick to the diet so study so the study was proceed on 38 hypercholesterolemia patients. Post two months of following the given diet their lipid profiles were compared and studied.

Participants were interviewed and examined to get required information. Semi-structured schedule was used to gather information regarding background characteristics and lifestyle related information. Food Frequency Questionnaire(FFQ) was used to know the frequency of intake fibre and omega 3 intakes. Questions related to physical fitness (frequency, duration and intensity), drinking, smoking etc. were also included.

Diet allocation

A high fibre and omega-3 rich diet chart was prepared for the hypercholesterolemia subjects providing almost 30-40 g of fibre and 4 g of omega-3 fatty acids. The diet chart prepared had a 6-8 meal pattern, where small meals but frequent meals were emphasized. A number of food options were given for each meal depending on the taste, availability and preference of the subjects. The portion size was adjusted according to the weight and BMI. The total calorie was altered accordingly. Each main meal consisted of one or two sources of fibre and the mid-meals were designed to supplement the omega-3 fatty acids and the remaining fibre need of these subjects. The recommendation of fibre which is 25-35 g/day for an adult or 40 g/2000 kcal was kept in mind while preparing the diet chart. Food like green leafy vegetables, whole fruits, whole pulses, whole grains etc. were emphasized in the diet chart.

The fat intake allowed was 3-4 tsp/day/person. Skim milk and milk products were allowed, non-vegetarians were allowed to take fish 2-3 times a week, only egg whites could be included in the diet and egg yolk once in a week, chicken (without skin) once or twice a week and red meat was limited to once in a fortnight. Refined foods like maida, white bread, white pasta etc. were restricted for that period of time. Multigrain flour, whole wheat flour, brown rice, whole cereals, whole pulses, sprouts etc. was encouraged in the diet.

Low cholesterol diet guidelines chart

A low cholesterol diet guidelines chart was prepared on cholesterol lowering food and their possible mechanism in bringing about the hypocholesterolemic effect. This chart consisted of three groups: Foods to be avoided, Foods to be taken in moderation and Food to be consumed in large portions. This chart was provided with diet to every subject.

Biochemical parameters

The lipid profile (LDL, HDL, Triglycerides, and Total Cholesterol) was recorded before and after the diet treatment by using conventional methods.

Statistical analysis

Normality tests were conducted to determine if a data set is well-modelled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed. However, for this Ryan-Joiner method was used for Normality check. Paired t-test was used on LDL, HDL, total cholesterol and triglycerides levels at 0.01 level of significance pre and post diet was calculated using Minitab Statistical tool.

Results and Discussion

General information

Age wise distribution of the respondents depicted in figure 1.The study consisted of 60.5% males and 39.5% females from the age group of 25 years .The hailed from different parts of the country but the majority were from Delhi.

Personal and familial medical history

Along with hypercholesterolemia, co-morbidities included in this study like diabetes and hypertension which are risk factors for CVDs were also present in some of the subjects thus putting them at a higher risk for CVD. It was found out that 18.4% subjects suffered from diabetes and 31.5% had hypertension. Most of the subjects had a family history of hypertension or high blood pressure. 31.5 % subjects had a family history of diabetes, and 23.6% of them had a family history of cardiac diseases.

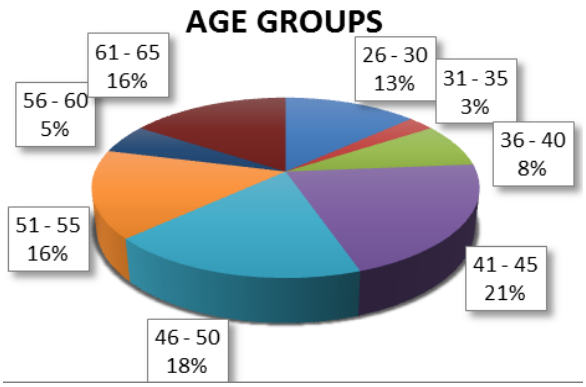

Figure 1: Age group of the sample.

