Results and Discussion

RESULTS AND DISCUSSION

IV

The results of the study entitled **'Development and Evaluation of Functional Food Mixes on Adults with Cardiovascular Diseases and Impact of Diet Counselling'** is presented and discussed under the following headings.

A. Details regarding the Formulated Functional Food Mixes

i. Nutrient analysis of the food mixes
ii. Acceptability testing of the food mixes and recipes
iii. Microbiological testing of the food mixes
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A. Details regarding the Formulated of Functional Food Mixes

i. Nutrient analysis of the food mixes

The nutrient composition of the developed functional food mixes is presented in Table I.

TABLE I

NUTRIENT COMPOSITION OF THE DEVELOPED FUNCTIONAL FOOD MIXES

Nutrients	Basic mix	Variation I	Variation II
Moisture (g)	7.82	8.14	8.36
Carbohydrate (g)	60.88	64.72	53.81
Protein (g)	15.26	19.74	13.17
Fat (g)	2.19	2.86	3.49
Fibre (g)	1.22	1.08	2.01
Energy (kcal)	324	364	299
Total carotenoids (µg)	8811	8493	8213
β carotene (µg)	6142	5967	5812
Vitamin E (mg)	1.745	1.437	1.381
Vitamin C (mg)	11.5	10.8	11.04
Iron (mg)	3.56	4.02	3.83
Calcium (mg)	185.6	169.2	173.5
Phosphorus (mg)	98.6	161.5	211.7
Sodium (mg)	0.077	0.068	0.056
Zinc (mg)	7.12	8.98	7.36
Copper (mg)	1.02	1.74	1.56
Magnesium (mg)	23.11	49.48	38.71
Selenium (mg)	1.93	2.14	1.77
Manganese (mg)	0.97	1.24	0.82
Potassium (mg)	0.093	0.057	0.064

Among the food mixes developed, variation II had a maximum moisture content of 8.36 g per 100 g followed by variation I with 8.14 g per 100 g and basic mix had a minimum moisture content of 7.82 g per 100 g. The total carbohydrate content of basic mix and variation II were 60.88 and 53.81 g per 100 g respectively, while variation I contained the maximum carbohydrate of 64.72 g per 100 g. With regard to the total fat content, variation II possessed the maximum of 3.49 g per 100 g followed by variation I with 2.86 g per 100 g and basic mix had only 2.19 g per 100 g. Fibre content of variation II was the maximum with 2.01 g due to its flax seed content in comparison with basic mix and variation I which had 1.22 and 1.08 g per 100 g respectively. The basic mix, variation I and variation II provided 324, 364 and 299 kcal of energy respectively.

Total carotenoids content of mixes ranged from 8213 to 8811 µg per 100 g with a maximum content in basic mix. Beta carotene content also ranged from 5812 to 6142 µg per 100 g respectively with a maximum in basic mix. Though vitamin E (1.381 to 1.745 mg per 100 g) vitamin C (10.8 to 11.5 mg per 100 g) and calcium levels (169.2 to 185.6 mg per 100 g) were in close range among the mixes, slightly higher values were seen in basic mix than the other two mixes. Iron content was the highest in variation I with 4.02 mg per 100 g followed by basic mix with 3.56 mg and variation II with 3.83 mg per 100 g.

Among the minerals, basic mix contained slightly higher amount of sodium and potassium with 0.077 mg and 0.093 mg per 100 g respectively. Variation II contained the maximum amount of phosphorus (211.7 mg), variation I contained the highest amounts of zinc (8.98 mg), copper (1.74 mg), magnesium (49.48 mg), selenium (2.14 mg) and manganese (1.24 mg) in 100 g. The trace element content was in close range among the other two mixes. All the mixes were found to be highly nutritious and suitable for supplementation.

ii. Acceptability testing of the food mixes and recipes

The process by which man accepts or rejects food is of multi-dimensional nature. In complex food matrices, it is not always easy to establish relationships between the individual chemical stimuli concentration, physiological perception, and consumer reaction (Costell *et al.*, 2009). Taste or sensory appeals are also frequently mentioned as criteria when food is described either positively or negatively (Font and Gil, 2009). The food mixes and various recipes incorporating the mixes were therefore subjected to organoleptic evaluation using the five point scoring pattern.

1. Organoleptic evaluation of the developed food mixes

Table II presents the mean scores given by the taste panel members to the various functional food mixes formulated for study.

TABLE II

MEAN SCORES OBTAINED BY THE DEVELOPED FOOD MIXES

(Max score=25)

Quality	Basic mix	Variation I	Variation II
Colour	4.2	3.7	3.4
Appearance	4.1	4.2	3.5
Texture	4.0	4.4	4.1
Flavour	4.2	4.5	4.2
Taste	4.3	4.5	4.5
Total score	**20.8**	**21.2**	**19.7**

Basic mix obtained the maximum score of 4.2 for colour followed by 3.7 for variation I and 3.4 for variation II. Flax seed powder gave a light brownish colour to variation II .The panel members found the appearance of variation I and basic mix to be most appealing and gave a maximum score of 4.2 and 4.1 respectively. Variation II got a score of 3.5 for appearance. Variation I obtained a maximum score of 4.4 for texture. Variation I containing wheat germ obtained the highest score of 4.5 for flavor and both basic mix and

variation II received a score of 4.2 each. Both the variations received a score of 4.5 each while basic mix received a slightly lesser score of 4.3 for taste. This might be due to the slightly astringent taste of amla and drumstick leaves that could have been masked by the presence of wheat germ and flax seed in the two variations.

Variation I obtained a maximum acceptability score of 21.2 followed by basic mix with a score of 20.8 and variation II with a score of 19.7. The total scores of the different food mixes revealed that all the food mixes scored more than 19 out of 25 revealing a good acceptability of the food mixes.

2. Organoleptic evaluation of recipes incorporating the food mixes

In order to facilitate easy consumption of the food mixes and further to break the monotony of consuming the food powders as such for the whole six months period of supplementation, the food mixes were incorporated into day to day recipes. The comparison of the incorporated recipes with the standard recipes are presented in Table III.

The mean scores of the standard recipes that were prepared without any incorporation ranged between 23.5 for paruppu powder and 24.9 for upma and sambar against a maximum score of 25. The overall acceptability scores received for various recipes incorporated with the basic food mix revealed that, , chappathi, idiyappam soup curry, kulambu and dhal were the best accepted recipes. Variation I was best accepted in recipes like idli, dosa,upma,paruppupowder, and sambar. Similarly, best scores were received with variation II for chappathi,paniyaram,porridge,kulambu and buttermilk. Among all the recipes incorporated with the food mixes, only upma and porridge were least accepted. In general, recipes like kulambu, chappathi, soup, buttermilk, paniyaram and idiyappam were found more suitable for incorporation of the food mixes.

TABLE III

ORGANOLEPTIC EVALUATION OF RECIPES INCORPORATED WITH THE FOOD MIXES

(Maximum score=25)

Items	Standard	Basic mix	Variation I	Variation II
Idli	24.3	20.8	22.3	21.6
Dosa	24.8	21.1	23.6	22.8
Idiyappam	24.7	22.9	22.8	21.1
Chappathi	24.3	23.4	22.6	23.8
Upma	24.9	18.7	19.2	18.9
Paniyaram	24.8	20.8	21.6	22.0
Paruppu powder	23.5	18.6	20.9	19.4
Soup	24.8	23.7	22.8	22.6
Porridge	23.6	19.6	18.4	19.8
Curry	23.8	20.6	19.7	20.1
Kulambu	24.7	23.9	23.5	23.9
Dhal	24.5	20.9	20.4	19.5
Sambar	24.9	19.8	20.7	18.9
Buttermilk	24.8	22.6	21.4	22.9

iii. Microbiological testing of the food mixes

The results of the microbiological testing of the food mixes is presented in Table IV.

TABLE IV

MICROBIOLOGICAL COUNTS OF THE FOOD MIXES

Criteria	Basic mix		Variation I		Variation II	
	Initial	After 3 months	Initial	After 3 months	Initial	After 3 months
Total Bacterial count (cfu/g)	10^1 to10^2	10^1 to 10^2	10^1 to10^2	10^1 to10^2	10^1 to10^2	10^1 to10^2
Yeast count	BDL	BDL	BDL	BDL	BDL	BDL
Mould count	BDL	BDL	BDL	BDL	BDL	BDL

BDL – Below Detectable Limits

The Prevention of Food Adulteration Act (1954) recommends a total count not more than 40,000 per g and absence of yeast and mould count in 0.1 g of the sample in cereal based food products. The total bacterial count of the food mixes was between 10^1 to 10^2 cfu per g, both initially and at the end of three months storage period. The yeast and mould counts were found to be below detectable limits in all the three food mixes both initially and after three months storage period. This indicates that the food mixes were free from contamination and safe for consumption for up to three months, after preparation.

iv. Cost analysis of the food mixes

Cost is an important criteria to be considered for any treatment. The cost incurred in the various stages of preparation of food mixes is given in Table V.

TABLE V

COST ANALYSIS OF THE FOOD MIXES

Category	Basic mix	Variation I	Variation II
Raw materials (Rs)	22.50	36.00	31.00
Processing charges (Rs)	5.50	5.50	5.50
Packaging charges (Rs)	3.00	3.00	3.00
Cost (Rs/ kg)	31	44.50	39.50
Cost per day (Rs/ 30 g)	0.93	1.34	1.19
Cost / month (Rs)	27.90	40.20	35.70
Cost spent for drugs			
Cost / day (Rs)	7.2 – 15.4		
Cost / month (Rs)	216.0 – 462.0		

The total expenditure incurred in the preparation of the food mixes were Rs 31per kg for basic mix, Rs 44.50 /kg for variation I and Rs 39.50 per kg for variation II. This accounts for a cost of Rs 0.93, Rs 1.34 and Rs 1.19 each day for the basic mix, variation I and variation II respectively.

The survey conducted among the adults revealed that many of them consumed hypotensive, hypolipidimic and hypoglycemic drugs on a regular basis. The average amount of money spent by them towards allopathic medications ranged from Rs 216 to 462 per month. This amounts to Rs 7.2 to 15.4 per day. It is therefore apparent that the food mixes are far more economical and affordable than the allopathic medicines and can be easily prepared at home. It is well known that continued consumption of allopathic medications has been associated with the risk of developing side effects which can easily be overcome with these functional food based formulations.

B. Socioeconomic, dietary background and nutritional status of the selected adults

The socioeconomic, dietary details and nutritional profile of the 1640 adults with cardiovascular disease comprising of 874 male and 766 female adults are presented in the following pages.

i. Socioeconomic profile of the adults

1. Age of the adults

Age wise distribution of the selected adults is presented in Table VI.

TABLE VI

AGE WISE DISTRIBUTION OF THE SELECTED ADULTS

Age (yrs)	Male		Female		Total	
	No.	%	No.	%	No.	%
41 – 45	95	10.9	49	6.4	144	8.8
46 – 50	106	12.1	142	18.5	248	15.1
51 – 55	149	17.1	186	24.3	335	20.4
56 – 60	321	36.7	175	22.9	496	30.3
61 – 65	203	23.2	214	27.9	417	25.4
Total	**874**	**100**	**766**	**100**	**1640**	**100**

Majority of the male (36.7%) adults belonged to the age group of 56 to 60 years, while majority of the female adults (27.9%) were of 61 to 65 years. Comparatively lesser number of both male (10.9%) and female (6.4%) adults were within 41 to 45 years of age.

The findings of the present study indicated that there is a gradual increase in the onset of cardiovascular disease as age advances among both male and female individuals. It is also evident that men fell prey to cardiovascular disease at an earlier age when compared to their female counterparts. Kinra *et al* (2010) reported that the prevalence of risk factors for non communicable diseases generally increased with age among Indians. Advancing age has been pointed out as a risk factor for cardiovascular disease among rural population of Bangladesh by Sayeed *et al* (2010). Further, higher prevalence of multiple risk factors for cardiovascular disease was reported among men than women in British Birth Cohort study (Power *et al.*, 2008).

2. Educational status of the selected adults

Table VII depicts the educational status of the selected adults.

TABLE VII

EDUCATIONAL STATUS OF THE SELECTED ADULTS

Education	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	288	33.0	221	28.9	509	31.1
Secondary	202	23.1	174	22.7	376	22.9
Higher secondary	109	12.5	119	15.5	228	13.9
Degree	154	17.6	131	17.1	285	17.4
Professional	68	7.7	8	1.0	76	4.6
Uneducated	53	6.1	113	14.8	166	10.1
Total	**874**	**100**	**766**	**100**	**1640**	**100**

Results of the present study revealed that a majority of 33.0 and 28.9 per cent of male and female adults respectively had completed primary education, whereas 6.1 per cent of the male and 14.8 per cent of the female

adults were uneducated. An equal percentage of male and female adults had studied upto secondary and degree education. A higher percentage of male adults were found to have professional education (7.7%) than their female counterparts (1.0%).

Findings of the present study revealed that a higher percentage of primary and secondary level educated adults were more affected by cardiovascular disease when compared to the more educated group of population in both sexes. Educational status corresponds to health literacy of an individual.

Similar results have been reported in Jaipur by Gupta *et al* (2010) that urban adults with moderate educational status had a greater cardiovascular risk. Patients with low literacy are more likely to have poorer health related knowledge, later stages of disease at presentation, increased incidence of chronic illness, less frequent screening and increased hospitalization costs (Simon *et al.*, 2009).

3. Occupation of the selected adults

Factors associated with jobs including high levels of stress, insecurity, long working hours, sedentary work, work scheduling issues, shifts, bullying and harassment can contribute to cardiovascular disease (LaMontagne, 2010). The occupation of the 1640 adults participating in the present study is presented in Table VIII.

TABLE VIII

OCCUPATION OF THE SELECTED ADULTS

Occupation	Male		Female		Total	
	No.	%	No.	%	No.	%
Business	221	25.3	33	4.3	254	15.5
Government	124	14.2	9	1.2	133	8.1
Private	149	17.1	71	9.3	220	13.4
Unskilled work	184	21.0	126	16.4	310	18.9
Retired	196	22.4	15	2.0	211	12.9
Homemakers	-	-	512	66.8	512	31.2
Total	**874**	**100**	**766**	**100**	**1640**	**100**

About 25.3 per cent adult men being the majority were engaged in business like running a departmental shop, tailoring unit, agents etc while 66.8 per cent of female adults being the majority were home makers. About 14.2 and 17.1 per cent of the male adults were employed in government and private concerns respectively. About 21 per cent of male and 16.4 per cent female adults were unskilled labourers and 22.4 per cent of male adults were retired from services.

A study by Ferrario *et al* (2011) in northern Italy has reported a higher coronary heart disease incidence rates among professionals, administrators and self employed individuals.

4. Family type and family size of the selected adults

The type and size of families of the selected adults are presented in Table IX.

TABLE IX

FAMILY TYPE AND FAMILY SIZE OF THE SELECTED ADULTS

Details	Male		Female		Total	
	No	%	No	%	No	%
Family type						
Joint	161	18.4	214	27	375	22.9
Nuclear	713	81.6	552	72.1	1265	77.1
Total	**874**	**100**	**766**	**100**	**1640**	**100**
Family size						
2-4	612	70.0	448	58.5	1060	64.6
5-7	224	25.6	247	32.3	471	28.7
>7	38	4.4	71	9.2	109	6.7
Total	**874**	**100**	**766**	**100**	**1640**	**100**

It is evident from the Table that out of the 1640 adults surveyed, only 22.9 per cent were from joint families whereas 77.1 per cent being the majority belonged to nuclear families. This finding suggested that increased stress and vulnerability to non-communicable diseases including cardiovascular disease are more prevalent among nuclear families than joint families where a better psychological and family support is possible. Lotfi *et al*

(2009) reported that among urban population of East Delhi, women belonging to nuclear families had a higher chance of getting coronary artery disease as compared to those living in joint families. Majority of the male (70%) and female adults (58.5%) had families with 2-4 members whereas only 6.7 per cent of the adults had more than seven members in their families. This finding reveals the trend towards small family norms.

5. Family Income of the selected adults

Table X presents the classification of the adults of the present study according to their family income.

TABLE X

FAMILY INCOME OF THE SELECTED ADULTS

Category	Income range *	Male		Female		Total	
		No.	%	No.	%	No.	%
Low	Rs.2,500-5,500	178	20.4	104	13.6	282	17.2
Middle	Rs.5,500-10,000	147	16.8	66	8.6	213	13.0
High	> Rs.10,000	549	62.8	596	77.8	1145	69.8
Total		**874**	**100**	**766**	**100**	**1640**	**100**

*HUDCO (2006)

Based on HUDCO (2006) classification, 20.4 per cent of the male and 13.6 per cent of female adults belonged to low income group. The families of 16.8 per cent of male and 8.6 per cent of female adults fell within the middle income group. A majority of 62.8 per cent male adults and 77.8 per cent of female adults belonged to high income group. In the present study, the highest prevalence of cardiovascular disease was found among adults from the high income group (69.8%) which may be associated with poor food choices,or increased intake of fats and oil and sugar.

6. Life style pattern of the selected adults

Physical inactivity makes a significant contribution to the incidence of cardiovascular disease mortality. Physical inactivity and sedentary behaviours are associated with higher rates of cardiovascular disease risk factors (Jones

et al., 2009). Classification of the adults based on their activity pattern as suggested by ICMR (2002) is presented in Table XI.

TABLE XI

LIFESTYLE PATTERN OF THE SELECTED ADULTS

Category	Male		Female		Total	
	No.	%	No.	%	No.	%
Sedentary	502	57.4	534	69.7	1036	63.2
Moderate	294	33.7	179	23.4	473	28.8
Heavy	78	8.9	53	6.9	131	8.0
Total	**874**	**100**	**766**	**100**	**1640**	**100**

Life style was found to be sedentary for more than 50 per cent of the male (57.4%) and female (69.7%) adults. The daily activity pattern of 33.7 of male and 23.4 per cent of female adults was moderate and that of 8.9 per cent of male and 6.9 per cent of female adults was of heavy activity pattern. It is evident from the study that the daily activity pattern has an important role to play in the cardiovascular health of an individual. As highlighted in the present study more sedentary workers had a greater probability of being affected by cardiovascular disease against heavy workers. Carnethon *et al* (2009) suggested that a comprehensive programme aimed at improving employees' cardiovascular and general health including education, training and changes in work environment can encourage healthy behaviour thereby promoting occupational safety and health.

ii. Information regarding disease condition

Data regarding the disease type, symptoms and family history are presented under the following headings.

1. Type of disease among the selected adults

Table XII presents the type of disease condition suffered by the 1640 adults based on clinical and biochemical findings.

Majority of the male - 48.2 per cent and female - 61.8 per cent adults participating in the present study were hypertensives. About 26.9 per cent of male adults and 18.1 per cent of female adults were suffering from ischemic heart disease. A total of 295 (18%) male and female adults had myocardial

infarction. About 5.8 per cent of male and 3.4 per cent of female adults had undergone coronary artery bypass graft surgery.

TABLE XII

CATEGORY OF CARDIOVASCULAR DISEASE AMONG THE SELECTED ADULTS

Category	Male		Female		Total	
	No.	%	No.	%	No.	%
HTN	421	48.2	473	61.8	894	54.5
IHD	235	26.9	139	18.1	374	22.8
MI	167	19.1	128	16.7	295	18.0
Post CABG	51	5.8	26	3.4	77	4.7
Total	**874**	**100**	**766**	**100**	**1640**	**100**

HTN-Hypertension, IHD-Ischemic heart disease, MI-Myocardial infarction, CABG- Coronary Artery Bypass Graft

Among the 1640 adults participating in the study, 34 per cent of male and 23.3 per cent of female adults had non-insulin dependant diabetes mellitus along with cardiovascular disease.

2. Duration of disease among the selected adults

Table XIII presents the duration of cardiovascular disease since it was first diagnosed among the selected adults.

TABLE XIII

DURATION OF CARDIOVASCULAR DISEASE AMONG THE SELECTED ADULTS

Duration (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
< 1	103	11.8	86	11.2	189	11.5
1 to 5	272	31.1	452	59.0	724	44.2
5 to 10	298	34.1	173	22.6	471	28.7
> 10	201	23.0	55	7.2	256	15.6
Total	**874**	**100**	**766**	**100**	**1640**	**100**

About 11.8 per cent of male and 11.2 per cent of female adults were suffering from cardiovascular disease within a period of one year. It is evident that a majority of 44.2 per cent of male and female adults were suffering from cardiovascular disease for the past one to five years, while 34.1 per cent of male and 22.6 per cent of female adults were suffering over a period of five to ten years. It is of great concern to note that 15.6 per cent of adults studied had cardiovascular disease for more than ten years.

3. Clinical symptoms experienced by the selected adults

The various cardiovascular disease symptoms experienced and reported by the adults are given in Table XIV.

TABLE XIV

SIGNS AND SYMPTOMS EXPERIENCED BY THE SELECTED ADULTS

Symptoms*	Male (N=874)			Female (N=766)		
	Frequent	Rare	Never	Frequent	Rare	Never
Breathlessness	226 (25.9)	423 (48.4)	225 (25.7)	246 (32.1)	159 (20.8)	361 (47.1)
Palpitation	76 (8.7)	186 (21.3)	612 (70.0)	67 (8.7)	124 (16.2)	572 (74.7)
Shivering	19 (2.2)	63 (7.2)	792 (90.6)	13 (1.7)	-- (0)	753 (98.3)
Giddiness	54 (6.2)	116 (13.3)	702 (80.3)	6 (0.8)	32 (4.2)	728 (95.0)
Inability to work	107 (12.2)	84 (9.6)	683 (78.1)	109 (14.2)	208 (27.2)	448 (58.5)
Chest/shoulder pain	31 (3.5)	163 (18.6)	680 (77.8)	36 (4.7)	53 (6.9)	677 (88.3)
Oedema	15 (1.7)	171 (19.6)	688 (78.7)	58 (7.6)	77 (10.1)	631 (82.4)
Lack of appetite	182 (20.3)	103 (11.8)	589 (67.4)	203 (26.5)	324 (42.3)	239 (31.2)
Vomiting	-- (0)	12 (1.4)	862 (98.6)	-- (0)	9 (1.2)	757 (98.8)
Profuse sweating	46 (5.3)	117 (13.4)	711 (81.4)	19 (2.5)	52 (6.8)	695 (90.7)
Heart burn	234 (26.8)	449 (51.4)	191 (21.9)	225 (29.4)	261 (34.1)	280 (36.6)

*Multiple response; Figures in parenthesis indicate percentage

Signs and symptoms of heart disease are important determinants of worsening health status. Learning their frequency relating to clinical status provides insight about the health status of the patient. Among the various symptoms of cardiovascular diseases breathlessness, lack of appetite and heart burn were more common among the adults of both sexes. Inability to work and palpitation were also reported as frequent occurrence. Other symptoms included shivering, giddiness, chest or shoulder pain, oedema, vomiting and profuse sweating were seen among lesser percentage of adults.

