4

RESULTS AND DISCUSSION

The findings of the present study on **"Hypolipidemic effect of high fiber and omega 3 rich foods"** was carried out with the following objectives of collecting information on demographic profile, dietary and lifestyle pattern; assess nutritional status; effect of dietary intervention on lipid profile and the results obtained are presented and discussed under the following headings:

A. DEMOGRAPHIC PROFILE OF THE SELECTED HYPERLIPIDEMICS

a. Age and sex of the selected hyperlipidemics
b. Educational status
c. Occupational status
d. Activity pattern
e. Type of the family
f. Income status of the selected hyperlipidemics

B. DIETARY PATTERN OF THE SELECTED HYPERLIPIDEMICS

a. Dietary habit and meal pattern of the selected hyperlipidemics
b. Food consumption pattern adapted by the hyperlipidemics
c. Consumption of dairy products and flesh foods by the hyperlipidemics
d. Type and quantity of fats and oils used for cooking

C. LIFESTYLE PATTERN OF THE SELECTED HYPERLIPIDEMICS

a. Alcohol consumption
b. Coffee consumption
c. Smoking pattern
d. Exercise pattern

D. PERSONAL AND FAMILY HISTORY OF THE SELECTED HYPERLIPIDEMICS

a. Duration of the hyperlipidemic condition
b. Personal history

c. Mode of treatment undertaken
d. Signs and symptoms prevalent among the selected hyperlipidemics
e. Familial history

E. ANALYSIS OF THE SELECTED SUPPLEMENTS

F. ANTHROPOMETRIC MEASUREMENTS

a. Mean height of the selected hyperlipidemics
b. Mean weight of the selected hyperlipidemics
c. Body Mass Index of the selected hyperlipidemics
d. Waist to Hip Ratio of the selected hyperlipidemics

G. BIOCHEMICAL PROFILE OF THE SELECTED HYPERLIPIDEMICS

a. Mean lipid profile

H. EFFECT OF SUPPLEMENTS ON THE NUTRITIONAL STATUS OF THE SELECTED HYPERLIPIDEMICS

a. Body weight
b. Body Mass Index
c. Food and nutrient intake of the male hyperlipidemics
d. Food and nutrient intake of the female hyperlipidemics

I. EFFECT OF SUPPLEMENTS ON THE SERUM LIPID PROFILE OF THE SELECTED HYPERLIPIDEMICS

a. Supplementation with Flaxseed, Almond and Walnut (FAW Group)
b. Supplementation with Almond and Walnut (AW Group)
c. Supplementation with Flaxseed and Garlic (FG Group)
d. Supplementation with Flaxseed (FS Group)
e. Comparison of mean difference and 't' values of the lipid profile between intervention groups
f. Correlation analysis.

A. Demographic profile of the selected hyperlipidemics

Background information with regard to age, sex, educational status, occupational status, and type of activity, family system and income status, dietary and eating pattern of the selected hyperlipidemic subjects were consolidated, tabulated and discussed in the following pages.

a. Age and sex of the selected hyperlipidemics

Age is one of the important factors for the development of any chronic disease in both the sexes. The age wise distribution of the selected 1000 male and female subjects is given in Table VIII and depicted in Figure 2 and Figure 3.

TABLE VIII

AGE AND SEX-WISE DISTRIBUTION OF SELECTED HYPERLIPIDEMICS

Age in Years	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
35-45	156	35.4	125	22.4	281	28.1
46-55	128	29.0	163	29.2	291	29.1
56-65	76	17.2	206	36.9	282	28.2
66-75	81	18.4	65	11.6	146	14.6
Total	**441**	**100**	**559**	**100**	**1000**	**100**

From the above table, it was clear that among the one thousand hyperlipidemics of both sexes selected for the present study, 441 were male and 559 were female in the age range between 35-75 years.

Among the 441 male subjects selected, 35.4 per cent were in the age group of 35-45 years, 29 per cent were in the age group of 46-55 years, 17.2 per cent were in the age group of 56-65 years and 18.4 per cent were in the age group of 66-75 years.

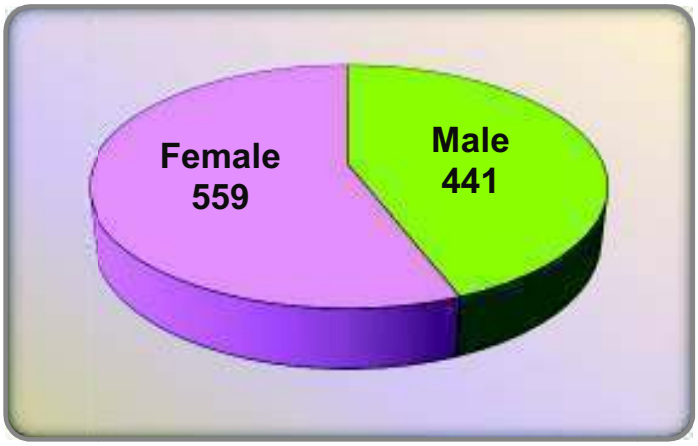
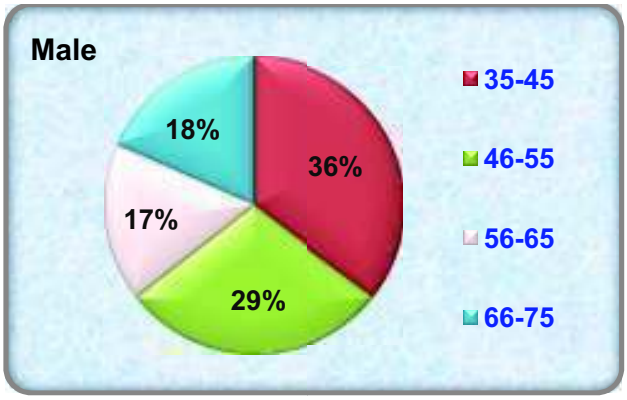


FIGURE 2 - SEX-WISE DISTRIBUTION OF SELECTED HYPERLIPIDEMICS



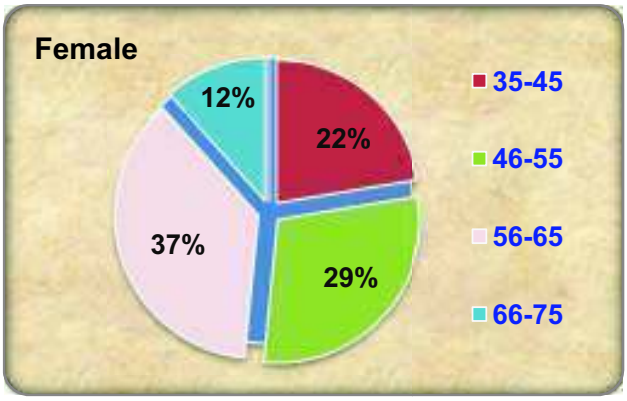


FIGURE 3 - AGE-WISE DISTRIBUTION OF HYPERLIPIDEMICS

The maximum (35.4 per cent) and minimum (17.2 per cent) of male belonged to the age group of 35-45 years and 56-65 years respectively.

Among the 559 female hyperlipidemics selected, 22.4 per cent were in the age group of 35-45 years, 29.2 per cent were in the age group of 46-55 years, 36.9 per cent were in the age group of 56-65 years and 11.6 per cent were in the age group of 66-75 years. The maximum (36.9 per cent) and minimum (11.6 per cent) of the female belonged to the age group of 56-65 years and 66-75 years respectively.

Out of the one thousand hyperlipidemics, the maximum percentage of 29.1 and the minimum percentage of 14.6 hyperlipidemics belonged to the age group of 46-55 years and 66-75 years respectively.

Age is the most powerful independent risk factor for cardiovascular disease; risk of stroke doubles every decade after age 55. According to Berry *et al.,* (2012), men and women aged 55 years with at least two major risk factors were six times and three times respectively as likely to die from cardiovascular diseases by age 80 than men with no or one CVD risk factor (29.6 per cent vs 4.7 per cent). Thus higher burden of risk factors is associated with a higher lifetime risk of death from cardiovascular disease. From the results, it is clear that individuals had risk factors at the age of 50 for men and women had at the age of 60.

According to Huffman (2011), in developed countries, ischemic heart disease is predicted to rise 30-60 per cent between 1990 and 2020 where as in developing countries, rates are likely to increase by 120 and 137 per cent in women and men respectively during the same period. India's economic development, industrialization and urbanization have been accompanied by transitions that contribute to the increase in the overall risk of heart failure. The population of India is ageing due to recent successes against communicable diseases such that the number of people >60 years old will increase from 62 million in 1996 to 113 million in 2016 (NCP, Government of India, 2010).

b. Educational status

The educational status of the selected hyperlipidemics is presented in Table IX and Figure 4.

TABLE IX

EDUCATIONAL STATUS

Educational Status	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Primary School	6	1.4	26	4.6	32.0	3.2
Higher Secondary	136	30.8	177	31.7	31.3	31.3
Graduate	141	32.0	192	34.4	33.3	33.3
Professional Degree	158	35.8	164	29.3	32.2	32.2
Total	**441**	**100**	**559**	**100**	**1000**	**100**

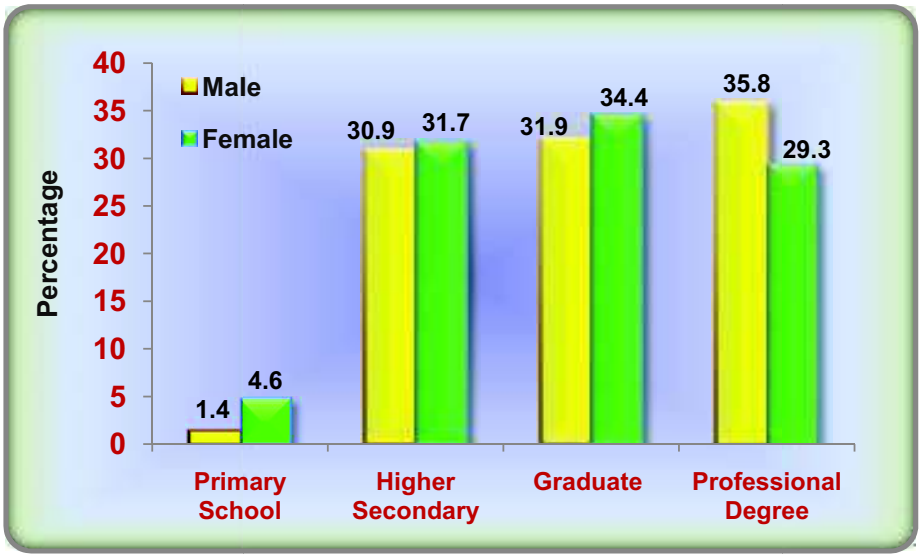


FIGURE 4 -EDUCATIONAL STATUS

From Table IX, it was revealed that among the 441 male hyperlipidemic selected, a lowest of only 1.4 per cent were educated upto primary school level, 30.8 per cent were educated upto higher secondary level, 32 per cent were educated upto graduate grade and a highest of 35.8 per cent were professional degree holders.

Among the 559 female hyperlipidemics, a lowest of only 4.6 per cent were educated upto primary level, 31.7 per cent were educated upto higher secondary level, a highest of 34.4 per cent were educated upto graduate level and 29.3 per cent were educated upto professional grade.

Thus Table IX indicates that it is glad to note that there are no illiterates and a very few per cent of both male (1.4) and female (3.2) were educated upto primary school level. All others were educated upto high school and college level.

c. Occupational status

The occupational status determines the stress level of the individual which is one of the predisposing factors for the accumulation of fat in the blood vessels which leads to the health risk of the selected hyperlipidemics. This occupational status of the selected hyperlipidemics was depicted in Table X and Figure 5.

TABLE X

OCCUPATIONAL STATUS

Occupation	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Professionals	112	25.4	134	24.0	246	24.6
Business	123	27.9	37	6.6	160	16.0
Agriculturist	26	5.9	3	0.5	29	2.9
Government/ Private Job	29	6.6	155	27.7	184	18.4
House wives	Nil	Nil	156	27.9	156	15.6
Retired	151	34.2	74	13.2	225	22.5
Total	**441**	**100**	**559**	**100**	**1000**	**100**

With regard to the male hyperlipidemics selected, only 5.9 per cent of male were found to be agriculturists, 6.6 per cent of male were holding Government/private jobs, 25.4 per cent were professionals, 27.9 per cent were doing business and a maximum of 34.2 per cent of men were retired.

It was evident from Table X that among the selected female hyperlipidemics, a negligible of only 0.5 per cent were agriculturist, 6.6 per cent were doing business, 13.2 per cent were retired, 24 per cent were professionals, 27.7 per cent were holding Government/private jobs and relatively high per cent of 27.9 were housewives.

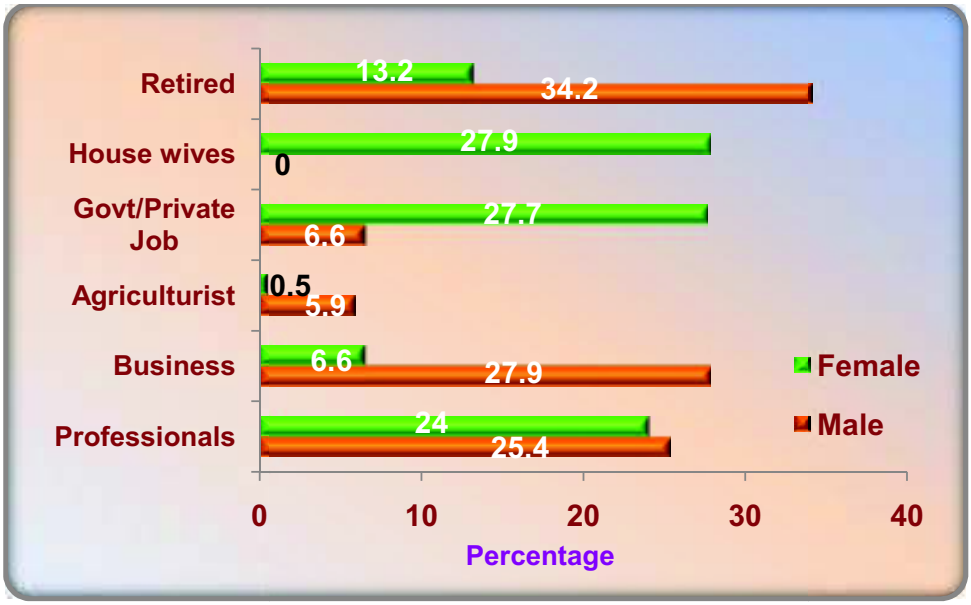


FIGURE 5 - OCCUPATIONAL STATUS

Out of the one thousand hyperlipidemics, a lowest of only 2.9 per cent were agriculturist and a highest of 24.6 per cent were professionals. About 15.6 per cent were housewives, 16 per cent were doing business, 18.4 per cent were holding Government/private jobs and 22.5 per cent were retired. It is evident that the people from rural background (Agriculture) were also prone to the degenerative diseases.

d. Activity pattern

The activity pattern of the individual determines the healthy lifestyle and prolonged lifespan of the hyperlipidemics. One thousand hyperlipidemic subjects were categorized as per their different levels of activities are divided into sedentary, moderate and heavy and shown in Table XI and Figure 6.

TABLE XI

ACTIVITY PATTERN

Type of activity	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Sedentary	296	67.1	322	57.6	618	61.8
Moderate	100	22.7	161	28.8	261	26.1
Heavy	45	10.2	76	13.6	121	12.1
Total	**441**	**100.0**	**559**	**100.0**	**1000**	**100.0**

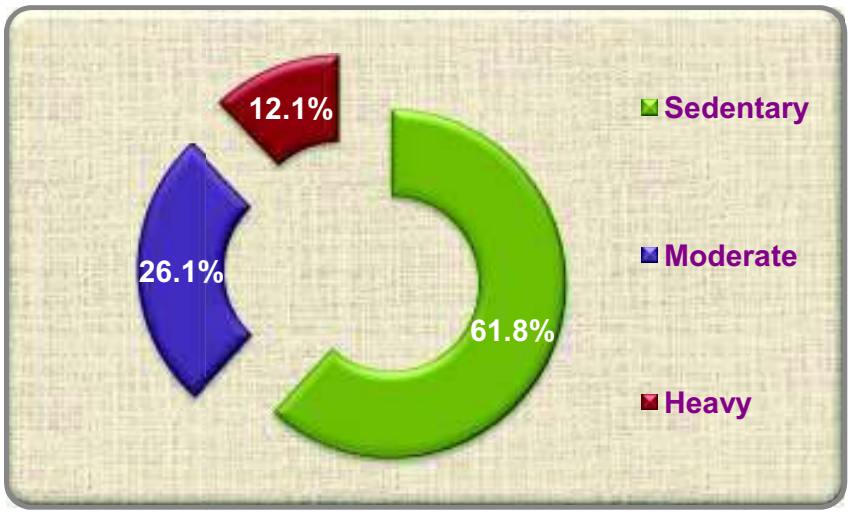


FIGURE 6 - ACTIVITY PATTERN

Sedentary activity includes household works, gardening and no physical activity. Moderate activity includes brisk walking, meditation, yoga, bicycling, playing with children and weight training. Heavy activity includes weight lifting (vigorous effort) and heavy yard work (ICMR, 2010).

Out of the 441 male hyperlipidemics selected, maximum (67.1 per cent) of them were doing sedentary activity, minimum (10.2 per cent) of them were doing heavy activity and 22.7 per cent were of moderate activity group.

Among the 559 female hyperlipidemics selected, a maximum (57.6 per cent) of them were doing sedentary activity, 28.8 per cent were doing moderate activity and a lower percentage of 13.6 were doing heavy activity.

Thus from the Table XI it was seen that majority (61.8 per cent) of the selected hyperlipidemics were doing sedentary activity and a very few per cent of 12.1 were doing heavy activity.

Sedentary activity includes retired personnel (20 per cent), business (12 per cent) and few professional (2.6 per cent) personnel. Moderate activity includes majority of professionals (22 per cent), few business (4 per cent) people and very few retired (2.5 per cent) personnel as they are health conscious and were diagnosed with the disorder. Heavy activity includes industrial workers and agriculturists.

e. Type of family

Table XII and Figure 7 depicts the type of the family of the selected hyperlipidemics.

TABLE XII

TYPE OF FAMILY

Type of Family	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Joint	118	26.8	132	23.6	250	25.0
Nuclear	323	73.2	427	76.4	750	75.0
Total	**441**	**100.0**	**559**	**100.0**	**1000**	**100.0**

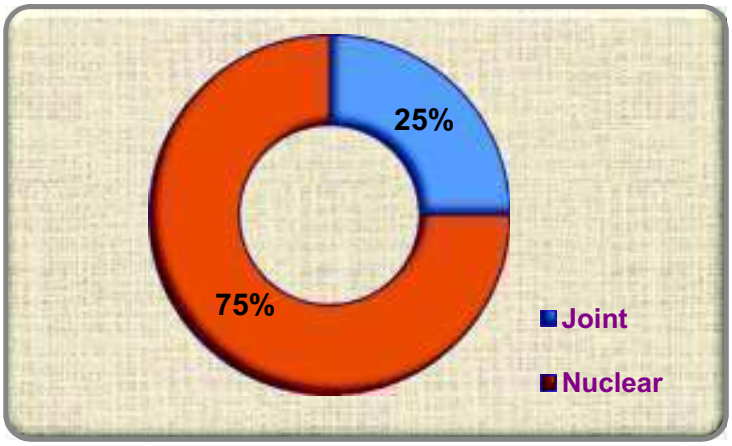


FIGURE 7- TYPE OF FAMILY

Among the one thousand hyperlipidemics selected, three fourth of the hyperlipidemics (75 per cent) belong to the nuclear family where as one fourth (25 per cent) of them belong to the joint family system.

f. Income status of the selected hyperlipidemics

Technical Report of 11th Five Year Plan, 2007-2012, income classification is used to classify the income status of the selected hyperlipidemics and is tabulated in Table XIII and Figure 8.