Dietary habits

The study showed that a higher percentage of these subjects lacked healthy dietary habits. Dietary intake of saturated fats either from ghee/butter or fried foods was high, as a greater proportion of the subjects consumed it on a daily basis. Also the intake of refined food products, fast foods and sweets was on the higher side and was consumed more than once a week. Consumption of fish among the non-vegetarians was very low with the majority of them consuming fish less than once a month. On the other hand, the intake of milk, vegetables, salads, fruits and nuts was satisfactory with most people consuming it every day, however, in some of these subjects the portion size, cooking method, choice of vegetables/fruits/nuts was not found to be appropriate. Thus this data indicates that unhealthy dietary habits contribute to deterioration of health and a change in the nutrition front is of utmost importance.

Lifestyle

21% of the subjects in the study were smokers and 34% consumed alcohol out of which many of them were heavy drinkers. The subjects also had a very low level of physical fitness which thus indicated that they had a sedentary lifestyle.

Biomedical parameters

In this study LDL, HDL, Triglycerides, Total Cholesterol contents were tested and compared.

Normality tests

Ryan-Joiner Test was carried out on all the 8 data sets as shown in figures 2-9 i.e. LDL-Pre-diet, LDL-Post-diet, HDL-Pre-diet, HDL-Post-diet, Triglycerides-Pre-diet, Triglycerides-Post-diet, Cholesterol-Pre-diet and Cholesterol-Post-diet to check whether they follow a normal distribution or not. The probability plots for all the 8 data sets depicted that the data points fall reasonably close to the reference line, indicating that the data follow a normal distribution. As the data under study is normal, a data transformation isn't required and the t-test can be run directly to statistically determine the differences in the means of the data collected for the subjects before and after (2 months) they were subjected to a change in their diet pattern.

Comparison of lipid profile

Figure 10 showed the comparison of the means lipid profile (LDL, VLDL, HDL, Triglycerides, Total cholesterol) based upon their regular diet and after the modified diet plan given to them.

A detail description of lipid profile before and after the dietary treatment is shown in Table 1 which depicted that mean LDL levels pre-diet was more than post-diet (155.91 and 116.72 respectively) with a difference of 39.12 at a standard deviation of 19.60 and standard error mean of 3.18, mean of HDL level pre-diet was less than post-diet (46.56 and 52.13 respectively) with a difference of -5.57 and a standard deviation of 4.01 and a standard error mean of 0.65 and mean of total cholesterol pre-diet was higher than post diet (227.32 and 197.71 respectively) with the difference being 29.61 at a standard deviation of 21.76 and standard error mean of 3.53.

The sample data were analysed with α-level of 0.01; and hence a 99% (or 0.99) confidence interval was constructed for the variables/factors. Since the reference value of 0 is not within the confidence interval of any of the type of lipid profile, we can reject the Null Hypothesis with 99% confidence and conclude that the population mean for the difference between the paired observations is not 0. The t-value for