Further, every adult reported ranging from two to eight symptoms and none of the adults participating in the study were asymptomatic. Albert *et al* (2010) reported the top five symptoms experienced by patients of heart failure to be shortness of breath, decreased ability to do exercise, orthopnea, profound fatigue and dizziness or light headedness.

4. Family history of the selected adults

The advantages of family history over other genomic tools include a lower cost, greater acceptability and a reflection of shared genetic and environmental factors (Valdez *et al.*, 2010). The family history of hypertension, hyperlipidemia and diabetes mellitus among the adults is presented in Table XV.

Hypertension was previously reported by the father and mother of 24.6 per cent and 16 per cent of the adults respectively. Both the father and mother were reported to be hypertensive by 16.8 per cent of the adults. As many as 20.7 per cent of the adults had no idea regarding their parental history of hypertension. About 25.2 and 5.2 per cent of the adults had either hypertensive siblings or hypertensive grandparents respectively. Only 21.5 per cent of the adults reported no familial history of hypertension.

Majority of the adults (33.6%) had no knowledge regarding their familial history of hyperlipidemia while as many as 32.1 per cent of the adults had no hyperlipidimic individuals in their family history. About 17.9 per cent of the patients had their fathers suffering from hyperlipidemia.

TABLE XV

FAMILY DISEASE HISTORY OF THE SELECTED ADULTS (percentage)

Relationship	Hypertension			Hyperlipidemia			Diabetes Mellitus		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Father	21.4	28.2	24.6	19.1	16.6	17.9	19.1	15.6	17.4
Mother	1.6	15.8	16.0	6.2	8.8	7.4	25.2	19.0	22.3
Both	19.1	14.2	16.8	11.1	5.1	8.3	19.3	28.3	23.5
Do not know	17.9	24.0	20.7	31.9	35.5	33.6	17.8	21.3	19.4
Siblings	24.4	26.2	25.2	25.2	10.7	18.4	21.4	13.6	17.7
Grandparents	3.9	6.8	5.2	6.2	3.1	4.8	7.0	8.8	7.8
Others	6.8	11.5	9.0	11.1	7.6	9.5	18.6	23.2	20.7
None	25.2	17.4	21.5	30.8	33.7	32.1	18.3	15.8	17.1

About 17.4 and 22.3 per cent of the adults reported the presence of diabetes mellitus among their fathers and mothers respectively. However, as many as 23.5 per cent of adults had both their parents suffering from diabetes mellitus. Self reported family history remains significantly associated with cardiovascular disease in multivariable models (Paynter *et al.*, 2010). Family history confers relative risk for coronary heart disease that ranges from twice to 12 times than in the general population (NCEP, 2002).

5. Drug history of the selected adults

Table XVI explains the various drugs taken by the adults of the present investigation.

TABLE XVI
VARIOUS DRUGS TAKEN BY THE SELECTED ADULTS

Drug	Male (N=874)		Female (N=766)		Total (N=1640)	
	No.	%	No.	%	No.	%
Antihypertensive	868	99.3	752	98.2	1620	98.8
Antidiabetic	298	34.1	346	45.2	644	39.3
Antianginal	114	13.0	86	11.2	200	12.2
Antiplatelet	97	11.1	146	19.2	243	14.2
Lipid lowering	596	68.2	441	57.2	1037	63.2
Antiobesity	202	23.1	225	29.4	427	26.0
Multivitamin	276	31.6	218	28.5	494	30.1
Antacid	554	63.4	532	69.5	1086	66.2
Others	197	22.5	288	37.5	485	29.6

Almost the entire male (99.3%) and female (98.2%) adults consumed antihypertensives. About 34.1 per cent of male and 45.2 per cent of female adults were taking antidiabetic drugs. More than 50 per cent of the male and female adults were consuming lipid lowering drugs and antacids. Other medications taken by the adults were antianginal, antiplatelet, and antiobesity drugs.

iii. Habits related to disease condition

Information on the exercise and yoga practices, smoking, alcohol, tobacco consumption pattern and type of toilet used by the adults are presented below. These lifestyle behavior patterns greatly influence the

incidence of cardiovascular disease as it has been suggested by the American College of Cardiology Foundation/American Heart Association (2011) that the risk for atherosclerosis accumulates over a lifetime and the greatest benefit accrues with early lifestyle changes.

1. Exercise pattern of the selected adults

The American Heart Association (AHA) has established sedentary lifestyle as a major modifiable risk factor for coronary heart disease (Thompson *et al.*, 2003). Increased levels of physical activity, exercise training and overall cardio respiratory fitness have provided protection in the primary and secondary prevention of cardiovascular disease. Exercise pattern of the adults is presented in Table XVII.

TABLE XVII

EXERCISE PATTERN OF THE SELECTED ADULTS

Type of exercise	Male (N=874)		Female (N=766)		Total (N=1640)	
	No.	%	No.	%	No.	%
Mild	146	16.7	53	6.9	199	12.1
Moderate	27	3.1	18	2.4	45	2.7
Heavy	23	2.6	-	-	23	1.4
No	678	77.6	695	90.7	1375	83.8
Duration (min)						
15-30	117	13.4	56	7.3	173	10.6
30	66	7.6	15	2.0	81	4.9
30-60	13	1.5	-	-	13	0.8

A large group of both male (77.6%) and female (90.7%) adults did not do any exercise. About 7.6 per cent of male and 2.0 per cent of female adults did exercise for 30 minutes every day and only 0.8 per cent of both male and female adults did exercise up to one hour every day. Habitual physical activity produces cardiovascular adaptations that increase exercise capacity, endurance and skeletal muscle strength and also prevents the development of coronary artery disease (Thompson *et al.*, 2003).

2. Yoga practices followed by the selected adults

Numerous studies have shown that yoga has an immediate down regulating effect on stress, blood glucose and heart rate along with systolic and diastolic blood pressure (Ross and Thomas, 2010). The number of male and female adults performing yoga is presented in Table XVIII.

TABLE XVIII

YOGA PRACTICES FOLLOWED BY THE SELECTED ADULTS

Duration (min)	Male		Female		Total	
	No.	%	No.	%	No.	%
0	818	93.6	695	90.7	1513	92.3
30	41	4.7	58	7.6	99	6.0
30-60	15	1.7	13	1.7	28	1.7
Total	**874**	**100**	**766**	**100**	**1640**	**100**

A majority of 93.6 per cent male and 90.7 per cent of female adults did not do any yoga practices. Yoga was practiced daily for a duration of 30 min by 4.7 per cent of male and 7.6 per cent of the female adults. Only 1.7 per cent of both male and female adults practiced yoga daily for a duration of 30 to 60 min. Pullen *et al* (2010) reported that yoga therapy offered additional benefits to the standard medical care of predominantly heart failure patients by improving cardiovascular endurance, inflammatory markers, and flexibility.

3. Smoking, tobacco and alcohol consumption among the adults

The net effect of smoking and alcohol consumption on health is detrimental and the disease burden is closely related to average volume of alcohol consumption (Rehm *et al.*, 2009). The frequency and quantum of smoking, tobacco chewing and alcohol consumption pattern of the adults are presented in the following paragraphs.

a. Smoking and alcohol consumption

Table XIX depicts smoking and alcohol consumption pattern of the male adults.

TABLE XIX

SMOKING AND ALCOHOL CONSUMPTION PATTERN OF MALE ADULTS

Category	Smoking		Alcohol	
	No	%	No	%
No	372	42.5	436	49.9
Previous	96	11.0	38	4.3
Occasional	101	11.6	90	10.3
Frequent	61	7.0	124	14.2
Chain	244	27.9	186	21.3
Total	**874**	**100**	**874**	**100**

It is encouraging to know that 42.5 per cent and 49.9 per cent of male adults did not smoke and consume alcohol respectively. But as many as 27.9 per cent and 21.3 per cent of the male adults were chain smokers and alcohol addicts respectively. About 7 and 14.2 per cent of the male adults were frequent smokers and alcohol consumers and only 11.0 and 4.3 per cent of male adults had discontinued smoking and alcohol consumption respectively upon doctor's advice after being diagnosed for cardiovascular disease.

Among smokers with coronary heart disease, smoking cessation was associated with a 36 per cent reduction in risk of all cause mortality, making smoking cessation fundamental to secondary prevention of cardiovascular disease (Rigotti *et al.*, 2010). A comparative study by Ahmed *et al* (2010) among non smokers and those who quit smoking more than 15 years ago revealed that current smoking was associated with a significantly increased risk and incidence of heart failure.

b. Quantum of smoking/tobacco chewing among the selected adults

The frequency of smoking and tobacco chewing habit of the adults is presented in Table XX.

TABLE XX

QUANTUM OF SMOKING AND TOBACCO CHEWING AMONG THE SELECTED ADULTS

(N=1640)

Times/ day	Smoking (Male)		Tobacco					
			Male		Female		Total	
	No	%	No.	%	No.	%	No.	%
<5	22	2.5	24	2.8	93	12.1	117	7.1
5-10	93	10.6	31	3.5	29	3.8	60	3.7
11-15	40	4.6	97	11.1	81	10.6	178	10.9
>15	251	28.7	176	20.1	70	9.1	246	15
No	468	53.5	546	62.5	493	64.4	1039	63.3
Duration (yrs)								
<5	22	2.5	20	2.3	53	6.9	73	4.5
5-10	119	13.6	45	5.1	39	5.1	84	5.1
11-15	98	11.2	33	3.8	58	7.6	91	5.6
16-20	73	8.4	96	11.0	36	4.7	132	8.1
>20	94	10.8	134	15.3	87	11.4	221	13.5

It is evident that majority of the smokers (28.7%) and tobacco chewers (15%) smoked or chewed more than 15 times a day. About 4.6 per cent of the male adults and 10.9 per cent of both male and female adults smoked or chewed 11 to 15 times a day. Such frequent smoking and tobacco chewing habits of the adults could have played a significant role in the occurrence of cardiovascular diseases.

About 10.8 and 13.5 per cent of the adults were habituated to smoking or tobacco chewing for more than 20 years and 8.4 and 8.1 per cent of the adults were in the habit for 16 to 20 years respectively. Only 2.5 per cent of male adults and 4.5 per cent of both male and female adults respectively had acquired the habit of smoking and tobacco chewing during the recent five years period. Zhang *et al* (2010) have reported an association between betel chewing with or without tobacco and the risk of cardiovascular disease, initiating a need for more effort in developing betel chewing cessation programmes among Asian population.

4. Type of toilet used by the adults

Majority of the male (62.1%) and female (67.1%) adults used the western style toilet while only 28.5 and 25.7 per cent of the male and female adults respectively used the Indian style. Few (9.4 and 7.2%) adults accessed both the types of toilets. About 36.9 per cent of the western style toilet users reported that they were more comfortable than the Indian style and the rest opted for western toilet owing to joint pains.

iv. Diet pattern of the adults

Diet is a major modifiable factor that is largely responsible for increased risk of cardiovascular diseases at population levels. A better understanding of the dietaries of the population is critical in order to effectively prevent this disease. Following Tables present the diet pattern, food habits and cooking methods followed by the adults.

1. Type of diet

The type of diet and meal pattern followed by the adults selected for the study are presented in Table XXI.

TABLE XXI

TYPE OF DIET AND MEAL PATTERN OF THE SELECTED ADULTS

Diet	Male (N=874)		Female (N=766)		Total (N=1640)	
	No	%	No	%	No	%
Vegetarian	90	10.3	67	8.8	157	9.6
Ova-vegetarian	129	14.8	55	7.2	184	11.2
Non-vegetarian	598	68.4	561	73.2	1159	70.7
Changed to vegetarian	57	6.5	83	10.8	140	8.5
Number of meals / day						
<3	51	5.8	58	7.6	109	6.6
3	805	92.1	656	85.6	1461	89.1
>3	18	2.1	52	6.8	70	4.3
Meal pattern						
Regular	257	29.4	228	29.8	485	29.6
Irregular	545	62.4	360	47.0	905	55.2
Frequent fasting	72	8.2	178	23.2	250	15.2

It is clear from the Table that majority of the adults (68.4% male and 73.2% female) were non-vegetarians. Presence of animal protein renders the diet atherogenic. A Cohort study by Fraser (2009) indicated a significantly higher risk of hypertension for non-vegetarians compared with vegetarians and lacto-ovo-vegetarians. McEvoy and Woodside (2010) highlighted that populations having vegetarian diets had potential health benefits including reduced risk of coronary heart disease.

In the present study, 14.8 and 7.2 per cent of the male and female adults were ova vegetarians and only 10.3 per cent of the male and 8.8 per cent of the female adults were vegetarians. Interestingly, it was also observed that 8.5 per cent of the adults had withdrawn from non-vegetarian diets for more than five years either after or prior to cardiac surgeries and owing to physicians or dietitian's advice. A vegetarian diet lowers blood pressure, serum total and low density lipoprotein cholesterol levels and also improves endothelial function and insulin sensitivity and thus reduces the risk of atherosclerosis (Chen *et al.*, 2011). Though many of the adults (89.1%) consumed three meals a day, some consumed either less than three (6.6%) or more than three (4.3%) meals a day.

Majority of the male (62.4%) and female (47%) adults were irregular in their food intake. Reasons reported were work pressure, habit and lack of hunger. Frequent fasting was observed by 8.2 per cent of male and 23.2 per cent of female adults. Only 29.6 per cent of the adults followed regular meal times. Studies by Legro (2009) pointed out that simple environmental factors such as irregular meals frequently appeared to increase the risk of metabolic syndrome which ultimately increased the risks of developing atherosclerosis. According to Frashchi *et al* (2005), regular eating was seen to be associated with lower energy intake, greater postprandial thermogenesis and lower fasting, total and LDL cholesterol levels.

2. Consumption pattern of non vegetarian foods

The frequency of consumption, preference and method of cooking non vegetarian foods by the adults is presented in Table XXII.

TABLE XXII

CONSUMPTION PATTERN OF NON VEGETARIAN FOODS BY THE SELECTED ADULTS

Frequency per week	Male (N=874)		Female (N=766)		Total (N=1640)	
	No	%	No	%	No	%
Once	95	15.9	131	23.4	226	19.5
2-4	374	62.5	287	51.1	661	57.0
5-7	129	21.6	143	25.5	272	23.5
Most consumed item						
Fish	132	22.1	128	22.8	260	22.4
Chicken	259	43.3	247	44.0	498	43.0
Mutton	163	27.3	120	21.4	283	24.4
Egg	203	34.0	107	19.1	310	26.8
Frequent form of consumption						
Frying	247	41.3	295	52.6	542	46.8
Stewing (gravy)	183	30.6	102	18.2	285	24.6
Roasted	168	28.1	164	29.2	332	28.6

Results of the present study revealed that majority of the non vegetarian male (62.5%) and female (51.1%) adults consumed fleshy foods 2 to 4 times a week while 21.6 and 25.5 per cent of the male and female adults consumed non vegetarian foods almost daily. Fleshy foods were consumed weekly once only by 19.5 per cent of the adults. Micha *et al* (2009) reported dietary patterns characterized by high consumption of processed meals to be associated with a greater risk of cardiovascular diseases.

Chicken was the most frequently consumed non vegetarian food among 43.3 per cent of male and 44 per cent of female adults. About 22.4 and 24.4 per cent of the adults consumed fish and mutton more frequently. Egg was frequently consumed by 34 per cent of the male and 19.1 per cent of the female adults. About 41.3 and 52.6 per cent of the male and female adults respectively practised frying of fleshy foods more frequently. About 30.6 and 18.2 per cent of male and female adults consumed non vegetarian foods as gravies and a total of 46.8 per cent of adults consumed fried sea foods and meat more frequently as compared to other forms of consumption.

These findings clearly indicated that there existed a poor dietary practice among the adults. A diet based on high heat treated foods increases markers associated with an enhanced risk of cardiovascular disease. Replacing with mild cooking techniques may help to positively modulate these biomarkers to reduce cardiovascular risk (Aragon *et al.*, 2010).

3. Type and quantity of oil consumed by the selected adults

Table XXIII and Figures 5 and 6 present the type and quantity of oil consumed by the adults.

TABLE XXIII

TYPE AND QUANTITY OF OIL CONSUMED BY THE SELECTED ADULTS

Type*	Male (N=874)		Female (N=766)		Total (N=1640)	
	No	%	No	%	No	%
Refined oil	685	78.4	632	82.5	1371	80.3
Groundnut oil	106	12.1	72	9.4	178	10.9
Gingelly oil	243	27.8	159	20.8	402	24.5
Rice bran oil	76	8.7	47	6.1	123	7.5
Ghee	144	16.5	171	22.3	315	19.2
Butter	15	1.7	24	3.1	39	2.4
Vanaspati	283	32.4	216	28.2	499	30.4
Quantity of oil (g/day)						
10-30	141	16.1	202	26.4	343	20.9
31-50	274	31.4	235	30.7	509	31.0
51-70	246	28.1	193	25.2	439	26.8
71-90	213	24.4	136	17.8	349	21.3

* Multiple response

It is seen that refined oil was consumed by a majority of 78.4 and 82.5 per cent of male and female adults respectively. About 10.9 and 24.5 per cent of the adults consumed groundnut and gingelly oils respectively. Recognizing the beneficial effect through mass media, rice bran oil was consumed by 7.5 per cent of the adults, most of them belonging to the high income category. Around 30.4 per cent of adults consumed vanaspati frequently, which is a saturated fat.

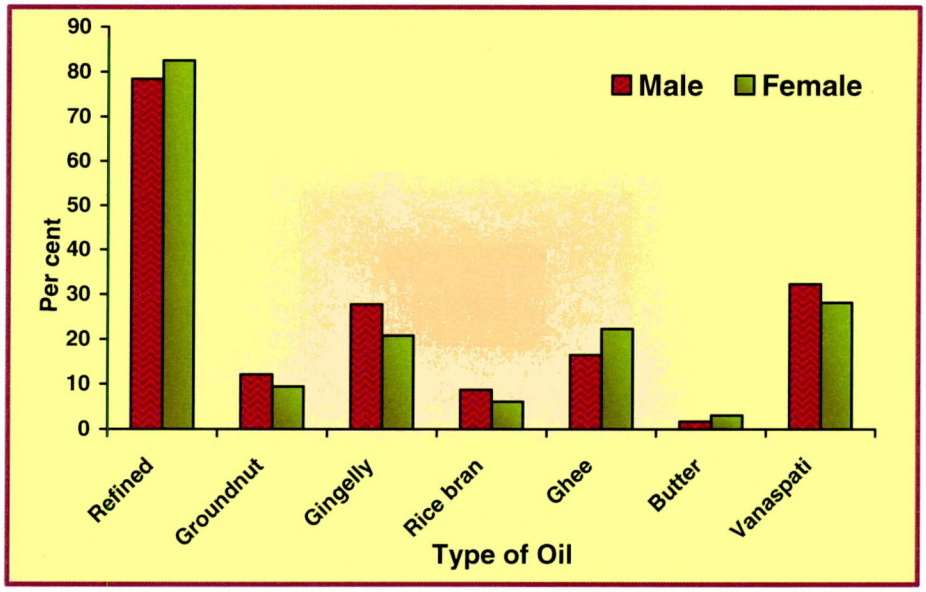

FIGURE 5

TYPE OF OIL CONSUMED BY THE SELECTED ADULTS

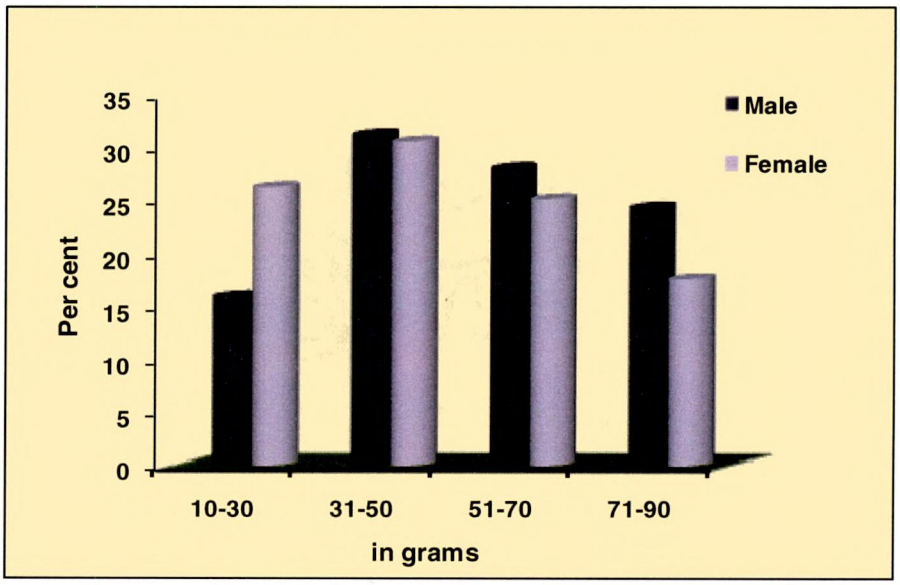

FIGURE 6

QUANTITY OF OIL CONSUMED BY THE SELECTED ADULTS

ICMR (2009) has recommended a fat intake of 15 to 20 g per day for adults. However, only 20.9 per cent of the adults participating in the present study consumed less than 30 g of fat every day. About 31 per cent and 26.8 per cent of the adults consumed 31 to 50 and 51 to 70 g of fat in their daily diet respectively. Fat intake was between 71 and 90 g per day for as many as 24.4 per cent of male and 17.8 per cent of female adults. Though many of the

adults made conscious efforts to reduce visible fat content in their diets, high levels of intake could be seen. High fat diets are associated with increased triglyceride levels and alterations in insulin/glucose homeostasis. A high fat diet also causes cardiac lipid accumulation, reduced cardiac contractility, conduction blocks, and severe structural pathologies reminiscent of diabetic cardiomyopathies (Birse *et al.*, 2010).