TABLE XIII

INCOME STATUS

Income level* (₹/Month)	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
3301-7300	37	8.4	55	9.8	92	9.2
7301-14500	141	32.0	231	41.3	372	37.2
14501 & above	263	59.6	273	48.8	536	53.6
Total	**441**	**100.0**	**559**	**100.0**	**1000**	**100.0**

** Technical Report of 11th Five Year Plan (2007-2012)*

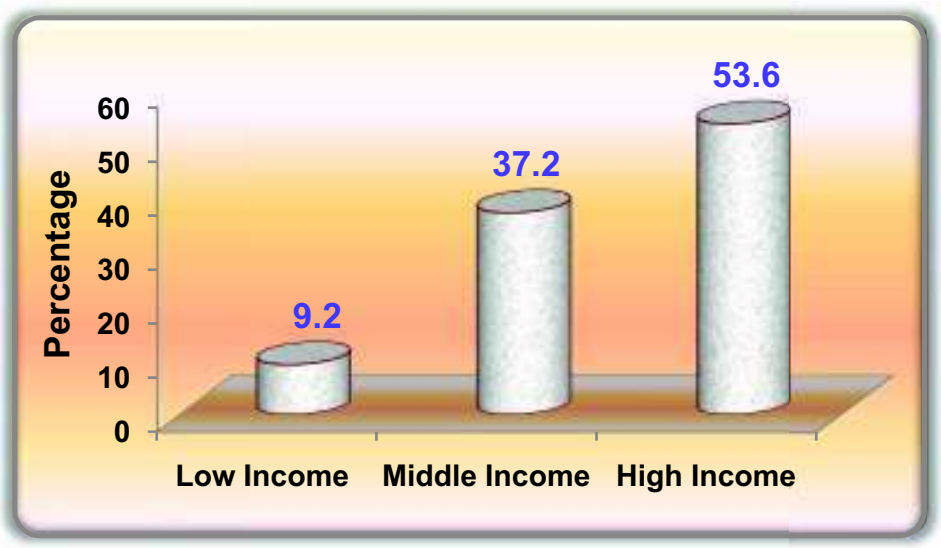


FIGURE 8 - INCOME LEVEL

The income level of the selected subjects were classified into low income (₹3301-7300), middle income (₹7301-14500) and high income (₹14501 & above).

Among the 441 male hyperlipidemics, only a few (8.4 per cent) of them belong to the low income group, 32 per cent belong to the middle income group and maximum of 59.6 per cent of the hyperlipidemics belong to the high income group.

Of the selected 559 female hyperlipidemics, 48.8 per cent belong to the high income group, 41.3 per cent belong to the middle income group and only 9.8 per cent belong to the low income group.

On the whole, almost fifty per cent of the hyperlipidemics belongs to the high income group and few of nine per cent belongs to the low income group.

According to University of Rochester Medical Center (ScienceDaily, 2009), ignoring the risk of lower income and education when making treatment decisions may exacerbate existing health care disparities, which have been increasing over time. Doctors who ignore the socioeconomic status of patients when evaluating their risk for heart disease are missing a crucial element that might result in inadequate treatment.

The socio-economic status of the 1000 hyperlipidemics recorded was revealed that, wide variation was observed in the present study which includes both urban and rural population. The important factors seen among the 1000 hyperlipidemics for the onset of the disorder are age, sex, activity pattern, type of work, type of family and income status. Higher percentage of the selected hyperlipidemics were in the age of 46-55 years with higher level of education and white collar jobs leading sedentary activity with high income levels and belongs to the nuclear family system. Due to these predisposing factors, many of them are vulnerable to the elevated blood cholesterol level may have the chance of getting cardiovascular problems.

These socioeconomic indicators of the present study were also quoted by Panagiotakos *et al.,* (2005), who conclude that social status is related with the

prevalence and incidence of cardiovascular disease. Socio-economic status indicators including education, income and occupation are associated with coronary heart disease risk factors, morbidity and mortality. In most industrialized nations, individuals with less education, lower income and white collar occupations have the highest coronary heart disease rates. According to WHO (2005), prevalence of coronary heart disease in Indian adult surveys has risen 4-fold over the last 40 years (to a present level of around 10 per cent) and even in rural areas the prevalence has doubled over the past 30 years (to a present level of around 4 per cent). Several surveys conducted across the country over the past two decades have shown a rising prevalence of major risk factors for cardiovascular disease in urban and rural populations (Bela and Prashant, 2010).

B. Dietary pattern of the selected hyperlipidemics

Hyperlipidemia cannot be cured but it can be well controlled, provided the person accepts responsibility for doing so. Details regarding the type of diet, daily meal pattern, consumption of food, dairy products and flesh foods, type of fats and oils used in cooking are tabulated and discussed in the following pages.

a. Dietary habit and meal pattern of the selected hyperlipidemics

The dietary habit of the hyperlipidemic subjects is shown in Table XIV and Figure 9.

TABLE XIV

TYPE OF DIET CONSUMED BY THE SUBJECTS

Type of diet	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Non Vegetarian	265	60.1	221	39.5	486	48.6
Vegetarian	119	27.0	256	45.8	375	37.5
Ova Vegetarian	57	12.9	82	14.7	139	13.9
Total	**441**	**100.0**	**559**	**100.0**	**1000**	**100.0**

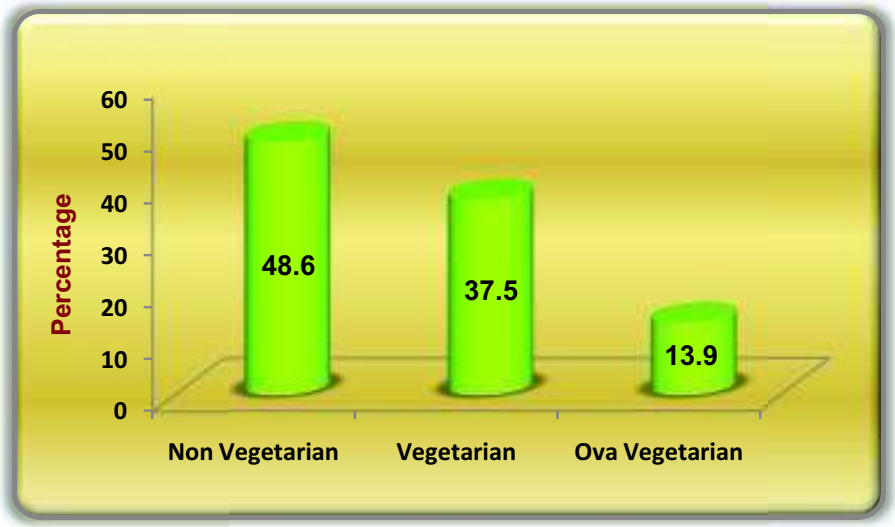


FIGURE 9 - DIETARY PATTERN

Among the hyperlipidemics selected, most of male hyperlipidemics (60.1 per cent) are non-vegetarians, 27 per cent are vegetarians and 12.9 per cent are ova-vegetarians. Among the female hyperlipidemics, 39.5 per cent are non-vegetarians, 45.8 per cent are vegetarians and 14.7 per cent are ova-vegetarians. Among the one thousand hyperlipidemics, 48.6 per cent are non-vegetarians, 37.5 are vegetarians and only 13.9 per cent are ova-vegetarians.

Meal pattern of the hyperlipidemic subjects selected is given in Table XV.

TABLE XV

MEAL PATTERN FOLLOWED BY THE SUBJECTS

Meal Pattern	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
3 meals with healthy snacks	139	31.5	71	12.7	210	21.0
3 meals	209	47.4	311	55.6	520	52.0
< 3 meals	32	7.3	123	22.0	155	15.5
Irregular eating pattern	61	13.8	54	9.7	115	11.5
Total	**441**	**100.0**	**559**	**100.0**	**1000**	**100.0**

From the above Table XV, it was clear that among the male hyperlipidemics maximum per cent (47.4) consuming three meals per day, 31.5 per cent eating three meals with healthy snacks, 13.8 per cent have irregular eating pattern and only seven per cent ate less than three meals per day. In the case of the female hyperlipidemic subjects, a minimum per cent of 9.7 ate irregular meals, 12.7 per cent taking three meals with healthy snacks, 22 per cent consuming less than three meals and a high percentage of 55.6 are having three meals per day.

The meal pattern as presented in Table XV, reveals that majority (52 per cent) of the hyperlipidemic subjects are having three meals per day regularly. The hyperlipidemic subjects having less than three meals a day are either skipping breakfast or lunch. Irregular eating pattern in hyperlipidemic individuals was mainly due to their work load and tension at work place. The results of the selected 1000 hyperlipidemics revealed that the increase in the risk of the disease was because of their eating pattern which was nutritionally not balanced.

b. Food consumption pattern adapted by the hyperlipidemics

The food consumption pattern of the selected hyperlipidemics is presented in Table XVI.

From the Table XVI, it indicates the food consumption pattern of the hyperlipidemic subjects like consumption of grains; vegetables, fruits, water and snacks are tabulated.

Of the one thousand hyperlipidemic subjects, 73.6 per cent were found to eat 6-8 servings and 26.4 per cent were found to eat 4-6 servings of grains. The grains include rice, wheat and millets. The daily servings of pulses were 67 per cent who are consuming more than four servings and 33 per cent were consuming 4-6 servings per day. The pulses used are red gram, black gram and green gram dhals in major proportions than others.

Among the 1000 hyperlipidemics, the consumption of vegetables who eat less than three servings were 14.9 per cent, a high per cent of 49.9 were found to eat 3-5 servings and 35.2 per cent were found to eat more than 5 servings of

vegetables. The individuals eat all types of leafy vegetables and other vegetables, include in their daily diet.

TABLE XVI

FOOD CONSUMPTION PATTERN OF THE SUBJECTS

Foods	No. of servings* / Day	Male		Female		Total	
		N	%	N	%	N	%
Grains	4-6 servings	119	27.0	145	25.9	264	26.4
	6-8 servings	322	73.0	414	74.1	736	73.6
Pulses	< 4 servings	296	67.1	374	66.9	670	67.0
	4-6 servings	145	32.9	185	33.1	330	33.0
Vegetables	< 3 servings	77	17.5	72	12.9	149	14.9
	3-5 servings	121	27.4	378	67.6	499	49.9
	> 5 servings	243	55.1	109	19.5	352	35.2
Fruits	< 2 servings	158	35.8	253	45.3	411	41.1
	2-4 servings	234	53.1	207	37.0	441	44.1
	> 4 servings	49	11.1	99	17.7	148	14.8
Water	2-4 glasses	225	51.0	89	15.9	314	31.4
	4-8 glasses	175	39.7	412	73.7	587	58.7
	> 8 glasses	41	9.3	58	10.4	99	9.9
Snacks	1 servings	121	27.4	245	43.8	366	36.6
	2 servings	264	59.9	167	29.9	431	43.1
	> 2 servings	56	12.7	147	26.3	203	20.3

*Note:1 serving =1 sl. Bread, 1/3 cup oat meal, rice or grain products,1cup of raw or 1/2 cup of cooked vegetables, 1 piece of fruit, 1 cup of milk.

Consumption of fruits was limited by some of the individuals due to their health conditions like diabetes and obesity. 41.1 per cent were found to have less than two servings per day, 44.1 per cent were found to have 2-4 servings and only 14.8 per cent were found to have more than four servings of fruits daily

Only 9.9 per cent of the hyperlipidemics had more than eight glasses of water, maximum per cent of 58.7 has 4-8 glasses and 31.4 per cent consumed only 2-4 glasses of water regularly.

Consumption of snacks by the hyperlipidemic subjects is biscuits, sprouts and salad. Maximum per cent of 43.1 were having two servings, 36.6 per cent have one serving and a minimum per cent of 20.3 were having more than two servings. All the hyperlipidemic subjects are having almost South Indian breakfast items like idli, dosa, pongal, upma and lunch and are having chapatis at their dinner time.

Table XVI inferred that the grain and snack consumption was more when compared to the other foods.

c. Consumption of dairy products and flesh foods by the hyperlipidemics

The consumption of dairy products of the selected hyperlipidemics is given in Table XVII.

It was clearly evident from the Table XVII that, among the male hyperlipidemics, 18.8 and 18.6 per cent are consuming <100ml of low and medium fat milk respectively, 20.9 per cent had low fat and 24.5 per cent had about 100 ml of medium fat milk. Only a very few (5.7) per cent had medium fat milk of >100 ml and 11.6 per cent has low fat milk of >100 ml per day.

From the survey it was revealed that among the female hyperlipidemics, none of them are consuming <100 ml of milk. Majority of the female hyperlipidemic individuals had 100 ml of both low fat (52.4 per cent) and medium fat (34.5 per cent) of milk respectively. Only 7.3 per cent had low fat milk of >100 ml and 22.2 per cent had medium fat milk.

None of the male hyperlipidemic individuals consumed >100 g of curd. 100 g of curd is consumed by 22 and 26.8 per cent of low and medium fat curd daily. Only 12.7 and 6.6 per cent of the hyperlipidemics had <100 g curd of low and medium fat respectively.

TABLE XVII

CONSUMPTION OF DIARY PRODUCTS

Dairy products		Quantity consumed/ day*											
		Male						Female					
		<100 g/ml		100 g/ml		>100 g/ml		<100 g/ml		100 g/ml		>100 g/ml	
		N	%	N	%	N	%	N	%	N	%	N	%
Milk	Low fat	83	18.8	92	20.9	51	11.6	Nil	Nil	231	52.4	32	7.3
	Medium fat	82	18.6	108	24.5	25	5.7	Nil	Nil	152	34.5	98	22.2
Curd	Low fat	56	12.7	97	22.0	Nil	Nil	116	26.3	82	18.6	21	4.8
	Medium fat	29	6.6	118	26.8	Nil	Nil	43	9.8	107	24.3	30	6.8
Buttermilk	Low fat	30	6.8	69	15.6	25	5.7	16	3.6	77	17.5	215	48.8
	Medium fat	44	10.0	35	7.9	134	30.4	29	6.6	81	18.4	66	15.0
Paneer	High fat	Nil	Nil	101	22.9	Nil	Nil	Nil	Nil	85	15.2	Nil	Nil

**Skimmed milk-low /zero fat*

Among the female hyperlipidemics, the consumption of low and medium fat curd was found to be 26.3 and 9.8 per cent respectively; who ate <100 g. 18.6 and 24.3 per cent ate 100 g of low and medium fat curd daily. Very less per cent of 4.8 and 6.8 ate >100 g of low and medium fat curd respectively per day.

Buttermilk prepared from low and medium fat milk of <100 ml was consumed by only 6.8 and 10 per cent of male hyperlipidemics respectively. 100 ml of low and medium fat buttermilk were consumed by 15.7 and 7.9 per cent regularly. Maximum per cent of 30.4 consumed >100 ml of buttermilk prepared from medium fat milk daily and only 5.7 per cent had low fat buttermilk.

In female hyperlipidemics, very less of 3.6 and 6.6 per cent of them had <100 ml of low and medium fat buttermilk daily, 17.5 per cent had low fat buttermilk and 18.4 per cent consumed medium fat buttermilk of 100 ml per day. Maximum per cent of 48.8 of them had low fat buttermilk and 15 per cent had medium fat buttermilk of <100 ml per day.

Only 22.9 and 15.2 per cent of male and female hyperlipidemic subjects were consuming paneer of 100 g.

Thus from the Table XVII, it was clear that the consumption of dairy products by the one thousand selected hyperlipidemics are milk, curd, buttermilk, paneer and cheese. Majority of the hyperlipidemics had low fat milk, curd and buttermilk (prepared from low fat milk). Very few subjects had paneer which is a high fat food. These subjects had paneer occasionally when they have family get-together, business meetings or during functions.

A meta-analysis of 17 prospective cohort studies that included over 600,000 participants was conducted by Soedamah *et al.,* (2011) to assess the associations between milk product consumption and cardiovascular disease, particularly ischemic heart disease and stroke. For each 200 ml serving of milk consumed, a decrease of 6 per cent in the risk of cardiovascular disease was observed. Moreover, the consumption of total milk products, low-fat milk products or high-fat milk products was not associated with risks of coronary heart disease and total milk

product intake was not associated with the risk of infarction. The popular belief that dairy products are detrimental to health is mainly because of their content in saturated fat. However, although saturated fat intake is generally related to an increase in blood LDL cholesterol concentrations and milk product consumption may be associated with an increase in saturated fat intakes, milk products may not necessarily be related to an increase in the risk of cardiovascular disease but rather possibly with a decrease (German *et al.,* 2009 and Marcia *et al.,* 2012). Many components of milk products are thought to play a role in the prevention of cardiovascular disease, which makes the hypothetically harmful effects of the saturated fat that they contain less significant.

The milk product components that most likely to play a role in the prevention of cardiovascular disease are calcium, potassium, phosphorus, vitamin-D, vitamin-K_2, various fatty acids and proteins, including certain peptides (Rice *et al.,* 2011).

The consumption of flesh foods by the selected hyperlipidemics is presented in Table XVIII.

TABLE XVIII

CONSUMPTION PATTERN OF FLESH FOODS

Frequency	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Daily	4	1.5	Nil	Nil	4	0.8
Twice a week	121	45.7	34	15.4	155	31.9
Once a week	92	34.7	159	71.9	251	51.6
Occasionally	48	18.1	28	12.7	76	15.6
Total	**265**	**100.0**	**221**	**100.0**	**486**	**100.0**

From the data collected, of 1000 hyperlipidemics, it was evident that most of the selected hyperlipidemics are from urban population, majority of them are non-vegetarians. The non-vegetarian items like chicken, fish and occasionally mutton either daily or twice a week or once a week was taken by the hyperlipidemic

individuals. The subjects who are consuming mutton daily are not ready to modify their eating habits. Even the chicken lovers are also unable to change their eating pattern and their preferences. The subjects are neither ready to change their lifestyle nor their eating habits. “Habits die hard” – this was truly accepted by the hyperlipidemics.

Table XVIII showed that most (45.7 per cent) of the male hyperlipidemics subjects were taking chicken and fish twice a week, 34.7 per cent were taking once a week, 18.1 per cent were taking occasionally and only 1.5 per cent were taking daily.

Among the female hyperlipidemic subjects, most (71.9 per cent) of them were eating fish than chicken once a week, 15.4 per cent were eating twice a week, 12.7 per cent were eating occasionally and none of the female hyperlipidemics had daily.

d. Type and quantity of fats and oils used for cooking

The types of fats and oils used for cooking by the selected hyperlipidemics are presented in Table XIX.