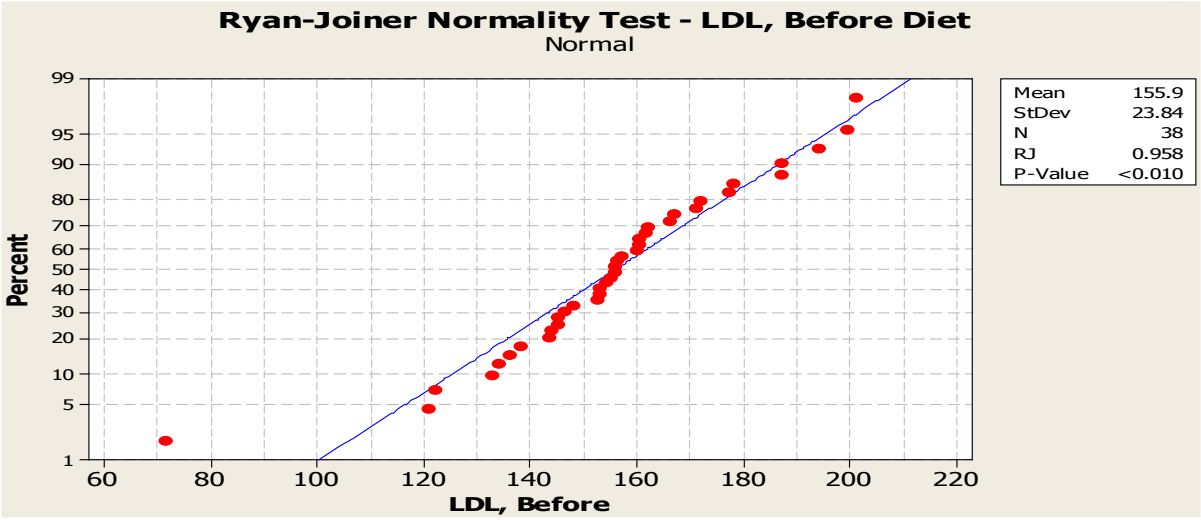

Figure 2: Ryan-Joiner Normality Test-LDL Pre-diet.

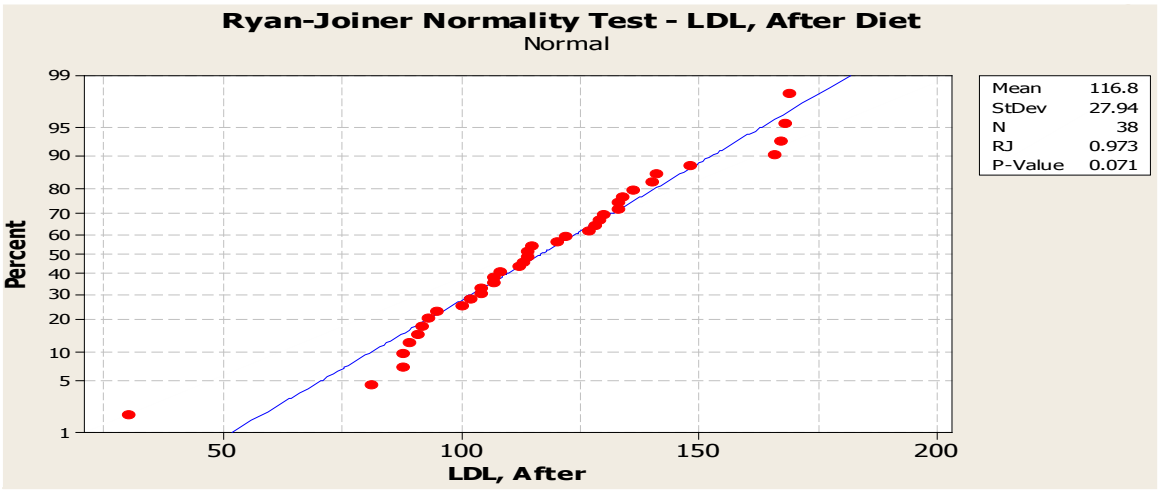

Figure 3: Ryan-Joiner Normality Test-LDL Post-diet.