4. Cooking methods followed by the selected adults

Prudence in selecting an appropriate cooking method can not only improve or preserve nutritional value, but also protect against harmful free radicals that are associated with increased risk of chronic diseases. The frequency of various cooking methods followed by the adults is presented in Table XXIV and Figure 7.

TABLE XXIV

COOKING METHODS FOLLOWED BY THE SELECTED ADULTS

(N=1640)

Method*	Frequent		Rare		Never	
	No.	%	No.	%	No.	%
Raw food intake	134	8.2	214	13.1	1292	78.7
Boiling	555	33.8	972	59.3	113	6.9
Steaming	1108	67.5	531	32.4	1	0.1
Pressure cooking	1384	84.4	203	12.4	53	3.2
Roasting	943	57.5	293	17.9	404	24.6
Baking	86	5.2	391	23.9	1163	70.9
Shallow frying	943	57.5	559	34.1	138	8.4
Deep frying	649	39.6	949	57.9	42	2.5

*Multiple Response

Only 8.2 per cent of the adults consumed raw fruits and vegetables frequently whereas 78.7 per cent of the adults never consumed raw salads because of their ignorance. Boiling of foods was frequent among 33.8 per cent of the families. The most commonly used methods of cooking were pressure cooking by 84.4 per cent and steaming by 67.5 per cent of families. Shallow and deep fat frying of foods were frequently adopted by 57.5 and

39.6 per cent of the adults respectively. Only 8.4 and 2.5 per cent of the adults avoided these methods of cooking. A maximum of 70.9 per cent of families did not use baking as a method of cooking.

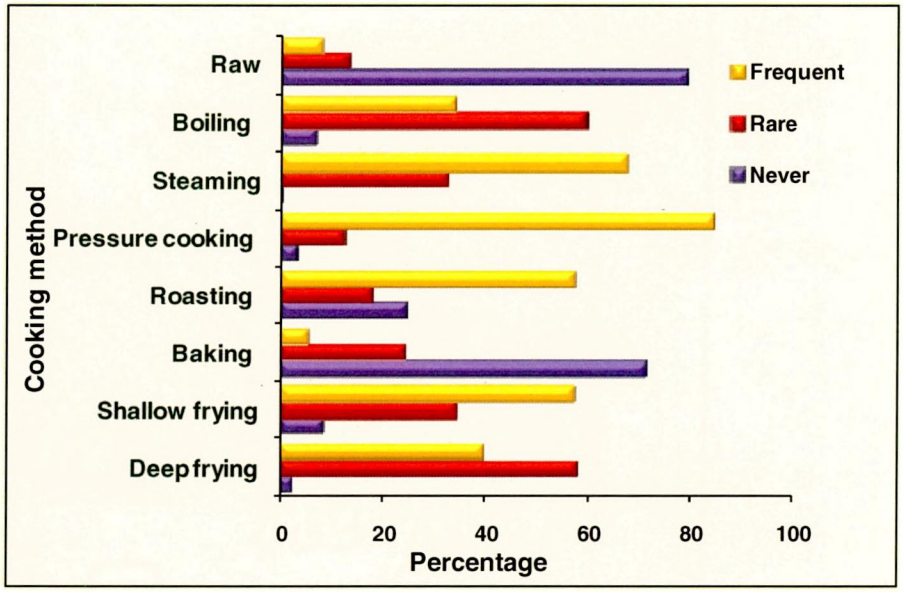

FIGURE 7

COOKING METHODS FOLLOWED BY THE SELECTED ADULTS

5. Beverage consumption pattern of the selected adults

The beverage consumption pattern of the adults taking part in the present study is depicted in Table XXV.

TABLE XXV

BEVERAGE CONSUMPTION PATTERN OF THE SELECTED ADULTS

Beverage	1-3 times		3-5 times		>5 times	
	No.	%	No.	%	No.	%
Coffee	103	6.3	143	8.7	252	15.4
Tea	130	7.9	191	11.1	246	15
Both (coffee & tea)	136	8.3	169	10.3	254	15.5
Green tea	95	5.8	3	0.2	-	-
Milk	34	2.1	32	1.9	-	-
Health drink	91	5.6	-	-	-	-
Soup	63	3.8	-	-	-	-
Fruit juice	11	0.7	-	-	-	-

Coffee was consumed more than five times a day by a greater percentage (15.4) of adults whereas only less percentage (6.3) consumed 1-3 times a day. Tea was consumed more than five times a day by 15 per cent of the adults and 15.5 per cent of the adults consumed more than five cups of either tea or coffee.

Many of the adults had the habit of consuming tea or coffee at mealtimes replacing their meals due to work pressure or lack of time. Such unhealthy eating habits could have increased the risk for cardiovascular disease among these adults. About 2.1 and 1.9 per cent of the adults consumed green tea less than three and three times a day respectively. They believed that this could bring down their body weight and blood cholesterol levels. Health drinks, soups and fruit juices were the other beverages consumed by some of the adults once or twice a day.

6. Modified food choice pattern of the selected adults

Some of the adults had modified their diets in order to maintain their cardiovascular health. Such modifications included the addition, restriction and elimination of certain foods in their diets which is shown in Table XXVI and Figures 8, 9 and 10.

Fibre rich foods such as salads, oats, and whole grains were included by 2.1, 10.9, and 4.3 per cent of the adults respectively. Green tea found its place in the diets of 6.0 per cent of the adults. As many as 5.7 and 7.6 per cent of the total adults included in the present study restricted their fat and oil intake and salt intake with the aim of controlling their blood cholesterol and blood pressure levels respectively.

Meat and pulse intakes were reduced by 16.1 and 7.5 per cent by the adults respectively. Egg and coconut intakes were reduced by 5.2 and 3.8 per cent of the adults respectively. About 7.3 and 5.4 per cent of the adults totally avoided fried snacks and visible oil content in their diets and about 3.5 per cent of the adults avoided sweets. Overall, it can be inferred that healthy diet choices were uncommon among the adults participating in the present study either due to lack of awareness or due to habit which might be one of the risk

factors leading to the progress of cardiovascular disease. Chow *et al* (2010) reported that adherance to dietary advice was associated with a substantially lower risk of recurrent cardiovascular events among patients with acute coronary syndrome.

TABLE XXVI

MODIFIED FOOD PATTERN OF THE SELECTED ADULTS

Food pattern	Male (N=874)		Female (N=766)		Total (N=1640)	
	No.	%	No.	%	No.	%
Included						
Salad /greens	13	1.5	21	2.7	34	2.1
Oats	82	9.4	96	12.5	178	10.9
Whole cereals	44	5.0	27	3.5	71	4.3
Green tea	48	5.5	54	7.1	102	6.2
Restricted						
Fat/ oil	36	4.1	58	7.6	94	5.7
Sugar/ sweets	71	8.1	86	1	157	9.6
Salt	73	8.4	52	11.2	125	7.6
Meat	125	14.3	139	6.8	264	16.1
Pulses	97	11.1	26	18.2	123	7.5
Egg	64	7.3	21	3.4	85	5.2
Coconut	36	4.1	27	2.7	63	3.8
Avoided						
Fried snacks	72	8.2	47	6.1	119	7.3
Sweets	23	2.6	35	4.6	58	3.5
Oil	36	4.1	53	6.9	89	5.4

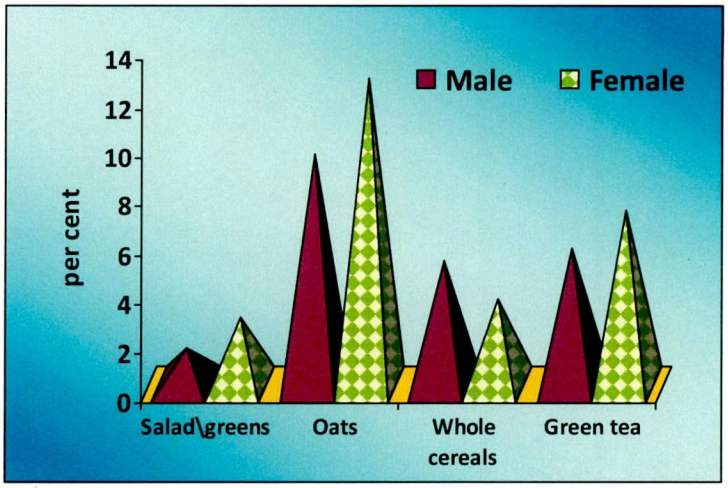

FIGURE 8
FOODS INCLUDED BY THE SELECTED ADULTS

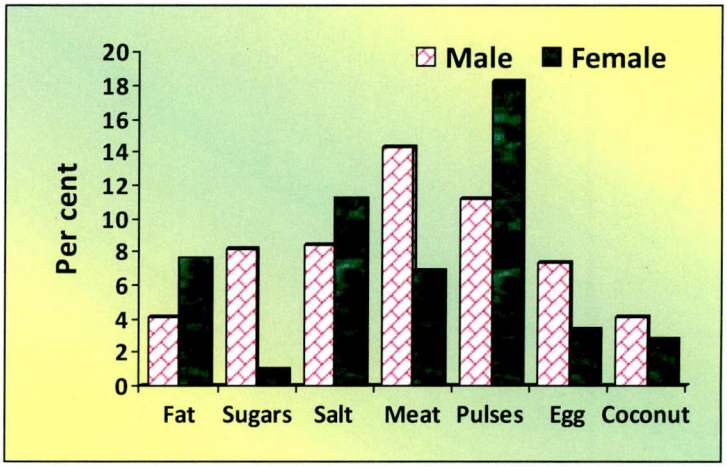

FIGURE 9
FOODS RESTRICTED BY THE SELECTED ADULTS

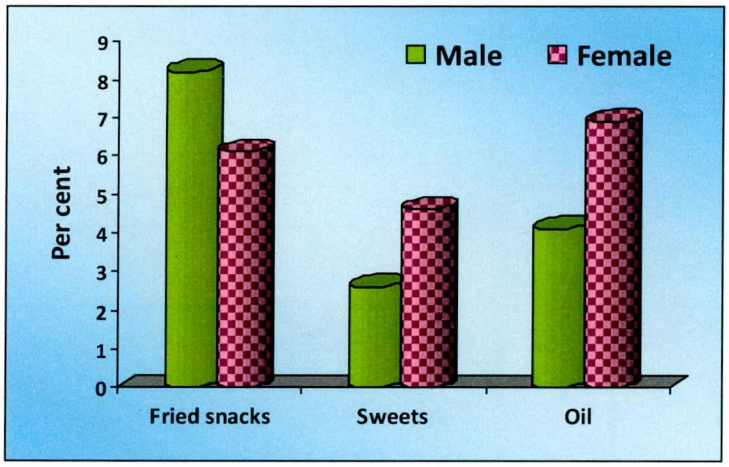

FIGURE 10
FOODS AVOIDED BY THE SELECTED ADULTS

7. Source of advice

The various sources through which the adults received nutrition and diet related information is given in Table XXVII.

TABLE XXVII

SOURCE OF ADVICE RECEIVED BY THE SELECTED ADULTS

Source	Male (N=874)		Female (N=766)		Total (N=1640)	
	No.	%	No.	%	No.	%
Doctors	326	37.3	205	26.8	531	32.4
Health workers	14	1.6	9	1.2	23	1.4
Mass media	162	18.5	223	29.1	385	23.5
Newspaper/magazine	82	9.4	29	3.8	111	6.8
Friends/ relatives	110	12.6	82	10.7	192	11.7
Elders	269	7.9	274	35.8	543	33.1

Elders were the major source of nutrition information as reported by 33.1 per cent of the adults being the majority. Doctors were the next common source as reported by 32 per cent of the adults. Health workers and mass media were the major sources of nutrition information for 1.4 and 23.5 per cent of the adults respectively. About 6.8 per cent of the adults reported news papers and magazines to be their source of nutrition information. It is evident that many adults relied on non professional health advice received through informal channels than professional channels. It is also worth mentioning that one of the reasons for this status was the scarcity of professional health guidance. It is an interesting observation that while a large number of male adults gathered nutrition information from doctors, health workers, news papers and friends, a greater number of female adults were influenced by the mass media and elders in their choice for health practices.

8. Knowledge regarding disease condition

Table XXVIII shows the knowledge of the adults regarding the role of diet and other cardiovascular risk factors.

TABLE XXVIII

KNOWLEDGE REGARDING DISEASE CONDITION OF THE SELECTED ADULTS

Category	Male (N=874)		Female (N=766)		Total (N=1640)	
	No.	%	No.	%	No.	%
Role of oils	98	11.28	112	14.6	210	12.8
Role of physical activity	160	18.3	128	16.7	288	17.6
Role of diet	23	2.6	39	5.1	62	3.8
Cooking method	32	3.7	52	6.8	84	5.1
Type of milk	27	3.1	35	4.6	62	3.8
Stress	33	3.8	18	2.4	51	3.1
Hypocholesterimic foods	29	3.3	21	2.7	50	3.1
Hypotensive foods	51	5.8	69	9.0	120	7.3
Ideal body weight	153	17.5	108	14.1	261	15.9
Alcohol/ smoking	552	63.2	644	84.1	1196	72.9

It is evident from the Table that though many adults (72.9%) had knowledge regarding the ill effects of alcohol and smoking on heart health, knowledge regarding other factors such as the role of diet, type of milk, stress and hypocholesterimic foods could be seen only among less than four per cent of the adults. About 12.8 and 17.6 per cent of the adults were aware of the role of oils and physical activity respectively upon cardiovascular health. About 15.9 per cent of the adults identified that people with excess body weight are more susceptible to heart diseases. It was observed that the need for reliable health information was in great demand remarkably among a majority of the surveyed adults. Their need for information was centered on healthy eating patterns, weight management and management of chronic disorders such as cardiovascular disease and diabetes.

v. Food intake and energy expenditure of the adults

Diet is one of the major culprits for cardiac diseases in India followed by lifestyle and stress (Mitra *et al.*, 2009). Following Tables deal with the dietary intake and energy expenditure pattern of the adults.

1. Food intake pattern of the selected adults

Diet plays an important part in the maintenance of optimal cardiovascular health. The mean food intake of the adults are compared with the RDA and presented in Table XXIX.

TABLE XXIX

MEAN FOOD INTAKE OF THE SELECTED ADULTS

Foods (g)	RDA* (g/day)	Male (N=874)		Female (N=766)	
		Mean	%excess /deficit	Mean	%excess /deficit
Cereals	460	652.3 ± 91.2	+41.8	587.2 ± 112.6	+27.7
Pulses	40	39.5 ± 24.7	-1.3	32.7 ± 21.2	-18.3
Leafy vegetables	50	21.9 ± 17.2	-56.2	18.7 ± 11.4	-62.6
Roots and tubers	50	43.5 ± 7.8	-13.0	62.5 ± 12.5	+25
Other vegetables	60	31.5 ± 12.3	-47.5	29.0 ± 14.6	-62
Fruits	--	21.1 ± 8.5	-	19.4 ± 13.6	-
Milk (ml)	150	161.5 ± 25.8	+7.7	164.5 ± 41.7	+9.7
Fats and oils (ml)	15	43.2 ± 19.5	+188	37.8 ± 18.4	+152
Meat and poultry	30	41.6 ±1 7.6	+121.3	36.6 ± 23.3	+116.6
Fish		24.8 ± 19.4		28.4 ± 11.6	
Salt	5#	8.47 ± 3.52	+69.4	7.94 ± 3.16	+58.8

*ICMR, 2002; # WHO 2007

The daily food intake of the adults collected through the 24 hour dietary recall method revealed an increased intake by 41.8 and 27.7 per cent of cereals among the male and female adults respectively in comparison with the RDA (ICMR, 2002). The pulse intake of male and female adults was less than the RDA by 1.3 and 18.3 per cent respectively but compensated very much by the intake of non vegetarian foods. The intake of leafy vegetables and other vegetables were less than the recommended levels by around 50 per cent. The intake of roots and tubers exceeded the recommended allowance by 25 per cent among female adults and the intake of milk and its products exceeded the recommendations by more than seven per cent among both sexes. However, the intake of fats and oils which need special restriction among cardiovascular patients exceeded the RDA by as much as 188 and 152 per cent among male and female adults respectively.

The mean salt intakes of the male and female adults were found to be 69.4 and 58.8 per cent respectively more than the levels recommended by WHO (2007). A meta-analysis by Strazzullo *et al* (2009) of 19 independent Cohort samples indicated that high salt intake significantly increased the risk of stroke and cardiovascular disease.

This observation reflects the extremely poor dietary management prevalent among the adults with cardiovascular disease which can quickly complicate the existing situation if not given immediate attention. The Japan Collaborative Cohort (JACC) study has reported a significant inverse relationship between vegetable intake and coronary heart disease related deaths (Nagura *et al.*, 2009). A 'prudent' dietary pattern, characterized by high intakes of fruits, vegetables, legumes, fish, poultry and whole grain cereals have been associated with significantly lower risks of cardiovascular disease (Kontogianni *et al.*, 2009).

2. Nutrient intake of the selected adults

Table XXX shows the daily nutrient intake of the adults in comparison with ICMR (2009) Recommended Allowances.

TABLE XXX
MEAN NUTRIENT INTAKE OF THE SELECTED ADULTS

Nutrients	RDA*		Male (N=874)		Female (N=766)	
	Male	Female	Mean	% excess/ deficit	Mean	% excess/ deficit
Energy (Kcal)	2318	1899	2734.2 ± 39.5	+17.9	2052.4 ± 406.2	+8.1
Protein (g)	60	55	58.3 ± 26.4	-2.8	47.6 ± 31.4	-13.5
Fat (g)	20	20	42.5 ± 9.2	+112.5	38.7 ± 11.5	+93.5
Calcium (mg)	600	600	423.6 ± 58.7	-29.4	496.5 ± 71.2	-17.3
Iron (g)	17	21	6.3 ± 2.5	-62.9	8.5 ± 4.1	-59.7
Thiamine (mg)	1.4	1.1	1.3 ±0.8	-7.1	1.1 ±0.9	0
Riboflavin (mg)	1.6	1.3	1.1 ±0.9	-31.3	1.4 ±1.2	+7.7
β carotene (µg)	4800	4800	973.4 ±286.4	-79.7	813.7 ±301.2	-83.7
Vitamin C (mg)	50	50	32.5 ±26.2	-35	29.3 ±17.8	-41.0
Folic acid (µg)	200	200	133.6 ±96.8	-33.2	176.2 ±89.4	-11.9
Sodium (mg)	1,500#	1,500#	3328.71 ±963.46	+121.9	3120.42 ±877.63	+108.0

*ICMR, 2009; #Institute of Medicine, 2005

The average nutrient intake of the 1640 adults revealed that the male and female adults had an energy intake which exceeded their respective RDA by 17.9 and 8.1 per cent respectively. There was also an alarmingly high intake of fat among both male (42.5 g/day) and female (38.7 g/day) as against the recommended levels (20 g/d). Further the intake of vitamin A precursor –

β carotene that has been established to play a leading role in cardiovascular disease is far less than the RDA in both male and female adults by 79.7 and 83.7 per cent respectively. The intake of iron was seen to be less than half of the recommended allowance among both sexes. There was also a deficit of 35 and 41 per cent in vitamin C intake among male and female adults respectively. Further, the adults also failed to meet the requirements of protein, folic acid and calcium. According to Miragila and Dwyer (2011), dietary choices should minimize the intake of excess calories, saturated and hydrogenated fats, cholesterol, salt and sugar to minimize chronic disease risk.

The Institute of Medicine (2005) recommends the total daily intake of sodium upto 1500 mg. However the average intake of the male and female adults was more than twice the recommended amounts. There are strong evidences linking high sodium intake to elevated blood pressure, which is the leading preventable risk factor for death worldwide. Hence a reduction in sodium intake of the adults under study becomes mandatory.

3. Activity profile and energy balance of the selected adults

Science has added to our understanding of the biological mechanisms by which physical activity provides health benefits and it is associated with enhanced health and quality of life. The activity profile of the adults studied through 24 hour activity schedule is presented in Table XXXI.

Both male and female adults spent majority of their time and energy in sedentary activity, mainly in the form of sitting, recreation and rest. Male adults spent more time and energy in moderate and heavy activities as compared to the female adults which were mainly contributed by their occupation. The total daily energy expenditure of the male and female adults was found to be 2545 K cal and 2147 K cal respectively. Many of the adults studied did not report any leisure time physical activity, much of it being spent in recreation and rest. Because of the dose response relation between physical activity and health, persons who wish to further improve their physical fitness can reduce their risk for chronic disease and disabilities and

benefit by exceeding the minimum amounts of physical activity (Haskell *et al.*, 2007).

