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Effect of fish oil, garlic oil supplementation and nutrition counselling on daily food and nutrient intake of at risk coronary heart subjects

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A group of 90 male subjects aged 30-50 years who were at risk of coronary heart disease were purposively selected. Nutritional status was assessed using dietary survey, 24 hour recall cum weighment method. Subjects were followed for one month and no treatment was given except the prescribed medicines and were treated as self control. Subjects were divided into three groups of 30 subjects each. Supplementation with fish oil capsules 300 mg was done in group I, with garlic oil capsules (250 mg) n group II and nutrition counseling with special emphasis on the use of raw garlic and fish in daily diet was imparted in group III. At the end of study significant decrease was seen in mean daily intake of meat and poultry, fats and oils, sugar and jaggery, GLVs, nuts and oilseeds in all the three groups. Intake of refined cereals, roots and tubers decreased in group I and II whereas milk and milk products in group III. Significant increase was seen in intake of pulses and legumes, other vegetables, fruits in all the three groups. Significant decrease was also seen in daily intake of energy, total fat, SFA, PUFA : SFA, cholesterol, n-6 fatty acids and n-6/n-3 ratio whereas intake of n-3 fatty acids, dietary fibre, MUFA and protein to increased in all the three groups. Significant increase in intake of cardioprotective foods was more in nutrition counseling group as subjects were advised to make dietary modifications also.

Key Words : Fish oil, Garlic oil, Nutrition Counseling, Coronary heart disease

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INTRODUCTION

Coronary heart disease is caused when heart is deprived of enough blood and oxygen due to coronary arteries getting blocked with fatty deposits or plaque. Formation of blood clot or blockage of coronary arteries leads to discomfort and chest pain, which suddenly cuts off blood flow in the arteries and hence leads to heart attack. Cardiovascular disease claims more lives each year than the next 5 leading causes of death combined. Heart disease and stroke kill 17 million people per year, which is almost one third of all deaths globally. By 2020, heart disease and stroke will become the leading cause of death and disability worldwide with number of fatalities projected to increase over 20 million a year and by 2030 to over 24 million a year. Coronary artery disease (CAD) is highly predictable, preventable and treatable. Judicious selection of cardioprotective foods is must in such situation. There is a growing evidence that intake of fish and fish oil decrease the risk of CAD. Fish oil is an abundant source of n-3 PUFA mainly EPA and DHA that lowers blood cholesterol more than vegetable oils. Garlic and various forms of deodourized garlic extracts and garlic oils prepared from it have claimed to possess beneficial effects for the prevention of various aspects of CAD due to antithrombolic properties. Nutrition counseling based on dietary modifications of implemented can decrease the morbidity associated with heart disease and bring about the regression of pathological process.

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METHODOLOGY

Selection of the subjects :

A group of 90 male patients aged 30 -50 who were at risk of coronary heart disease *i.e.* hypertensive, hypercholesterolemia, obese, diabetic or with strong family history of coronary heart disease belonging to middle and high socio-economic status, attending the OPD of Delta Heart Centre, Ludhiana were purposively selected.

Dietary survey :

Nutritional status of at risk coronary heart patients was assessed using dietary survey. Detailed information on food intake was recorded for three consecutive days by using 24 hour recall cum weighment method. The different food items were converted to their raw equivalents and the average intake of nutrients were calculated on raw weight basis using computer programme 'MSU' Nutriguide (Song *et al.*,1992). After assessing the nutritional status subjects were followed for one month period and no treatment was given except the prescribed medicines and were treated as self control. At one month interval nutrient intake was again assessed and subjects were divided into three groups of 30 each. Pretest of KAP was conducted on 30 subjects in nutrition counseling group. Supplementation with fish oil capsules 300 mg (100 mg EPA and 200 mg DHA) thrice a day was done in group I, supplementation with garlic oil capsules 250 mg twice a day was done in group II. Nutrition counseling programme was planned and demonstration regarding use of baked, roasted, grilled, steamed fish on daily basis and inclusion of 2-4 cloves of raw garlic in soups, dals and chutneys was provided. Knowledge regarding heart disease and functions of heart and its related risk factors, heart healthy diet, dietary fats, dietary cholesterol, beneficial effects of fish, fish oils, garlic and garlic oils, healthy dietary and cooking practises was imparted to subjects through charts, posters, floppies, leaflets, lectures and personal discussion to subjects in group III. Experimental trial period was two months. Post collection of data was done to assess the effect of fish oil, garlic oil supplementation and nutrition counseling on daily food and nutrient intake of the subjects.