TABLE XIX

TYPE AND QUANTITY OF FATS AND OILS USED FOR COOKING

Type of fats and oils	Male				Female			
	<25ml		25ml		<25ml		25ml	
	N	%	N	%	N	%	N	%
Sunflower oil	258	58.5	134	30.4	251	44.9	221	39.5
Groundnut oil	120	27.2	56	12.7	101	18.1	56	10.0
Olive oil	121	27.4	32	7.3	95	17.0	78	14.0
Rice bran oil	152	34.5	235	53.3	105	18.8	125	22.4
Coconut oil	21	4.8	11	2.5	34	6.1	Nil	Nil
Ghee	11	2.5	Nil	Nil	5	0.9	Nil	Nil

**Multiple responses*

There is a multiple response from the subjects about the usage of the types of fats and oils in their daily cooking. Majority of the subjects are using sunflower oil and keep changing the oils every month. The other oils used by the subjects in the order of preference are rice bran oil, olive oil, groundnut oil and coconut oil. Ghee is used by the subjects occasionally during lunch and sometimes in breakfast.

From the above table, it was recorded that majority of the male hyperlipidemics (58.5 per cent) were found to use sunflower oil <25 ml per day, 34.5 per cent were found to use rice bran oil, 27.4 per cent were found to use olive oil, 27.2 per cent were found to use groundnut oil and few per cent of 4.8 were found to use coconut oil. A very few per cent of 2.5 were found to use ghee in their daily diet.

The hyperlipidemic male subjects who used 25 ml of oil per day, where majority of 53.3 per cent were found to use rice bran oil, 30.4 per cent were found to use sunflower oil, 12.7 per cent were found to use groundnut oil, 7.3 per cent were found to use olive oil and a minimum per cent of 2.5 were found to use coconut oil.

Among the female hyperlipidemic individuals who use <25 ml of oil in daily cooking where 44.9 per cent were found to use sunflower oil, 18.8 per cent were found to use rice bran oil, 18.1 per cent were found to use groundnut oil, 17 per cent were found to use olive oil and few per cent of 6.1 were found to use coconut oil. A very few per cent of 0.9 were found to use ghee in their daily consumption.

Among the hyperlipidemic female individuals who use 25 ml of oil per day where 93.5 per cent were found to use sunflower oil, 22.4 per cent were found to use rice bran oil, 14 per cent were found to use olive oil and 10 per cent were found to use groundnut oil.

As we see people with different walks of life, the dietary habits also varied from individual to individual and from one region to another. Most of them are non-vegetarians which are rich sources of dietary fat and are having three meals per day and are using mainly sunflower oil for cooking. Sufficient amount is being taken by them which are inappropriate nutritionally.

Woo *et al*., (2008) expressed that excess intake of dietary fat is one of the most important factors contributed to the development of obesity and hyperlipidemia in human. Similarly in the present study also the intake of fat was high among the selected one thousand hyperlipidemic subjects.

C. Lifestyle pattern of the selected hyperlipidemics

The lifestyle pattern is mainly affected by the epidemiological transition with increased globalization. As most of the population was busy in their day-to-day activities they are much prone to easily accessible foods like ready to eat and fast foods etc., which is mainly affecting the lifestyle of a particular individual.

a. Alcohol consumption

The alcohol consumption is a major risk factor for the development of the disease and was observed among the male hyperlipidemic subjects. It was depicted in the Table XX and Figure 10.

TABLE XX

ALCOHOL CONSUMPTION PATTERN BY THE MALE SUBJECTS

Frequency	Quantity consumed					
	100ml		150ml		200ml	
	Number	Per cent	Number	Per cent	Number	Per cent
Daily	40	9.0	Nil	Nil	Nil	Nil
Twice a week	54	12.2	Nil	Nil	67	15.2
Once a week	Nil	Nil	Nil	Nil	29	6.6
Occasionally	77	17.5	36	8.2	Nil	Nil
Total	**171**	**38.7**	**36**	**8.2**	**96**	**21.8**
Never	**138 (31.3 per cent)**					

It is very heart-warming to note that none of the female subjects are consuming alcohol. Though the male subjects had onset of the disorder with elevated levels of cholesterol they could not give up the habit of drinking. A very few subjects of 40 stopped the habit of drinking after the onset of this disorder.

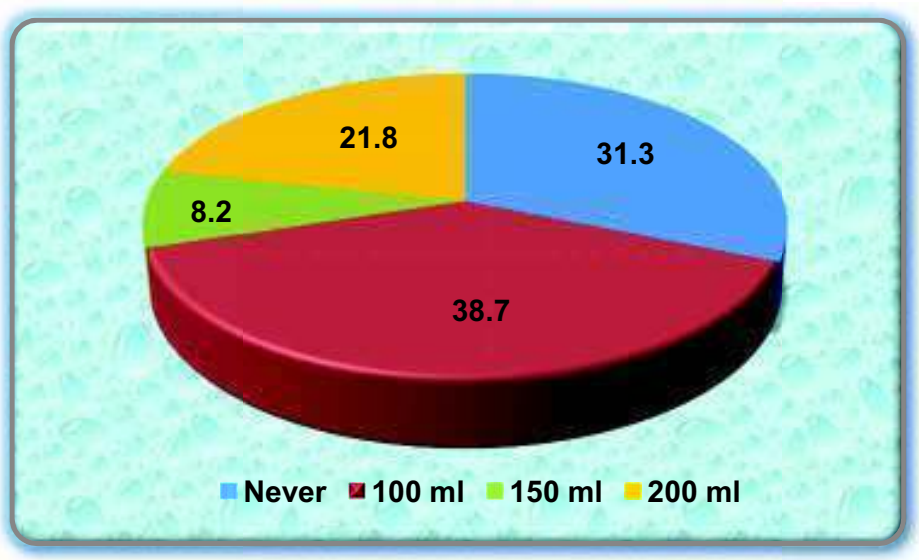


FIGURE 10-FREQUENCY OF ALCOHOL CONSUMPTION

From the data consolidated, it was recorded that among the 441 selected male hyperlipidemic subjects, 31.3 per cent hyperlipidemic individuals are not using any type of alcoholic beverages and the remaining 68.7 per cent hyperlipidemics were consuming it.

With regard to the duration of the alcohol consumption, 72 per cent were consuming for the past 5 to 10 years, 20 per cent were consuming for the past 5 years and only 8 per cent were consuming for more than 10 years.

With respect to the frequency of consumption, 17.5 per cent were found to be taking occasionally, 12.2 per cent were found to be taking twice a week and only 9 per cent were taking on daily basis of 100ml. Thirty six (8.2 per cent) hyperlipidemic subjects were found to be consuming 150 ml occasionally. Among the 15.2 per cent hyperlipidemic individuals who consume 200ml of alcohol, were found to be consuming twice a week and only 6.6 per cent were found to be consuming once a week.

b. Coffee consumption

Coffee consumption pattern of the hyperlipidemic subjects is presented in Table XXI.

TABLE XXI

CONSUMPTION OF COFFEE BY HYPERLIPIDEMIC SUBJECTS

No. of servings / day	Quantity consumed							
	Male				Female			
	100ml		150ml		100ml		150ml	
	N	%	N	%	N	%	N	%
1-3 servings	95	21.5	153	34.7	224	40.1	67	12.0
3-5 servings	41	9.3	Nil	Nil	27	4.8	Nil	Nil
Occasionally	49	11.1	28	6.3	49	8.8	26	8.2
Total	**185**	**42.0**	**181**	**41.0**	**300**	**53.7**	**113**	**20.2**
Never	75 (17 per cent)				146 (26.1 per cent)			

Among the 441 male hyperlipidemic subjects, 21.5 per cent were found to be consuming 1-3 servings, 9.3 per cent were found to be consuming 3-5 servings and 11.1 per cent were found to be consuming occasionally of 100 ml of coffee daily. Majority of 34.7 per cent were found to be consuming 1-3 servings daily and only 6.3 per cent were consuming occasionally of 150 ml of coffee and almost 17 per cent were not consuming coffee.

Table XXI, showed that 40.1 per cent of the female hyperlipidemics were found to be consuming 1-3 servings, 4.8 per cent were found to be consuming 3-5 servings of 100 ml of coffee daily and around nine per cent were consuming occasionally. Among the female subjects who are consuming 150 ml of coffee, 12 per cent were found to be consuming 1-3 servings daily and eight per cent were consuming occasionally.

Coffee is a complex mixture of compounds that may have either beneficial or harmful effects on the cardiovascular system. Randomized controlled trials conducted by Cornelis and El-Sohemy (2007), opines that the cholesterol-raising effect of diterpenes present in boiled coffee may contribute to the risk of coronary heart disease associated with unfiltered coffee consumption.

A 2010 study examined the effects of coffee, as well as green, black and oolong teas, on cardiovascular disease mortality in Japanese men and women.

The researchers found a reduced risk of mortality from cardiovascular disease among coffee, green tea and oolong tea drinkers; however, black tea did not show any association (Mineharu *et al.,* 2011).

c. Smoking pattern

Smoking pattern by the selected male subjects is represented in Table XXII and Figure 11.

TABLE XXII

SMOKING PATTERN BY MALE SUBJECTS

Items	Number smoked / day					
	3-5		>5		Occasionally	
	Number	Per cent	Number	Per cent	Number	Per cent
Cigarette	135	30.6	51	11.6	36	8.1
Piper	17	3.9	Nil	Nil	Nil	Nil
Total	**152**	**34.5**	**51**	**11.6**	**36**	**8.1**
Never	**202** (45.8 per cent)					

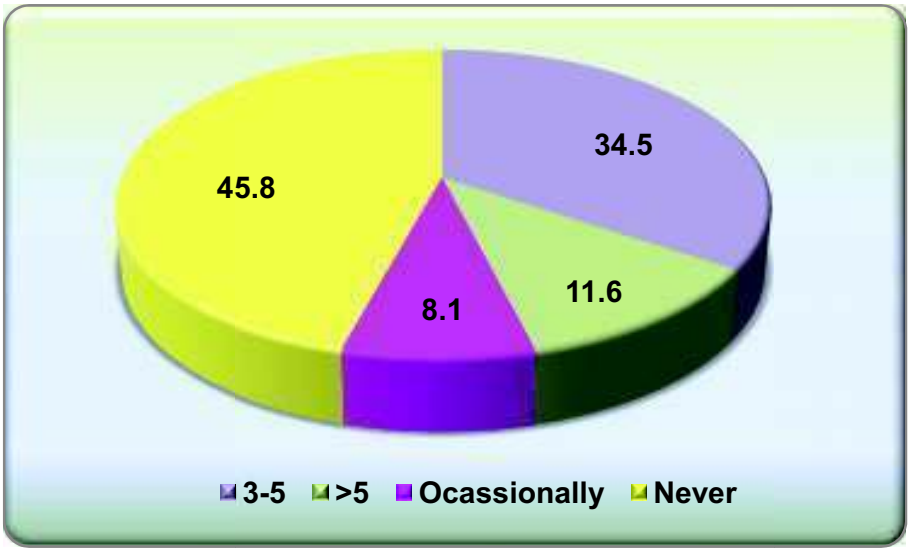


FIGURE 11- SMOKING PATTERN

It was revealed from the table, that among the male hyperlipidemic subjects, 239 hyperlipidemics (54.2 per cent) were found to be having the habit of smoking either of the items like cigarette, beedi and piper and 202 (45.8 per cent) hyperlipidemics does not smoke.

Among the smoking items, cigarette smoking was found to be more common among the selected male hyperlipidemic subjects. Most of the male hyperlipidemic individuals (30.6 per cent) smoked cigarette of 3-5 numbers per day, 11.6 per cent were smoked more than 5 cigarettes per day, 8.1 per cent were smoking cigarettes occasionally and only 3.9 per cent were found to be smoking piper.

With regard to the smoking habit of some of the male hyperlipidemics are not used to regular smoking but they intend to smoke to maintain relationship and social status.

In the present study the male hyperlipidemics reported that due to smoking habit there was tremendous increase in the development of risk factors for cardiovascular problems.

Cigarette smoking is thought to be major risk factor and an important cause of morbidity and mortality in developed and developing countries. In a cross-sectional study by Yathish *et al.,* (2011), showed that the occurrence of coronary artery disease was higher in the smokers (61 per cent), with a relative risk of 1.71 (95 per cent confidence interval 1.4, 2.0) as compared to the non-smokers (36 per cent), which was significant. They also concluded that, smoking not only accelerates the early onset of coronary artery disease but also increases the risk of the development of coronary artery disease by more than 80 per cent. In another case-controlled study carried out by Ram and Trivedi (2012), opines that smokers and smokeless tobacco users were significantly higher among the cases as compared to controls. Significant association was also observed between current smokers, smokeless tobacco users and coronary artery disease. Strong associations were also observed between frequency and duration of smoking with coronary artery disease.

d. Exercise pattern

Exercise makes an individual lead a healthy life as well as increases the lifespan tremendously. Exercise plays an important role in an every individual's life. It also plays a major role in many of the degenerative diseases like cardiovascular disease, diabetes, obesity and hypertension. It also helps to reduce high blood pressure, increased blood cholesterol levels as well as increased blood glucose levels (Dietary Guidelines, ICMR, 2010).

The exercise pattern of the selected hyperlipidemic subjects is given in Table XXIII and Figure 12.

TABLE XXIII

EXERCISE PATTERN OF THE SUBJECTS

Activity	Duration					
	30min		45min		60min	
	Number	Per cent	Number	Per cent	Number	Per cent
No Exercise	42 (4.2 per cent)					
Mild (62.2 per cent)						
Normal walking	239	23.9	121	12.1	Nil	Nil
Household work	11	1.1	16	1.6	204	20.4
Gardening	12	1.2	19	1.9	Nil	Nil
Moderate (33.6 per cent)						
Brisk walking	101	10.1	7	0.7	Nil	Nil
Jogging	15	1.5	9	0.9	Nil	Nil
Cycling	4	0.4	0	0	Nil	Nil
Yoga	100	10	100	10	Nil	Nil

Mild exercise involves normal walking (avoid vehicles for short distances, leisure walking), household work (manual housekeeping activities like dusting, washing, cleaning, arranging things) and gardening (watering plants).

Moderate exercise involves brisk walking (about 3½ miles per hour) which includes climbing, gardening/yard work, dancing, walking short distances for fetching milk and vegetables, jogging (2 ½ miles per hour), bicycling (less than

10 miles per hour) and yoga includes yogasanas and pranayama (Dietary Guidelines, ICMR, 2010).

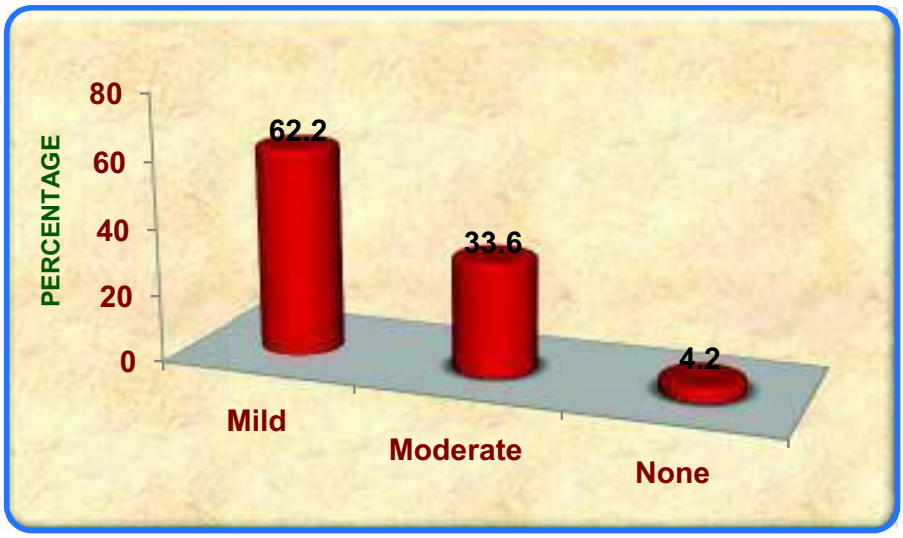


FIGURE 12 - EXERCISE PATTERN

From Table XXIII, it was observed that among the one thousand hyperlipidemics, 23.9 per cent were found to be walking regularly, 1.1 per cent were engaged in household work and 1.2 per cent were engaged in gardening for 30 min of mild activity. Some hyperlipidemic individuals were doing exercise regularly for 45 min., among them 12.1 per cent were engaged in walking, 1.6 per cent was engaged in household work and 1.9 per cent was engaged in gardening. Most of the hyperlipidemic subjects (20.4) were engaged in household work regularly for 60 minutes.

In moderate activity group, 10.1 per cent were engaged in brisk walking, 1.5 per cent are engaged in jogging, 0.4 per cent are engaged in cycling and 10 per cent are practicing in yoga for 30 minutes regularly. With regard to the hyperlipidemic individuals, 0.7 per cent are engaged in brisk walking, 0.9 per cent are engaged in jogging and 10 per cent are engaged in yoga for 45 min daily.

Of the one thousand hyperlipidemics, 4.2 per cent were not engaged in any type of exercise pattern due to old age and other health problems mainly arthritis and breathlessness.

Liu *et al.,* (2012) opined that maintaining a healthy lifestyle from young adulthood into 40s is strongly associated with low cardiovascular disease risk in middle age according to new North-western Medicine Study. By middle age, many individuals have often already accumulated significant risk, yet the potential for ongoing accumulation exists. This is demonstrated by the effectiveness of rigorous prevention and reduction of risk factors during middle age, including continued management of blood pressure, blood lipids and diabetes; promotion of exercise and healthful eating and quitting smoking (Goldman *et al.,* 2009). Aside from preventing the onset of disease and premature death, another key goal of risk factor reduction efforts, especially in middle age, is to prevent premature morbidity and disability.

In the present study, the lifestyle pattern of the individuals was mostly seen in the male subjects who are almost having either alcohol or smoking habit or both. Though the exercise was common among the individuals, “Habits die hard” was true and proved to be significant for the onset of the disorder. With this lifestyle pattern, they are more prone for the cardiovascular diseases.

D. Personal and family history of the selected hyperlipidemics

a. Duration of hyperlipidemic condition

Table XXIV depicts the duration of the hyperlipidemic condition of the selected subjects.

TABLE XXIV

DURATION OF THE DISORDER

Duration	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
< 6 months	59	13.4	114	20.4	173	17.3
6 months- 1year	101	22.9	96	17.2	197	19.7
1- 5 years	189	42.9	157	28.1	346	34.6
5 -10 years	63	14.3	150	26.8	213	21.3
> 10 years	29	6.6	42	7.5	71	7.1
Total	**441**	**100**	**559**	**100**	**1000**	**100**

From the table, it is clearly seen that among the 441 male hyperlipidemic subjects, 13.4 per cent were found to have the disorder for the past 6 months, 22.9 per cent were found to have from six months to one year, 42.9 per cent were found to have this problem for the past five years, 14.3 per cent were found to have for the past 10 years and a few (6.6) per cent were found to have more than 10 years.

Of the 559 female hyperlipidemic subjects, 20.4 per cent were found to have the disorder for the past 6 months, 17.2 per cent were found to have from 6 months-1 year, 28.1 per cent were found to have elevated level of cholesterol from 1-5 years, 26.8 per cent were found to have from 5-10 years and only 7.5 per cent were found to have more than 10 years.

Thus from the Table XXIV, it was clear that majority of 34.6 per cent of the hyperlipidemic individuals were having this disorder for the past 1-5 years and 21.3 per cent were having for the past 5-10 years.

b. Personal history

Information recorded on personal history of the selected hyperlipidemic subjects is presented in Table XXV.