TABLE XXXI

MEAN ACTIVITY PROFILE OF THE SELECTED ADULTS

Category*	Activity	Male (N=874)		Female (N=766)	
		Time (min)	Energy (Kcal)	Time (min)	Energy (Kcal)
Sedentary	Sleeping, eating, walking, rest	1037.2 ± 214.3	1247 ± 471.8	1251.7 ± 263.5	1507 ± 509.6
Moderate	Washing, cleaning, climbing stairs	264.4 ± 82.4	479 ± 146.4	115.9 ± 105.4	211 ± 98.5
Heavy	Exercise, vigorous physical activity	138.4 ± 67.5	819 ± 204.1	72.4 ± 26.3	429 ± 151.3
Total		**1440**	**2545**	**1440**	**2147**

*ICMR (2002)

4. Energy balance of the selected adults

Recent studies on trends in dietary patterns suggest a significant drift towards less healthful eating patterns and over consumption of calorie rich foods, which have been associated with increased prevalence of obesity, metabolic syndrome and diabetes (Gidding *et al.*, 2009). A key component of cardiovascular disease is energy balance that is balancing energy consumption with expenditure to maintain optional body weight and waist circumference (Nimptsch *et al.*, 2011). The following Table XXXII depicts energy balance of the adults for one day.

TABLE XXXII

ENERGY BALANCE OF THE SELECTED ADULTS

Energy (Kcal)	Male	Female
Intake	2734	2053
Expenditure	2545	2147
Balance	**+189.2**	**+94.6**

A comparison of the energy intake and expenditure per day among the adults revealed that both the male (189.2 K cal) and female (94.6 K cal) adults were in a state of positive energy balance with their energy intake exceeding the expenditure. Positive energy balance with as low as 110 to 165 calorie surplus daily can yield an excess of ten or more pounds over one year's time (Nielsen *et al.*, 2005). There is hence a need to manipulate their lifestyle such that their energy expenditure is increased.

vi. Anthropometric parameters of the adults

Many research findings relate various anthropometric parameters directly or indirectly to cardiovascular disease. Several studies have recommended the use of anthropometric measurement that capture abdominal adiposity such as waist circumference, waist hip ratio or waist height ratio in assessing disease prediction in clinical practice and public health surveillance (Taylor *et al.*, 2010).

Details regarding the anthropometric parameters of the 1640 adults have been tabulated as follows.

1. Anthropometric parameters of the adults

Table XXXIII presents the mean anthropometric parameters of the adults.

The mean heights of the 1640 adult men and women were 162.4 cm and 153.3 cm respectively. The mean body weights of the male and female adults were 79.95 kg and 71.9 kg respectively which were found to be 33.3 and 43.8 per cent more than the ICMR (2009) reference values. This finding confirms that body weight is an important causative factor for cardiovascular disease. Paganini-Hill (2011) reported increased risk of cardiovascular disease death among over weight men aged less than 75 years compared to their normal weight counterparts. Numerous adverse effects of obesity in general and especially cardiovascular health have been reported by Lavie *et al* (2009).

TABLE XXXIII

MEAN ANTHROPOMETRIC PARAMETERS OF THE SELECTED ADULTS

Parameters	Cut-off values		Male (N=874)	Female (N=766)
	Male	Female		
Height (cm)	-	-	162.4 ± 9.1	153.3 ± 8.6
Weight (Kg)*	60	50	79.95 ± 13.5	71.9 ± 16.2
Body Mass Index#	18.5	24.99	30.61 ± 3.5	30.3 ± 4.1
Waist Circum-ference$ (cm)	102	88	104.1 ± 11.4	98.93 ± 9.96
Hip Circum-ference (cm)	-	-	109.3 ± 9.4	103.1 ± 9.97
Waist Hip Ratio$	0.95	0.80	1.0 ± 0.06	0.96 ± 0.93
Waist Height Ratio§	<0.5	<0.5	0.65 ± 0.05	0.63 ± 0.07
Mid upper arm circumference (cm)	-	-	29.55 ± 3.83	31.25 ± 3.21

*ICMR 2009; #WHO 2004; $ WHO 2008a; §McCarthy *et al.*, 2006

Excess weight increases the risk of developing hypercholesterolemia, hypertension and diabetes. Each of these co morbid medical conditions are associated in turn with an increased risk of cardiovascular disease (Flint *et al.*, 2010). In the present study the mean values of BMI of both male and female adults were seen to be 30.61 and 30.3 respectively indicating that majority of them were either pre obese or obese when compared to the WHO guidelines for BMI.

The mean waist circumferences of the male and female adults were 104.1 cm and 98.93 cm respectively which were greater than the limits for substantially increased risk of metabolic complications as suggested by WHO (2008b) to be 102 cm for men and 88 cm for women. These are far higher than the International Diabetes Federation (2006) cut-off points for South

Asians which are >90 cm for men and >80 cm for women. A recent study among nearly 3,60,000 participants from nine European countries showed that both general obesity and abdominal obesity were associated with the risk of death and this highlights the importance of WC or WHR in addition to BMI for assessing mortality risk (Pischon *et al.*, 2008).

The hip circumferences of the male and female adults were 109.3 cm and 103.1 cm respectively. The WHR of the male and female adults were 1.0 and 0.96 respectively. The WHtR of the male and female adults were 0.65 and 0.63 respectively. It was seen that both the waist hip ratio and waist height ratio of the male and female adults exceeded the cut-off values. The mean mid upper arm circumference of the male and female adults were 29.55 and 31.25 cm respectively. The mean values of all the anthropometric parameters of the adults in the present study were found to be higher than the reference values. This indicates that anthropometric parameters of adults might have played a major role in increasing cardiovascular disease risk among the adults and hence is a major area of concern for the present study.

2. Classification of the adults based on BMI

Classification of the adults based on BMI is presented in Table XXXIV.

TABLE XXXIV

CLASSIFICATION OF THE ADULTS BASED ON BMI

Category	BMI Range*	Male		Female		Total	
		No	%	No	%	No	%
Underweight	<18.5	62	7.1	41	5.4	103	6.3
Normal	18.5-24.9	278	31.8	198	25.8	476	29.0
Pre obese	25.0-29.9	305	34.9	324	42.3	629	38.4
Obese I	30.0-34.9	146	16.7	56	7.3	202	12.3
Obese II	>35	83	9.5	147	19.2	230	14.0
Total		**874**	**100**	**766**	**100**	**1640**	**100**

*WHO, 2004

It is evident from the Table that only 31.8 and 25.8 per cent of the male and female adults respectively had normal BMI while 7.1 and 5.4 per cent of male and female adults were in the underweight category. Majority of male (34.9%) and female (38.4%) adults were pre obese. About 16.7 and 9.5 per cent of adult males were in the first and second grade obesity respectively whereas 7.3 and 19.2 per cent of female adults were in first and second grade obesity respectively. A study among urban men in Tanzania revealed a significant correlation of BMI with blood pressure, total triglycerides, LDL and HDL cholesterol and fasting glucose levels (Njelekela *et al.*, 2009). In the present study maximum percentage of adults were having a higher BMI and categorized to be obese which could be a strong predisposing factor for cardiovascular diseases.

3. Abdominal obesity

Table XXXV presents the classification of adults on the basis of abdominal obesity.

TABLE XXXV

CLASSIFICATION OF ADULTS BASED ON ABDOMINAL OBESITY

Parameters	Cut-off values		Male		Female	
	Male	Female	No	%	No	%
Waist circumference*	102	88	508	58.1	477	62.3
Waist hip ratio*	0.95	0.80	468	53.55	552	72.06
Waist height ratio#	0.05	0.05	391	44.74	307	40.08

*WHO 2008a; #McCarthy *et al.*, 2006

It is seen that more than 50 per cent of the male adults had abdominal obesity according to the waist circumference and waist hip ratio. Compared to men a greater percentage of about 62.3 and 72.06 per cent of adult women had abdominal obesity based on waist circumference and waist hip ratio respectively. The waist height ratio of the male and female adults revealed that more than 40 per cent of adults in both groups had greater than 0.5 which is classified to be at risk of obesity. Excess adiposity is a key risk factor for congestive heart failure and cardiovascular disease because it is a

fundamental precursor of several cardiovascular risk factors including high blood pressure, dyslipidemia and impaired glucose homeostasis (Lieb *et al.*, 2009). Casanueva *et al* (2010) reported that abdominal obesity was strongly associated with cardiovascular disease and diabetes, even in patients leaner by BMI.

vii. Biochemical parameters of the adults

Lipid profile of the adults included total cholesterol, triglyceride, HDL, LDL, and VLDL cholesterol levels and fasting glucose levels.

1. Lipid profile and fasting glucose levels

Lipid profile and fasting blood glucose levels (mean values) of the adults are presented in Table XXXVI.

TABLE XXXVI
LIPID PROFILE AND FASTING BLOOD GLUCOSE LEVELS OF THE ADULTS

Parameter (mg/dl)	Desirable levels*	Male	Female
Total cholesterol (TC)	<200	240.9 ± 26.14	273.04 ± 25.89
Triglyceride	<150	180.84 ± 19.22	165.38 ± 19.27
HDL cholesterol	>40	35.8 ± 4.16	43.11 ± 7.30
LDL cholesterol	>100	169.97 ± 22.70	174.74 ± 6.79
VLDL cholesterol	-	35.85 ± 3.48	30.77 ± 15.38
TC/HDL ratio	Male-4.0 Female-3.8	6.47 ± 0.73	5.36 ± 0.97
LDL/HDL ratio	Male-1 Female-1.5	4.86 ± 0.84	4.93 ± 0.96
Glucose#	80-100	98.52 ± 19.74	96.87 ± 11.77
HbA1C§ (%)	6.5	8.12 ± 2.17	7.95 ± 3.01

*NCEP (2002); # WHO/IDF, 2006; §ADA (2009)

The mean total cholesterol levels of the male and female adults were 240.9 and 273.04 mg per dl respectively being higher than the NCEP (2002) desirable levels of <200 mg per dl. Among the many contributing factors, elevated cholesterol levels play a dominant role in both the initiation and progression of atherosclerosis, as well as in the clinical consequences such as myocardial infarction, stroke and heart failure (Brunzell *et al.*, 2008).

Male and female adults had serum triglyceride levels of 180.84 and 165.38 mg per dl respectively which were higher than the desirable levels of 150 mg per dl. Female adults had 43.11 mg per dl of HDL cholesterol which meets the desirable levels whereas male adults had 35.85 mg per dl being lesser than the standards. The INTERHEART study (Karthikeyan *et al.*, 2009) conducted among a large group of Asians revealed that south Asians had HDL cholesterol levels about 10 mg per dl lower than the others which is related to the high prevalence of Insulin resistance and related metabolic abnormalities, which may be the consequence of genetic predisposition, decreased physical activity and a high carbohydrate diet.

Serum LDL cholesterol levels among male adults was 169.97 mg per dl and among female adults was 174.74 mg per dl which were found to be greater than the reference values. The mean VLDL cholesterol levels of male and female adults were 35.85 and 30.77 mg per dl respectively. LDL cholesterol has a causal role in the development of cardiovascular disease. Regulation of LDL cholesterol represents a fundamental target for devising interventional strategies to reduce the risk of cardiovascular disease (Sandhu *et al.*, 2008).

The mean ratio of TC/HDL was 6.47 among male and 5.36 among female adults and LDL/HDL ratio was 4.86 and 4.93 among male and female adults respectively which were also seen to be greater than the NCEP (2002) reference levels. Mean fasting blood glucose levels of the male and female adults were 98.52 and 96.87 mg per dl respectively which were within safe levels suggested as <100 mg per dl according to WHO/IDF (2004). The mean glycosylated haemoglobin levels of the 297 male and 179 female diabetic adults were 8.12 and 7.95 per cent respectively which exceeded the cut-off

levels of 6.5 per cent revealing a very poor control on blood glucose levels over a long period.

2. Classification of adults according to lipid profile

Table XXXVII and Figure 11 presents the classification of the male and female adults according to the lipid profile suggested by NCEP (2002).

TABLE XXXVII

CLASSIFICATION OF ADULTS ACCORDING TO LIPID PROFILE

Category	Range (mg/dl)	Male		Female		Total	
		No	%	No	%	No	%
Total cholesterol							
Desirable	<200	124	14.4	65	8.5	189	11.5
Border line	200-239	213	24.4	278	36.3	491	29.9
High risk	>240	537	61.4	423	55.2	960	58.6
Triglyceride							
Normal	<150	186	21.3	238	31.1	424	25.9
Border line	150-199	327	37.4	221	28.8	548	33.4
High	200-499	361	41.3	307	40.1	668	40.7
Very high	>499	0	-	0	-	0	-
HDL cholesterol							
Low	<40	706	80.8	575	75.1	1281	78.1
Desirable	40-60	168	19.2	191	24.9	359	21.9
High	>60	0	-	0	-	0	-
LDL cholesterol							
Optimal	<100	58	6.6	63	8.2	121	7.4
Near Optimal	100-129	113	12.9	46	6.0	159	9.7
Border line	130-159	68	7.8	89	11.6	157	9.5
High	160-189	616	70.5	561	73.3	1177	71.8
Very high	>189	19	2.2	7	0.9	26	1.6

Only 11.5 per cent of adults had desirable levels of total cholesterol. The cholesterol levels of about 24.4 per cent of male and 36.3 per cent of female adults were in border line category. Majority of both male (61.4%) and female (55.2%) adults had high risk levels of total cholesterol. A similar pattern was also seen in the triglyceride levels with only 21.3 and 31.1 per cent of male and female adults having normal levels. A study by Wijeysundera *et al* (2010) revealed that deaths due to congestive heart disease could be prevented or delayed by reducing total cholesterol levels.

A total of 33.4 and 40.7 per cent of adults had borderline and high triglyceride levels. "Good cholesterol" HDL was seen to be low among more than 75 per cent of the female and more than 80 per cent of the male adults. Less than ten per cent of the adults maintained optimal LDL cholesterol levels and an alarmingly high percentage of male (70.5%) and female (73.3%) adults had high serum LDL cholesterol levels. Very high LDL cholesterol level of more than 189 mg per dl was found among 1.6 per cent of adults.

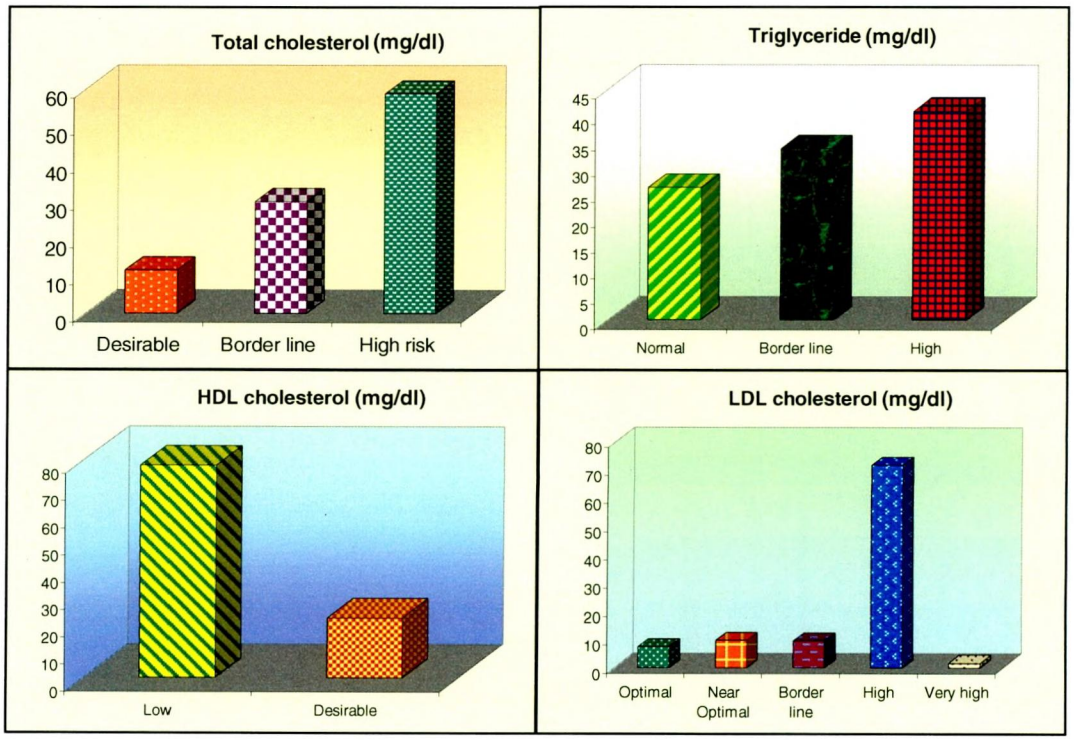

FIGURE 11
CLASSIFICATION OF THE ADULTS ACCORDING TO LIPID PROFILE

The Ibaraki Prefectural Health study (Noda *et al.*, 2010) conducted among Japanese men and women revealed that higher concentration of non HDL cholesterol were associated with an increased risk of mortality from coronary heart disease. The cardiovascular risk in Young Fins study (Magnussen *et al.*, 2009) revealed that the risk of having high intima media thickness was significantly higher in people with borderline and high risk LDL cholesterol levels as compared to those classified as normal.

The present study revealed that there existed a very poor control on serum lipid levels among the adults. In addition, a majority of these adults were ignorant about this condition, its causes or consequences despite consuming prescribed hypolipidimic drugs as a part of their regular medication. Poor compliance with lipid lowering treatment is an important health issue that has been associated with unfavorable cardiovascular outcomes (Liberopoulos *et al.*, 2008).

viii. Cardiovascular parameters of the adults

Heart rate and blood pressure measurement are the primary indicators in the assessment of cardiovascular disease that are being widely practiced and simple to perform.

1. Heart rate and blood pressure values of the adults

The mean heart rate and blood pressure values of the adults are presented in Table XXXVIII.

TABLE XXXVIII

MEAN HEART RATE AND BLOOD PRESSURE VALUES OF THE ADULTS

Parameter	Normal*	Male	Female
Heart rate (beats/min)	50-100	72.4 ± 13.54	71.3 ±19.66
Systolic BP (mm Hg)	120	143.76 ± 15.07	146.61 ±14.38
Diastolic BP (mm Hg)	80	95.77 ± 10.99	94.08 ± 9.88

*JNC, 2004

The mean heart rates of the male and female adults were 72.41 and 71.3 beats per min which were within normal levels. The mean systolic blood pressure of the male and female adults were 143.76 and 146.61 mm Hg and the diastolic blood pressure were 95.11 and 94.08 mm Hg respectively. Both the systolic and diastolic blood pressures of the adults were more than the NCEP (2002) guidelines. It has been shown that the increase in heart rate by ten beats per minute was associated with an increase in the risk of cardiac death by at least 20 per cent, and this increase in risk is similar to the one observed with an increase in systolic blood pressure by 10 mm Hg (Guillaume *et al.*, 2009). Treatment and control of hypertension are particularly low in most developing countries and even developed countries have far from ideal levels of control (Bakris *et al.*, 2008).

2. Categorization of the adults based on WHO (2001) hypertension classification

Categorization of the adults based on WHO (2001) hypertension classification is presented in Table XXXIX.

TABLE XXXIX

CATEGORIZATION OF THE ADULTS BASED ON WHO HYPERTENSION CLASSIFICATION

Classification	Range (mm Hg)	Male		Female		Total	
		No	%	No	%	No	%
Normal	≤ 120 / ≤ 80	141	16.13	163	21.28	304	18.54
Systolic hypertension	>120	215	24.6	141	18.41	356	21.41
Diastolic hypertension	>80	193	22.1	94	12.21	287	17.5
Both	>120 and >80	325	37.2	368	48.04	693	42.25
Any one	>120 or >80	733	83.9	603	78.72	1336	81.46

Staging of a disease process such as hypertension is an assessment of the extent to which the disease has advanced at a particular time and is a snap shot of the pathophysiologic process (Giles *et al.*, 2009). There is a

recent shift of interest from blood pressure as a whole to the relative importance of various blood pressure components in cardiovascular disease. The Framingham Heart Study (Franklin *et al.*, 2009) reported that diastolic blood pressure was considered a better predictor of cardiovascular disease events whereas systolic blood pressure was accepted as a clinically useful predictor of congestive heart failure and stroke.

Among the adults, 16.13 per cent of male and 21.28 per cent of female adults maintained both their systolic and diastolic blood pressure within normal levels. Systolic hypertension was seen among 24.6 per cent and 18.4 per cent male and female adults respectively. Hypertension of the diastolic blood pressure was seen among 22.1 per cent and 12.21 per cent male and female adults respectively. Canadian Statistics Catalogue (Wilkins *et al.*, 2010) has reported high systolic blood pressure to be twice as common as high diastolic blood pressure among Canadians. In the present study 42.25 per cent of the adults had systolic as well as diastolic hypertension while majority of the adults (81.46%) had any of the two types of hypertension. A large percentage of women were seen to have both systolic and diastolic blood pressures when compared to men.

Studies by Coylerwright *et al* (2008) suggested a positive relationship between menopause and hypertension and that the association between blood pressure and age was steeper in post menopausal women. According to ACCF/AHA (Redberg *et al.*, 2009), good blood pressure control is a challenge for patients including those with multiple co morbidities and some older patients with isolated systolic hypertension. This situation further emphasizes the need for counselling and guidance towards diet and lifestyle changes which has to accompany any medical treatment in order to get maximum benefits.

3. Classification of adults according to JNC hypertension guidelines

Table XL presents the categorization of the adults based on the Joint National Committee (2004) hypertension guidelines.

Based on the JNC guidelines, 35.24 and 40.1 per cent of the male and female adults were categorized under the pre hypertension category. Pre

hypertension is associated with an increased risk of cardiovascular events. About half of the health related burden of elevated blood pressure is estimated to occur at less than 145 mm Hg of systolic blood pressure (Winkins *et al.*, 2010).

TABLE XL

CLASSIFICATION OF ADULTS BASED ON JNC (2004) HYPERTENSION GUIDELINES

Category	Range (mm Hg)	Male		Female		Total	
		No	%	No	%	No	%
Normal	SBP<120 DBP<80	141	16.1	163	21.3	304	18.5
Pre hypertension	SBP 120-139 DBP 80-89	308	35.2	307	40.1	615	37.5
Stage I hypertension	SBP 140-149 DBP 90-99	289	33.1	213	27.8	502	30.6
Stage II hypertension	SBP ≥ 160 DBP ≥ 100	136	15.6	83	10.8	219	13.4

In the present study a large percentage of male (33.1) and female (27.8) adults had stage I hypertension while as many as 15.6 per cent and 10.8 per cent of male and female adults respectively had stage II hypertension. Pre hypertensive and hypertensive blood pressure were seen to be associated with low levels of cardiorespiratory fitness among women making them vulnerable to cardiovascular events (Hageman *et al.*, 2010).