OBSERVATIONS AND ASSESSMENT

The findings of the present study as well as relevant discussion have been presented under the following heads :

Daily food intake of the subjects :

The mean daily intake of cereals among subjects in group I, II and III were 327.05, 286 and 291.64 g, respectively at baseline (Table 1). A significant decrease was observed in group II and III *i.e.* the percentage adequacy decreased from 76.50 to 69.58 and 77.77 to 49.43 whereas, nonsignificant increase in cereal consumption was observed in group I. As a result of nutrition counselling, subjects of group III started preferring whole cereals, unconventional cereals such as oats, jowar and bajra and avoided refined cereals. Harris and Kris (2010) reported that whole grains high in viscous fibre (oats, barley) decrease serum low-density lipoprotein cholesterol and blood pressure and improve glucose and insulin responses. Grains high in insoluble fibre (wheat) moderately lower glucose and blood pressure but also have a prebiotic effect. The mean daily intake of pulses and legumes among three groups were 45.92, 43.76 and 44.69 g, respectively. Significant increase in intake of pulses to 52.6 g was seen in nutrition counselling group with increase in percentage adequacy from 99.31 to 117.44 as the subjects started opting for whole pulses, sprouts and soya nuggets. Significant increase in intake to 48.52 g was also seen in group I with increase in percentage adequacy from 102.06 to 107.82 followed by non-significant increase in group II. Antia and Abraham (1997) reported that pulses tend to lower blood cholesterol and blood sugar. Pulses contain high levels of phytochemicals like polyphenols, phytates and saponins that have been shown to offer cholesterol lowering or antioxidant benefits. Clinical studies have shown that regular consumption of pulses can reduce blood levels of total cholesterol and low-density lipoprotein (LDL also known as the "bad") cholesterol - two major risk factors for CVD. Pulses have little or no effect on high-density lipoprotein (HDL or "good") cholesterol or blood lipids (triglycerides) Hernandez *et al.* (2010). Most commonly consumed fruits among subjects at the beginning were banana, orange, grapes and apples. The mean daily intake of fruits among three groups was within the suggested intake. Significant increase was seen in all the groups due to seasonal availability of different fruits such as mangoes, papaya, chikoo, watermelon and guavas. Increase in percentage adequacy was 144.9 to 157.8, 129.54 to 153.6 and 141.74 to 173.82 amongst group I, II and III.

Mean intake of meat and poultry amongst group I and III was above the suggested intake *i.e.* 74.61 g and 81.19 followed by 19.59 g in group II. Subjects were however, not able to differentiate between cholesterol and fat rich foods *i.e.* whole egg, red meat and egg white, white meat that has lower cholesterol and fat content. However, significant decrease was seen in intake of meat and poultry in the nutrition counselling group due to decreased intake of whole egg, mutton and chicken with decrease in percentage adequacy from 162.38 to 144.98. American Heart Association(2014) suggested that red meats have more cholesterol and saturated (bad) fat than chicken, fish and vegetable proteins such as bean. Chicken and fish have less saturated fat than most red meat. The unsaturated fats in fish, such as salmon, actually have health benefits. Omega-3 fatty acids, found in fish and some plant sources, may reduce the risk of cardiovascular disease. However, non-significant decrease in intake of meat and poultry was seen in group I and II. Mean daily intake of

Table 1 : Daily food intake of the subjects (mean±S.E.)