TABLE XXV

PERSONAL HISTORY OF THE SUBJECTS

Details	Male (per cent)	Female (per cent)
Asthma	1.5	3.4
Angina	4.8	5.0
High blood pressure	14.2	13.1
Low blood pressure	Nil	3.9
Arthritis	4.6	7.8
Hypothyroidism	1.0	1.5
Diabetes	7.1	3.4
Total	**49.6**	**60.6**

*Multiple Responses

Among the one thousand hyperlipidemics subjects 50 per cent and 40 per cent of the male and female hyperlipidemics respectively were not having any complications.

Of the 441 male hyperlipidemic subjects, 14.2 per cent were found to have high blood pressure, 7.1 per cent were found to have diabetes, 4.8 per cent were found to have angina, 4.6 per cent have arthritis, 1.5 per cent were found to have asthma and only a few of 1.0 per cent were found to have hypothyroidism. There were no hyperlipidemics of low blood pressure.

Among the one thousand hyperlipidemic subjects, 559 female hyperlipidemic subjects were found to have high blood pressure (13.1 per cent), arthritis (7.8 per cent) and 5 per cent were found to have angina, 3.9 per cent have low blood pressure, 3.4 per cent were found to have respectively asthma and diabetes and only a few of 1.5 per cent were found to have hypothyroid.

c. Mode of treatment undertaken

Mode of treatment is the major step in the treatment of any disease. Type of treatment under taken by the selected hyperlipidemic subjects is listed in Table XXVI.

TABLE XXVI

MODE OF TREATMENT

Details	Male (%)	Female (%)
Ayurveda	11.6	3.0
Homeopathy	22.7	31.8
Siddha	Nil	9.7
Allopathy	48.3	35.6
None	17.5	19.9
Total	**100.0**	**100.0**

Among the one thousand hyperlipidemic subjects, allopathy is the most common treatment taken by both the male hyperlipidemics (48.3 per cent) and female hyperlipidemic subjects (35.6 per cent) respectively. Homeopathy treatment

was taken by 22.7 and 31.8 per cent of male and female hyperlipidemics respectively.

Very little percentage was seen in female hyperlipidemics who are taking siddha of 9.7 per cent and ayurveda three per cent. Only 11.6 per cent of the males were taking ayurveda and none of the male hyperlipidemic subjects were taking siddha medicine.

With regard to the mode of treatment 17.5 per cent of male and 19.9 per cent female hyperlipidemics were not taking any treatment.

d. Signs and symptoms prevalent among the selected hyperlipidemics

Signs and symptoms of selected hyperlipidemic subjects were found to have some common signs and symptoms of cardiovascular disease. These include weakness, palpitations, shortness of breath, nausea, anxiety, dizziness and memory loss and is listed and presented in Table XXVII.

TABLE XXVII

SIGNS AND SYMPTOMS OF SELECTED SUBJECTS

Details	Male (%)	Female (%)
Weakness	15.0	30.2
Dizziness/fainting	5.7	2.3
Fatigue	14.1	15.9
Palpitations	5.2	Nil
Backache	Nil	3.6
Shortness of breath	12.7	11.3
Memory loss	20.0	7.2
Vomiting andnausea	Nil	2.0
Anxiety	Nil	13.2
None	27.4	14.3

From Table XXVII, it was clearly seen that among the male hyperlipidemic subjects, 20 per cent were found to have memory loss, 15 per cent were found to have weakness, 14.1 per cent were found to have fatigue, 12.7 per cent were found

to have shortness of breath, 5.7 per cent were found to have dizziness, 5.2 per cent were found to have palpitations and 27.4 per cent do not have any symptoms of the disease. Among the female hyperlipidemic subjects, 30.2 per cent were found to have weakness, 15.9 per cent were found to have fatigue, 13.2 per cent were found to have anxiety, 11.3 per cent were found to have shortness of breath, 7.2 per cent were found to have memory loss, a very few of 2.3per cent were found to have dizziness and 2 per cent were found to have vomiting and 14.3 per cent do not have any symptoms of the disease.

A Cognitive Behavioural Therapy (CBT) program focusing on stress management appears to decrease the risk of recurrent heart attacks and other cardiovascular events in patients with heart disease, according to a report published in *Archives of Internal Medicine* (Gulliksson *et al.,* 2011). Positive affect is defined as the experience of pleasurable emotions such as joy, happiness and contentment is associated with increased survival, lower risk of diabetes and hypertension. Increased positive effect is said to be protective against 10-year incident coronary heart disease (Davidson *et al.,* 2010).

e. Familial history

Family history of the selected hyperlipidemics is given in Table XXVIII.

TABLE XXVIII

FAMILY HISTORY OF THE SUBJECTS

Details	Father (%)	Mother (%)	Sister (%)	Brother (%)	Grandparents (%)
Obesity	3.4	4.5	1	0.8	6.6
Coronary heart disease	1.8	1.9	NIL	NIL	3.3
Stroke	2.8	1.6	NIL	NIL	NIL
Cerebrovascular disease	NIL	NIL	NIL	NIL	0.4
Cardiovascular diseases	7.8	4.8	0.8	2.2	1.5
Cancer	1.1	2.1	NIL	0.6	0.9

It was seen that family history is one of the indicator for the onset of cardiovascular disease of the particular hyperlipidemic individual. Apart from the lifestyle, diet and exercise, heredity also plays a major role in degenerative diseases. The data given is based on the multiple responses of the hyperlipidemic subjects.

The various problems like obesity, coronary heart disease, stroke, cerebro-vascular disease, cardiovascular disease and cancer were seen in the families of the selected 1000 hyperlipidemics.

From the Table XXVIII, it was evident that 7.8 per cent of the fathers, 4.8 per cent of the mothers and only 1.5 per cent of the grandparents were found to have cardiovascular diseases. It is clearly seen that both mothers (4.5 per cent) and grandparents (6.6 per cent) were found to have obesity when compared to the siblings. According to WHO (2011), there is an increased risk of cardiovascular diseases if a first-degree blood relative had coronary heart disease or stroke before the age of 55 years (for a male relative) or 65 years (for a female relative).

E. Analysis of the of the selected supplements

The selected omega 3 and fibre rich foods are analysed for its nutritional and anti-nutritional factors to find out the trustworthy and appropriate qualities for dietary intervention. Analysed and calculated nutritional and anti-nutritional content of the supplements is given in Table XXIX.

- Flaxseed, almond and walnut (FAW)
- Flaxseed and garlic (FG) and
- Flaxseed (FS)

From Table XXIX, the estimated value for the 100g of the FAW was 23.64 g for total dietary fibre whereas the calculated value is 19.61 g. The fat content was 46.38g and 49.15 g for estimated and calculated value respectively. The total sugars present in the estimated and calculated value of FAW was 3 g and 2.37 g respectively. The essential fatty acids like oleic acid, linoleic acid and linolenic acid was 14.93 g, 13.78 g and 13.03 g respectively for estimated value were as

Table XXIX

NUTRITIONAL AND ANTI-NUTRITIONAL CONTENT OF THE SELECTED SUPPLEMENTS

	Method	Flaxseed, Almond and Walnut (FAW)		Flaxseed and Garlic (FG)		Flaxseeds (FS)		Almond and Walnut (AW)
		Estimated	Calculated	Estimated	Calculated	Estimated	Calculated	Calculated
Nutrient content / 100 g								
Total dietary fibre (g)	IS 11062: 1984	23.64	19.61	32.49	26.13	33.21	27.46	1.89
Fat	IS 548 (Part 3)	46.38	49.15	38.06	38.04	39.84	40.57	12.34
Total sugars (g)	AOAC 923.09	3	2.37	2.92	1.61	1.77	1.64	0.65
Essential Fatty Acids								
Oleic acid (g)	IS 548 (Part 3)	14.93	Nil	8.49	Nil	8.92	Nil	Nil
Linoleic acid (g)		13.78		5.52		5.80		
Linolenic acid (g)		13.03		19.13		20.03		
Eicosatrienoic acid (g)		< 0.01		0.07		0.08		
EPA (g)		< 0.01		0.52		0.06		
DHA (g)		< 0.01		< 0.01		< 0.01		
Anti-Nutritional content / kg								
Arsenic (mg)	SO-CHML-CTS-C-01-QU-063-BY ICPMS	BLQ	Nil	BLQ	Nil	BLQ	Nil	Nil
Mercury (mg)		BLQ		BLQ		BLQ		
Lead (mg)		BLQ		BLQ		BLQ		
Tin (mg)		BLQ		BLQ		BLQ		
Zinc (mg)		2.60	3.61	2.62	4.06	2.96	4.20	0.59

eicosatrienoic acid, EPA and DHA were less than 0.01. The anti-nutritional content of arsenic, mercury, lead and tin is below the limit of quantification (BLQ) both for estimated and calculated value except for the zinc content which was 2.60 mg for estimated and 3.61 mg for calculated.

The nutrient content 100 g of FG supplement revealed that it contains 32.49 g dietary fibre, 38.06 g fat and 2.92 g total sugars. The essential fatty acids present in the supplement is 8.49 g oleic acid, 5.52 g linoleic acid, 19.13 g linolenic acid, 0.07 g eicosatrienoic acid, 0.52 g EPA and DHA <0.01 for the estimated value Anti-nutritional factors were below the limit of quantification (BLQ) except for zinc which was 2.62 mg. The 100g of calculated value of FG contains 26.13 g dietary fibre, 38.04 g fat, 1.61 g total sugars, 4.06 mg zinc and other nutrients were not calculated as they were not mentioned in the nutritive value of Indian foods

The nutrient content of 100 g FS supplement for the estimated value contains 33.21 g dietary fibre, 39.84 g fat and 1.77 g total sugars8.92 g oleic acid, 5.80 g linoleic acid, 20.03 g linolenic acid, 0.08 g eicosatrienoic acid, 0.06 g EPA and DHA <0.01 are the essential fatty acid present. Anti-nutritional factors for zinc were 2.96 mg whereas others were below the limit of quantification (BLQ). The 100g of calculated value of FG contains 27.64 g dietary fibre, 40.57 g fat, 1.64 g total sugars, 4.20 mg zinc and other nutrients were not calculated as they were not mentioned in the nutritive value of Indian foods.

The calculated value of AW supplement in 100g contains 9.45 g dietary fibre, 61.7 g fat, 3.25 g total sugars and 2.95 mg zinc. The other nutrients were not calculated as they were not mentioned in the nutritive value of Indian foods.

F. Anthropometric measurements

Anthropometric measurements include height, weight, waist and hip circumference and were recorded, Body Mass Index (BMI) and Waist to Hip Ratio (WHR) were calculated for all one thousand hyperlipidemic subjects selected and used for assessing the health status of the selected hyperlipidemics.

a. Mean height of the selected hyperlipidemics

Height measurement of the selected hyperlipidemic subjects were recorded, categorized and presented in Table XXX. Data suggested from the table, shows that the height of the selected one thousand hyperlipidemic subjects was found to be less than the standard reference height for men and women.

TABLE XXX

MEAN HEIGHT OF THE SELECTED SUBJECTS

Height (cm)	Male			Female		
	NIN * Standard (cm)	Number	Per cent	NIN * Standard (cm)	Number	Per cent
<150	174	51	11.6	163.8	108	19.3
151-160		66	15.0		173	30.9
161-170		211	47.8		248	44.4
171 and above		113	25.6		30	5.4
Total		**441**	**100.0**		**559**	**100.0**

** Ray and Iqbal, 2011*

Among the 441 male hyperlipidemic subjects, only one fourth of the hyperlipidemic subjects were found to be having same height when compared with the standard reference height for man (174 cm). Of the three fourth of the male hyperlipidemic subjects, 11.6 per cent were found to be having their height less than 150 cm, 15 per cent were found to be between 151-160 cm and the remaining 47.8 per cent were found to be in their height ranged between 161-170 cm and also they were less than the standard reference height for man recommended by ICMR.

Of the 559 female hyperlipidemic subjects, almost 44.4 per cent of the hyperlipidemic subjects were found to be same in comparison with the reference standard height for woman (163.8 cm). Of the rest, 19.3 per cent were found to be less than 150 cm, 30.9 per cent were found to be between 151-160 cms and were less than the standard reference height for woman. Only very few per cent of 5.4 were found to be more than 171 cm and were higher when compared with standard reference height for woman.

b. Mean weight of the selected hyperlipidemics

The following Table XXXI brings out the weight of the selected hyperlipidemic subjects.

TABLE XXXI

MEAN WEIGHT OF THE SELECTED SUBJECTS

Weight (Kg)	Male			Female		
	Number	Per cent	NIN * Standard (kg)	Number	Per cent	NIN * Standard (kg)
41-50	10	2.3	**60**	61	10.9	**55**
51-60	38	8.6		140	25.0	
61-70	158	35.8		136	24.3	
71-80	120	27.2		137	24.5	
81 -90	78	17.7		65	11.6	
91 and above	37	8.4		20	3.6	
Total	**441**	**100**		**559**	**100**	

** Ray and Iqbal, 2011*

Table XXXI, shows the weight of the 441 male hyperlipidemic subjects, 8.6 per cent were found to be between 51-60 kg and were comparable with the standard reference weight for man (60 kg). Most of the male hyperlipidemic subjects of 35.8 per cent were found to be between 61-70 kg, 27.2 per cent were found to be between 71-80 kg, 17.7 per cent were found to be between 81-90 kg and 8.4 per cent were found to be above 91 kg and were higher when compared with standard reference weight for man. Only few per cent of 2.3 were found to be between 41-50 kg and are less than the standard reference weight for man.

Among the mean weight of the 559 female hyperlipidemic subjects, one fourth of the hyperlipidemics were found to be between 51-60 kg and were comparable with the standard reference weight for woman (55 kg). Of the remaining three fourth, first one fourth were found to be in the weight range between 61-70 kg, second one fourth were found to be between 71-80 kg as their

body weight, 11.6 per cent were found to be between 81-90 kg, and only less per cent of 3.6 were found to be above 91 kg. This three fourth per cent of the hyperlipidemic subjects were found to be higher than the standard reference weight for women. Only ten per cent were found to be between 41-50 kg and are less than the standard reference weight for woman.

c. Body Mass Index of the selected hyperlipidemics

Body Mass Index was computed using height and weight and classified on the basis of Methodologies for fitness assessment, NIN, 2011 and depicted in Table XXXII.

TABLE XXXII

BODY MASS INDEX OF THE SELECTED SUBJECTS

BMI Classification*	Obesity grade	Male		Female	
		Number	Per cent	Number	Per cent
<18.49	**Underweight**	7	1.6	35	6.3
18.50 – 24.99	**Normal**	138	31.3	207	37
25.00-29.99	**Pre obese/ Overweight**	214	48.5	181	32.4
30.00- 32.49	**Mild Obese class I**	26	5.9	56	10.0
32.50-34.99	**Moderate Obese class I**	29	6.6	40	7.2
35.00- 37.49	**Mild Obese class II**	26	5.9	23	4.1
37.50-39.99	**Moderate Obese class II**	1	0.2	8	1.4
≥40.00	**Obese class III**	Nil	Nil	9	1.6
Total		**441**	**100.0**	**559**	**100.0**

** WHO 2004*

From the Table XXXII, it was clear that among 559 female hyperlipidemic subjects, majority of the selected female hyperlipidemic subjects had BMI in the range of 18 to 25 are considered to be normal. The quantum of subjects, who had normal BMI constituted 37 per cent for female hyperlipidemic subjects.

Almost 57 per cent of the female hyperlipidemic subjects were overweight whose BMI is ≥25. The quantum of hyperlipidemic subjects who are under

pre obese category constitute 32.4 per cent, 10 per cent of the hyperlipidemics falls under mild obese class I category. Seven per cent of hyperlipidemic subjects were found under the category of moderate obese class I. Under mild obese class II, 4.1 per cent of the female hyperlipidemics are present and moderate obese class II, very few of 1.4 per cent was present. Only 1.6 per cent was categorized has obese class III.

Of the 441 male hyperlipidemic subjects 31.3 per cent were considered to be normal. Sixty seven per cent of the male hyperlipidemics constitute the overweight with BMI ≥25. Among the overweight male hyperlipidemic subjects, majority of 48.5 per cent were of pre obese. Around six per cent falls under the category of mild obese class I and 6.6 per cent belongs to moderate obese class I. Around six per cent belongs to the mild obese class II category. Very negligible per cent of 0.2 were there under the moderate obese class II category. None of the male hyperlipidemic subjects were in the category of obese class III.

It is surprised to note that the selected hyperlipidemic subjects were also included in underweight category. A very few per cent of 1.6 male hyperlipidemics and 6.3 per cent female hyperlipidemics falls under this category.Another interesting point to note is that 56.7 and 67.1 per cent of both female and male hyperlipidemic subjects were considered as “At risk” (BMI ≥25).

d. Waist to Hip Ratio of the selected hyperlipidemics

Table XXXIII depicts the waist to hip ratio of the selected hyperlipidemic subjects.

Waist hip ratio is also one of the determinants for the major health risks in life at present situation, particularly in females the waist hip ratio is the major problem for the degenerative diseases after they attain their menopause stage. From Table XXXIII, it was seen that among 441 male hyperlipidemics, 52.4 per cent were normal and found to have WHR < 0.9 and 47.6 per cent were obese and found to have WHR >0.9.

TABLE XXXIII

WAIST TO HIP RATIO OF THE SELECTED SUBJECTS

WHR* classification	Male		WHR classification*	Female	
	Number	Per cent		Number	Per cent
< 0.9 Normal	231	52.4	**< 0.8 Normal**	351	62.8
> 0.9 Obese	210	47.6	**> 0.8 Obese**	208	37.2
Total	**441**	**100**	**Total**	**559**	**100**

**ICMR 2010*

Among 559 female hyperlipidemic subjects 62.8 per cent were normal and found to have WHR ≤ 0.8 and 37.2 per cent were obese and found to have WHR above 0.8. Only 10 per cent difference is observed between male and female hyperlipidemic subjects in the both normal and obese categories respectively.

The anthropometric measurements like weight, height, BMI and WHR are the indicators of health. As the weight increases, BMI increases and sometimes the fat is accumulated at the waist line thus increasing the WHR ratio and thereby increasing the cardiovascular disease risk factors. In the present study the hyperlipidemics were either had BMI increase or WHR increase or both where weight is the major factor for the increase in these parameters.

G. Biochemical profile of the selected hyperlipidemics

a. Mean Lipid profile

Lipid profile of the selected hyperlipidemics were recorded individually and the mean values were computed and presented in Table XXXIV.

From the table, it was seen that the blood parameters of the lipid profile include total cholesterol, Low Density Lipoprotein Cholesterol (LDL-C), High Density Lipoprotein Cholesterol (HDL-C), Very Low Density Lipoprotein Cholesterol (VLDL-C) and triglycerides. These parameters of the selected hyperlipidemic subjects were recorded from the medical report available in the hospital.

TABLE XXXIV

MEAN LIPID PROFILE LEVELS OF THE SELECTED SUBJECTS

Lipid Profile (mg/dl)	Desirable Values*	Mean Values ± SD	
		Male	Female
Total cholesterol	< 200 mg/dl	261.9 ± 26.8	250.2 ± 19.7
LDL cholesterol	< 130 mg/dl	179.2 ± 18.8	172.0 ± 21.3
HDL cholesterol	> 50 mg/dl	40.9 ± 3.4	40.2 ± 3.8
Triglycerides	< 150 mg/dl	202.4 ± 68.4	192.0 ± 63.3
VLDL cholesterol	< 30 mg/dl	41.0 ± 13.2	38.1 ± 12.5
TC/HDL ratio	Upto 5.0	6.4 ± 0.8	6.3 ± 0.7

** National Cholesterol Education Program-ATP IV Guidelines (NCEP), 2012*

Among the one thousand hyperlipidemic subjects, mean serum total cholesterol of the 559 female subjects were found to have 250.2 mg/dl, 172.0 mg/dl as their mean LDL cholesterol, mean HDL cholesterol was recorded as 40.2 mg/dl, 192.0 mg/dl was recorded for triglycerides and as an average of 38.1 mg/dl for VLDL cholesterol and TC/HDL ratio was found to be 6.3.