4. Electrocardiogram findings of the adults

The electrocardiogram (ECG) remains one of the few diagnostic tools available to predict acute coronary syndrome, myocardial infarction, or adverse cardiac outcomes (O'Neil *et al.*, 2010). The results of the 12 – lead electrocardiogram analysis of the adults is presented in Table XLI.

Resting ECG analysis revealed the absence of any form of abnormalities among 71.2 and 82.9 per cent of the male and female adults. Q-wave abnormalities were identified among 15.6 per cent of the adults. S-T and T-wave abnormalities were present among 3.2 and 2.7 per cent of the adults respectively. The Minnesota Code which is the most widely used

electrocardiographic classification systems suggests that Q- and ST-T–wave abnormalities predict coronary heart disease and total mortality (Prineas *et al.*, 2010).

TABLE XLI

ELECTROCARDIOGRAM FINDINGS OF THE ADULTS

Abnormality	Male		Female		Total	
	No	%	No	%	No	%
No abnormality	622	71.2	635	82.9	1257	76.6
Q and QS items	144	16.5	112	14.6	256	15.6
Ventricular hypertrophy	71	8.1	24	3.1	95	5.8
S – T depression	32	3.7	21	2.7	53	3.2
T wave items	29	3.3	16	2.1	45	2.7
Arrythmias	94	10.8	65	8.5	159	9.7

A total of 5.8 per cent of the adults showed presence of ventricular hypertrophy. Arrhythmias were noticed among 9.7 per cent of adults. Cardiac arrhythmias are a common accompaniment of a variety of cardiac diseases. They become important when they cause symptoms, threaten life, or are indicative of an adverse prognosis (Gothwal *et al.*, 2011).

ix. Abnormalities of metabolic syndrome among the adults

The NCEP (2002) has added the metabolic syndrome, a multidimensional risk factor for cardiovascular disease, as a coequal partner of elevated LDL cholesterol for risk reduction therapies. Table XLII classifies the adults participating in the present study based on their abnormalities linked to metabolic syndrome.

Out of the five abnormalities of metabolic syndrome namely abdominal obesity, elevated blood pressure, elevated fasting glucose, high triglyceride levels and low HDL cholesterol levels, nearly 30 per cent of adults were having any one of the abnormalities. A total of 12.3 per cent of adults had any two abnormalities of metabolic syndrome. Any three and any four abnormalities of metabolic syndrome were seen among 28.5 per cent and 21.9 per cent of the adults respectively. It was encouraging to observe that

only 7.6 per cent of adults had all the five abnormalities of metabolic syndrome.

TABLE XLII

ABNORMALITIES OF METABOLIC SYNDROME AMONG THE ADULTS

Abnormalities	Male		Female		Total	
	No	%	No	%	No	%
Any one	226	25.6	261	34.1	487	29.7
Any two	103	11.8	98	12.8	201	12.3
Any three	275	31.5	193	25.2	468	28.5
Any four	236	27.0	123	16.0	359	21.9
All five	34	3.9	91	11.9	125	7.6

The presence of metabolic syndrome is a strong predictor of cardiovascular disease and death, and the increase in risk begins with the presence of just one metabolic syndrome component (Arnlov *et al.*, 2010). The CURES-52 study (Mohan *et al.*, 2007) revealed that 85 per cent of hypertensive adults and 78 per cent of diabetic hypertensive adults in India did not achieve adequate control over hypertension, which underscored the urgent need to develop national strategies for prevention and treatment of hypertension.

C. Impact of supplementation of the formulated functional food mixes

Impact evaluation is the most important step in any nutrition intervention programme as it gives an overview of the effectiveness of the intervention and improvements for future. In order to assess the impact of six months supplementation of food mixes to adults with cardiovascular disease, various nutritional parameters were assessed both before and after supplementation and compared.

The different groups supplemented with different mixes are indicated below.

EG1: Adults with cardiovascular disease supplemented with basic mix

EG2: Adults with cardiovascular disease supplemented with variation 1

EG3: Adults with cardiovascular disease supplemented with variation 2

CG1: Adults with cardiovascular disease without supplementation

EG4: Adults with cardiovascular disease and Type II Diabetes Melitus supplemented with basic mix

CG2: Adults with cardiovascular disease and Type II Diabetes Melitus without supplementation

i. Anthropometric parameters of the adults

1. Changes in body weights of the adults

The initial and final mean body weight of the adults before and after supplementation is given in Table XLIII.

TABLE XLIII

MEAN BODY WEIGHT OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Body weight (kg)			't' value		
	Initial	Final	Difference	I Vs F	Groups compared	
EG1	68.73 ± 8.99	66.68 ± 8.98	2.05 ± 0.65	17.33**	EG1vsCG1	12.79**
EG2	67.73 ± 7.61	65.70 ± 7.78	2.03 ± 0.79	14.15**	EG2vsCG1	7.55**
EG3	66.08 ± 8.33	63.82 ± 8.24	2.27 ± 0.74	16.78**	EG3vsCG1	16.07**
CG1	67.50 ± 8.56	67.38 ± 8.57	0.12 ± 0.47	1.37^{NS}	EG4vsCG2	5.16**
EG4	67.10 ± 8.46	65.93 ± 8.23	1.17 ± 0.75	8.56**	EG1vsEG2	0.67^{NS}
CG2	71.95 ± 7.49	71.63 ± 7.39	0.32 ± 0.57	3.07**	EG2vsEG3	0.12^{NS}
					EG1vsEG3	1.26^{NS}
					EG1vsEG4	5.51**

** $p<0.01$; NS-Not significant

The mean body weight of the adults belonging to all the six groups ranged from 66.08 to 71.95 kg and were seen to be more than the ideal body weight of 60 kg suggested by ICMR (2009) for reference man and 50 kg for reference woman. Clinically significant weight loss can bring about favourable changes in cardio metabolic risk factors (Goodpaster *et al.*, 2010).

Adults belonging to all the four experimental groups EG1, EG2, EG3 and EG4 showed a reduction in their body weight by 2.05, 2.03, 2.27 and 1.17 kg respectively after the supplementation period which were found to be statistically significant at one per cent level. An insignificant reduction was observed in the body weights of control groups CG1 and CG2. Tanumihardjo *et al* (2009) observed a significant reduction in body weights after three months of feeding carrot among obese individuals.

A comparison of the effect of supplementation of food mixes between the experimental groups revealed that maximum weight reduction was observed in EG2 closely followed by EG1 and EG3. These differences were not statistically significant showing that all the three mixes had almost an equal potential in reducing body weight among the adults of the present study. It was further noted that a significant difference between weight changes in EG1 and CG1, EG4 and CG2 revealing that basic mix supplementation could bring about weight reduction among adults with cardiovascular disease and diabetes. Wu *et al* (2010) revealed a significant reduction in body weights upon supplementation of 30 g per day of flax seed for 12 weeks among adults with metabolic syndrome which may be attributed to the high amount of poly unsaturated fatty acids present in flax seed.

2. Changes in BMI of the adults

The initial and final BMI values of the adults is shown in Table XLIV.

At the beginning of the study, the BMI of the adults belonging to all the four experimental and two control groups were almost similar, ranging between 26.50 and 30.02. Population based measures revealed that an increase in BMI status equates to higher incidence of mortality from cardiovascular disease (Flegal *et al.*, 2010). After supplementation, the adults belonging to EG3 group recorded the maximum reduction in BMI by 0.94

followed by EG2 with 0.90 and EG1 with 0.83 which were seen to be significant at one per cent level. The group EG4 that constituted of adults with cardiovascular disease along with diabetes recorded a reduction in BMI by 0.48 which was the least among the experimental groups but significant at one per cent level.

TABLE XLIV

MEAN BODY MASS INDEX OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Body Mass Index			't' value		
	Initial	Final	Difference	I Vs F	Groups compared	
EG1	27.27 ±3.66	26.44 ±3.59	0.83 ±0.29	15.78**	EG1vsCG1	11.41**
EG2	26.50 ±2.96	25.59 ±3.07	0.90 ±0.48	10.28**	EG2vsCG1	7.60**
EG3	27.10 ±3.14	26.16 ±3.09	0.94 ±0.30	17.20**	EG3vsCG1	14.95**
CG1	27.58 ±2.85	27.50 ±2.89	0.08 ±0.20	2.14*	EG4vsCG2	9.90**
EG4	27.50 ±3.58	27.02 ±3.55	0.48 ±0.32	8.36**	EG1vsEG2	0.29 NS
CG2	29.55 ±4.01	29.39 ±3.93	0.16 ±0.25	3.56**	EG2vsEG3	0.64 NS
					EG1vsEG3	0.92 NS
					EG1vsEG4	5.01**

*p<0.05; ** p<0.01; NS-Not significant

The overall findings revealed that the functional food mixes formulated in the present study were very effective in reducing body weights and thereby the BMI of individuals under study. Comparing the difference in BMI between the experimental groups indicated that all the three food mixes were almost equally effective in controlling BMI of the adults. However, basic mix was significantly more effective among adults with cardiovascular disease alone than with a co-morbidity of diabetes mellitus.

3. Changes in BMI category of the adults

The BMI category of the adults based on WHO (2004) criteria before and after supplementation study is presented in Table XLV.

TABLE XLV

BMI CLASSIFICATION OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

BMI	Normal (18.5 - 24.9)		At risk (25.0 - 29.9)		Obese I (30.0 - 34.9)		Obese II (35.0 - 39.9)	
Group	**Initial**	**Final**	**Initial**	**Final**	**Initial**	**Final**	**Initial**	**Final**
EG1	10	12	13	12	7	6	-	-
EG2	9	13	17	15	4	2	-	-
EG3	9	11	16	16	5	3	-	-
EG4	8	9	14	15	7	5	1	1
Total	**36**	**45**	**60**	**58**	**23**	**16**	**1**	**1**
CG1	7	8	16	17	9	5	-	-
CG2	5	5	12	13	10	9	3	3
Total	**12**	**13**	**28**	**30**	**19**	**14**	**3**	**3**

It is obvious from the Table that at the beginning of the study a maximum number of adults in each group were at risk of becoming obese with their BMI values ranging between 25 and 29.9. None of the adults belonging to the present study were under weight. It was encouraging to find that over the six months supplementation, nine adults moved to normal BMI from other categories among all the supplementation groups. The number of adults in the at risk group also reduced by two and those in obese I group reduced by seven. There were slight changes among adults of control groups.

4. Changes in waist circumference

Table XLVI projects the changes in the waist circumference of the adults as a result of supplementation.

At the beginning of the study, the mean waist circumference of the adults belonging to groups EG1, EG2, EG3, and CG1, were 104.37, 101.87, 96.77 and 99.93 cm respectively and among the diabetic experimental and control groups, the values were 100.6 and 100.17 cm. The observed figures

considerably exceeded the suggested cut-off values by NCEP (2002) for adults to be 102 cm for men and 88 cm for women. It has been established by numerous research studies that abdominal obesity is a potential etiologic factor for cardiovascular disease and a reverted abdominal obesity is important for overall cardiovascular management.

TABLE XLVI

MEAN WAIST CIRCUMFERENCE OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Waist circumference (cm)			't' value		
	Initial	Final	Difference	I Vs F	Groups compared	
EG1	104.37 ±7.85	103.97 ±7.80	0.40 ±0.56	3.889**	EG1vsCG1	4.176**
EG2	101.87 ±6.41	101.63 ±6.39	0.23 ±0.43	2.970**	EG2vsCG1	2.503**
EG3	96.77 ±9.63	96.40 ±9.61	0.37 ±0.56	3.611**	EG3vsCG1	3.889**
CG1	99.93 ±5.70	99.97 ±5.75	0.03 ±0.32	0.570 NS	EG4vsCG2	1.681 NS
EG4	100.0 ±6.29	100.43 ±6.26	0.17 ±0.38	2.408*	EG1vsEG2	1.15 NS
CG2	100.17 ±9.24	100.13 ±9.23	0.03 ±0.02	0.570 NS	EG2vsEG3	1.00 NS
					EG1vsEG3	0.24 NS
					EG1vsEG4	2.25*

** p<0.01; *p<0.05; NS-Not significant

The supplementation programme was effective in cutting down the waist circumference by 0.40, 0.23 and 0.37 cm among the three experimental groups. In the case of the diabetic experimental group a reduction of 0.17 cm was observed. The reduction in waist circumference was statistically significant at one per cent level among all the three cardiovascular disease groups and at five per cent level among the diabetic group revealing the effectiveness of functional food supplementation.

There was a marginal difference in the reduction in waist circumference between the three experimental groups. However, the reduction in waist

circumference among EG4 was significantly lower than EG1. The adults with co-morbidity of diabetes mellitus along with cardiovascular disease could probably require little longer periods of supplementation in order to obtain greater reduction in waist circumference.

5. Changes in Waist Hip Ratio

Table XLVII presents the impact of supplementation of food mixes on the waist hip ratio of the adults.

TABLE XLVII

MEAN WAIST HIP RATIO OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Waist hip ratio			't' value		
	Initial	Final	Difference	I Vs F	Groups compared	
EG1	0.984 ±0.03	0.981 ±0.03	0.003 ±0.01	3.05**	EG1vsCG1	3.023**
EG2	0.976 ±0.03	0.974 ±0.03	0.002 ±0.004	2.671**	EG2vsCG1	2.227*
EG3	0.973 ±0.03	0.969 ±0.03	0.004 ±0.006	3.323**	EG3vsCG1	3.331**
CG1	0.964 ±0.04	0.964 ±0.039	0.000 ±0.003	0.027 NS	EG4vsCG2	2.229*
EG4	0.958 ±0.029	0.955 ±0.029	0.002 ±0.005	2.571**	EG1vsEG2	1.11 NS
CG2	0.965 ±0.034	0.965 ±0.033	0.000 ±0.003	0.046 NS	EG2vsEG3	1.38 NS
					EG1vsEG3	0.15 NS
					EG1vsEG4	0.94 NS

** p<0.01; *p<0.05; NS-Not significant

Mc Carthy *et al* (2006) suggested the safe limits of waist hip ratio of less than 0.95 for men and less than 0.80 in the case of women. However, the initial values of WHR among various groups categorized in the present study were greater than these limits. General abdominal obesity measured by waist circumference is independently associated with an increased risk of heart failure (Hu *et al.*, 2010). This explains the necessity for intervention among this population.

Supplementation of the different food mixes for the various experimental groups over a period of six months resulted in a gradual but significant (1% level) reduction in the WHR by less than 0.01. A maximum reduction of 0.004 was observed among the flax seed mix group (EG3). During this period, both the control groups did not change from the initial WHR measurements highlighting the significance of supplementation of food mixes to different groups.

A statistical comparison of the effect of supplementation of the different food mixes namely basic mix, variation I and variation II against control groups among the adults revealed that all the three mixes were almost equally effective in reducing the WHR of the adults. There was no significant difference between experimental groups.

6. Changes in waist height ratio

The waist height ratio prior to and post supplementation among the adults is presented in Table XLVIII.

TABLE XLVIII

MEAN WAIST HEIGHT RATIO OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Waist height ratio			't' value		
	Initial	Final	Difference	I Vs F	Groups compared	
EG1	0.658 ±0.052	0.655 ±0.052	0.003 ±0.003	4.172**	EG1vsCG1	4.026**
EG2	0.638 ±0.054	0.636 ±0.053	0.002 ±0.003	3.425**	EG2vsCG1	2.517**
EG3	0.620 ±0.061	0.617 ±0.061	0.002 ±0.003	3.838**	EG3vsCG1	3.296**
CG1	0.641 ±0.056	0.641 ±0.057	0.000 ±0.002	0.411 NS	EG4vsCG2	1.678 NS
EG4	0.645 ±0.059	0.644 ±0.060	0.001 ±0.002	2.673**	EG1vsEG2	0.75 NS
CG2	0.641 ±0.065	0.641 ±0.066	0.000 ±0.002	1.435 NS	EG2vsEG3	0.63 NS
					EG1vsEG3	0.23 NS
					EG1vsEG4	1.50 NS

** p<0.01; NS-Not significant

All the adults in the present study had almost the same mean waist height ratio of 0.6 cm at the beginning. No change was observed among the control groups CG1 and CG2 but the supplemented groups showed a gradual reduction which was statistically significant at one per cent level.

A statistical comparison of the effect of supplementation of the different food mixes namely basic mix, variation I and variation II among the adults revealed that all the three mixes were almost equally effective in reducing the waist height ratio of the adults.

ii. Biochemical parameters of the adults

1. Changes in lipid profile of the adults

The effect of supplementation of functional food mixes on the blood lipid levels of the adults with cardiovascular disease was assessed based on the changes in the total cholesterol, triglyceride, LDL, VLDL and HDL cholesterol levels.

a. Changes in total cholesterol

Table XLIX and Figure 12 depict the changes in the total cholesterol levels of the adults before and after supplementation with the formulated food mixes.

All the adults of the six groups were in the category of high total cholesterol levels (>240 mg/dl) based on the NCEP (2002) guidelines. Successful intervention programmes in a number of countries have further supported the casual link between dyslipidemia and cardiovascular disease by demonstrating that reductions in cholesterol levels lead to decreased cardiovascular disease morbidity and mortality (Committee on Preventing the Global Epidemic of Cardiovascular Disease, 2010).

TABLE XLIX

MEAN TOTAL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Total cholesterol (mg/dl)			't' value		
	Initial	Final	Difference	I Vs F	Groups compared	
EG1	254.67 ±11.18	234.63 ±11.57	20.03 ±6.14	17.87**	EG1vsCG1	13.57**
EG2	258.83 ±9.48	227 ±13.57	31.83 ±9.51	18.34**	EG2vsCG1	12.38**
EG3	253.83 ±8.36	221.5 ±10.51	32.33 ±10.35	17.11**	EG3vsCG1	14.88**
CG1	256.5 ±11.95	254.07 ±13.10	2.43 ±5.55	2.40*	EG4vsCG2	9.10**
EG4	258.17 ±8.44	239.63 ±12.78	18.53 ±6.54	15.53**	EG1vsEG2	6.05**
CG2	257.20 ±10.13	255.13 ±10.51	2.07 ±6.02	1.88 NS	EG2vsEG3	0.17 NS
					EG1vsEG3	4.98**
					EG1vsEG4	1.10 NS

** p<0.01; NS-Not significant

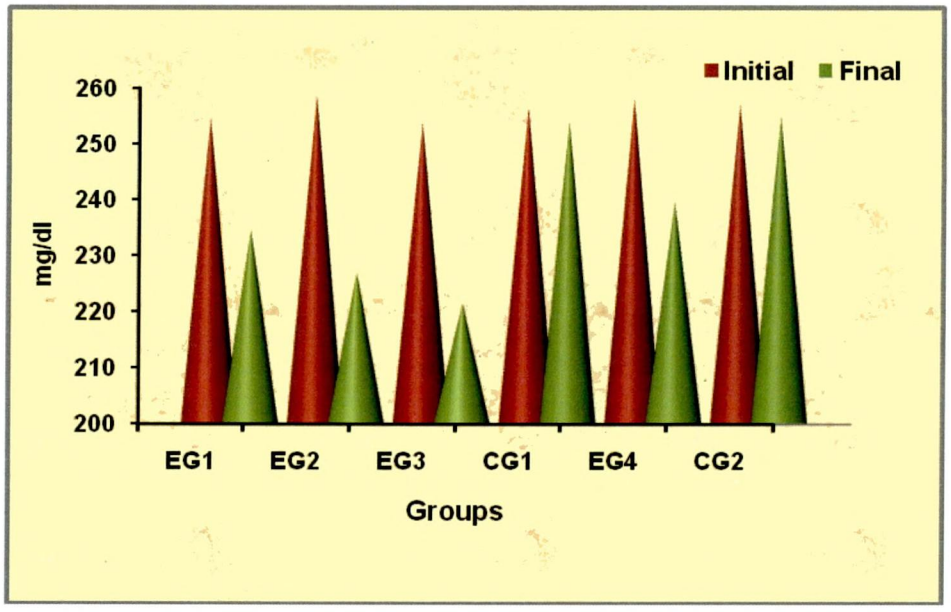

FIGURE 12

CHANGES IN TOTAL CHOLESTEROL LEVELS OF THE ADULTS

The supplementation programme for a period of six months resulted in maximum reduction in the total cholesterol levels of group EG3 by 32.33 mg per dl, closely followed by EG2 (31.83 mg/dl), then by EG1 (20.03 mg/dl) and finally EG4 (18.53 mg/dl). This change has brought down the total cholesterol from 'high' to 'borderline' (200 to 239 mg/dl) levels among adults of EG1, EG2 and EG3 groups and very close to 'borderline' among EG4 groups. Though the adults in the control groups CG1 and CG2 did not receive any supplementation, a marginal reduction in cholesterol by 2.43 and 2.07 mg per dl was observed respectively, which might be attributed to the influence of diet change.

It is evident that supplementation of all the three functional food mixes over a period of six months was effective in substantially reducing the total cholesterol levels among the adults. Studies by Kim *et al* (2009) revealed that the daily consumption of an antioxidant rich leafy vegetable mix resulted in decreased lipid peroxidation among mice fed with high cholesterol diets.

It is interesting to note that the two variations incorporating wheat germ and flax seed were significantly more effective in reducing total cholesterol levels when compared to basic mix. However, there was no significant difference between the two variations. Further, the basic mix was seen to be similarly effective in reducing total cholesterol in both the groups EG1 and EG4 either with or without diabetes mellitus. Peterson *et al* (2010) also confirmed that flax seed supplementation was effective in significantly lowering serum total cholesterol levels.

b. Changes in triglyceride levels

The changes observed in the serum triglyceride levels of the groups at the beginning and end of six months supplementation is presented in Table L and Figure 13.