Food group	Group I fish oil supplementation (n_1=30)	Group II garlic oil supplementation (n_2=30	Group III nutrition counselling (n_3=30)	F-ratio	C.D.	Suggested intake (g)#
Cereals						
Baseline	327.05±32.16[a]	286.91±29.14	291.64±31.45[c]	11.34	19.3461	
After Exp.	329.33±30.34[a]	260.93±31.07[b]	185.37±19.64[c]	14.48	38.5223	350-400
Paired t-value	0.84NS	2.11**	4.69**			
Pulses and legumes						
Baseline	45.93±9.14	43.76±8.54	44.69±10.13	1.56	NS	
After Exp.	48.52±9.72	44.27±8.91[b]	52.85±10.52[c]	4.96	6.1309	40-50
Paired t-value	2.21**	0.71NS	3.74***			
Green leafy vegetables						
Baseline	75.98±9.01[a]	97.08±12.34	98.35±12.61[c]	6.51	11.2318	
After Exp.	66.61±6.59	84.51±8.13	71.47±9.24[c]	7.93	4.1855	50-100
Paired t-value	3.96***	3.57***	6.24***			
Other vegetables						
Baseline	135.11±15.21	141.07±17.61	138.51±17.33	2.18	NS	
After Exp.	140.34±16.69[a]	146.65±18.84[b]	153.46±20.26[c]	7.25	6.2518	60-75
Paired t-value	2.37**	2.19**	4.66***			
Roots and tubers						
Baseline	65.11±8.16[a]	62.57±7.56[b]	53.83±6.21[c]	6.13	5.0036	
After Exp.	61.23±6.31	58.18±6.09	59.16±6.64	2.81	NS	70-100
Paired t-value	2.03**	1.97**	2.37**			
Fruits						
Baseline	108.34±15.26[a]	97.16±13.92[b]	106.31±19.65	4.29	5.2107	
After Exp.	118.41±19.97	115.24±18.86[b]	130.37±20.16c	16.51	9.1433	50-100
Paired t-value	3.62***	3.16***	7.72***			
Meat and poultry						
Baseline	74.61±6.43[a]	19.59±1.11[b]	81.19±8.54[c]	5.01	4.2916	
After Exp.	70.22±5.19[a]	15.14±1.98[b]	72.49±6.29	6.43	4.5763	40-60
Paired t-value	1.22NS	1.31NS	3.38***			
Milk and milk products						
Baseline	363.34±0.67	361.57±30.16[b]	378.46±31.19[c]	6.54	10.1656	
After Exp.	387.12±32.34[a]	362.22±31.25[b]	321.93±28.26[c]	19.31	21.0031	200-250
Paired t-value	3.84***	0.89NS	5.46***			
Sugar and jaggery						
Baseline	17.28±2.41	16.07±2.23	18.24±2.52	2.23	NS	
After Exp.	16.19±1.37	14.98±1.97[b]	10.76±0.93[c]	7.45	2.2511	20-30
Paired t-value	1.46NS	1.52NS	5.57***			
Fats and oils						
Baseline	49.35±8.17	51.72±8.84[b]	46.34±7.91	4.98	3.4865	
After Exp.	41.02±6.38[a]	47.5±7.27[b]	23.28±3.14[c]			20-40
Paired t-value	3.35***	1.98**	8.85***			
Nuts and oilseeds						
Baseline	5.47±0.98	5.56±1.01	6.81±1.12	2.61	NS	
After Exp.	4.96±0.89	5.08±0.92[b]	4.11±0.87[c]	4.39	0.6193	--
Paired t-value	1.63NS	1.03NS	2.91***			

#Gopalan *et al.* (2011)
NS=Non-significant ** and *** indicate significance of values at P=0.05 and 0.01, respectively
a=Significant difference between group I and II b=Significant difference between group II and III
c=Significant difference between group III and