Out of the 441 male hyperlipidemic subjects, mean total cholesterol level was found to be 261.9 mg/dl, mean LDL cholesterol was 179.2 mg/dl, average HDL cholesterol values were found to be 40.9 mg/dl, triglyceride level was 202.4 mg/dl and the average VLDL cholesterol level recorded was 41 mg/dl and TC/HDL ratio was calculated and noted as 6.4. Mean total cholesterol, LDL cholesterol; triglyceride and VLDL cholesterol values of the male hyperlipidemic subjects were higher than the desirable values. The mean HDL cholesterol values were lower when compared with the desirable values. Table XXXIV, clearly shows that both male and female hyperlipidemic subjects had elevated lipid profile when compared with the desirable levels given by NCEP (2012).

The increase in these blood parameters of the hyperlipidemics may be due to their diet, smoking, alcohol consumption, genetic factors and activity pattern.

Campbell (2010) states that cholesterol and fats present in the blood are responsible for the disease as they cannot dissolve in the blood. They have to be transported to and from the cells by special carriers called lipoproteins. There are several kinds, but the ones to focus on are Low-Density Lipoprotein (LDL) and High-Density Lipoprotein (HDL) This may be related to diet, genetic factors (such as LDL receptor mutations in familial hypercholesterolemia) and the presence of other diseases such as diabetes and an underactive thyroid. The type of hypercholesterolemia depends on which type of particle (such as low-density lipoprotein) is present in excess (Fernandez and Webb 2008).

According to NHLBI (2009) high blood cholesterol is one of the major risk factors for heart disease and other cardiovascular diseases. The higher the blood cholesterol, the greater the risk of developing the heart disease or having a heart attacks. It is number one killer of men and women in the United States and elevated blood cholesterol was observed among the hyperlipidemics in the study.

The WHO had warned that cardiovascular disease-related mortality in India will increase to epidemic proportion by 2020. An important focus of recent studies is the changing trends in cardiovascular risk factors. Reviews show that all major risk factors are increasing in India (Gupta, 2009). In the last 30 years, the prevalence of hypertension and hypercholesterolemia has doubled while that of diabetes has trebled.

The Jaipur Heart Watch studies in India evaluated multiple cardiovascular risk factors in urban middle-class subjects using a multiple cross-sectional study design over a 20-year period from 1991 to 2010 (Gupta *et al.,* 2011). Over this period, the prevalence of smoking declined, hypertension did not change significantly (due to increased awareness and treatment), while all other risk factors such as obesity, truncal obesity, hypercholesterolemia, diabetes and metabolic syndrome increased significantly in these urban subjects. No similar studies that have evaluated multiple cardiovascular risk factors are available from India.

Based on a very large evidence base, Katcher *et al*., (2009) clearly recommends that diet and lifestyle practices can markedly affect the major

coronary heart disease lipid risk factors and consequently decrease coronary heart disease risk substantively. The recommended dietary pattern is low in saturated fatty acids, TFA and dietary cholesterol and emphasize on unsaturated fats. It also promotes consumption of fruits, vegetables, whole grains, low fat/skim dairy products, lean meats, poultry and fish, liquid vegetable oils, nuts and seeds. For maximum LDL cholesterol reduction, emphasis on viscous fibre is recommended as well as inclusion of plant sterols/stanols. In addition, weight loss and regular physical activity will beneficially affect the major lipid and lipoprotein cardiovascular risk factors. Adhering to the healthy diet is an important tool for combating heart disease through lipid and lipoprotein modulation. Major public health efforts are needed to help people adhere to this dietary pattern with recommended lifestyle behaviours.

H. Effect of supplements on the nutritional status of the selected hyperlipidemics

To study the effect of high fibre and omega-3 rich foods like flaxseed, walnut and almond supplementation on nutritional status (weight, Body Mass Index, Waist-Hip ratio), food consumption and biochemical parameter (serum lipid profile) of both the experimental and control group were carried out before and after intervention period. The findings are discussed below.

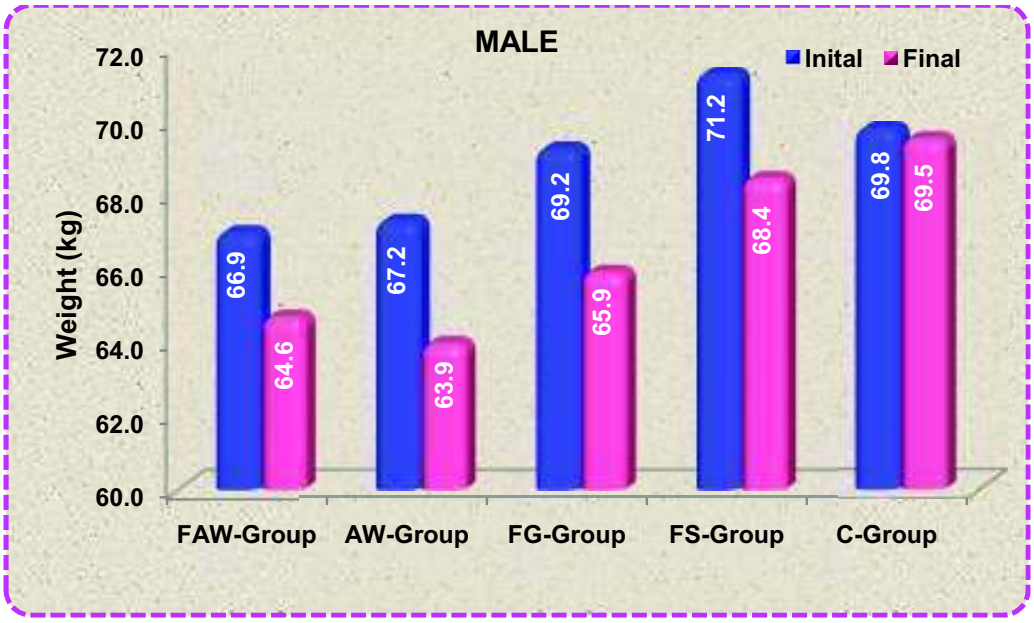
a. Body weight

Body weight of both male and female hyperlipidemics in the in-depth study was recorded before and after the intervention period and depicted in Table XXXV and Figure 13. The results as shown in the table revealed that there was a notable reduction in the body weight of the male and female hyperlipidemic subjects after the intervention period when compared with their initial values.

TABLE XXXV

BODY WEIGHT BEFORE AND AFTER THE INTERVENTION PERIOD

Intervention groups	Body Weight in kg(Mean ± SD)					
	Male			Female		
	Initial	Final	Diff	Initial	Final	Diff
Flaxseed, Almond and Walnut (FAW)	79.9± 12.3	77.2± 12.2	-2.7±0.7	66.9± 14.5	64.6±14.6	-2.3±1.0
Almond and Walnut (AW)	72.2± 7.1	69.6± 7.3	-2.6±0.7	67.2± 11.1	63.9±10.9	-3.3±1.0
Flaxseed and Garlic (FG)	72.9±13.4	70.3± 12.8	-2.6±1.0	69.2± 16.8	65.9±16.3	-3.3±1.1
Flaxseed (FS)	76.6± 8.5	73.9± 8.4	-2.8±0.4	71.2± 14.1	68.4±13.7	-2.8±1.2
Control	73.9± 11.8	73.4±11.6	-0.5±0.8	69.8± 11.9	69.5±11.2	-0.3±1.2



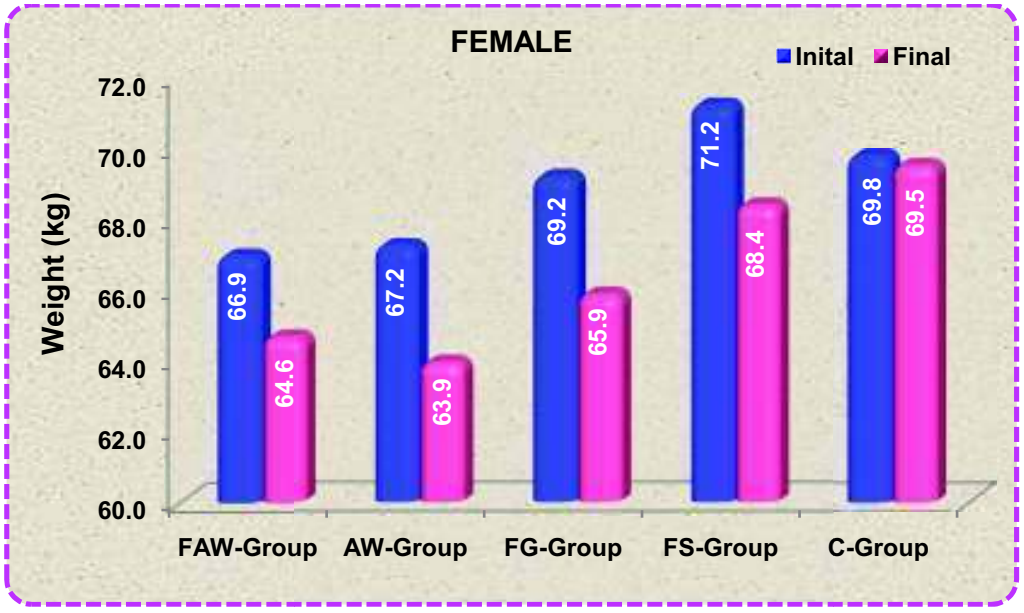


FIGURE 13- BODY WEIGHT OF THE STUDY GROUP BEFORE AND AFTER THE INTERVENTION PERIOD

In the experimental group which was supplemented with flaxseed, almond and walnut powder (FAW) for the selected hyperlipidemics, the mean body weight of the male hyperlipidemic subjects was 79.9 kg which had reduced to 77.2 kg after the intervention period of 90 days.

The female hyperlipidemic subjects showed a reduction from 66.9 kg to 64.6 kg before and after the intervention period respectively. The results indicated that there was a reduction of 2.7 kg and 2.3 kg respectively in male and female hyperlipidemics due to the dietary intervention with FAW.

The mean body weight of selected hyperlipidemics who were supplemented with almond and walnut (AW) before the start of the intervention period was 72.2 kg and 67.2 kg respectively for both male and female hyperlipidemics which had been reduced to 69.6 kg and 63.9 kg respectively by the end of the intervention period. The reduction observed in body weight for male and female hyperlipidemics was 2.6 kg and 3.3 kg correspondingly.

Table XXXV also revealed that the mean body weight of the FG group before and after the intervention period were 72.9 kg and 70.3 kg respectively for male subjects. They showed a reduction of 2.6 kg in their body weight during the intervention period. The initial and final values of the mean body weight of female hyperlipidemics were 69.2 kg and 65.2 kg respectively and showed a reduction of 3.3 kg during the intervention period of three months. This group showed similar results as shown by the AW group with respect to both male and female hyperlipidemics.

The findings of the FS group had recorded that the mean body weight of male hyperlipidemic subjects of the FS group which was supplemented with flaxseed powder was 76.6 kg before the intervention which had reduced to 73.9 kg after the intervention period. The female hyperlipidemic subjects showed a mean body weight of 71.2 kg which had reduced to 68.4 kg after the intervention period. The reduction observed was 2.8 kg in both male and female hyperlipidemic subjects after the intervention period of 90 days. There was not much difference

before and after the intervention period in control group of both male and female hyperlipidemics.

Apart from many beneficial effects of nuts, it helps to achieve weight management thus reducing the risk of developing obesity. Nutrients like fats, fibre, protein and low gastro-intestinal effect present in nuts increases satiety helping to control appetite (Bes *et al.,* 2009).

b. Body Mass Index

Body Mass Index was computed using the height and weight of the selected hyperlipidemics of both experimental and control group, before and after the intervention period and classified as given in Table XXXVI.

With regard to the FAW group, in the normal category, initially 30 per cent of the hyperlipidemics were recorded and finally it was increased to 36.7 per cent. From the pre obese category the percentage was decreased from 36.7 to 33.3, but in the mild obese class I there were 6.7 per cent initially which had increased to 16.7 per cent finally. A drastic difference was noted in the moderate obese class I i.e., 20 per cent initial value had been reduced to 6.7 finally.

In the case of AW group supplemented with almond and walnut, 3.3 per cent hyperlipidemics were in obese class III initially and were shifted to moderate obese class II (3.3 per cent) after the intervention. In the case of mild obese class II, mild obese class I and pre obese category reduction in the percentage of the hyperlipidemics were observed whereas these hyperlipidemics were shifted to normal category.

In the third intervention group which was supplemented with flaxseed and garlic powder (FG), none of the subjects were in the mild obese class II category and percentage of the subjects remained the same in underweight category even after the intervention period. Decrease in the percentage of subjects from 13.3 to 6.7 per cent and 40 to 36.7 per cent were observed in moderate obese class I and pre obese categories respectively before and after the intervention period.

TABLE XXXVI

BODY MASS INDEX BEFORE AND AFTER THE INTERVENTION PERIOD

BMI Grades	Experimental and Control Groups (%)									
	FAW		AW		FG		FS		Control	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Underweight	3.3	3.3	NIL	NIL	6.7	6.7	NIL	NIL	NIL	NIL
Normal	30.0	36.7	36.7	50.0	30.0	36.7	36.7	46.7	46.7	50.0
Pre obese / Overweight	36.7	33.3	33.3	26.7	40.0	36.7	46.7	40.0	36.7	36.7
Mild Obese class I	6.7	16.7	10.0	3.3	6.7	13.3	3.3	6.7	6.7	6.7
Moderate Obese class I	20.0	6.7	3.3	10.0	13.3	6.7	13.3	6.7	10.0	6.7
Mild Obese class II	NIL	NIL	13.3	6.7	3.3	NIL	NIL	NIL	NIL	NIL
Moderate Obese class II	NIL	NIL	NIL	3.3	NIL	NIL	NIL	NIL	NIL	NIL
Obese class III	3.3	3.3	3.3	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Thirty per cent of the subjects were included in the normal category before the intervention which had increased to 36.7 per cent after the intervention period with a notable weight reduction. Similarly in mild obese class I category, 6.7 per cent was observed initially which had increased to 13.3 per cent finally. This shows that flaxseed also helped in lowering the BMI and thus reducing the risk of cardiovascular problems.

In the FS group, there was 10 per cent increase after the intervention period in the normal category when compared to their initial percentage. Almost six per cent decrease was observed in both pre obese and moderate class I categories respectively. Three per cent increase was observed in mild obese class I category after the intervention period. From the results it was concluded that flaxseed which is consumed with or without any combination possesses it's most beneficial effects and had cardio-friendly benefits to the individuals.

There was no difference in the BMI grades of the control group before and after the intervention period except for the normal category which had decreased to three per cent and increase of three per cent in case of moderate obese class I category. As the weight decreases, BMI decreases, thus leading to the lesser chance of the risk of hyperlipidemia which in turn reduces the CVD risk factors.

c. Food and nutrient intake of the male hyperlipidemics (Experimental and control group)

Dietary habits of population in different regions of the world have been determined mainly by the availability of foods locally and local practices. Man has evolved his habitual dietary pattern to maintain good health. The nutrients are chemical substances which are present in the food we eat daily. The foods containing these nutrients are classified as cereals, legumes (pulses), nuts and oilseeds, vegetables, fruits, milk and milk products, fats and oils and sugars.

Life cannot be sustained without adequate nourishment. Man needs adequate food for growth, development and to lead an active and healthy life and requires various nutrients to perform various functions in the body. The nutrients include energy, protein, fat, carbohydrates, vitamins and minerals.

The daily food intake of the selected male hyperlipidemics is given in Table XXXVII.

TABLE XXXVII

FOOD INTAKE OF THE MALE HYPERLIPIDEMICS

Food groups	RDA* (ICMR, 2010)	Experimental Group				Control Group			
		Before		After		Before		After	
		Actual intake (g)	Excess/ deficit (%)	Actual intake (g)	Excess/ deficit (%)	Actual intake (g)	Excess/ deficit (%)	Actual intake (g)	Excess/ deficit (%)
Cereals	375	330	-12	283.8	-24.3	340	-9.3	325	-13.3
Pulses	75	53	-29.3	56.8	-24.3	49	-34.7	52	-30.7
Roots and tubers	200	125	-37.5	117	-41.5	114	-43	120	-40
Green leafy vegetables	100	30	-70	40	-60	25	-75	30	-70
Other vegetables	200	123	-38.5	140	-30	119	-40.5	116	-42
Fruits	100	54.3	-45.8	65.3	-34.8	60	-40	50	-50
Milk and Milk products	300	207.5	-30.8	227.5	-24.2	225	-25	215	-28.3
Fats and Oils	25	32.5	+30	19.5	-22	35	+40	30	+20
Sugar & Jaggery	20	32.5	+62.5	29.5	-47.5	35	+75	30	+50

From the table, the recorded intake of cereals of the male hyperlipidemic subjects of the experimental group before and after the intervention period was 330 g and 283.8 g respectively. The intake of cereals when compared with the recommended dietary allowances was deficit by 12 and 24.3 per cent respectively before and after the intervention period.

With regard to the experimental group the intake of pulses, roots and tuber, green leafy vegetables, other vegetables, fruits and milk and milk products were deficit by 29.3, 37.5, 70, 38.5, 45.8 and 30.8 per cent respectively before the intervention period. After the intervention period all the above mentioned food groups were also deficit when compared to RDA. The consumption of fats and oils and sugar and jaggery were excess by 30 and 62.5 per cent respectively in the initial period and it got reduced and shows deficit by 22 and 47.5 per cent correspondingly after the intervention period of three months.

In the case of control group, deficit was observed in cereals (9.3 per cent), pulses (34.7 per cent) roots and tuber (43 per cent), green leafy vegetables (75 per cent), other vegetables (40.5 per cent), fruits (40 per cent) and milk and milk products (25 per cent) before the intervention except fats and oils (40 per cent) and sugar and jaggery (75 per cent) which are in excess. Similar trend was found in all the food groups even after the intervention period.

The daily nutrient intake of the male hyperlipidemic subjects were recorded and presented in Table XXXVIII before and after the intervention period.