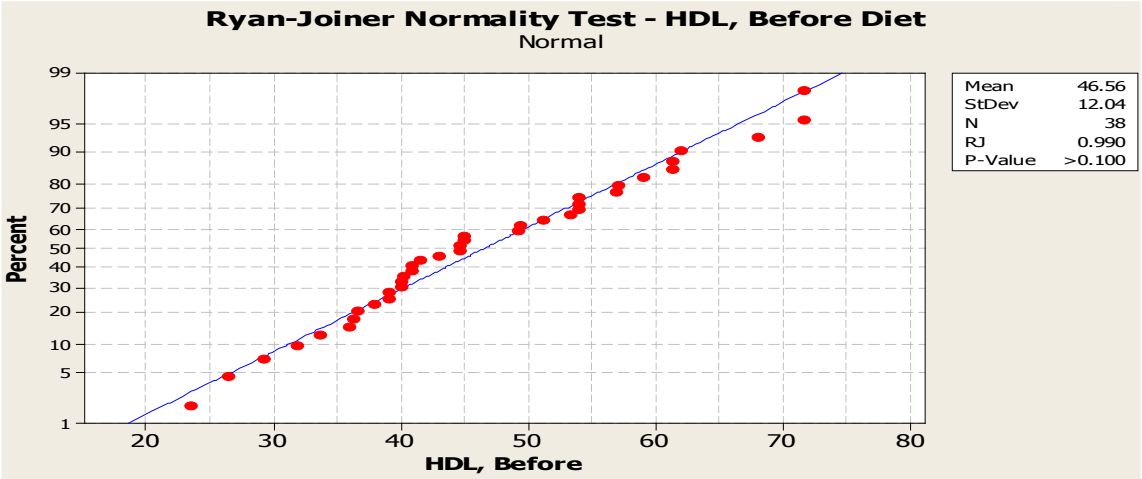

Figure 4: Ryan-Joiner Normality Test-HDL Pre-diet.

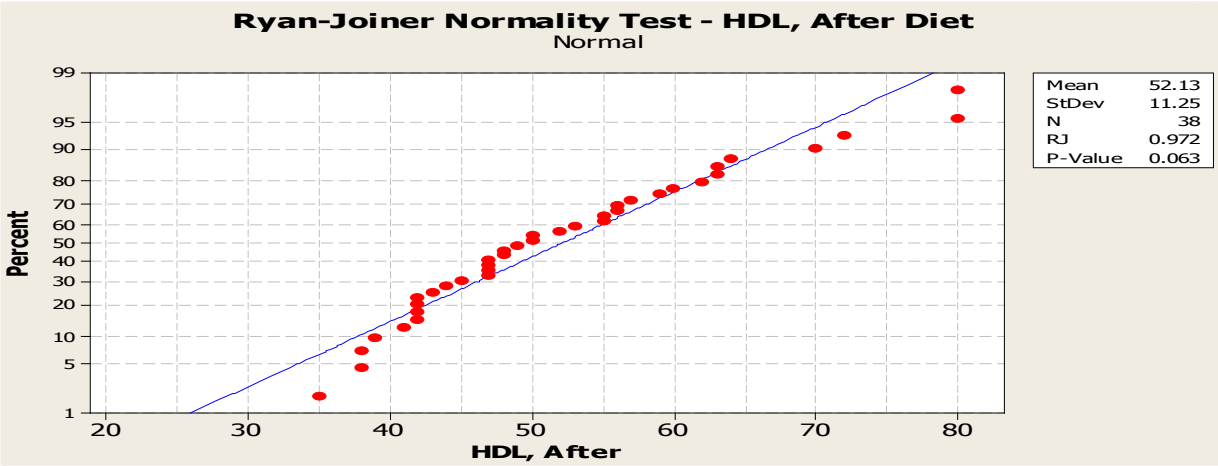

Figure 5: Ryan-Joiner Normality Test-HDL Post-diet.