milk and milk products among three groups at baseline was more than suggested intake which significantly increased in group-I followed by nonsignificant increase in group-II. However, in group-III significant decrease was observed with decrease in percentage adequacy from 168.20 to 143.08 (Table 2) as subjects started avoiding coffee, sweet dishes, khoya, paneer and preferred to use skim milk for preparing milk and milk based products. Results from short-term intervention studies on CVD biomarkers have indicated that a diet higher in saturated fat from whole milk and butter increases LDL cholesterol when substituted for carbohydrates or unsaturated fatty acids, however, they may also increase HDL and therefore might not affect or even lower the total cholesterol : HDL cholesterol ratio. (Peter and Keigan, 2012) Mean daily intake of sugar amongst three groups was within the suggested range. Significant decrease was seen in group III with decrease in percentage adequacy from 72.96 to 43.04 as majority of subjects avoided adding sugar to milk and beverages. Non-significant decrease was also seen in group I and II owing to doctor's advice. The mean daily intake of fats and oils among three groups were above the suggested intake *i.e.* 49.35, 51.72 and 46.34 g at baseline. Intake of fats and oils ranged from 35 to 90g at baseline and 30 to 75 g/day after the study. Significant decrease was observed in all the three groups with

Table 2 : Percentage adequacy of the foods

Food group	Group I fish oil supplementation (n_1=30)	Group II garlic oil supplementation (n_2=30)	Group III nutrition counselling (n_3=30)	Suggested intake (g)#
Cereals				
Baseline	87.21	76.50	77.77	350-400
After Exp.	87.82	69.58	49.43	
Pulses and legumes				
Baseline	102.06	97.24	99.31	40-50
After Exp.	107.82	98.37	117.44	
Green leafy vegetables				
Baseline	101.30	129.44	131.13	50-100
After Exp	88.8	112.68	95.29	
Other vegetables				
Baseline	200.15	208.9	205.2	60-75
After Exp	207.91	217.25	227.34	
Roots and tubers				
Baseline	76.6	73.61	63.32	70-100
After Exp.	72.03	68.44	69.6	
Fruits				
Baseline	144.4	129.54	141.74	50-100
After Exp	157.8	153.6	173.82	
Meat and poultry				
Baseline	149.2	39.18	162.38	40-60
After Exp.	140.22	30.28	144.98	
Milk and milk products				
Baseline	161.48	160.69	168.20	200-250
After Exp.	172.05	160.98	143.08	
Sugar and jaggery				
Baseline	69.12	64.28	72.96	20-30
After Exp.	64.76	59.92	43.04	
Fats and oils				
Baseline	164.5	172.4	154.4	20-40
After Exp.	136.7	158.83	77.6	
Nuts and oilseeds				
Baseline	-	-	-	-
After Exp.	-	-	-	-

#Gopalan *et al.* (2011)

Table 3 : Daily nutrient take of the subjects (mean±S.E.)