TABLE L

MEAN TRIGLYCERIDE LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Triglyceride (mg/dl)			't' value	
	Initial	Final	Difference	I Vs F	Groups compared
EG1	166.77 ±13.69	144.73 ±16.40	22.03 ±9.79	12.33**	EG1vsCG1 6.24**
EG2	161.67 ±13.62	138.33 ±12.72	23.33 ±7.26	17.60**	EG2vsCG1 6.24**
EG3	164.37 ±14.12	127.80 ±11.27	36.57 ±9.65	20.75**	EG3vsCG1 12.50**
CG1	162.2 ±11.84	157.37 ±14.79	4.83 ±10.28	2.58**	EG4vsCG2 7.62**
EG4	170.83 ±10.25	151.5 ±11.46	19.33 ±6.33	16.72**	EG1vsEG2 0.65 NS
CG2	175.13 ±10.93	170.27 ±10.36	4.87 ±6.65	4.01**	EG2vsEG3 6.03**
					EG1vsEG3 5.27**
					EG1vsEG4 1.30 NS

** p<0.01; NS-Not significant

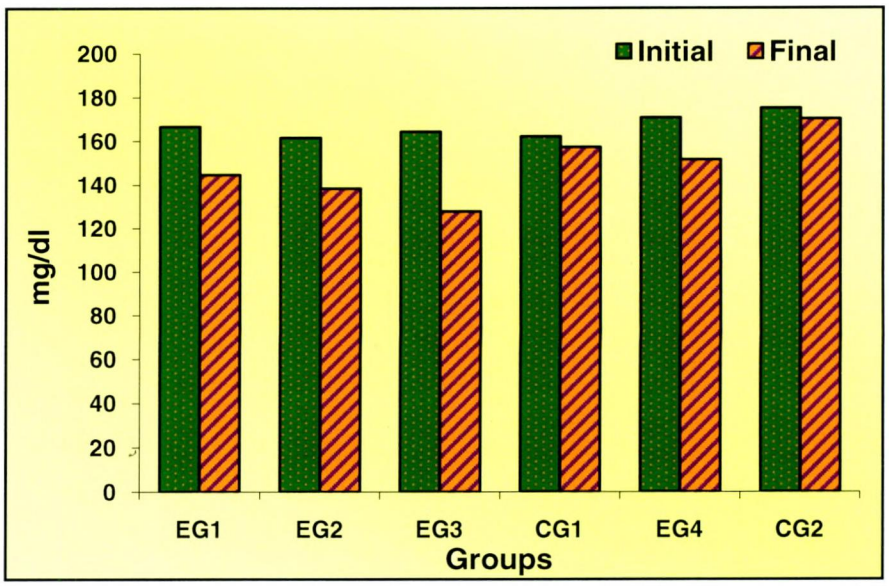

FIGURE 13

CHANGES IN TRIGLYCERIDE LEVELS OF THE ADULTS

The mean serum triglyceride levels of the adults of all the groups were found to be higher than the levels suggested by NCEP (2002) as 150 to 199 mg per dl and fell under the 'borderline high' category. Supplementation of the functional food mixes reduced the triglyceride levels among all the experimental groups which were found to be significant at one per cent level. The difference between the initial and the final triglyceride levels was 22.03, 23.33, 36.57 and 19.34 mg per dl among EG1, EG2, EG3, and EG4 groups respectively, with a maximum reduction in EG3 group which received flax seed incorporated mix.

There was also a significant reduction in the triglyceride levels of the control groups CG1 and CG2, however, the reduction was far less when compared to the experimental groups. Studies by Nambiar *et al* (2010) proved that supplementation of dehydrated drumstick leaves resulted in a significant reduction in serum cholesterol levels among hyperlipidimic adults.

c. Changes in LDL cholesterol

Table LI and Figure 14 present the comparison of the serum LDL cholesterol levels of the different groups before and after supplementation.

TABLE LI
MEAN LDL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	LDL cholesterol (mg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	181.39 ±12.43	163.05 ±12.01	18.34 ±7.53	13.34**	EG1vsCG1	12.13**
EG2	179.51 ±15.61	151.03 ±16.24	28.47 ±12.03	12.96**	EG2vsCG1	9.13**
EG3	175.26 ±13.88	145.16 ±15.63	30.1 ±11.26	14.64**	EG3vsCG1	12.33**
CG1	184.31 ±14.23	182.47 ±14.95	1.84 ±5.60	1.80 NS	EG4vsCG2	4.05**
EG4	176.39 ±15.44	162.40 ±25.35	13.99 ±17.69	4.33**	EG1vsEG2	3.81**
CG2	181.84 ±11.00	180.15 ±12.16	1.79 ±7.01	1.40 NS	EG2vsEG3	0.54 NS
					EG1vsEG3	4.10**
					EG1vsEG4	1.25 NS

** p<0.01; NS-Not significant

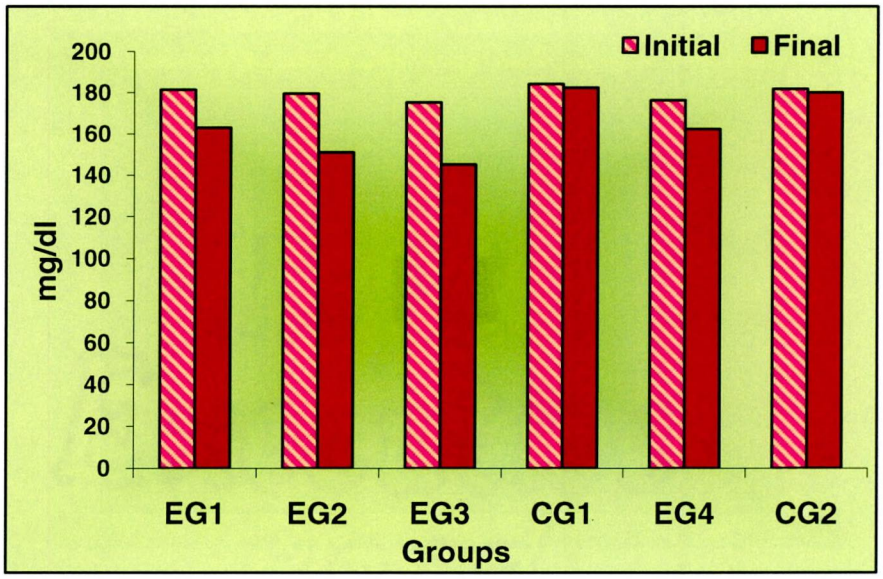

FIGURE 14

CHANGES IN LDL CHOLESTEROL LEVELS OF THE ADULTS

The mean initial serum LDL cholesterol levels of the adults were found to be within the 'high' level category of 130-159 mg per dl suggested by NCEP (2002). As stated by the Fenofibrate Intervention and Event Lowering in Diabetes (FIELD) study (Scott *et al.*, 2008), individuals with high lipid levels had 24 per cent high risk of developing cardiovascular disease complications and required reduction strategies.

The experimental group supplemented with the flax seed mix (EG3) recorded the maximum reduction in LDL cholesterol level by 30.1 mg per dl followed by the wheat germ group EG2 (28.47 mg/dl) and the basic mix group EG1 (18.34 mg/dl). The diabetic group recorded the least reduction in LDL cholesterol levels (13.99 mg/dl) amongst the four experimental groups. The reduction in LDL cholesterol levels among all the four groups was seen to be significant at one per cent level. There was also a very low reduction in the LDL cholesterol levels among the two control groups by less than 2 mg per dl during this period. Dhindsa *et al* (2008) also reported a significant reduction in LDL cholesterol levels in a three month supplementation of leaf powder among males with diabetes mellitus and hyperlipidemia.

The overall observation revealed that the presence of wheat germ and flax seed in food mixes resulted in most appreciable reduction of LDL cholesterol followed by basic mix.

d. Changes in VLDL cholesterol

The mean VLDL cholesterol levels of the adults before and after supplementation are presented in Table LII and Figure 15.

TABLE LII

MEAN VLDL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	VLDL cholesterol (mg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	33.37 ± 2.75	28.95 ± 3.28	4.42 ±1.97	12.33**	EG1vsCG1	6.35**
EG2	32.33 ±2.72	27.67 ± 2.54	4.67 ±1.45	17.60**	EG2vsCG1	9.40**
EG3	32.87 ± 2.82	25.61 ±2.31	7.27 ±1.91	20.86**	EG3vsCG1	13.04**
CG1	32.39 ±2.37	31.29 ±2.91	1.09 ±2.01	2.98**	EG4vsCG2	6.75**
EG4	34.04 ±2.22	30.31 ±2.31	3.73 ±1.40	14.54**	EG1vsEG2	0.69^{NS}
CG2	35.03 ±2.19	34.05 ±2.07	0.97 ±1.33	4.01**	EG2vsEG3	6.02**
					EG1vsEG3	5.14**
					EG1vsEG4	1.60^{NS}

** p<0.01; NS-Not significant

Due to the effect of supplementation of the functional food mixes, the serum VLDL cholesterol levels of the adults reduced by 4.42 mg per dl in the EG1, 4.67 mg per dl in EG2, 7.27 mg per dl in EG3 and 3.73 mg per dl in EG4. The differences were found to be statistically significant at one per cent level. The flax seed incorporated food mix (variation II) group seemed to bring about a maximum reduction in VLDL levels as against the other two mixes.

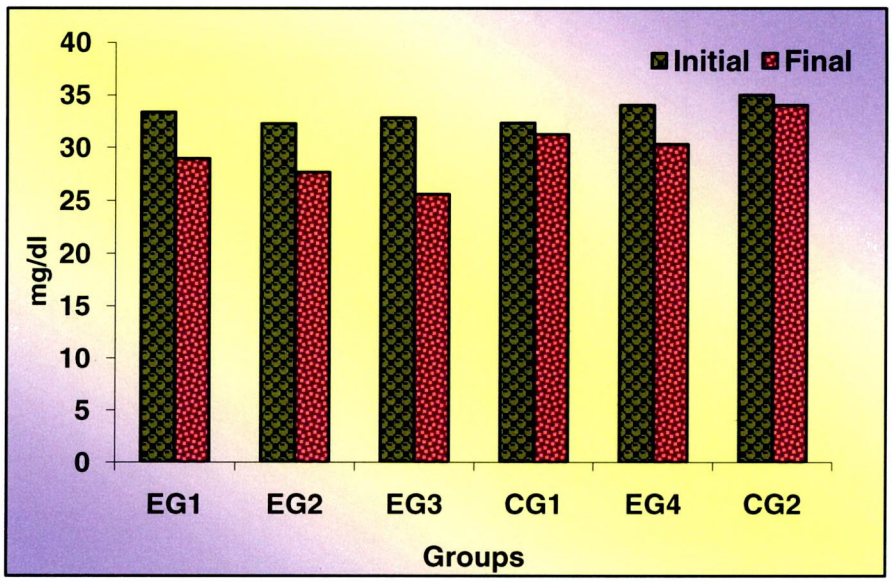

FIGURE 15

CHANGES IN VLDL CHOLESTEROL LEVELS OF THE ADULTS

The differences seen among all the experimental groups in comparison with control groups were significant at one per cent level. There was no difference between EG1 and EG2 as well as EG1 and EG4. It therefore appears that presence of wheat germ was comparatively more effective in reducing serum VLDL cholesterol levels. Thaker *et al* (2009) reported a significant reduction in serum VLDL cholesterol levels among diabetic individuals after a three month supplementation of flax seed incorporated wheat flour chapathis.

e. Changes in HDL cholesterol

The mean values of HDL cholesterol among the adults before and after supplementation are given in Table LIII and Figure 16.

The mean initial serum HDL levels of the adults among the experimental groups EG1, EG2, EG3 and EG4 were 39.30, 40.10, 39.70, and 40.07 mg per dl respectively. Among the control groups the levels were 39.8 (CG1) and 40.23 (CG2) mg per dl. This shows that all the groups either had just normal levels (>40 mg/dl) or close to normal levels of HDL. After the supplementation period, all the four groups had increased levels of HDL. The differences in HDL levels were found to be 3.13, 3.20, 5.03 and 2.57 mg per dl respectively among EG1, EG2, EG3 and EG4 with a maximum increase in EG3 where flax

seed incorporation was found. This increase was found to be statistically significant at one per cent level. However, control groups also recorded an increase but they were not statistically significant.

TABLE LIII

MEAN HDL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	HDL cholesterol (mg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	39.30 ± 5.30	42.43 ± 4.67	3.13 ±1.70	10.12**	EG1vsCG1	8.43**
EG2	40.10 ±5.84	43.30 ± 5.22	3.20 ±1.56	11.22**	EG2vsCG1	7.65**
EG3	39.70 ± 4.99	44.73 ±3.64	5.03 ±2.94	9.37**	EG3vsCG1	6.94**
CG1	39.80 ±4.95	40.30 ±4.80	0.50 ±1.53	1.79 NS	EG4vsCG2	6.43**
EG4	40.07 ±3.53	42.63 ±3.05	2.57 ±1.50	9.36**	EG1vsEG2	0.17 NS
CG2	40.23 ±4.12	40.47 ±3.92	0.23 ±1.01	1.27 NS	EG2vsEG3	2.95**
					EG1vsEG3	3.54**
					EG1vsEG4	1.33 NS

** p<0.01; NS-Not significant

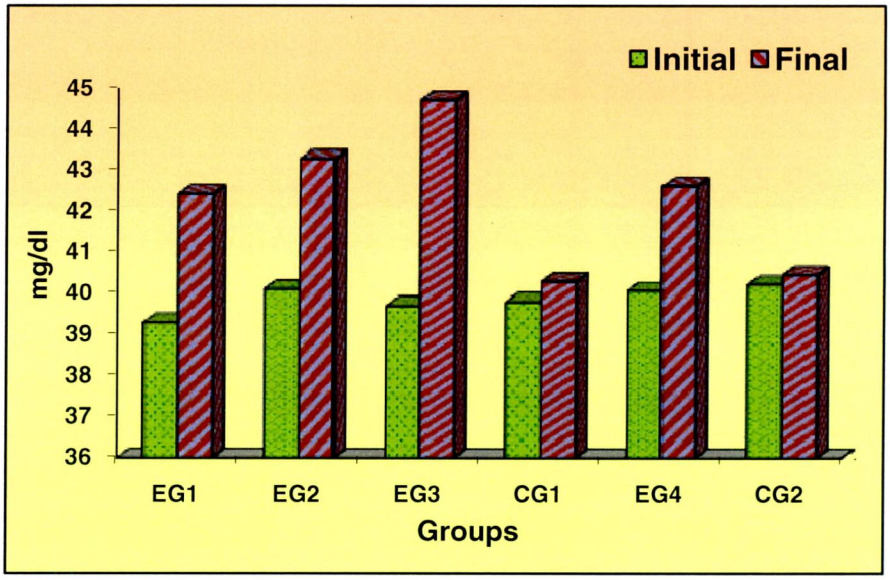

FIGURE 16

CHANGES IN HDL CHOLESTEROL LEVELS OF THE ADULTS

The trend in improvements in the HDL cholesterol levels among the four experimental groups in comparison with control groups revealed a statistically significant difference at one per cent level. Comparison of HDL cholesterol increase between basic mix group and flax seed and wheat germ incorporated groups showed a statistically significant difference. Mani *et al* (2011) reported an 11.9 per cent increase in the serum HDL cholesterol levels upon supplementation of recipes incorporated with flax seed.

2. Changes in fasting blood glucose levels of the adults

The initial and final fasting blood glucose levels of the adults participating in the present study are shown in Table LIV and Figure 17.

TABLE LIV

MEAN FASTING BLOOD GLUCOSE LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Fasting blood glucose (mg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	98.97 ± 7.08	94.77 ± 6.22	4.20 ±2.37	9.71**	EG1vsCG1	10.03**
EG2	104.37 ± 7.30	100.30 ± 7.06	4.07 ±1.39	16.04**	EG2vsCG1	14.99**
EG3	99.13 ± 5.70	94.73 ± 5.36	4.40 ±1.10	21.87**	EG3vsCG1	18.41**
CG1	98.57 ± 5.51	98.53 ± 5.17	0.03 ±0.85	0.22 NS	EG4vsCG2	13.05**
EG4	197.73 ± 33.64	186.80 ± 34.16	10.93 ±4.44	13.49**	EGvsEG2	0.28 NS
CG2	188.83 ± 33.77	188.80 ± 33.63	0.03 ±0.72	0.25 NS	EG2vsEG3	1.04 NS
					EG1vsEG3	0.48 NS
					EG1vsEG4	7.11**

**. p<0.01; NS-Not significant

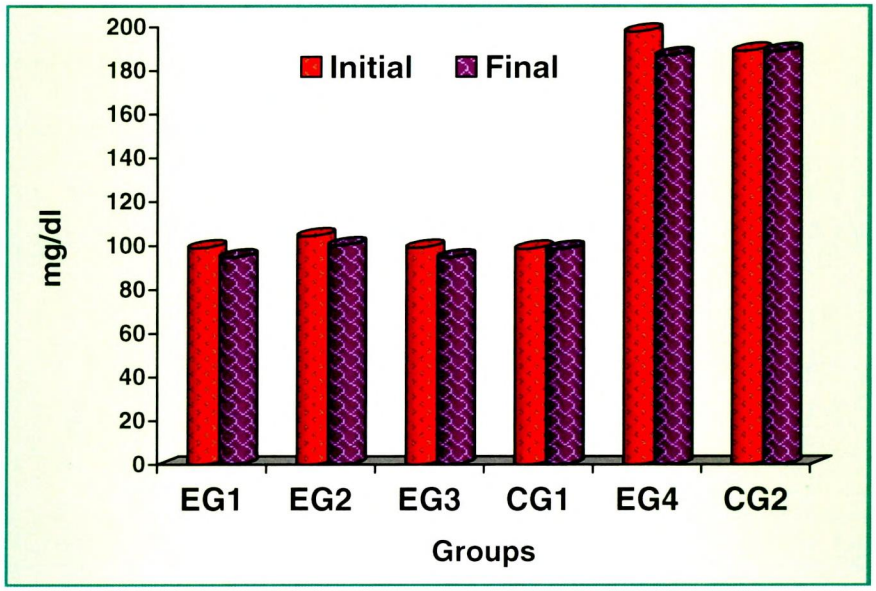

FIGURE 17
CHANGES IN BLOOD GLUCOSE LEVELS OF THE ADULTS

The initial fasting glucose levels ranged from 98.57 to 197.73 mg per dl among all the groups with high values of 197.73 and 188.83 mg per dl among diabetic experimental and control groups respectively. High blood levels are associated with insulin resistance and increased cardiovascular disease mortality (Ning *et al.*, 2010). The Emerging Risk Factors Collaboration Committee (Sarwar *et al.*, 2010) has further confirmed that fasting blood glucose is modestly and non- linearly associated with risk of vascular diseases.

The supplementation of basic mix, wheat germ and flax seed mixes among the normoglycemic cardiovascular disease adults resulted in a reduction in fasting blood sugar levels by 4.20, 4.07 and 4.40 mg per dl respectively. A more beneficial outcome could be observed among the hyperglycemic group EG4 supplemented with basic mix with a reduction of fasting blood glucose levels by 10.93 mg per dl. Statistical analysis revealed that the reduction in all the four experimental groups were significant at one per cent level highlighting the hypoglycemic potentials of the functional food mixes.

It is further evident that all the three food mixes were equally effective in reducing the fasting blood glucose levels among the adults. It is an interesting observation that there was a remarkably greater reduction in the fasting

glucose levels of the adults in group EG4 than in EG2 which was statistically significant at one per cent level. This observation suggests that the basic mix was more effective in reducing fasting glucose levels among hyperlipidimic adults than among normolipidimic adults. Mani *et al* (2011) reported a decrease in fasting glucose levels by 19.7 per cent upon flax seed supplementation.

3. Changes in glycosylated haemoglobin levels (HbA1C)

The changes in HbA1C levels of the diabetic adults belonging to groups EG4 and CG2 is presented in Table LV and Figure 18.

TABLE LV

MEAN GLYCOSYLATED HAEMOGLOBIN LEVELS BEFORE AND AFTER SUPPLEMENTATION

(N=60)

Group	HbA1C (%)			't' value	
	Initial	Final	Difference	I vs F	Between groups
EG4	7.36 ± 0.67	6.92 ± 0.65	0.44 ± 0.09	28.13**	EG4vsCG2
CG2	7.56 ± 0.62	7.56 ± 0.64	0.01 ± 0.07	0.49^{NS}	18.61*

** p<0.01; *p<0.05; NS-Not significant

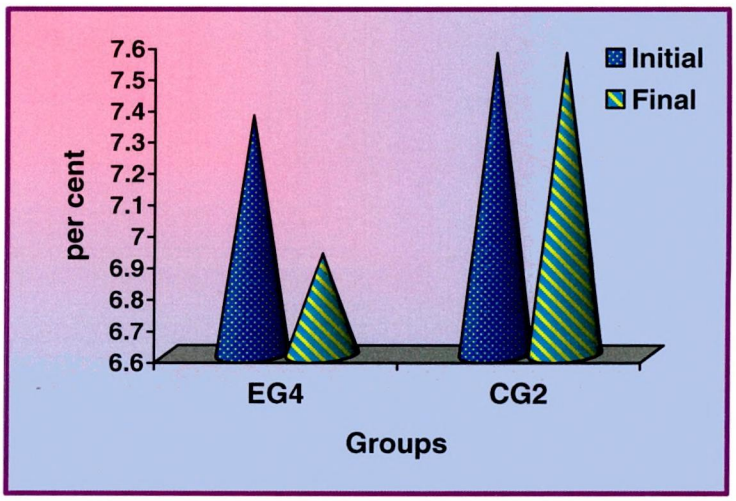

FIGURE 18

CHANGES IN HbA1C LEVELS OF THE ADULTS

The initial HbA1C levels of experimental group EG4 was 7.36 per cent while that of the control group was 7.56 per cent. This shows that the adults were having a fair control upon their blood glucose levels for the past three months. The A1C Derived Average Glucose (AOAG) study (Borg *et al.*, 2011) described strong and consistent association between HbA1C and cardiovascular events. In the present study as a result of supplementation of the basic mix, the final glycosylated haemoglobin level of the experimental group decreased to 6.92 per cent with a difference of 0.44 per cent which was statistically significant at one per cent level. However, the control group recorded a very marginal reduction of 0.01 per cent over the six months period. The beneficial effect of supplementing the basic mix to experimental group is evident from the study.