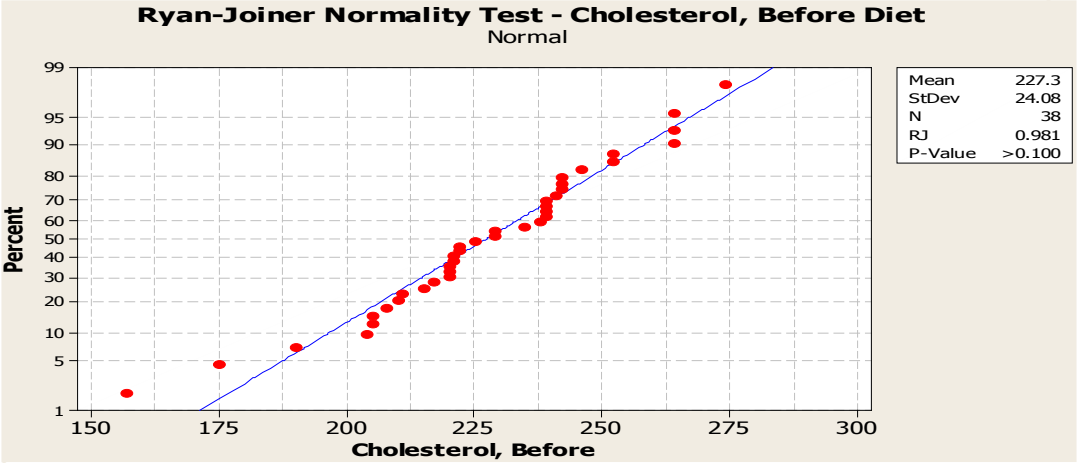

Figure 6: Ryan-Joiner Normality Test-Cholesterol Pre-diet.

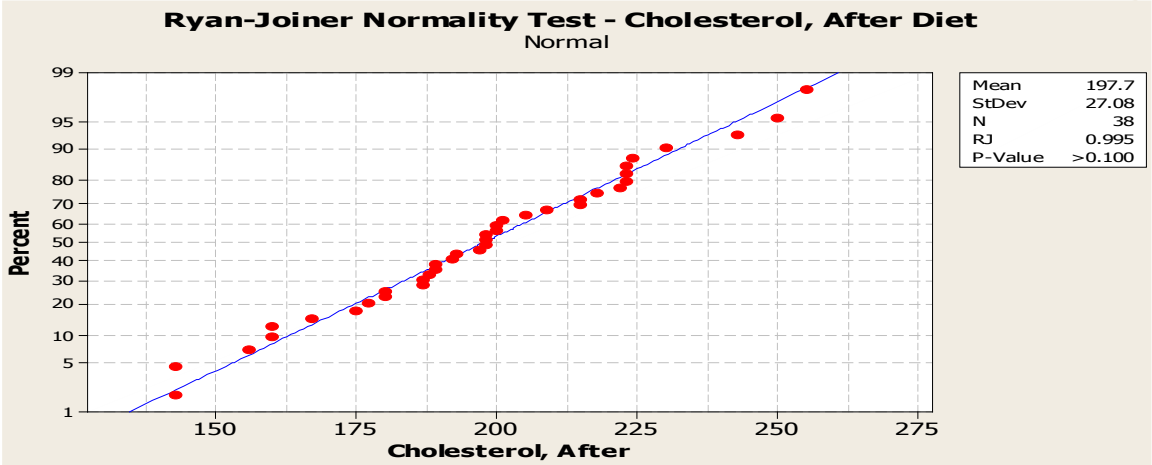

Figure 7: Ryan-Joiner Normality Test-Cholesterol Post-diet.

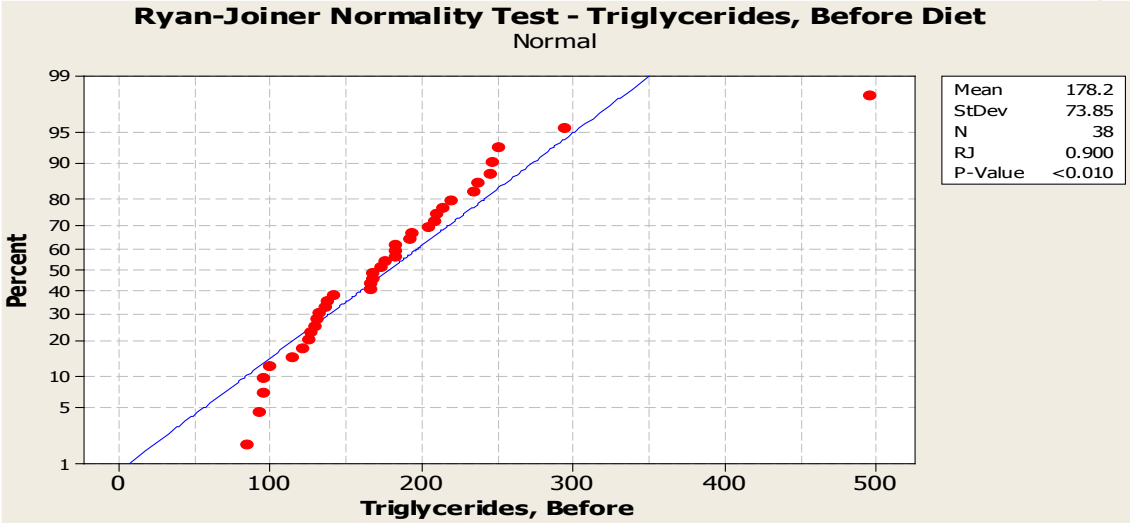

Figure 8: Ryan-Joiner Normality Test-Triglycerides Pre-diet.