Food group	Group–I fish oil supplementation (n_1=30)	Group–II garlic oil supplementation (n_2=30)	Group–III nutrition counselling (n_3=30)	F-ratio	C.D.	RDA#
Energy (Kcal)						
Baseline	2295.87±51.88	2384.99±39.12	2387.49±44.03	2.03	NS	1800-2400
After Exp.	2320.16±46. 05	2284.26±48.11[b]	1829.11±41.32[c]	8.66	42.244	
Paired t-value	1.57[NS]	2.11**	6.78***			
Protein (g)						
Baseline	59.06±0.70	59.26±0.72[b]	66.46±0.75[c]	8.54	3.44	50-70
After Exp.	62.39±0.73	60.53±0.74[b]	70.23±0.80	9.65	4.21	
Paired t-value	3.89***	1.61[NS]	5.76***			
Carbohydrates(g)						
Baseline	334.12±4.89a	352.06±5.14	357.86±5.34[c]	6.41	6.19	300-340
After Exp.	339.45±4.95	331.12±5.36[b]	267.46±3.44[c]	10.56	17.23	
Paired t-value	1.24[NS]	3.87***	7.23***			
Total fat (g)						
Baseline	80.35±0.93	82.19±0.93[b]	76.69±0.77	7.69	4.21	40-60
After Exp.	79.2±0.63	79.74±0.66[b]	53.15±0.56[c]	7.26	11.3	
Paired t-value	2.53	2.49**	6.39***			
PUFA (g) 1.48						
Baseline	16.04±0.32[a]	19.37±0.55[b]	17.41±0.50	3.62		<18.56
After Exp	18.26±0.52	17.92±0.35[b]	12.19±0.22[c]	4.57		
Paired t-value	2.37***	2.39***	8.26***	1.355		
SFA (g)						
Baseline	44.53±0.86	43.91±0.91	46.34±0.92	2.26	NS	<20
After Exp	41.13±0.72	40.49±0.58[b]	23.65±0.52[c]	9.55	6.22	
Paired t-value	2.46**	3.91***	11.33***			
MUFA (g)						
Baseline	18.88±0.54	18.91±0.53[b]	12.94±0.23[c]	16.21	3.63	<20
After Exp	19.81±0.58	21.33±0.55[b]	17.31±10.43[c]	5.49	1.89	
Paired t-value	1.31[NS]	3.63***	6.73****			
PUFA : SFA						
Baseline	0.3804±0.0007[a]	0.4410±0.0009[b]	0.3757±0.005	21.62	0.21	0.8-1
After Exp	0.4044±0.0009[a]	0.4426±0.00009[b]	0.5154±0.0013	29.37	0.02	
Paired t-value	3.74***	1.34[NS]	13.88***			
Cholesterol (mg)						
Baseline	109.04±1.44[a]	114.26±1.51[b]	102.37±1.38	3.86	3.4844	300
After Exp	106.45±11.19[a]	111.63±1.36[b]	76.28±0.75[c]	19.56	3.5129	
Paired t-value	1.89*	1.36[NS]	19.34***			
Dietary fibre(g)						
Baseline	20.95±0.41	19.91±0.37[b]	18.42±0.39[c]	6.21	1.2116	40
After Exp	22.01±0.44	20.96±0.45[b]	26.80±0.66[c]	8.53	1.3926	
Paired t-value	1.91*	1.84*	12.84***			
n-6 (g)						
Baseline	19.54±0.57	19.23±0.56	18.04±0.54	2.16	NS	11.56
After Exp	18.26±0.54	18.46±0.52[b]	9.21±0.44[c]	14.67	3.35	
Paired t-value	1.69*	1.49[NS]	13.56***			
n-3 (g)						
Baseline	1.52±0.14	1.59±0.18	1.53±0.16	1.68	NS	2.3
After Exp	1.96±0.15	1.63±0.19	2.04±0.18	2.31	NS	
Paired t-value	2.26***	1.03[NS]	2.37**			
n-6 / n-3						
Baseline	12.86±0.44	12.09±0.43	11.79±0.40	2.04	NS	5-10
After Exp	9.31±0.36[a]	11.32±0.37[b]	4.51±0.23[c]	8.64	1.39	
Paired t-value	5.14***	1.71*	13.63***			

#Ghafoorunissa and Krishnaswamy (2004), NS = Non -significant, ***, ** and * indicates of significance of values at P=0.01, 0.05 and 0.1, respectively, a-Significant difference between group I and II, b-Significant difference between group II and III, c-Significant difference between group III and I

increase in percent adequacy from 154.4 to 77.6 in nutrition counselling group. The intake of fats and oils in group III subjects was within the recommended daily intake. They also started using oils in combinations instead of sticking to just one oil. Intake of nuts and oilseeds was more amongst the three groups at the beginning due to winter season. Significant decrease was observed in the mean intake of nuts and oilseeds in group III due to seasonal variation. Non-significant decrease was seen in group I and II. Alper and Mattes (2003) reported that regular peanut consumption lowers TAG and is associated with reduced CVD. Kris *et al.* (2001) reported that diets high in nuts (peanuts, walnuts or almonds) significantly lower the LDL-C and inhibit platelet adhesion and aggregation.

Daily nutrient intake of the subjects :

The mean daily intake of energy in group I, II and III was 2296, 2385 and 2387 Kcal, respectively (Table 3) which was near to upper limit of RDA. Significant decrease was observed in the intake of energy in group II and III with decrease in percentage adequacy 113.57 to 103.77 and 113.69 to 91.86. A decrease in consumption of visible fat and refined cereals by the subjects resulted in the decrease in intake of energy, milk and milk products. Owing to increased intake of refined cereals significant increase in intake of energy was