4. Changes in serum antioxidant vitamin levels of the adults

Variations in the serum antioxidant vitamin levels of cardiovascular significance such as vitamin A, C, and E among the adults before and after supplementation are presented and discussed below.

a. Changes in serum vitamin A levels of the adults

Table LVI and Figure 19 present the initial and final levels of serum vitamin A among the adults with cardiovascular disease.

At the end of six months supplementation, the group supplemented with the basic mix (EG1) evidenced a maximum increase in the serum vitamin A levels of 2.85 µg per dl. This could be due to the high amount of vitamin A present in the basic mix owing to the incorporation of drumstick leaves and carrots. This was followed by the wheat germ incorporated food mix supplemented group (EG2) with an increase of 2.16 µg per dl followed by the flax seed incorporated food mix supplemented group (EG3) with an increase of 1.75 µg per dl. The diabetic experimental group EG4 recorded an increment of 1.72 µg per dl. However, the increment was least among the two control groups CG1 and CG2.

TABLE LVI

MEAN SERUM VITAMIN A LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Vitamin A (µg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	17.33 ± 1.74	20.18 ± 2.29	2.85 ± 1.68	9.30**	EG1 vsCG1	9.18**
EG2	17.38 ± 2.43	19.54 ± 2.48	2.16 ± 0.77	15.68**	EG2 vsCG1	15.24**
EG3	18.19 ± 2.15	19.93 ± 1.91	1.75 ± 0.70	13.66**	EG3 vsCG1	13.82**
CG1	20.15 ± 2.08	20.16 ± 2.09	0.03 ± 0.07	0.25^{NS}	EG4 vsCG2	20.37**
EG4	18.15 ± 1.98	19.87 ± 1.94	1.72 ± 0.46	20.67**	EG1vsEG2	2.19^{NS}
CG2	18.66 ± 1.99	18.70 ± 2.02	0.04 ± 0.07	3.25**	EG2vsEG3	2.01^{NS}
					EG1vsEG3	3.22**
					EG1vsEG4	3.50**

** p<0.01; NS-Not significant

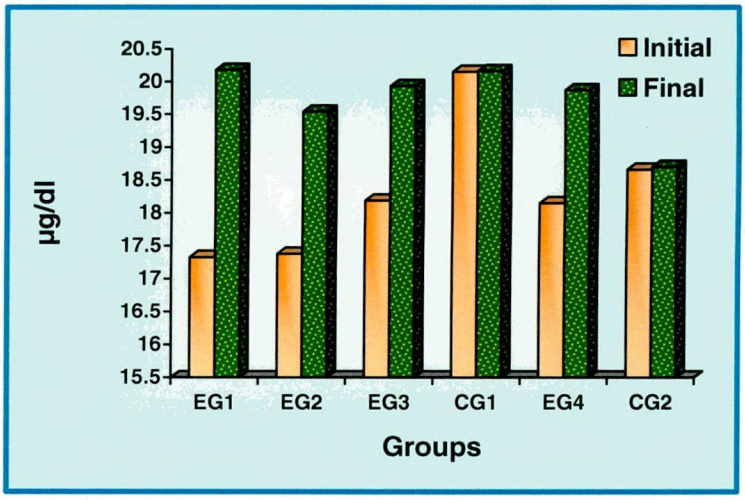

FIGURE 19

CHANGES IN SERUM VITAMIN A LEVELS OF THE ADULTS

Comparison between groups revealed that group EG1 had significantly greater improvement in serum vitamin A levels than groups EG2 (1% level), EG3 (5% level) and EG4 (5% level). However, the differences in the impact of supplementation between groups EG2 and EG3 was not statistically significant.

b. Changes in serum vitamin C levels of the adults

Vitamin C is a chain breaking antioxidant, scavenging reactive oxygen species thereby directly preventing the propagation of chain reactions that would otherwise lead to a reduction in protein glycation (Riccioni *et al.*, 2007). The changes in serum vitamin C levels of the adults before and after supplementation are presented in Table LVII and Figure 20.

TABLE LVII

MEAN SERUM VITAMIN C LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Vitamin C (mg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	1.25 ± 0.31	1.98 ± 0.37	0.73 ± 0.14	28.92**	EG1 vsCG1	28.48**
EG2	1.20 ± 0.24	1.53 ± 0.27	0.32 ± 0.23	7.77**	EG2 vsCG1	7.56**
EG3	1.08 ± 0.26	1.49 ± 0.28	0.42 ± 0.14	16.49**	EG3 vsCG1	14.88**
CG1	1.16 ± 0.30	1.16 ± 0.23	0.01 ± 0.04	1.23 NS	EG4 vsCG2	12.58**
EG4	1.26 ± 0.34	1.81 ± 0.27	0.55 ± 0.23	13.17**	EGvsEG2	8.61**
CG2	1.16 ± 0.33	1.17 ± 0.35	0.01 ± 0.04	1.07 NS	EG2vsEG3	2.06*
					EG1vsEG3	8.30**
					EG1vsEG4	3.30**

** p<0.01; *p<0.05; NS-Not significant

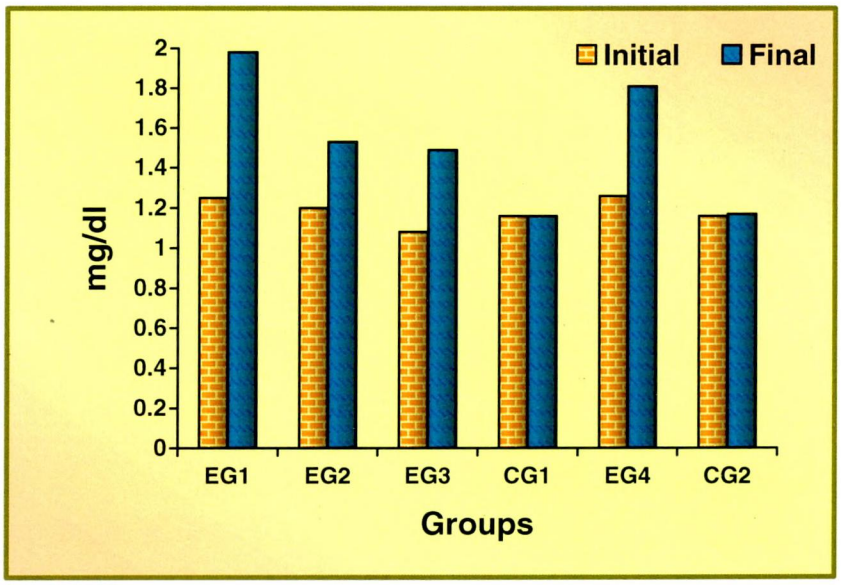

FIGURE 20
CHANGES IN SERUM VITAMIN C LEVELS OF THE ADULTS

The initial levels of serum vitamin C among the adults in the present study were almost similar, ranging from of 1.08 to 1.26 mg per dl. After supplementation the increase in serum vitamin C levels evidenced by the experimental groups were 0.73, 0.32, 0.42, and 0.55 mg per dl among EG1, EG2, EG3 and EG4 respectively. All the differences were found to be statistically significant at one per cent level. However, both the control groups CG1 and CG2 did not change their initial levels of serum vitamin C. This revealed the effectiveness of functional food mix supplementation especially the basic mix in increasing serum vitamin C levels.

The Japan Collaborative Cohort Study (JACC) (Kubota *et al.*, 2011) revealed a inverse relationship between vitamin C intake and cardiovascular disease mortality among Japanese women. This was also supported by Yamada *et al* (2011) who reported that frequent intakes of citrus fruits was associated with lower incidence of cardiovascular disease.

It is further seen that the experimental group EG1 supplemented with basic mix evidenced a greater increment in serum vitamin C levels than all the other three experimental groups which was statistically significant at one per cent level.

c. Changes in serum vitamin E levels of the adults

Vitamin E, a component of the total peroxyl radical tapping antioxidant system, reacts directly with peroxyl and superoxide radicals and singlet oxygen and protects membranes from lipid peroxidation (Riccioni *et al.*, 2007). The changes in serum vitamin E levels due to supplementation among the adults in comparison with the control groups are presented in Table LVIII and Figure 21.

TABLE LVIII

MEAN SERUM VITAMIN E LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Vitamin E (mg/dl)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	0.88 ± 0.18	1.22 ± 0.13	0.34 ± 0.14	13.74**	EG1 vsCG1	8.19**
EG2	0.90 ± 0.17	1.12 ± 0.12	0.21 ± 0.11	10.97**	EG2 vsCG1	3.67**
EG3	0.91 ± 0.17	1.19 ± 0.20	0.29 ± 0.20	7.92**	EG3 vsCG1	4.03**
CG1	0.89 ± 0.18	1.01 ± 0.21	0.16 ± 0.08	7.62**	EG4 vsCG2	8.83**
EG4	0.92 ± 0.20	1.23 ± 0.13	0.31 ± 0.19	9.07**	EGvsEG2	3.87**
CG2	0.86 ± 0.17	0.88 ± 0.17	0.01 ± 0.04	2.09*	EG2vsEG3	1.76 NS
					EG1vsEG3	1.14 NS
					EG1vsEG4	0.77 NS

** p<0.01; *p<0.05; NS-Not significant

The initial serum vitamin E levels of the adults belonging to the various groups ranged between 0.8 and 0.92 mg per dl. Six months functional food mix supplementation resulted in a maximum increase in vitamin E levels of 0.34 mg per dl in EG1 followed by the diabetic experimental group EG4 with an increase of 0.31 mg per dl.

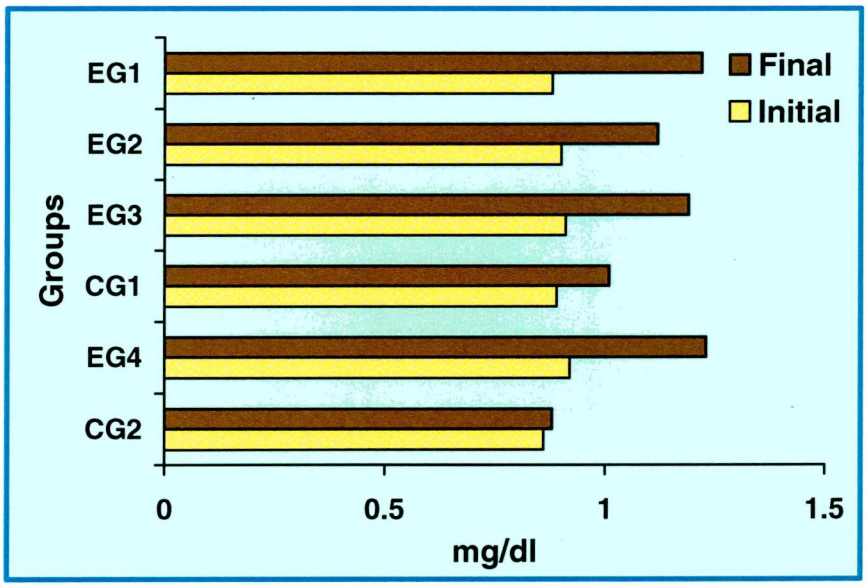

FIGURE 21

CHANGES IN SERUM VITAMIN E LEVELS OF THE ADULTS

Group EG3 showed a minimum increase of 0.29 mg per dl and EG2 with an increase of 0.21 mg per dl. However, all the four groups showed a statistically significant increase at one per cent level. The American Heart Association (Saremi and Arora, 2010) proclaimed that the consumption of foods rich in vitamin E has been associated with low risk of coronary heart disease and further recommended the consumption of foods abundant in antioxidant vitamins.

Comparison between EG1 and EG2 groups revealed a statistically significant difference at one per cent level. However the other groups did not vary significantly.

iii. Cardiovascular parameters of the adults

Guidelines for diagnosis and treatment of cardiovascular diseases focus mainly on the underlying mean blood pressure levels (Rothwell *et al.*, 2010). It is a simple method of assessing prognosis to enable doctors to target treatment and potentially assess the impact of therapies (Raphael *et al.*, 2009). The impact of supplementation on the various cardiovascular parameters are discussed below.

1. Changes in systolic blood pressure of the adults

The impact of supplementation on the systolic blood pressure of the adults is presented in Table LIX.

TABLE LIX

MEAN SYSTOLIC BLOOD PRESSURE OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Systolic blood pressure (mm Hg)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	144.67 ± 14.08	144.00 ± 13.29	0.67 ± 3.65	1.00 NS	EG1 vsCG1	0.37 NS
EG2	142.33 ± 10.06	138.33 ± 9.86	4.00 ± 4.98	4.39**	EG2 vsCG1	3.00*
EG3	138.33 ± 14.40	135.00 ± 14.08	3.33 ± 4.79	3.80**	EG3 vsCG1	3.07**
CG1	140.00 ± 12.59	139.67 ± 11.59	0.33 ± 3.20	0.57 NS	EG4 vsCG2	0.81 NS
EG4	142.67 ± 15.07	141.33 ± 14.79	1.33 ± 3.46	2.11*	EGvsEG2	2.76**
CG2	143.67 ± 12.99	143.00 ± 11.49	0.67 ± 3.65	1.00 NS	EG2vsEG3	0.57NS
					EG1vsEG3	2.28*
					EG1vsEG4	0.70NS

** p<0.01; *p<0.05; NS-Not significant

All the adults participating in the present study were already diagnosed for hypertension and the systolic blood pressure ranged between 138.33 and 144.67 mm Hg, thus coming under stage I hypertension according to the JNC criteria (2004). Cardiovascular disease risk increases, beginning with systolic blood pressure levels of 115 mm Hg (Thompson *et al.*, 2011).

The three supplementation groups namely EG2, EG3 and EG4 showed a significant reduction in blood pressure by 4.00, 3.33, and 1.33 mm Hg respectively, whereas EG1 showed a marginal reduction by 0.67 mm Hg. The systolic blood pressure of the adults belonging to both the control groups CG1 and CG2 remained almost unchanged highlighting the effect of supplementation on experimental groups. The INTERMAP research group

(Shay et al., 2011) reported that individuals with favorable levels of blood pressure experience notably lower long term cardiovascular disease mortality, greater longevity and better health related quality of life.

A comparison between the effect of supplementation among EG1 with EG2 revealed a statistically significant difference at one per cent level. When EG1 was compared with EG3, a difference at five per cent level of significance was seen.

2. Changes in diastolic blood pressure of the adults

The changes in the mean diastolic blood pressure of the adults are presented in Table LX.

TABLE LX

MEAN DIASTOLIC BLOOD PRESSURE LEVELS OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Diastolic blood pressure (mmHg)			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	95 ± 12.80	94.33 ± 13.05	0.67 ± 3.65	1.00 NS	EG1 vsCG1	0.37 NS
EG2	91.00 ± 10.62	89.00 ± 10.23	2.00 ± 4.07	2.69**	EG2 vsCG1	2.41*
EG3	89.33 ± 10.15	87.67 ± 9.35	1.67 ± 4.61	1.98 NS	EG3 vsCG1	1.44 NS
CG1	90.33 ± 11.59	90.00 ± 10.83	0.33 ± 3.20	0.57 NS	EG4 vsCG2	0.81 NS
EG4	91.00 ± 11.85	90.00 ± 12.03	1.00 ± 3.05	1.79 NS	EGvsEG2	1.44 NS
CG2	90.67 ± 11.73	90.33 ± 11.29	0.33 ± 3.20	0.57 NS	EG2vsEG3	0.30 NS
					EG1vsEG3	1.14 NS
					EG1vsEG4	0.37 NS

** p<0.01; *p<0.05; NS-Not significant

The mean diastolic blood pressure of the adults were 95.00, 91.00, 89.33 and 90.33 mm Hg among the four cardiovascular disease groups namely EG1, EG2, EG3, CG1 respectively. The two diabetic groups EG4 and

CG2 had diastolic blood pressure levels of 91 and 90.67 mm Hg respectively. It is evident that the mean diastolic blood pressure of all the groups were greater than normal values of 80 mm Hg as suggested by JNC (2004).

The six months supplementation had brought about a marginal reduction in the diastolic blood pressure among all the experimental groups. The reduction in diastolic blood pressure among EG2 (wheat germ) was 2 mm Hg which was statistically significant at one per cent level. Among the other three groups slight reduction in diastolic pressure was observed but not statistically significant.

Direct evidence from observational follow up of large hypertension prevention trials suggested that these small changes in blood pressure can result in a 30 per cent reduction in cardiovascular disease events and revascularization in persons with mildly elevated diastolic blood pressure (Cook *et al.*, 2007). The present findings are in line with the findings of Yokozawa *et al* (2007) who reported a decrease in blood pressure upon administration of amla extract in male rats. A comparison within the experimental groups did not reveal any significant difference in their impact on diastolic blood pressure levels of the adults.

3. Classification of adults based on hypertension

Table LXI gives the classification of the adults on the basis of the blood pressure values at pre and post supplementation stages based on the JNC criteria (2004).

TABLE LXI

CLASSIFICATION OF ADULTS BASED ON HYPERTENTION

(N=180)

Group	Normal		Pre HTN		Stage I HTN		Stage II HTN	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Experimental (n=120)	10 (8.3)	15 (12.5)	25 (20.8)	25 (20.8)	46 (38.3)	47 39.2)	39 (32.5)	33 (27.5)
Control (n=60)	4 (6.7)	4 (6.7)	16 (26.7)	14 (23.3)	22 (36.7)	27 (45.0)	18 (30.0)	15 (25.0)

*Figures in parentheses indicate percentage; HTN-Hypertension

It was discouraging to note that in the beginning of the study among the 180 adults selected for supplementation, only 8.3 and 6.7 per cent of adults in the experimental and control groups respectively maintained their blood pressure within normal limits, a maximum percentage of adults in the experimental (38.3) and control (36.7) groups with stage I hypertension followed by 32.5 and 30.0 percentage of adults in the experimental and control groups respectively with stage II hypertension.

The percentage of adults with normal blood pressure increased from 8.3 to 12.5 in the supplementation groups and a very slight change in stage I and stage II hypertension whereas no change was observed in the pre hypertension group. Among the control groups the percentage of adults with stage I hypertension increased from 36.7 to 45.0 whereas slight reductions in pre hypertension and stage II hypertension, with no change in normal blood pressure groups were observed.

4. Changes in Carotid Intima Media Thickness (CIMT)

The changes in the CIMT of the adults before and after supplementation are presented in Table LXII.

TABLE LXII
CHANGES IN CAROTID INTIMA MEDIA THICKNESS OF THE ADULTS

(N=8)

Group	Initial (mm)	Final (mm)	Difference (mm)
EG1	0.9	0.9	0.0
	0.9	0.9	0.0
EG2	1.0	0.9	0.1
	0.9	0.9	0.0
EG3	1.1	1.0	0.1
	1.0	1.0	0.0
CG1	1.1	1.1	0.0
	1.2	1.2	0.0

The initial carotid intima media thickness (Figure 22) assessed for the eight adults measured between 0.9 and 1.2 mm. An increase in CIMT more than 0.9 mm is predictor of cardiovascular disease (Krishna, 2010). After

supplementation, it is seen that there was a marginal reduction in the CIMT by 0.1 mm among the two adults each belonging to groups EG2 and EG3 respectively. CIMT is a tool in providing potential information in assessing the progress of atherosclerosis. This gradual reduction suggests that consumption of the food mixes for a long period could result in substantial reduction in CIMT.

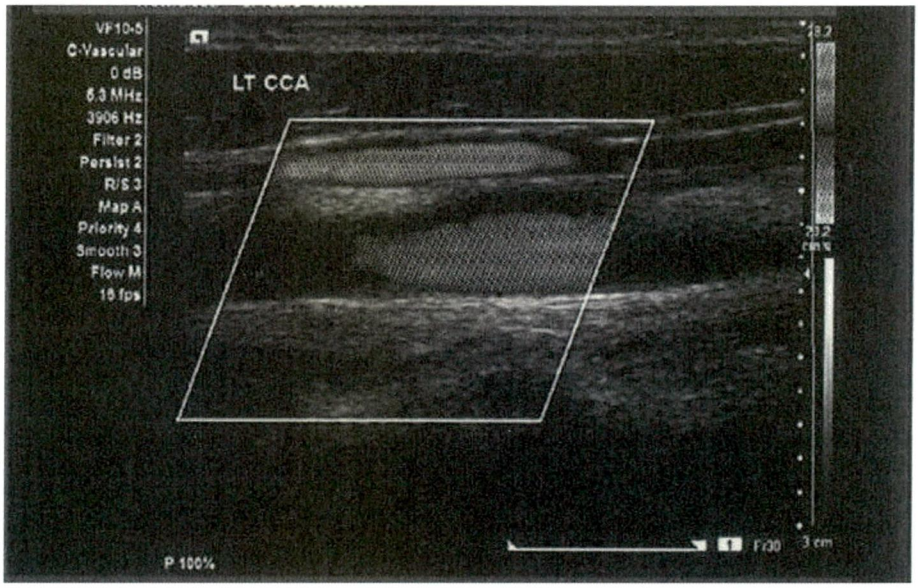

FIGURE 22

CIMT IMAGE OF THE ADULTS

iv. Performance test by the adults

1. Ruffier functional test scores of the adults

Cardiovascular disease may result in impaired capacities to perform activities of daily living (Pihl *et al.*, 2011). The cardiovascular functional capacity of the adults as assessed by Ruffier functional test is presented in Table LXIII and Figure 23.