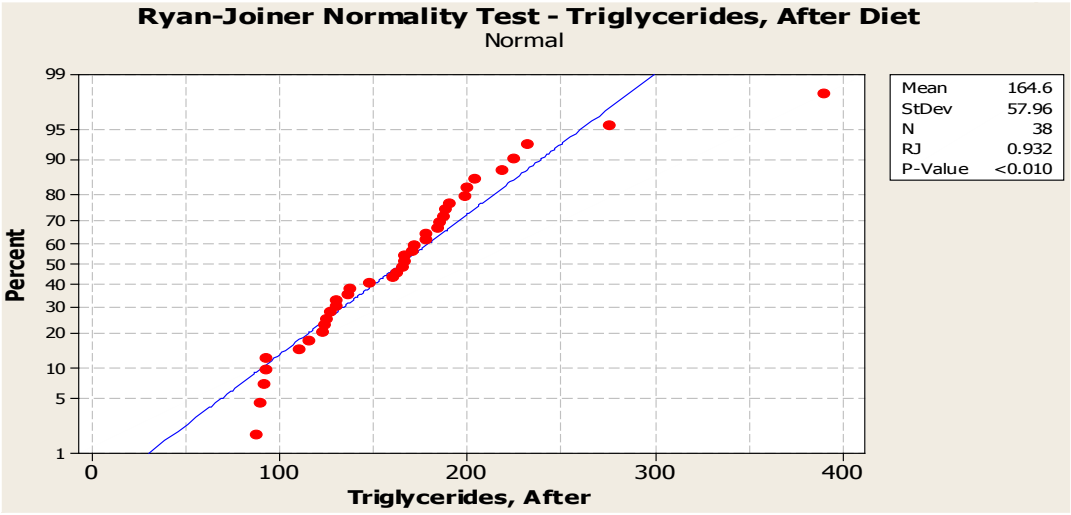

Figure 9: Ryan-Joiner Normality Test-Triglycerides Post-diet.

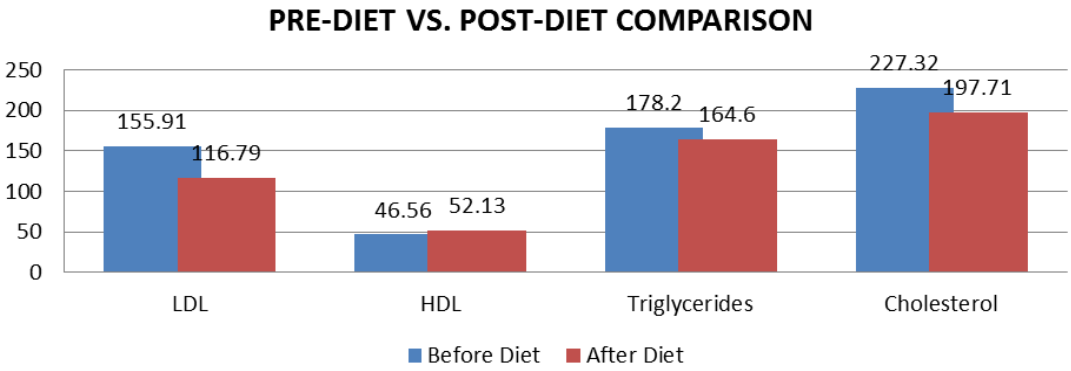

Figure 10: Comparisons of mean lipid profiles before diet and after the modified diet plan.