TABLE XXXVIII

NUTRIENT INTAKE OF MALE HYPERLIPIDEMICS

Nutrients	RDA * (ICMR 2010)	Experimental Group				Control Group			
		Before		After		Before		After	
		Actual intake	Excess/ deficit (%)	Actual intake	Excess/ deficit (%)	Actual intake	Excess/ deficit (%)	Actual intake	Excess/ deficit (%)
Energy (Kcal)	2320	2167.5	-6.6	2025.4	-12.7	2232.3	-3.8	2116.1	-8.8
Protein (g)	60	50.7	-15.6	58.5	-2.4	47.8	-20.3	52.9	-11.8
Fat (g)	25	49.6	98.6	34.6	38.4	53.1	112.6	45.0	80.0
Fibre (g)	40	17.8	-55.5	32.0	-20.0	15.0	-62.5	21.0	-47.5
Calcium (mg)	600	781.1	30.2	531.0	-11.5	650.0	8.3	690.0	15.0
Iron (mg)	17	15.0	-11.8	20.5	20.8	13.0	-23.5	14.0	-17.6
Beta carotene (µg)	4800	3327.5	-30.7	3804.0	-20.8	3129.5	-34.8	3485.0	-27.4
Thiamine (mg)	1.2	1.3	8.3	1.2	0.0	1.0	-16.7	0.9	-25.0
Riboflavin (mg)	1.4	1.3	-7.1	1.5	7.1	1.0	1.1	-28.6	-24.0
Niacin (mg)	16	14.0	-12.5	13.5	-15.6	12.4	-22.5	14.0	-12.5
Ascorbic acid (mg)	40	68.0	70.0	100.1	150.3	70.0	8.3	690.0	15.0

The daily nutrient intake by the male hyperlipidemics in the experimental group before the intervention period was deficit in energy (6.6 per cent), protein (15.6 per cent), fibre (55.5 per cent), iron (11.8 per cent), beta carotene (30.7 per cent), riboflavin (7.1 per cent) and niacin (12.5 per cent), whereas the

intake was excess for fat (98.6 per cent), calcium (30.2 per cent), thiamine (8.3 per cent) and ascorbic acid (70 per cent) when compared to recommended dietary allowances. After the intervention, excess intake was recorded for fat (38.4 per cent), iron (20.5 per cent), riboflavin (7.1 per cent) and ascorbic acid (150.3 per cent) when compared to RDA, whereas other nutrients namely energy, protein, fibre, calcium, beta carotene, thiamine and niacin are deficit when compared with RDA.

In the case of control group the intake of energy, protein, fibre, iron, beta carotene, thiamine, riboflavin and niacin were deficit whereas fat, calcium and ascorbic acid were excess before the intervention when compared to RDA. Similar trend was observed even after the intervention period of three months.

d. Food and nutrient intake of the female hyperlipidemics (Experimental and control)

The daily food intake of the female hyperlipidemic subjects before and after the intervention period is presented in Table XXXIX.

TABLE XXXIX

FOOD INTAKE OF THE FEMALE HYPERLIPIDEMICS

Food groups	RDA* (ICMR, 2010)	Experimental Group				Control Group			
		Before		After		Before		After	
		Actual intake (g)	Excess/ deficit (%)	Actual intake (g)	Excess/ deficit (%)	Actual intake (g)	Excess/ deficit (%)	Actual intake (g)	Excess/ deficit (%)
Cereals	270	248.8	-7.9	211.3	-21.8	305	+13	240	-11.1
Pulses	60	45.8	-23.8	55	-8.3	46	-23.3	51	-15
Roots and tubers	200	155.3	-22.4	121.8	-39.1	150	-25	115	-42.5
Green leafy vegetables	100	20	-80	25.5	-74.5	35	-65	38.9	-61.1
Other vegetables	200	127	-36.5	140	-30	117	-41.5	120	-40
Fruits	100	61.3	-38.8	80.8	-19.3	40	-60	50	-50
Milk and Milk products	300	210	-30	245	-18.3	250	-16.7	240	-20
Fats and Oils	20	34.8	+74	25	-25	38	+90	25	+25
Sugar & Jaggery	20	31	+55	26.5	-32.5	34	+70	22	+10

The mean daily food intake of cereals by the female hyperlipidemics in the experimental group was 248.8 g and 211.3 g with a deficit of 7.9 and 21.8 per cent respectively before and after the intervention period. For the intake of cereals the female hyperlipidemics of the control group showed an excess (13 per cent) before the intervention and deficit (11.1 per cent) after the intervention period.

With regard to the intake of pulses in the experimental group before the intervention was 23.8 per cent deficient and this had been decreased to 8.3 per cent after the intervention period of 90 days. In the control group the female hyperlipidemic subjects showed a deficit of 23.3 per cent with regard to pulse intake before the intervention and decreased to 15 per cent after the intervention period when compared to the recommended dietary allowances.

Roots and tubers, green leafy vegetables, other vegetables, fruits and milk and milk products consumed by the female hyperlipidemics were deficient in quantity when compared to the RDA before the intervention but fats and oils and sugar and jaggery consumption seems to be excess by 74 and 55 per cent respectively when compared to RDA. After the intervention the consumption of all the food groups followed a similar trend with a drastic change when compared to recommended allowances.

In the case of control group, intake of roots and tubers, green leafy vegetables, other vegetables, fruits and milk and milk products were deficient whereas fats and oils and sugar and jaggery were excess when compared to RDA before the intervention period of three months. After the intervention period only fats and oils and sugar and jaggery intake was excess and all other foods groups were found to be deficit.

The daily nutrient intake of the female hyperlipidemics before and after the intervention were recorded and presented in Table XL.

The female hyperlipidemics of the experimental group showed deficit in energy intake by 1.6 per cent, protein by 22.7 per cent, fibre by 65 per cent, iron by 19 per cent, beta carotene by 21.7 per cent, thiamine by 10 per cent and niacin by

TABLE XL

NUTRIENT INTAKE OF THE FEMALE HYPERLIPIDEMICS

Nutrients	RDA * (ICMR 2010)	Experimental group				Control group			
		Before		After		Before		After	
		Actual intake	Excess/ deficit (%)	Actual intake	Excess/ deficit (%)	Actual intake	Excess/ deficit (%)	Actual intake	Excess/ deficit (%)
Energy (Kcal)	1900	1870.0	-1.6	1752.8	-7.7	2191.2	15.3	2020.0	6.3
Protein (g)	55	42.5	-22.7	53.0	-3.6	48.1	-12.6	56.3	2.3
Fat (g)	20	41.0	105.0	32.0	60.0	37.0	85.0	40.8	104.0
Fibre (g)	40	14.0	-65.0	27.0	-32.5	13.0	-67.5	18.0	-55.0
Calcium (mg)	600	624.5	4.1	688.0	14.7	717.7	19.6	851.4	41.9
Iron (mg)	21	17.0	-19.0	18.0	-14.4	16.5	-21.4	17.1	-18.6
Beta carotene (µg)	4800	3760.0	-21.7	3840.0	-20.0	3378.6	-29.6	3501.6	-27.1
Thiamine (mg)	1.0	0.9	-10.0	1.1	10.0	0.9	-10.0	1.2	20.0
Riboflavin (mg)	1.1	1.3	18.2	1.5	36.7	1.2	9.1	1.5	35.6
Niacin (mg)	12	9.1	-24.0	14.1	17.4	10.1	-15.4	13.0	8.3
Ascorbic acid (mg)	40	74.7	86.7	85.0	112.5	70.8	77.0	72.0	80.0

24 per cent before the intervention period. In the case of other nutrients namely fat, calcium, riboflavin and ascorbic acid are excess by 105, 4.1, 18.2 and 86.7 per cent respectively. After the intervention period, fat, calcium, thiamine, niacin and ascorbic acid showed an excess consumption by 60 per cent, 14.7 per cent, 10 per cent, 17.4 per cent and 85 per cent respectively when compared to RDA. With regard to the intake of energy (7.7 per cent), protein (3.6 per cent), fibre (32.5 per cent), iron (14.4 per cent) and beta carotene (20 per cent) showed deficit when compared with RDA.

The intake of nutrients by the control group before the intervention period showed a deficit of 12.6, 67.5, 21.4, 29.6, 10 and 15.4 per cent respectively for protein, fibre, iron, beta carotene, thiamine and niacin. Whereas energy, fat, calcium, riboflavin and ascorbic acid were excess by 15.3, 85, 19.6, 9.1 and 77 per cent respectively when compared to recommended dietary allowances. But after the intervention period, intake of energy, protein, fat, calcium, thiamine, riboflavin, niacin and ascorbic acid are excess by 6.3 per cent, 2.3 per cent, 104 per cent, 41.9 per cent, 20 per cent, 35.6 per cent, 8.3 per cent and 80 per cent respectively.

I. Effect of supplements on the serum lipid profile of the selected hyperlipidemics

The effect of the supplements on the lipid profile of the selected hyperlipidemics for the different experimental groups were analysed before and after the intervention period. The lipid profile values were statistically analyzed and compared between the groups and presented below.

a. Supplementation with Flaxseed, Almond and Walnut (FAW group)

Table XLI and Figure 14 represents the serum lipid profile of the selected hyperlipidemics before and after the intervention period with flaxseed, almond and walnut powder.

From Table XLI, it was evident that the mean total cholesterol level of the flaxseed, almond and walnut supplemented group (FAW) was 270.93 mg/dl which was reduced to 222.50 mg/dl at the end of the intervention period. The initial and final values were analyzed statistically and found to be significant at ($P<0.01$) level.

TABLE XLI

SERUM LIPID PROFILE OF FAW AND CONTROL GROUP BEFORE AND AFTER THE INTERVENTION

Lipid Parameters (mg / dl)	Desirable levels (NCEP, 2012)	FAW group (Mean ± SD)			't' value	Control group (Mean ± SD)			't'value	't' value Initial-E Vs Initial-C	't' value FAW Vs Con
		Initial	Final	Diff		Initial	Final	Diff			
Total cholesterol	< 200 mg/dl	270.93 ±15.12	222.50 ±24.50	-48.43 ± 16.26	**16.31****	263.03 ±16.35	265.50 ± 23.52	-2.47 ±17.15	0.79^{NS}	**1.87^{NS}**	**11.32****
LDL Cholesterol	< 130 mg/dl	179.63 ±17.40	131.77 ±30.04	-47.87 ±18.93	**13.85****	185.33 ±13.49	186.43 ±21.12	-1.10 ±17.99	0.34^{NS}	**1.36^{NS}**	**10.64****
HDL Cholesterol	> 50 mg/dl	40.83 ±3.62	49.83 ±8.60	9.00 ±7.45	**6.62****	42.33 ±2.63	43.80 ±4.24	1.47 ± 4.44	1.81^{NS}	**1.67^{NS}**	**4.78****
Triglycerides	< 150 mg/dl	252.83 ±42.74	205.47 ±38.81	-47.37 ± 19.58	**13.25****	177.87 ±69.04	177.97 ±63.81	-0.10 ±16.07	0.03^{NS}	**5.24****	**9.91****
VLDL Cholesterol	< 30 mg/dl	50.47 ±8.42	40.90 ±7.71	-9.57 ±3.78	**13.85****	35.37 ±13.79	35.27 ±12.85	-0.10 ±3.13	0.18^{NS}	**5.32****	**10.45****
TC/HDL Ratio	Upto 5.0	6.68 ±0.68	4.60 ±0.96	-2.08 ±0.68	**16.76****	6.24 ±0.61	6.13 ±0.91	-0.11 ±0.74	0.78^{NS}	**2.34***	**11.22****

****Significant at (P<0.01)** ***Significant at (P<0.05)** **^{NS}Not Significant** **E- FAW group** **C- Control group**

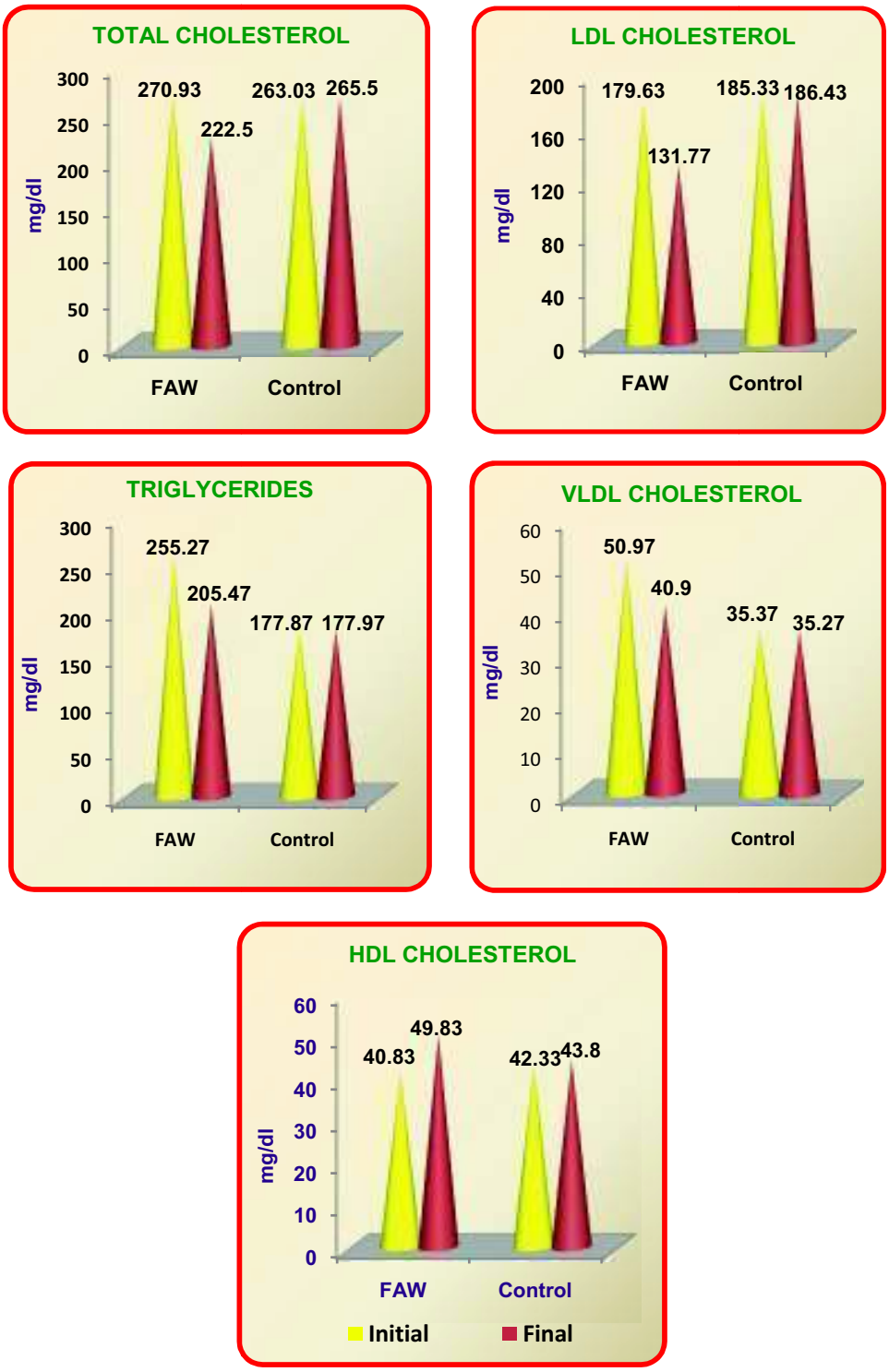


FIGURE 14 - LIPID PROFILE OF FAW AND CONTROL GROUP

No significant difference was found between the initial (263.03 mg/dl) and final (265.5 mg/dl) levels of the total cholesterol with regard to the control group. Significant difference was not seen within the initial levels of FAW and control group. Total cholesterol level of the FAW group and control group was statistically compared and found to be significant at ($P<0.01$) level with the 't' value of 11.32.

With regard to the mean LDL cholesterol level of FAW group it was recorded as 179.63 mg/dl before the intervention and it had been decreased to 131.77 mg/dl at the end of the intervention period with a statistical significance at ($P<0.01$) level. Significant difference was observed between LDL cholesterol level of the FAW and control group at ($P<0.01$) level. Initial LDL cholesterol level of the FAW and control group and also within the control group was statistically analyzed and the difference obtained was found to be not significant.

The mean HDL cholesterol level of FAW group had increased significantly ($P<0.01$) from 40.83 mg/dl to 49.83 mg/dl. Though there was an increase from 42.57 mg/dl to 43.8 mg/dl in the control group, the difference was analyzed and found to be not significant between the initial and final levels. Significant difference was not found for the HDL cholesterol level between FAW and control group before the start of the intervention period. With regard to the HDL cholesterol level significant difference was observed between the FAW and control group at ($P<0.01$) level when it was statistically analyzed.

The mean triglyceride level of the FAW group of the selected hyperlipidemics had found to be decreased from 252.83 mg/dl to 205.47 mg/dl after the intervention with a statistical significant difference at ($P<0.01$) level. No significant difference was observed between the initial and final levels of the control group after the intervention period.

The VLDL cholesterol level which depends on the level of triglyceride showed reduction from initial value of 50.47 mg/dl to 40.90 mg/dl finally and the difference was statistically proved to be significant at ($P<0.01$) level. It was statistically found that no significant difference was recorded between the initial and final levels of the control group during the intervention period.

The ratio between total cholesterol and HDL cholesterol (TC/HDL) before and after the intervention period was statistically proved to be significant at (P<0.01) level and the levels were decreased from 6.68 to 4.6 with a notable reduction of 2.08 which showed that the hyperlipidemics were out of risk zone because of the flaxseed, almond and walnut supplement. No significant difference was observed in the ratio (TC/HDL) within the control group.

Significant difference was seen within the initial levels of the FAW and control group for triglycerides, VLDL cholesterol (P<0.01) and TC/HDL ratio only at (P<0.05) level. The same results were noted between the values recorded for FAW and control group at (P<0.01) level respectively.

Flaxseed, almond and walnut supplementation had helped to lower the total cholesterol, LDL cholesterol, triglycerides and VLDL cholesterol levels and also enhance the HDL cholesterol level among the selected hyperlipidemics.

The portfolio diet is a Mediterranean eating plan that incorporates the nutritional ingredients like nuts (almonds and walnuts), soy protein and plant sterols. It has been found to reduce LDL cholesterol by about 30 per cent (similar to 20 mg of the statin lovastatin), when the foods were provided and by 13 per cent when only the dietary recommendations were provided (Jenkins *et al.,* 2011).The Mediterranean diet is characterized by a high consumption of monounsaturated fats (primarily from olive oil) and low consumption of saturated fats (Katcher *etal*., 2009*)* which shows that the Mediterranean diets lowered the total-to-HDL cholesterol ratio more when compared to other diets like low-fat diet.

b. Supplementation with Almond and Walnut (AW group)

The experimental group supplemented with almond and walnut (AW) for the selected hyperlipidemics is presented in Table XLII and Figure 15. The serum lipid profile values recorded are analyzed statistically and interpreted.