Table 4 : Percentage adequacy of nutrient compared with RDA

Food group	Group–I fish oil supplementation (n_1=30)	Group–II garlic oil supplementation (n_2=30)	Group–III nutrition counselling (n_3=30)	RDA#
Energy (Kcal)				
Baseline	109.32	113.57	113.69	1800-2400
After exp.	110.48	108.77	91.86	
Protein (g)				
Baseline	98.4	98.76	110.76	50-70
After exp.	103.98	100.88	117.05	
Carbohydrates(g)				
Baseline	104.41	110.01	111.33	300-340
After exp.	106.07	103.47	83.58	
Total fat (g)				
Baseline	160.7	164.38	153.38	40-60
After exp.	158.4	159.48	106.3	
PUFA (g)				
Baseline	86.4	104.36	93.80	<18.56
After exp.	98.38	96.55	65.56	
SFA (g)				
Baseline	222.65	219.55	231.17	<20
After exp.	205.65	202.45	118.25	
MUFA (g)				
Baseline	94.4	94.55	64.7	<20
After exp.	99.05	106.65	86.55	
Cholesterol (mg)				
Baseline	36.34	38.08	34.12	300
After exp.	35.48	37.21	25.42	
Dietary fibre(g)				
Baseline	52.37	49.75	46.05	40
After exp.	55.02	52.4	57.02	
n-6 (g)				
Baseline	169.03	166.34	156.05	11.56
After exp.	157.95	159.68	79.67	
n-3(g)				
Baseline	66.08	69.13	66.52	2.3
After exp.	85.21	70.86	88.69	

#Ghafoorunissa and Krishnaswamy (2004)

seen in group I. Significantly increase in intake of pulses by group I and increased intake of whole pulses, soyabean and sprouted pulses by group III. Singh (2001) and Clarkson (2002) reported that increase in intake of soyabean and pulses could result in 20-30 per cent reductions in heart disease. Significant decrease in the carbohydrate intake from 352.06 to 331.12 and 357.86 to 267.46 was observed due to decrease in intake of refined cereals, sugar and jaggery. Non significant increase was however seen in group I. Intake of complex CHO increased in nutrition counselling due to increased consumption of whole grains, fruits and vegetables. Mean daily intake of total fat was above the suggested intake in all the groups. Highly significantly decrease was observed in intake of total fat in group III with decrease in percentage adequacy from 153.38 to 106.3 (Table 4). Percentage decrease in group III was attributed to avoidance of visible fat, fried food, whole milk, fast food and butter. Highly significant decrease was seen in intake of PUFA in nutrition counselling group as the subjects were advised to use the oils in combination with *desi ghee* instead of sticking just to the refined oils rich in n-6 fatty acids. Significant decrease was also seen in group II, however increased intake of PUFA was seen in group-I owing to the intake of fish. Highly significant decrease was observed in intake of SFA from 46.34 to 23.65 g by the nutrition counselling group with decrease in percentage adequacy from 231.17 to 118.25 but it was still higher than suggested intake, Mehta (2004) reported that SFA showed positive correlation with CVD risk. The mean PUFA : SFA ratio increased significantly from 0.3804 to 0.4044 and 0.3757 to 0.5 154 in group I and III, but was still below the suggested intake. Significant decrease was seen in intake of cholesterol in group I and III but was below the suggested range. Mean intake of dietary fibre significantly increased in all the three groups. Behall *et al*. (2004) reported that increased consumption of fibre rich diet lowers CVD risk by lowering triacyiglycerol by 6, 10 and 16 per cent and total cholesterol by 14, 17 and 20 per cent, respectively. The mean daily intake of n-6 fatty acids in group-I, II and III were 19.54, 19.23 and 18.04, respectively. Highly significant decrease was seen in nutrition counselling group with decrease in percentage adequacy from 156.05 to 79.67. Nutrition counselling resulted in less intake of n-6 fatty acid rich refined oils such as corn, sunflower, safflower.