Parameter	Mean	Standard Deviation	SE Mean	T-Value	P-Value	Confidence Interval	
						Lower	Upper
LDL, Before Diet	155.91	23.84	3.87	12.3	0	30.49	47.76
LDL, After Diet	116.79	27.94	4.53				
Difference	**39.12**	**19.6**	**3.18**				
HDL, Before Diet	46.56	12.04	1.95	-8.57	0	-7.34	-3.81
HDL, After Diet	52.13	11.25	1.82				
Difference	**-5.57**	**4.01**	**0.65**				
Triglycerides, Before Diet	178.2	73.8	12	3.75	0.001	3.76	23.55
Triglycerides, After Diet	164.6	58	9.4				
Difference	**13.66**	**22.46**	**3.64**				
Cholesterol, Before Diet	227.32	24.08	3.91	8.39	0	20.02	39.19
Cholesterol, After Diet	197.71	27.08	4.39				
Difference	**29.61**	**21.76**	**3.53**				

Table 1: Comparison of Mean lipid profile of the subject before and after the dietary treatment.

LDL and cholesterol is 12.30 and 8.39 respectively, and the associated p-value is 0.000. This shows that statistically significant difference exists between the two data. The t value of HDL is -8.57 and the associated p-value is 0.000. The t value of triglycerides is 3.75 and the associated p-value is 0.001also shows a statistical significant difference between the two variables.

Comparison of lipid profile with normal levels

Total cholesterol <200 mg/dL is considered normal; most of the subjects had cholesterol levels between 200 and 250 mg/dL while only a few had above 250 mg/dL. As shown in figure 11, after 2 months, some of the patients had a drastic fall in their cholesterol levels where it fell

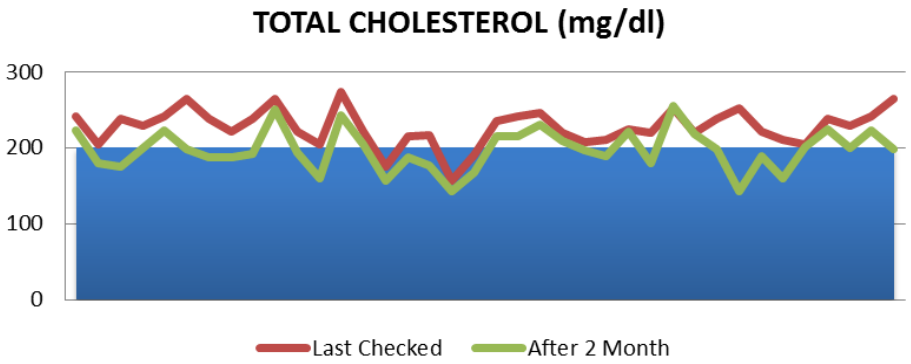

Figure 11: Total cholesterol profile of the subjects before and after diet.

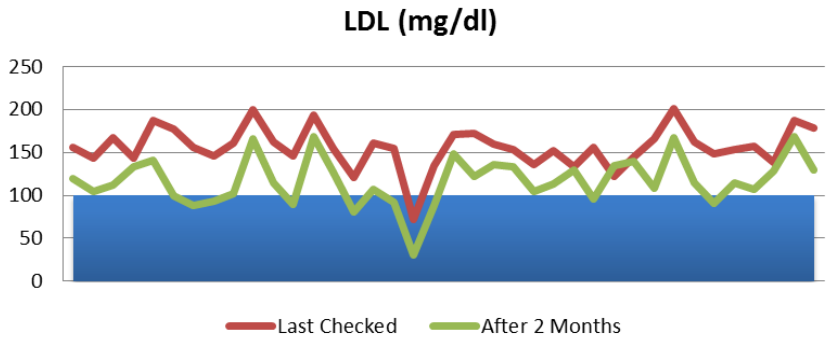

Figure 12: LDL profile of the subjects before and after diet.