As evident from Table XLII the AW group comprising thirty hyperlipidemic male and female subjects who were supplemented with almond and walnut showed marked significant decrease at (P<0.01) level with the difference (36.63 mg/dl) of

TABLE XLII

SERUM LIPID PROFILE OF AW GROUP BEFORE AND AFTER THE INTERVENTION

Lipid Parameters (mg / dl)	Desirable levels (NCEP, 2012)	AW group (Mean ± SD)			't' value	Control group (Mean ± SD)			't' value	't' value Initial-E Vs Initial-C	't' value AW Vs Con
		Initial	Final	Diff		Initial	Final	Diff			
Total cholesterol	< 200 mg/dl	269.67 ±18.91	233.03 ±22.59	-36.63 ± 9.77	**20.53****	263.03 ±16.35	265.50 ± 23.52	-2.47 ±17.15	0.79^{NS}	**1.85^{NS}**	**10.96****
LDL Cholesterol	< 130 mg/dl	179.63 ±17.40	140.63 ±22.70	-39.00 ±28.91	**7.39****	185.33 ±13.49	186.43 ±21.12	-1.10 ±17.99	0.34^{NS}	**1.36^{NS}**	**6.00****
HDL Cholesterol	> 50 mg/dl	41.37 ±2.82	51.47 ±7.17	10.10 ±7.85	**7.04****	42.33 ±2.63	43.80 ±4.24	1.47 ± 4.44	1.81^{NS}	**1.38^{NS}**	**5.97****
Triglycerides	< 150 mg/dl	247.53 ±36.88	202.63 ±34.19	-44.90 ± 21.69	**11.34****	177.87 ±69.04	177.97 ±63.81	-0.10 ±16.07	0.03^{NS}	**5.05****	**8.58****
VLDL Cholesterol	< 30 mg/dl	48.93 ±7.20	40.93 ±7.09	-8.00 ±3.09	**14.20****	35.37 ±13.79	35.27 ±12.85	-0.10 ±3.13	0.18^{NS}	**4.85****	**9.54****
TC/HDL Ratio	Upto 5.0	6.53 ±0.54	4.60 ±0.71	-1.93 ±0.76	**13.94****	6.24 ±0.61	6.13 ±0.91	-0.11 ±0.74	0.78^{NS}	**2.17***	**10.61****

****Significant at (P<0.01)** ***Significant at (P<0.05)** **^{NS}Not Significant** **E - AW group** **C- Control group**

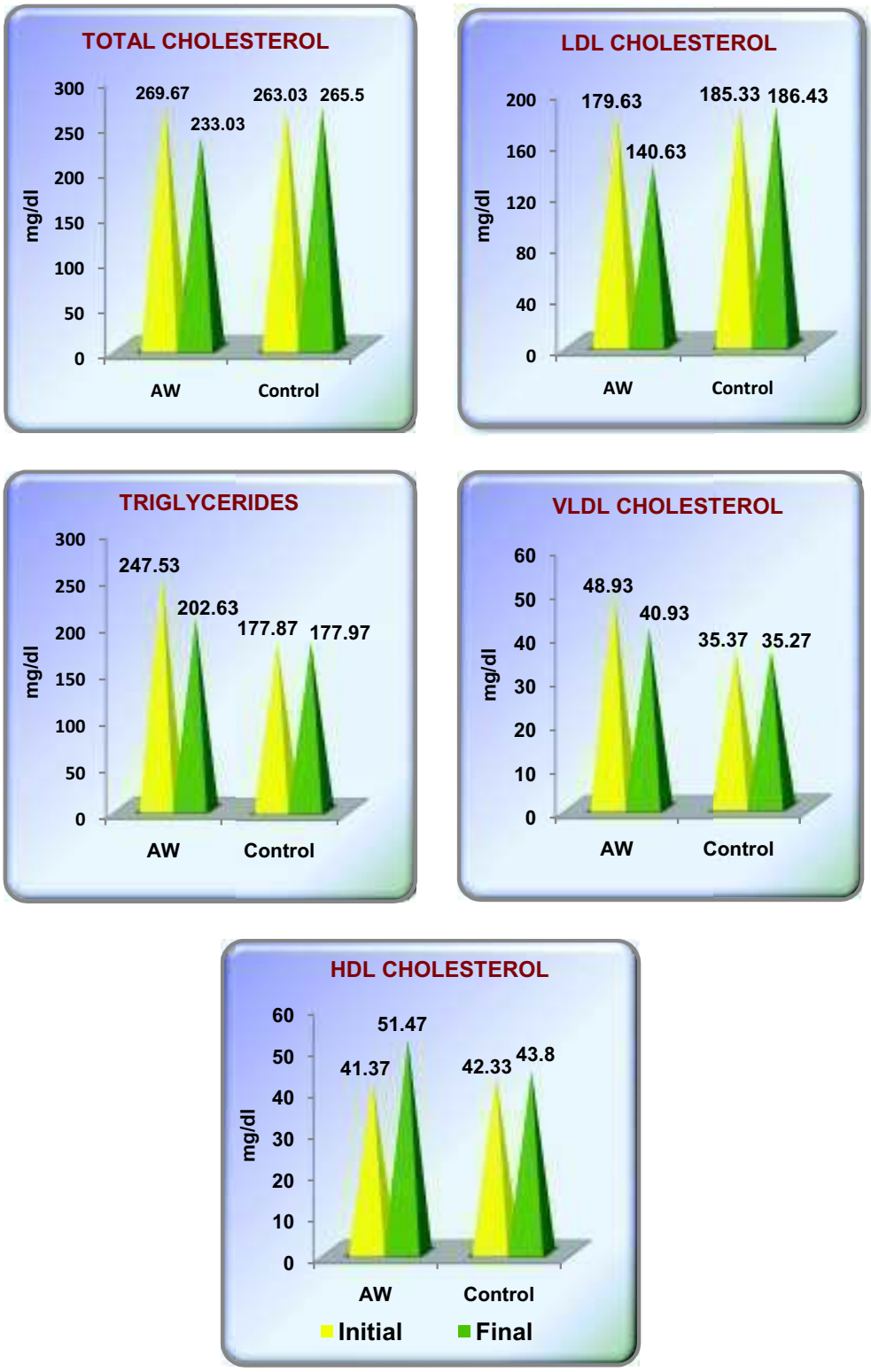


FIGURE 15 - LIPID PROFILE OF AW AND CONTROL GROUP

total cholesterol from 269.67 mg/dl to 233.03 mg/dl before and after the intervention period respectively. With regard to the total cholesterol level of AW group compared with control group the difference was statistically proved to be significant at ($P<0.01$) level. Initial (263.03 mg/dl) and final (265.50 mg/dl) values recorded for the control group was statistically analysed and found to be not significant.

The mean initial LDL cholesterol level (179.63 mg/dl) of the AW group was lowered (140.63 mg/dl) and it was almost nearer to the desirable value after the intervention period. It was clearly showed that the significant difference between the two values was at ($P<0.01$) level within the supplemented group AW and between the groups (AW and control). There was no significant difference was recorded between the initial levels of the AW and control group and also between the initial (185.33 mg/dl) and final (186.43 mg/dl) levels of the control group.

The mean HDL level of the AW group was 41.37 mg/dl before the intervention and it got increased to 51.47 mg/dl with the difference of 10.10 mg/dl after the intervention period. The difference was highly significant with the 't' value of 7.04. With regard to the AW group and control group the difference between the initial and final values showed a statistical significance at ($P<0.01$). The initial values of the both groups were compared and found that there is no statistical significance between the groups. The HDL cholesterol levels recorded initially and finally for the control group was compared and found to be not significant.

When comparison was made between the initial and final levels of AW group of both mean triglyceride and VLDL cholesterol levels, there was significant reduction at ($P<0.01$) level after the intervention period with the values got reduced from 247.53 mg/dl to 202.63 mg/dl and 48.93 mg/dl to 40.93 mg/dl respectively. Significant difference ($P<0.01$) was also observed within the initials of AW and control group and also the difference between the AW and control group with regard to both triglyceride and VLDL cholesterol levels. In the case of control group, significant difference was not found in both triglyceride and VLDL cholesterol levels when the initial and final values were analyzed statistically.

It was clearly stated that there was a significant increase (P<0.01) in the TC/HDL ratio from 6.53 to 4.60. Significant difference at (P<0.05) level was observed between the initial level of the AW and control group and significance at (P<0.01) level was recorded between the groups (AW and control). The TC/HDL ratio was found to be not significant with initial (6.24) and final (6.13) levels of the control group before and after the intervention period of 90 days.

Handful of nuts per day keeps health risks away. Nuts like almond and walnut intake daily reduces the LDL cholesterol and thereby decreasing total cholesterol level, thus lowering the risks of hyperlipidemia. In a case-control study by Zibaeenezhad *et al.,* (2005), determined the lipid-lowering properties of walnut in Group A (consumed walnuts) and Group B (consumed no walnuts) of20 per day for 8 weeks. Triglycerides, total high-density lipoprotein (HDL), and low-density lipoprotein (LDL) levels were checked initially, after 4 weeks and at 8 weeks during study. In group A, the mean plasma TG level dropped by 17.1 per cent from the baseline and HDL cholesterol also increased significantly by 9 per cent. It was shown that frequent consumption of nuts in the daily diet was associated with a potentially decreased risk of coronary artery disease by decreasing the level of triglyceride and increasing the level of HDL.A recent meta-analysis of 13 studies found that 40–100g of walnuts a day can lower both total and 'bad' LDL cholesterol levels without effecting 'good' HDL cholesterol. In addition it was found that walnut enriched diets raised antioxidant capacity and improved inflammatory markers, with no adverse effects on body weight measured as BMI (Banel and Hu, 2009).

c. Supplementation with Flaxseed and Garlic (FG group)

Table XLIII and Figure 16 depicts the various levels of lipid profile of the hyperlipidemics before and after the intervention with flaxseed and garlic (FG) powder as a supplement for a period of three months.

The mean total cholesterol level of the FG group was 256.50 mg/dl before the intervention and was reduced to 217.67 mg/dl after the intervention period. The difference between the initial and final total cholesterol levels were statistically analyzed and recorded to be significant at (P<0.01) level. Comparison was made

TABLE XLIII

SERUM LIPID PROFILE OF FG AND CONTROL GROUP BEFORE AND AFTER THE INTERVENTION

Lipid Parameters (mg / dl)	Desirable levels (NCEP, 2012)	FG group (Mean ± SD)			't' value	Control group (Mean ± SD)			't' value	't' value Initial-E Vs Initial-C	't' value FG Vs Con
		Initial	Final	Diff		Initial	Final	Diff			
Total cholesterol	< 200 mg/dl	256.50 ±12.14	217.67 ±22.37	-38.83 ± 16.84	**12.63****	263.03 ±16.35	265.50 ± 23.52	-2.47 ±17.15	0.79^{NS}	**1.62^{NS}**	**9.71****
LDL Cholesterol	< 130 mg/dl	189.80 ±12.55	142.53 ±23.27	-47.27 ±18.47	**14.02****	185.33 ±13.49	186.43 ±21.12	-1.10 ±17.99	0.34^{NS}	**1.37^{NS}**	**11.06****
HDL Cholesterol	> 50 mg/dl	40.57 ±2.51	53.13 ±5.56	12.57 ±5.89	**11.69****	42.33 ±2.63	43.80 ±4.24	1.47 ± 4.44	1.81^{NS}	**2.84****	**8.11****
Triglycerides	< 150 mg/dl	131.70 ±16.54	111.43 ±15.98	-20.27 ± 15.96	**6.95****	177.87 ±69.04	177.97 ±63.81	-0.10 ±16.07	0.03^{NS}	**3.51****	**5.77****
VLDL Cholesterol	< 30 mg/dl	26.13 ±3.27	22.00 ±3.31	-4.13 ±3.32	**6.82****	35.37 ±13.79	35.27 ±12.85	-0.10 ±3.13	0.18^{NS}	**3.53****	**5.47****
TC/HDL Ratio	Upto 5.0	6.35 ±0.48	4.13 ±0.59	-2.22 ±0.72	**16.92****	6.24 ±0.64	6.13 ±0.91	-0.11 ±0.74	0.78^{NS}	**0.76^{NS}**	**11.39****

****Significant at (P<0.01)** **^{NS}Not Significant** **E-FG group** **C-Control group**

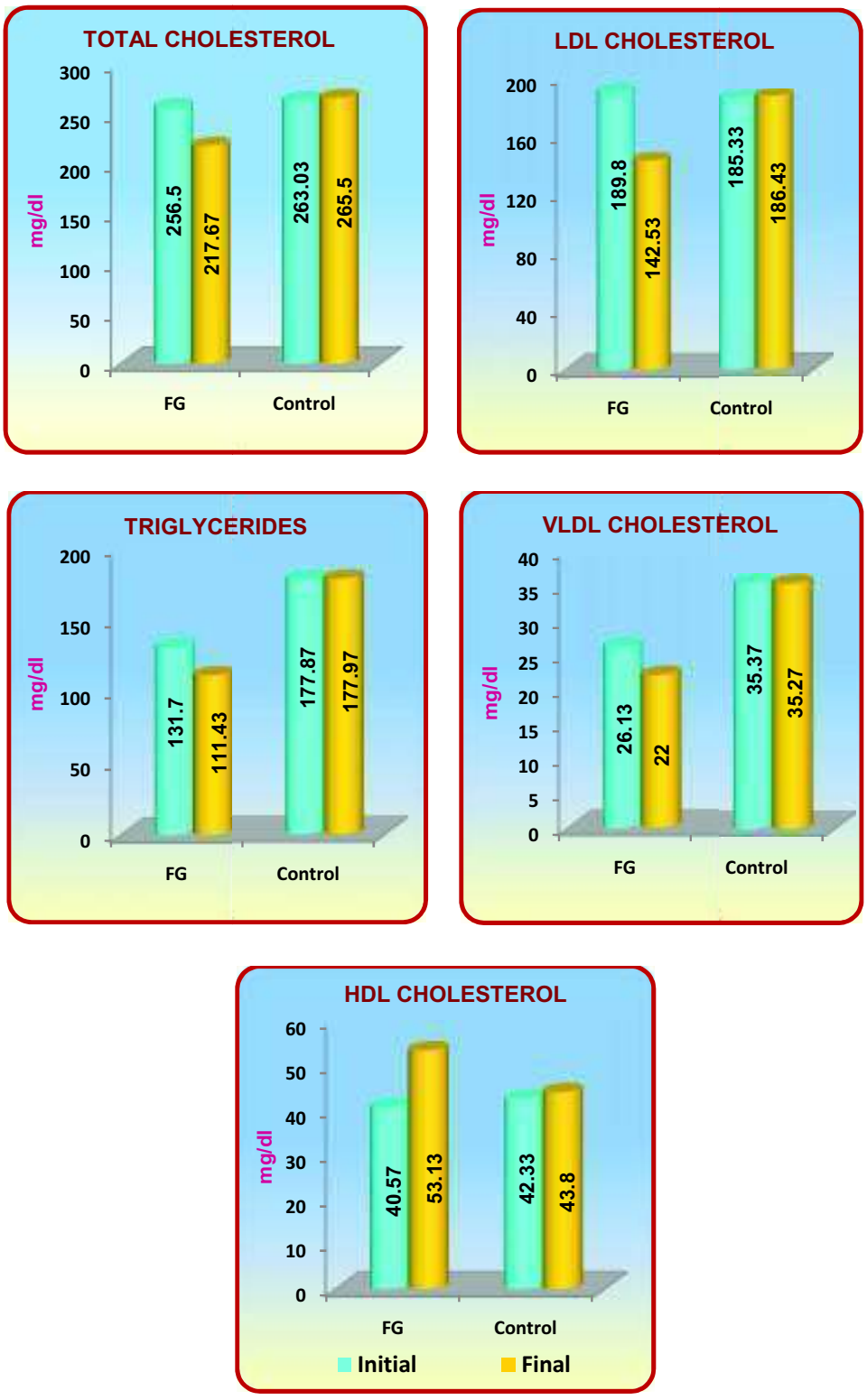


FIGURE 16 - LIPID PROFILE OF FG AND CONTROL GROUP

between the FG and control group before and after the intervention period the total cholesterol level was found to be significant at (P<0.01) level. There was no significant difference before and after the intervention period within the control group and between the initial levels of FG and control group.

It was evident that there was reduction in the mean LDL cholesterol levels of the FG group from 189.80 mg/dl to 142.53 mg/dl with a reduction of 47.27 mg/dl and was statistically significant at (P<0.01). When the initial (185.33 mg/dl) and final (186.43 mg/dl) LDL cholesterol levels of the control group were compared and analyzed statistically the results revealed insignificant differences. Similarly initial levels of the LDL cholesterol of FG and control group were found to be not significant. LDL cholesterol level of the FG group was significantly different from control group at (P<0.01) level.

The HDL cholesterol level was within the desirable level after the intervention period of 90 days in the hyperlipidemics who had supplemented with flaxseed and garlic (FG). The level of HDL cholesterol was increased from 40.57 mg/dl to 53.13 mg/dl with a difference of 12.57 mg/dl. This was statistically analyzed and found to be significant at (P<0.01) level. The difference between the initial and final levels of the FG (12.57 mg/dl) and control (1.47 mg/dl) group were statistically insignificant at (P<0.01) level. There was no significant difference with the initial (42.57 mg/dl) and final (43.8 mg/dl) levels of the control group. When the comparison was calculated between the initial levels of both the groups, the result revealed that the values differ significantly at (P<0.01) level.

The mean triglyceride and VLDL cholesterol levels are interrelated with each other and as the triglyceride level increases VLDL cholesterol also increases. The mean triglyceride level was decreased from 131.7 mg/dl to 111.43 mg/dl and VLDL cholesterol level from 26.13 mg/dl to 22 mg/dl respectively before and after the intervention period of three months. Both the parameter levels are within the desirable range and was statistically analyzed and proved to be significant at (P<0.01) level. The significant difference was also observed between the initial levels of FG and control group and between the groups (FG and control) at

(P<0.01) level. No statistical significance was observed in the initial and final values of the control group as excepted.

It was evident from Table XLIII that the TC/HDL ratio of the FG group was decreased from 6.35 to 4.13 and the difference in the ratio was statistically proved to be significant at (P<0.01) level. Statistical significance was not found in the initial and final levels of the control group. A similar result was observed between the initials of FG and control group. TC/HDL ratio recorded for FG and control group before and after the intervention was found to be significant at (P<0.01) level.

In another study involving 40 patients with high cholesterol (greater than 240 mg/dl), daily consumption of 20 grams of ground flaxseed was compared to taking a statin drug. After 60 days, significant reductions were seen in total cholesterol; LDL cholesterol, triglycerides and the ratio of total to HDL cholesterol-in both groups. Those receiving flaxseed did just as well as those given statin drugs. Body mass index, total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, and the ratio of total cholesterol/HDL-cholesterol were measured at the beginning of the study and after 60 days. In those eating flaxseed, significant reductions were seen in total cholesterol (-17.2 per cent), LDL-cholesterol (-3.9 per cent), triglycerides (-36.3 per cent) and the ratio of total cholesterol/HDL-cholesterol (-33.5 per cent) were observed in the diet+flax group, compared to baseline. Similar reductions were seen in those taking the statin. Benefits did not significantly differ between the two groups (http://www.whfoods.com/genpage.php?tname= fightdz&dbid=29).

Flaxseed, the most benefit is due to its awesome characteristics and garlic, a natural antioxidant had helped the hyperlipidemics to lower their total cholesterol and LDL cholesterol levels. Thus reducing the risks of hyperlipidemia and other related cardiovascular problems. A meta-analysis of 26 studies reported in 2012 found that garlic significantly reduced total cholesterol and triglyceride levels but not HDL and LDL. Compared with the placebo groups, serum total cholesterol and triglyceride levels in the garlic group were reduced by 0.28 (95 per cent CI, −

0.45, − 0.11) mmol L−1 (P = 0.001) and 0.13 (95 per cent CI, − 0.20, − 0.06) mmol L−1 (P < 0.001), respectively. The benefits of garlic were greater for individuals who used it long-term and who had higher baseline total cholesterol levels (Zeng *et al.,* 2012).

d. Supplementation with Flaxseed (FS group)

The effect of flaxseed (FS) supplement on various parameters of lipid profile of the hyperlipidemics before and after the intervention period is given in Table XLIV and Figure 17.

When comparison was made between the initial and final lipid parameter levels of the hyperlipidemic subjects who were supplemented with the flaxseed of FS group, significant difference was seen in the mean total cholesterol level before (255.67 mg/dl) and after (210.63 mg/dl) the intervention period at (P<0.01) level. No significant difference was observed in the initial (263.03 mg/dl) and final (265.50 mg/dl) levels of the control group. Significant difference was also not shown between the initial levels of FS and control groups. It signifies that there was significant difference at (P<0.01) level for the total cholesterol level between the FS and control group.