Simapoulos (1999) reported that high intake of n-6 fatty

Table 5 : Percentage contribution of carbohydrates, protein and fat in total energy

Food group	Group–I fish oil supplementation (n_1=30)	Group–II garlic oil supplementation (n_2=30	Group–III nutrition counselling (n_3=30)	RDA#
Carbohydrates				
Baseline	1336.48 (58.21)	1408.24 (59.05)	1431.44 (59.96)	55-65
After exp	1357.80 (58.52)	1324.48 (57.96)	1069.84 (58.49)	
Protein (g)				
Baseline	236.24 (10.29)	237.04 (9.94)	265.84 (11.13)	10-15
After exp	249.56 (10.75)	242.12 (10.60)	280.92 (15.36)	
Total Fat(g)				
Baseline	723.15 (31.50)	739.71 (31.01)	690.21 (28.91)	15-30
After exp	712.8 (30.72)	717.66 (31.42)	478.35 (26.15)	
PUFA				
Baseline	152.46 (6.64)	174.33 (7.31)	156.69 (6.56)	8
After exp	164.37 (7.08)	161.28 (7.08)	109.71 (6.00)	
SFA				
Baseline	400.77 (17.46)	395.19 (16.57)	417.06 (17.47)	10
After exp	370.17 (15.95)	364.41 (15.95)	212.85 (11.64)	
MUFA				
Baseline	169.92 (7.40)	170.19 (7.14)	116.46 (4.88)	
After exp	178.29 (7.68	191.97 (8.40)	155.79 (8.52)	
n-6 (g)				
Baseline	175.86 (7.66)	173.07 (7.26)	162.36 (6.80)	3-7
After exp	164.16 (7.08)	166.14 (7.27)		82.89 (4.53)
n-3(g)				
Baseline	13.68 (0.60)	14.31 (0.60)	13.77 (0.58)	<1
After exp	17.64 (0.76)	14.67 (0.64)	16.02 (0.88)	

acids results in increased blood viscosity and vasoconstriction. There was significant increase in intake of n-3 fatty acids in group-I and III from 1.52 to 1.96 g and 1.53 to 2.04 g, respectively with increase in percentage adequacy from 66.08 to 85.21 and 66.52 to 88.69. Significant decrease in ratio of n6:n3 from fatty acids 12.86 to 9.31 and 11.79 to 4.51 in group land III was seen. Highly significant decrease was seen in nutrition counselling group due to decreased intake of n-6 fatty acid rich oils like increased intake of whole wheat, black gram, rajmah, soybean, mustard, methi and fish. Siscovick *et al.* (2000), Schacky (2000) and Thies *et al.* (2001) also reported that low intake of n-6 fatty acids and high intake of n3 fatty acids is associated with lower risk of heart disease.

Percentage contribution of carbohydrates, protein and fat in total energy :

Based on the per cent contribution of energy by the major nutrients *i.e.* carbohydrate, fats and protein it was found that there was increase in the percentage contribution of energy from protein in all the three groups *i.e.* 10.29 to 10.76, 9.94 to 10.60, 11.13 to 15.36 (Table 5). Increase was also seen in percentage contribution of energy from carbohydrates in group I *i.e.* 58.21 to 58.52 but decrease was seen in percentage contribution of energy from CHO in group II and III *i.e.* 59.04 to 57.98 and 59.96 to 58.49. Decrease was observed in percentage contribution of energy from total fat amongst I and III groups *i.e.* 31.50 to 30.72 and 28.91 to 26.18.

Conclusion :

Nutrition counselling resulted in significant decrease in intake of refined cereals and refined pulses which lowered the energy intake, decreased intake of meat and poultry, nuts and oil seeds that lowered cholesterol intake, decreased intake of milk and milk products, fats and oils that lowered cholesterol intake and total fat intake. Usage of oils in combination lead to decreased intake of n-6 fatty acids and increased intake of n-3 fatty acid which improved their n-6/ n-3 ratio and also resulted in decreased intake of polyunsaturated fatty acids and improved ratio of PUFA : SFA and intake of MUFA. Significant increase was seen in intake of whole cereals, pulses, fruits and vegetables, raw garlic and fish which led to increased intake of protein, dietary fibre, n-3 fatty acids significant increase in intake of n-3 fatty acids.

Noteworthy changes was also seen in fish oil and garlic oil supplementation groups but impact was more in nutrition counselling group as subjects were advised to make dietary modifications instead of sticking just to supplements.

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