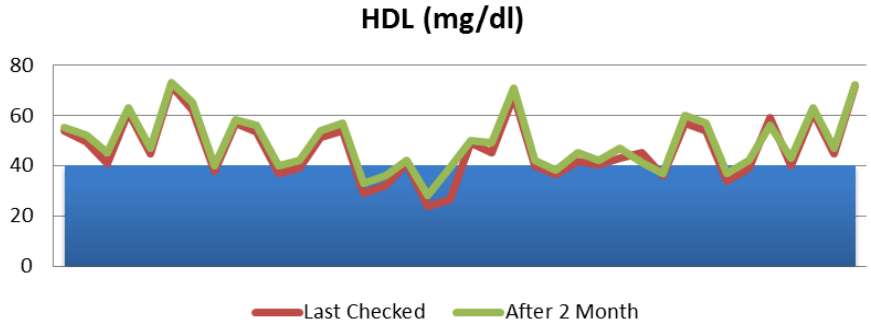

Figure 13: HDL profile of the subjects before and after diet.

within the normal range, however in the others we can see a fall in the cholesterol levels as compared to the earlier levels.

As depicted in figure12, the level of LDL is higher than the safe zone in most of the subjects. After two months following the high fibre and omega-3 rich diet a drop in the LDL levels was found among most of the subjects.

Figure 13 shows the comparisons of HDL contents before and after the dietary treatment. An HDL level of >40mg/dL is considered normal but an HDL level of >55 mg/dL is considered protective for heart. The blue zone signifies the normal levels for HDL. Following the diet for 2 months, we can see a slight raise in the HDL levels in most of the patients.

Figure 14 shows that a diet low in carbohydrates, especially simple carbohydrates and sugars and high fibre and omega-3 fats helps in decreasing the triglycerides levels to a greater extent as opposed to a low fat diet [18].

Conclusions

With the changing lifestyle and dietary habits, dyslipidemia and CVD mortality has been growing at an alarming rate. Hypercholesterolemia is prevalent even in the younger age-group thus it becomes essential to prevent or treat dyslipidemia to avert further health deterioration and other derangements. Fortunately, certain lifestyle changes like diet modifications and physical activity have proved beneficial in initially treating these conditions before moving onto drug therapy.

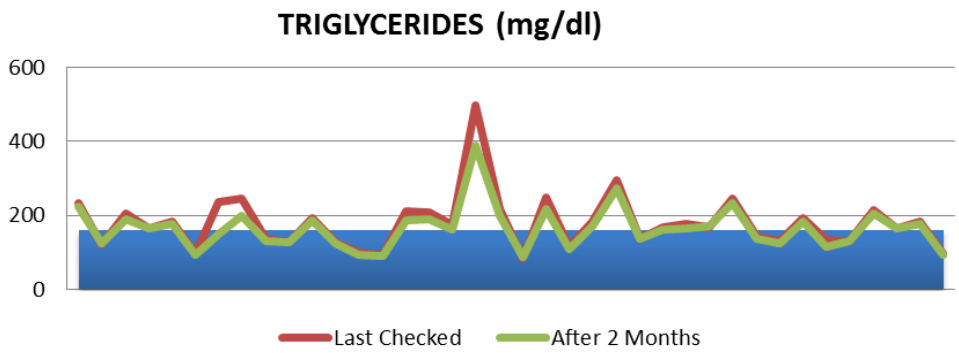

Figure 14: Triglyceride profile of the subjects before and after diet.

In this study, the high fibre and omega-3 rich diet which contained 30-40 g of fibre from sources such as whole grains, whole fruits and vegetables, salads, psyllium, oats, flax seeds, soy etc. and 3-4 g of omega-3 fatty acids from almonds, walnuts and flax seeds proved beneficial in controlling and lowering the total cholesterol and LDL levels significantly in most of the subjects. However the increase in HDL cholesterol was minimal. This all signifies that the high fibre and omega-3 rich diet indeed play a beneficial role in combating deranged lipid profile and improves them simultaneously but diet along with exercise is necessary to increase the HDL levels. Thus, high fibre and omega 3 rich foods can be incorporated in one's daily diet for the prevention or manage most of the prevalent chronic conditions to lead a healthy lifestyle.

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