The mean LDL cholesterol level of the hyperlipidemics had lowered from 187.63 mg/dl to 136.47 mg/dl in FS group due to the dietary intervention. It denotes the significant difference between the initial and final levels of LDL cholesterol at (P<0.01) level. Initial (185.33 mg/dl) and final (186.43 mg/dl) levels of LDL cholesterol of control group was found to be non-significant. Similarly insignificant difference was seen between initial levels of FS and control group. However the difference in the LDL cholesterol levels of the FS group compared with control group was found to be significant at (P<0.01) level.

TABLE XLIV

SERUM LIPID PROFILE OF FS AND CONTROL GROUP BEFORE AND AFTER THE INTERVENTION

Lipid Parameters (mg / dl)	Desirable levels (NCEP, 2012)	FS group (Mean ± SD)			't' value	Control group (Mean ± SD)			't' value	't' value Initial-E Vs Initial-C	't' value FS Vs Con
		Initial	Final	Diff		Initial	Final	Diff			
Total cholesterol	< 200 mg/dl	255.67 ±13.28	210.63 ±29.81	-45.03 ± 24.39	**10.11****	263.03 ±16.35	265.50 ± 23.52	-2.47 ±17.17	0.79^{NS}	**1.89^{NS}**	**8.73****
LDL Cholesterol	< 130 mg/dl	187.63 ±11.33	136.47 ±28.33	-51.17 ±24.14	**11.61****	185.33 ±13.49	186.43 ±21.12	-1.10 ±17.99	0.34^{NS}	**0.67^{NS}**	**9.52****
HDL Cholesterol	> 50 mg/dl	41.47 ±2.74	52.23 ±6.54	10.77 ±6.52	**9.04****	42.33 ±2.63	43.80 ±4.24	1.47 ± 4.44	1.81^{NS}	**1.27^{NS}**	**6.18****
Triglycerides	< 150 mg/dl	133.47 ±25.20	111.17 ±27.43	-22.30 ± 18.07	**6.76****	177.87 ±69.04	177.97 ±63.81	-0.10 ±16.07	0.03^{NS}	**3.34****	**4.94****
VLDL Cholesterol	< 30 mg/dl	26.57 ±5.07	21.93 ±5.49	-4.63 ±3.72	**6.83****	35.37 ±13.79	35.27 ±12.85	-0.10 ±3.13	0.18^{NS}	**3.33****	**4.97****
TC/HDL Ratio	Upto 5.0	6.19 ±0.45	4.08 ±0.73	-2.11 ±0.68	**16.86****	6.24 ±0.61	6.13 ±0.91	-0.11 ±0.74	0.78^{NS}	**0.35^{NS}**	**10.07****

****Significant at (P<0.01)** **^{NS}Not Significant** **E - FS group** **C - Control group**

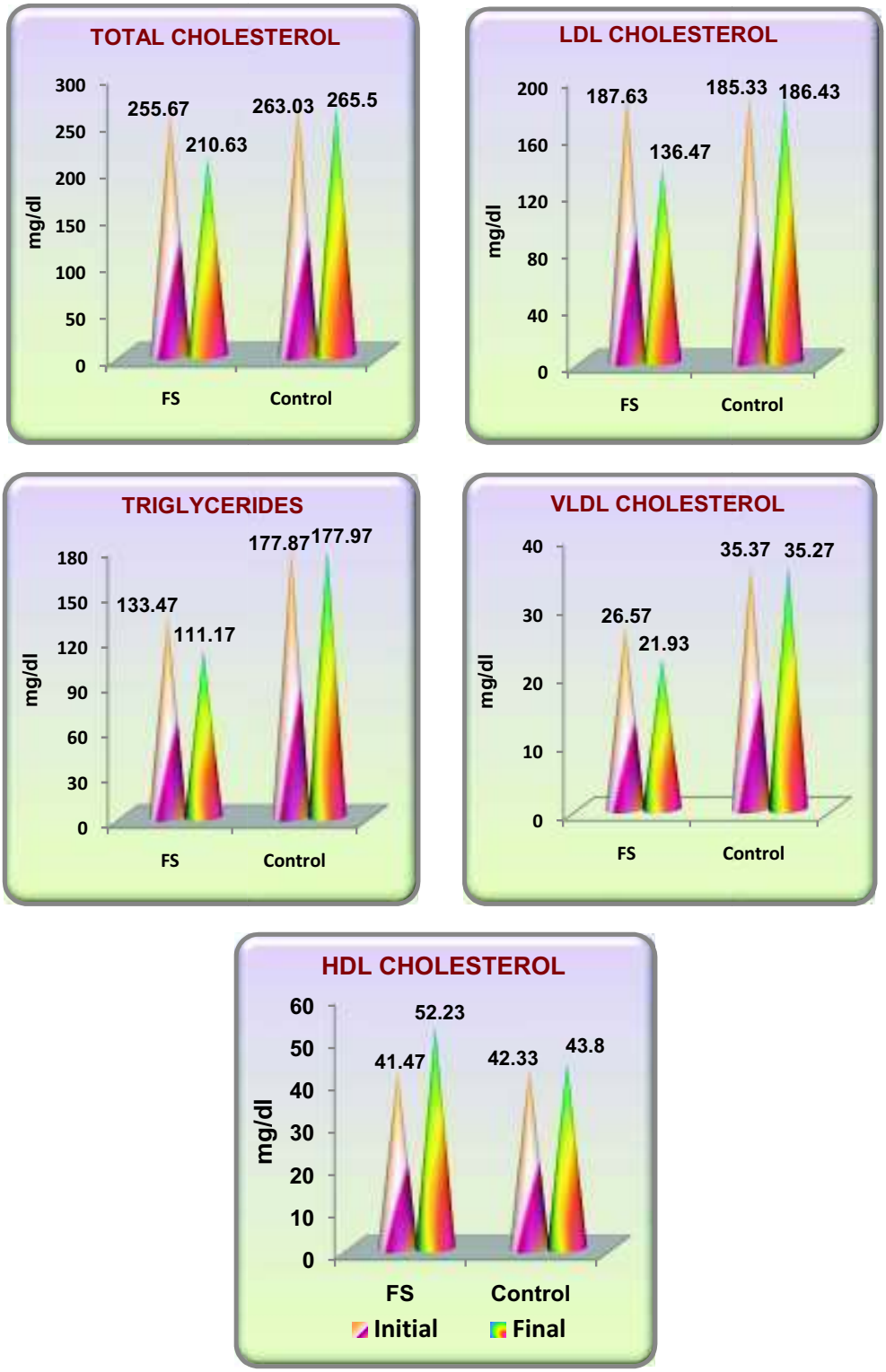


FIGURE 17 - LIPID PROFILE OF FS AND CONTROL GROUP

From Table XLIV, the mean HDL cholesterol level of the FS group was increased from 41.47 mg/dl to 52.23 mg/dl before and after the intervention period and signifies at (P<0.01) level. Statistical significance was not observed between the initial (42.33 mg/dl) and final (43.80 mg/dl) levels of the control group and also between the initial HDL cholesterol levels of the two groups. The difference in HDL cholesterol level after the intervention period was recorded as 10.77mg/dl in FS group and was compared with the difference noted in the control (1.47 mg/dl) group and found to be significant at (P<0.01) level.

The triglyceride level of the FS group showed significant decrease from 133.47 mg/dl to 111.17 mg/dl and VLDL cholesterol level also decreased from 26.57 mg/dl to 21.93 mg/dl before and after the intervention period respectively with a statistical difference at (P<0.01) level. Significant difference was not seen within the control group before and after the intervention period. Both triglyceride and VLDL cholesterol levels were found to be statistically significant at (P<0.01) level for initial levels of FS and control group and also between the groups (FS and control).

It clearly showed that the significant difference at (P<0.01) level was observed in case of TC/HDL ratio of FS group from 6.19 to 4.08 and it was also found to be significant at (P<0.01) level when compared with the control group. There was no significant difference within the control group. When comparison was made between initial levels of both the groups, statistical significance was not observed.

Flaxseed is a natural laxative of dietary fibre which helps to lower the metabolism, thus reducing the effect of cholesterol of various cardiovascular problems of the hyperlipidemic subjects.

Compared to control, Flax drink lowered fasting total-cholesterol and LDL-cholesterol by 12 and 15 per cent respectively (P< 0.01), whereas Flax bread only produced a reduction of 7 and 9 per cent respectively (p < 0.05). Both Flax drink and Flax bread resulted in decreased plasma total and LDL-cholesterol (Kristensen *et al.,* 2012).

Bassett (2009), reviewed in several clinical trials, reported that daily consumption of flax seed lowers total cholesterol by 6-11 per cent and LDL cholesterol by 9-18 per cent in people with normal cholesterol profiles and 5-17 per cent for total cholesterol and 4-10 per cent for LDL-cholesterol in hypercholesterolemic patients as well as lowers various markers associated with atherosclerotic CVD in humans. It also significantly decreases in the people who have high cholesterol levels. It also reports that 100 g of whole or ground flax seed contains approx. 41 g of fat, of which > 50 per cent is omega-3 fatty acid, alpha-linolenic acid, 20g of protein, 29 g of carbohydrates, 28 g of fiber, up to 2.6 g of lignan (antioxidant) and 450 calories. Fiber / lignin content are responsible for the hypercholesterolemic action while the ALA contributes to the anti-atherogenic effects. A high intake of flax seed in several human studies showed a decrease in multiple risk factors for cardiovascular disease.

Jessica (2013) in her article concluded that the use of flaxseed significantly improved the total cholesterol levels. In the study 30 participants were divided into flax-seed group and control group. The flax-seed group received flax-seed powder to take twice per day with meals (5 grams with lunch, 5 grams with dinner; n=18) for 1-month. The control group (n=11) was not given any flax-seed supplementation or placebo. Significant improvements in lipid levels were also shown in the flax-seed group. Total cholesterol was significantly lowered (200.3 +/- 39.8 to 175.1 ± 34.7 mg/dl; $p<0.001$), triglycerides were significantly lowered (197.4 ± 86.1 to 167.9 ± 56.5 mg/dl; $p<0.001$) and LDL or “bad” cholesterol was also significantly lowered (115.4 ± 36/9 to 96.3 ± 29.3 mg/dl; $p<0.005$).

In another study forty hyperlipidemic patients with plasma total cholesterol greater than 240 mg/dl were distributed in 3 groups: 10 patients received hypo-lipidic diet (diet group), 10 patients received hypo-lipidic diet plus statins (diet+HL group) and 20 patients received hypo-lipidic diet plus 20 g ground flax-seeds/day (diet+flax group). Flaxseed supplementation was associated with significant reductions in TC (-17.2 per cent), LDL-C (-3.9 per cent), TG (-36.3 per cent) and TC/HDL-C ratio (-33.5 per cent). Dietary flaxseed significantly improves

lipid profile in hyperlipidemic patients and may favourably modify cardiovascular risk factors (Mandaşescu *et al.,* 2005).

Flaxseed significantly reduced circulating total and LDL-cholesterol concentrations, but the changes were dependent on the type of intervention, sex and initial lipid profiles of the subjects. Further studies are needed to determine the efficacy of flaxseed on lipid profiles in men and premenopausal women and to explore its potential benefits on other cardio-metabolic risk factors and prevention of cardiovascular disease (An *et al.,* 2009).

e. Comparison of mean difference and 't' values of the lipid profile between experimental groups

The mean difference of the experimental groups is presented in the Table XLV.

TABLE XLV

MEAN DIFFERENCE OF THE INTERVENTION GROUPS

Lipid parameters (mg/dl)	Groups			
	FAW	AW	FG	FS
Total cholesterol	-48.43	-36.63	-38.83	-45.03
LDL cholesterol	-47.87	-39.00	-47.27	-51.17
HDL cholesterol	9.00	10.10	12.57	10.77
Triglycerides	-47.37	-44.90	-20.27	-22.30
VLDL cholesterol	-9.57	-8.00	-4.13	-4.63
TC/HDL ratio	-2.08	-1.93	-2.21	-2.11

Among the four experimental groups, FAW group had a maximum reduction of 48.43 mg/dl of total cholesterol followed by FS group (45.03 mg/dl), FG group (38.83 mg/dl) and AW group (36.63 mg/dl).

With regard to the LDL cholesterol, FS group (51.17 mg/dl) showed a tremendous decrease and the next in order comes is FAW group (47.87 mg/dl), FG group (47.27 mg/dl) and AW group (39.00 mg/dl).

In the case of HDL cholesterol the increase was from 9 mg/dl to 12.5 mg/dl in all the intervention groups. The highest reduction was seen in FG group (12.57 mg/dl) and least in FAW group (9.00 mg/dl).

Triglycerides showed a maximum reduction in FAW (47.37 mg/dl) and minimum in FG group (20.27 mg/dl).

With regard to VLDL cholesterol the highest reduction was seen in FAW (9.57 mg/dl) and the least reduction in FG group (4.13 mg/dl).

TC/HDL ratio observed in FG group (2.21) followed by FS group (2.11), FAW group (2.08) and AW group (1.93).

The t values between the experimental groups were given in Table XLVI.

TABLE XLVI

COMPARISON OF THE 't' VALUES OF SERUM LIPID PROFILE OF BETWEEN THE INTERVENTION GROUPS

Lipid parameters (mg/dl)	Groups					
	FAW & AW	FAW & FG	FAW & FS	AW & FG	AW & FS	FG & FS
Total cholesterol	3.71**	2.09*	0.54 NS	0.62 NS	1.68 NS	1.23 NS
LDL cholesterol	1.29 NS	0.12 NS	0.49 NS	1.30 NS	1.70 NS	0.77 NS
HDL cholesterol	0.57 NS	2.07*	1.03 NS	1.27 NS	0.34 NS	1.32 NS
Triglycerides	0.53 NS	5.93**	5.27**	5.02**	4.96**	0.55 NS
VLDL cholesterol	1.82 NS	6.05**	5.18**	4.19**	4.73**	0.68 NS
TC/HDL ratio	0.77 NS	0.74 NS	0.17 NS	1.49 NS	0.95 NS	0.73 NS

****Significant (P<0.01)** ***Significant (P<0.05)** **NSNot Significant**

Table XLVI clearly depicts the comparison between the experimental groups. The difference between the initial and final levels of the lipid parameters of all the experimental groups were compared and analysed statistically.

The comparison between FAW and AW groups shows that there is a significant difference in the total cholesterol level at (P<0.01) level with a 't' value of 3.71. No significant difference between the groups with regard to LDL cholesterol, HDL cholesterol, triglycerides, VLDL cholesterol and TC/HDL ratio.

When FAW and FG groups are compared, statistically proved significant difference was found in the total cholesterol and HDL cholesterol at (P<0.05) level. Triglycerides and VLDL cholesterol levels showed a statistical significance at (P<0.01) level. No significant difference was found in the LDL cholesterol and TC/HDL ratio.

The experimental groups FAW and FS clearly showed that there was no significant difference was found in all the lipid parameters except triglycerides and VLDL cholesterol. Statistical significant difference was found in the levels of triglycerides and VLDL cholesterol with the 't' value of 5.27 and 5.18 respectively at (P<0.01) level.

Almond and walnut (AW) and Flaxseed and Garlic (FG) were compared and statistically analyzed. The statistical significance was not found in the levels of total cholesterol, LDL cholesterol, HDL cholesterol and TC/HDL ratio. But statistical significance was found in the levels of triglycerides and VLDL cholesterol at (P<0.01) level.

The experimental groups of Almond and walnut (AW) and Flaxseeds (FS) were compared statistically. The statistical analysis showed insignificant in the levels of total cholesterol, LDL cholesterol, HDL cholesterol and TC/HDL ratio. Triglycerides and VLDL cholesterol levels showed statistical significance at (P<0.01) level.

When the comparison was made between the experimental groups of Flaxseed and Garlic (FG) and Flaxseeds (FS), the statistical results showed no significant difference in all the lipid parameters.

When the mean difference and 't' values obtained were compared within the intervention groups, the group supplemented with FAW was found to be the best in lowering total cholesterol and triglycerides levels when compared to other groups.

f. Correlation analysis

- **Income and Cholesterol levels**

The hypothesis set for the correlation is when the income increases there is an increased blood cholesterol levels. Correlation was computed between the income and cholesterol levels of the one thousand hyperlipidemic subjects selected, the chi-square analysis revealed that the income level had influence on the cholesterol levels (χ^2=15.730, P<0.01). Therefore, the hypothesis concluded that as the income level increases cholesterol level also increases and is associated with one another.

- **Activity and cholesterol levels**

The activity level of the hyperlipidemic subjects determines the cholesterol levels maintained individually. When the activity level increases blood cholesterol levels decreases. The values were recorded and correlation was computed using chi-square analysis between the activity and cholesterol levels of the one thousand hyperlipidemics selected revealed that the activity level effects the cholesterol levels among the individuals (χ^2= 32.919 P<0.01). Hence it can be concluded that the activity level is a major player towards the lowering of cholesterol levels.

- **Fat intake and cholesterol levels**

The hypothesis set for the correlation is when fat consumption increases total cholesterol levels may increase or decrease depending on the type of fat consumed by the individual. The fat consumption by the individual was calculated and computed for correlation. The ‘r’ value is 0.097 and compared to be low degree correlation.

- **Body weight and cholesterol levels**

The relationship between the body weight and total cholesterol always remains to be interrelated and is the cause for many risk factors which leads to various degenerative diseases.

Body weight and total cholesterol levels of the intervention groups were correlated and computed as given in Table XLVII.

TABLE XLVII

CORRELATION BETWEEN LIPID PROFILE AND BODY WEIGHT OF THE SELECTED HYPERLIPIDEMICS

Lipid parameters (mg/dl)	Groups				
	FAW	AW	FG	FS	CON
Total cholesterol	+0.267	-0.287	+0.205	+0.288	+0.237
LDL cholesterol	+0.286	-0.339	+0.167	+0.235	+0.108
HDL cholesterol	-0.290	-0.040	+0.009	-0.039	-0.007
Triglycerides	+0.005	+0.023	+0.139	+0.238	+0.173
VLDL cholesterol	-0.015	+0.041	+0.113	+0.250	+0.176
TC/HDL ratio	+0.406	-0.203	+0.134	+0.284	+0.128

From Table XLVII, it revealed that the FAW group showed positive correlation in the lipid parameters of total cholesterol, LDL cholesterol and TC/HDL ratio. Negative correlation was seen in HDL cholesterol, triglycerides and VLDL cholesterol

The AW group showed negative correlation with total cholesterol, LDL cholesterol, HDL cholesterol and TC/HDL ratio, whereas triglycerides and VLDL cholesterol showed positive correlation. There observed low degree correlation between the body weight and lipid profile of AW group

It was surprising to note that lipid profile of FG group when correlated with body weight, the results showed low degree positive correlation of all the lipid parameters.

In FS group also the correlation between the lipid parameters and body weight showed a low degree positive correlation except for HDL cholesterol which showed negative correlation.

Similar results were observed in the control group which showed low degree positive correlation of all the lipid parameters except for the HDL cholesterol, showing negative correlation.

The correlation between the cholesterol level and body weight of the hyperlipidemics was recorded and computed for the intervention groups, the results showed that r value is 0.10 and considered to be low degree correlation. It clearly says that the body weight and cholesterol were interrelated and as the body weight increases there were chances of increase in the cholesterol level.