The Ruffier functional test scores at the beginning of the study was 8.44, 8.85, 8.98 and 8.84 among the four cardiovascular disease groups EG1, EG2, EG3 and CG1, and 8.96 and 8.89 among the two diabetic groups EG4 and CG2. These values correspond to 'Average' cardiovascular functional condition. After supplementation, the functional capacity of the adults belonging to EG3 (flax seed mix) showed maximum improvement with a difference of 0.54 followed by EG1 (basic mix) with a difference of 0.51 and

EG2 (wheat germ) with a difference of 0.49 and EG4 (diabetic group) with a minimum difference of 0.33. The differences among all the four groups were statistically significant at one per cent level. On the contrary there was no improvement in cardiovascular performance among the two control groups CG1 and CG2.

TABLE LXIII
MEAN RUFFIER FUNCTIONAL TEST SCORES OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Test scores			't' value		
	Initial	Final	Difference	I vs F	Groups compared	
EG1	8.44 ± 2.49	7.92 ± 2.47	0.51 ± 0.10	28.89**	EG1 vsCG1	23.10**
EG2	8.85 ± 2.33	8.36 ± 2.33	0.49 ± 0.10	27.56**	EG2 vsCG1	24.10**
EG3	8.98 ± 2.22	8.44 ± 2.22	0.54 ± 0.12	24.81**	EG3 vsCG1	25.98**
CG1	8.84 ± 2.00	8.84 ± 2.0	0.01 ± 0.06	0.63^{NS}	EG4 vsCG2	19.77**
EG4	8.96 ± 1.99	8.63 ± 1.98	0.33 ± 0.06	27.97**	EGvsEG2	1.16^{NS}
CG2	8.89 ± 1.93	8.87 ± 1.93	0.02 ± 0.07	1.88^{NS}	EG2vsEG3	1.65^{NS}
					EG1vsEG3	1.16^{NS}
					EG1vsEG4	10.51**

** p<0.01; *p<0.05; NS-Not significant

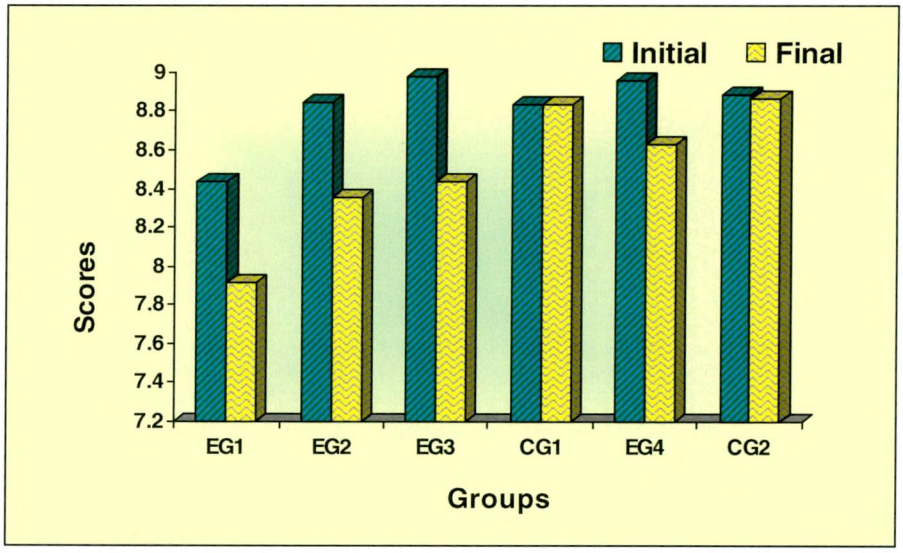

FIGURE 23
CHANGES IN RUFFIER FUNCTIONAL TEST SCORE OF THE ADULTS

There exists a relation between frailty and cardiovascular disease and the presence of frailty confers an incremental increase in mortality (Afilalo *et al.*, 2009). Studies by McDermott *et al* (2011) further added that individuals with peripheral artery disease with declining functional performance were at an increased risk for later morbidity.

All the three mixes were seen to have a similar impact on the functional capacity of the adults. However, the improvement in the functional capacity of the adults belonging to group EG4 was seen to be significantly lower than group EG1 both supplemented with basic mix suggesting that the presence of diabetes mellitus might have significantly affected the functional capacity of the adults.

2. Classification of Ruffier functional test

Table LXIV presents the classification of Ruffier functional test scores based on the functional capacity of the adults.

TABLE LXIV

CLASSIFICATION OF RUFFIER FUNCTIONAL TEST SCORES OF THE ADULTS BEFORE AND AFTER SUPPLEMENTATION

(N=180)

Group	Excellent (< 3.0)		Good (3.1 – 7.0)		Average (7.1- 12.0)		Poor (12.1 – 15.0)		Very poor (>15.1)	
	I	F	I	F	I	F	I	F	I	F
EG (n=120)	-	-	31 (25.8)	36 (30.0)	81 (67.5)	78 (65.0)	8 (6.7)	6 (5.0)	-	-
CG (n=60)	-	-	12 (20.0)	12 (20.0)	43 (71.7)	43 (71.7)	5 (8.3)	5 (8.3)	-	-

*Figures in parentheses indicate percentage

The cardiovascular functional scores of all the adults participating in the present study were either 'good', 'average' or 'poor'. None of the adults had either 'excellent' or 'very poor' scores. At the start of the study, majority of the adults had 'average' cardiovascular functional capacity. The number of adults with good scores were 31 and 12 among the experimental and control groups

respectively. Further, eight and five adults in the experimental and control groups respectively had poor performance scores of 12.1 to 15.0.

Upon supplementation with the functional food mixes, the number of adults with good cardiovascular functional capacity increased by five among the experimental groups. Further, the experimental groups also evidenced a reduction in the number of adults with poor cardiovascular functional scores by two. However there were no changes in the cardiovascular functional capacity of the adults belonging to the control groups.

D. Impact of diet counselling

i. Impact of diet counselling on the knowledge scores of the adults

Patients counselling is a process that improves them to cope with their disease and make informed decisions regarding diet and lifestyle management and modification (Malathy *et al.*, 2011). The changes in the knowledge scores of the selected adults before and after diet counselling are presented in Table LXV and Figure 24.

TABLE LXV
MEAN KNOWLEDGE SCORES OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Knowledge scores (per cent)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	33.77 ± 9.79	62.3 ± 15.97	28.53 ± 11.10	14.08**	DCGvsCG 13.92**
DCSG	38.73 ± 9.80	68.02 ± 11.97	29.15 ± 8.54	18.70**	DCSGvsCG 18.34**
CG	28.08 ± 9.69	28.27 ± 9.69	0.18 ± 0.52	1.94^{NS}	DCGvsDCSG 0.26^{NS}

** $p<0.01$; NS-Not significant

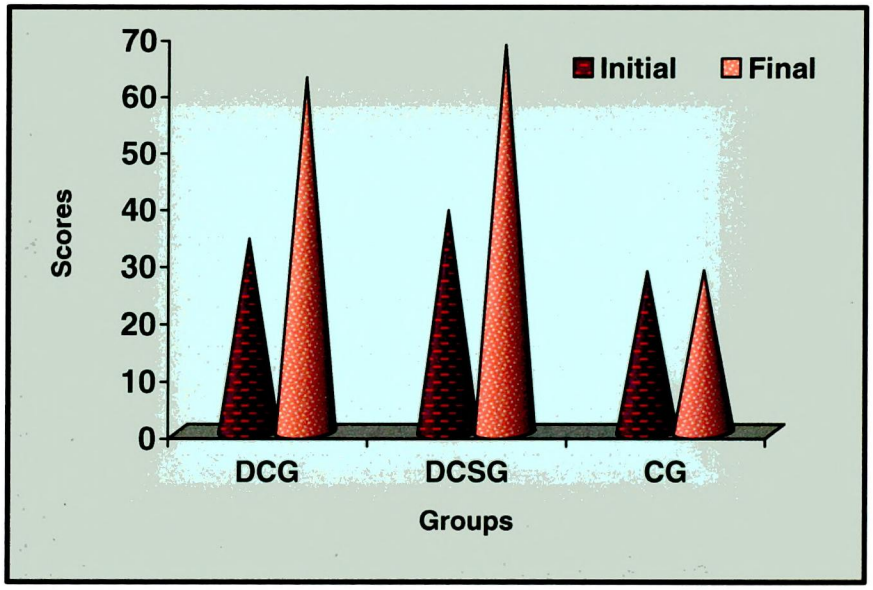

FIGURE 24

CHANGES IN KNOWLEDGE SCORES OF THE ADULTS

The mean initial knowledge scores were 33 per cent in DCG, 38.73 per cent in DCSG and 28.08 per cent in control group. A noteworthy observation was that a greater percentage of correct answers were obtained from adults who had a pervious history of cardiovascular disease in their families making them more familiar to the disease and the mode of treatment. The counselling provided to these adults resulted in an increase in scores by 28.53 and 29.15 per cent among both the experimental groups DCG and DCSG and the increase was found to be statistically significant at one per cent level. In the case of control group since there was no education given the mean knowledge scores did not increase much over the six months. There was no significant difference between the two experimental groups revealing that diet counselling with or without supplementation will improve knowledge scores.

ii. Impact of diet counselling on eating index of the adults

The ultimate aim of any diet counselling regimen is to improve the diets of the clients to suit the disease. The effect of diet counselling on the eating index of the adults using food frequency questionnaire are presented in Table LXVI and Figure 25.

TABLE LXVI

MEAN EATING INDEX SCORES OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Eating index (per cent)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	25.13 ± 7.22	44.88 ± 8.33	19.75 ± 6.89	15.70**	DCGvsCG 15.30**
DCSG	34.12 ± 6.73	52.30 ± 7.50	18.18 ± 6.13	16.25**	DCSGvsCG 16.06**
CG	21.53 ± 5.10	21.73 ± 5.01	0.20 ± 0.52	2.11*	DCGvsDCSG 0.94^{NS}

** p<0.01; *p<0.05; NS-Not significant

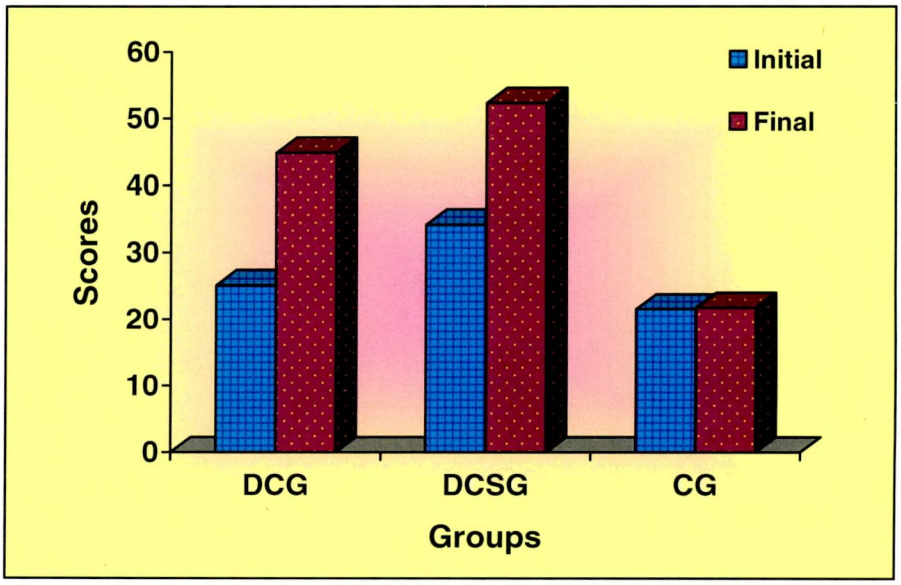

FIGURE 25

CHANGES IN EATING INDEX SCORES OF THE ADULTS

Positive response was obtained in terms of healthy diet choices after diet counselling from both the experimental groups. The eating index improved by 19.75 per cent in DCG and by 18.18 per cent in DCSG which were statistically significant at one per cent level. Very negligible improvement was seen among the control group. Consumption of specific foods and dietary patterns

appear especially beneficial in reducing cardiovascular risk and warrant a focus on foods and overall dietary patterns of the individuals (Mozaffarian *et al.*, 2011).

iii. Impact of diet counselling on the practice index scores of the adults

The changes in the practice index scores of the adults before and after diet counselling is presented in Table LXVII and Figure 26.

TABLE LXVII

MEAN PRACTICE INDEX SCORES OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Practice index (per cent)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	35.82 ± 8.24	56.57 ± 9.70	20.75 ± 7.23	15.71**	DCGvsCG 15.64**
DCSG	39.97 ± 6.01	66.47 ± 5.95	26.50 ± 7.63	19.03**	DCSGvsCG 19.22**
CG	27.82 ± 7.08	27.80 ± 7.00	0.02 ± 0.52	0.18^{NS}	DCGvsDCSG 3.28**

** p<0.01; NS-Not significant

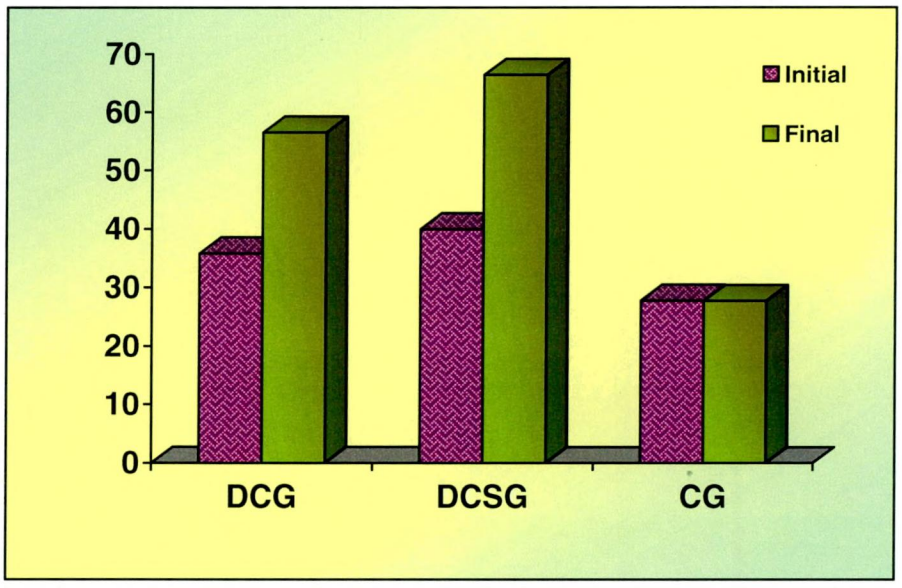

FIGURE 26
CHANGES IN PRACTICE INDEX SCORES OF THE ADULTS

The initial practice index scores of the adults were 35.82, 39.97 and 27.82 per cent among the groups DCG, DCSG and control. This reflects the uncontrolled food behaviour of the adults which can become a leading cause for cardiovascular complications. However, it was encouraging to note that diet counselling had brought about an improvement in the practice index of the adults in the experimental groups by 20.75 and 26.50 per cent among DCG and DCSG respectively, both being statistically significant at one per cent level. Studies by Mozafarrian *et al* (2010) reported that the replacement of less healthy foods in the diet with healthier foods can lead to lower incidence of coronary heart disease.

Category of scores of the adults before and after diet counselling

Table LXVIII presents the category scores of the adults related to knowledge, eating and practice indices.

TABLE LXVIII

CATEGORY OF KNOWLEDGE, EATING AND PRACTICE SCORES OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Low (<25)		Average (26-50)		Good (51-75)		Excellent (>75)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Knowledge scores								
DCG	6	0	22	7	2	15	0	8
DCSG	4	0	23	3	3	18	0	9
CG	12	12	18	18	0	0	0	0
Eating Index Scores								
DCG	17	0	13	22	0	8	0	0
DCSG	2	0	28	11	0	19	0	0
CG	23	23	7	7	0	0	0	0
Practice Index								
DCG	3	0	27	10	0	20	0	0
DCSG	1	0	28	1	1	28	0	1
CG	12	13	18	17	0	0	0	0

The knowledge scores of majority of the adults were 'average' at the beginning of the study among all the three groups. After diet counselling, maximum number of adults in both the groups DCG and DCSG improved to 'good' category with scores between 51 and 75 per cent. After counselling eight adults from DCG and nine adults from DCSG groups moved to excellent category. However, there were no changes in the knowledge score category of the adults in the control group.

With regard to eating index, after diet counselling none of the adults in both groups DCG and DCSG had 'low' scores. There were also greater number of adults with 'average' scores and eight and 19 adults in groups DCG and DCSG had 'good' eating index scores.

In the case of practice index, majority of the adults had 'average' scores of 26 to 50 at the beginning of the study. After diet counselling, maximum number of adults in both the groups DCG and DCSG had 'good' practice scores between 51 to 75, however all the adults belonging to the control group had either 'low' or 'average' practice index scores both at the beginning and at the end of diet counselling.

iv. Impact of diet counselling on anthropometric parameters

1. Changes in weight of the adults

The changes in body weight of the adults before and after diet counselling is presented in Table LXIX.

The body weights of the adults in DCG1, DCG2 and CG were 70.47, 69.15 and 67.5 kg in the initial stage. Diet counselling resulted in a decrease in body weight of the adults by 1.28 kg while combined effect of diet counselling and supplementation resulted in a greater reduction of body weight by 2.18 kg and they were statistically significant at one per cent level among both the groups. Thus, diet counselling along with supplementation was more effective in weight reduction as compared to diet counselling alone.

TABLE LXIX

MEAN BODY WEIGHT OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Body weight (kg)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	70.47 ± 6.11	69.18 ± 6.22	1.28 ± 0.55	12.73**	DCGvsCG 7.96**
DCSG	69.15 ± 8.18	66.97 ± 8.35	2.18 ± 0.61	19.65**	DCSGvsCG 14.03**
CG	67.50 ± 8.56	67.38 ± 8.57	0.12 ± 0.47	1.37^{NS}	DCGvsDCSG 8.31**

** p<0.01; NS-Not significant

2. Changes in BMI of the adults

The changes in BMI of the adults before and after diet counselling are presented in Table LXX.

TABLE LXX

MEAN BMI OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	BMI			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	27.81 ± 2.93	27.26 ± 2.98	0.55 ± 0.24	12.27**	DCGvsCG 7.26**
DCSG	27.70 ± 3.78	26.78 ± 3.81	0.92 ± 0.28	17.78**	DCSGvsCG 11.52**
CG	27.58 ± 2.85	27.50 ± 2.89	0.08 ± 0.20	2.14*	DCGvsDCSG 6.15**

** p<0.01; *p<0.05; NS-Not significant

The mean BMI of the two experimental groups and one control group were almost similar before counselling programme with all the groups belonging to the category of 'at risk of obesity'. Assessment of BMI after diet counselling indicated that the BMI values had decreased in both DCG and DCSG groups by 0.55 and 0.92 respectively, both being significant at one per cent level. The control group evidenced a marginal reduction in BMI by 0.08 and significant at five per cent level.

The BMI of the adults belonging to group DCSG was seen to be significantly greater than group DCG suggesting that a combination of counselling and supplementation was more effective than diet counselling alone.

3. Changes in Waist Hip Ratio (WHR) of the adults

The waist hip ratio of the selected adults before and after diet counselling is given in Table LXXI.

TABLE LXXI

MEAN WAIST HIP RATIO OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Waist hip ratio			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	0.969 ± 0.037	0.966 ± 0.035	0.003 ± 0.005	3.79**	DCGvsCG 2.99**
DCSG	0.971 ± 0.038	0.968 ± 0.039	0.030 ± 0.050	3.07**	DCSGvsCG 0.31^{NS}
CG	0.960 ± 0.040	0.960 ± 0.039	0.000 ± 0.003	0.27^{NS}	DCGvsDCSG 0.31^{NS}

** p<0.01; NS-Not significant

The initial levels of WHR in the study sample ranged from 0.96 to 0.971. The experimental groups DCG and DCSG showed a negligible reduction of 0.003 to 0.03 in the WHR with diet counselling and supplementation. This reduction was found to be statistically significant at one per cent level as

compared to the control group which showed no change in WHR values. Comparison between the two experimental groups revealed a minor difference which was not statistically significant.

4. Changes in Waist Height Ratio (WHtR) of the adults

Comparison between the WHtR of the adults before and after diet counselling is presented in Table LXXII.

TABLE LXXII

MEAN WAIST HEIGHT RATIO OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	WHtR			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	0.637 ± 0.061	0.635 ± 0.061	0.002 ± 0.003	3.92**	DCGvsCG 2.87**
DCSG	0.646 ± 0.054	0.643 ± 0.054	0.002 ± 0.004	3.49**	DCSGvsCG 3.03**
CG	0.64 ± 0.06	0.64 ± 0.06	0.00 ± 0.00	0.41^{NS}	DCGvsDCSG 0.21^{NS}

** p<0.01; NS-Not significant

The initial WHtR of the adults among the three groups ranged from 0.637 to 0.646. A statistically significant (1% level) reduction was observed in the WHtR of the adults belonging to the diet counselling group (DCG) and the diet counselling coupled with supplementation group (DCSG). However, the adults belonging to the control group did not show any change in their WHtR during the study period. The WHtR of the adults in group DCSG had reduced more than the DCG group but not statistically significant.

v. Impact of diet counselling on the serum lipid profile of the adults

The effect of exclusive diet counselling and diet counselling combined with supplementation on the various blood lipid parameters namely total cholesterol, triglyceride, LDL, VLDL and HDL cholesterol are presented below.

1. Changes in total cholesterol levels of the adults

Table LXXIII presents the initial and final total cholesterol levels of the adults with cardiovascular diseases.

TABLE LXXIII

MEAN TOTAL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Total cholesterol (mg/dl)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	257.23 ± 9.94	238.77 ± 13.02	18.47 ± 6.79	14.89**	**DCGvsCG** 10.68**
DCSG	259.23 ± 9.21	233.43 ± 41.67	25.8 ± 39.79	3.55**	**DCSGvsCG** 3.04**
CG	256.5 ± 11.95	254.07 ± 13.10	2.43 ± 5.55	2.40*	**DCGvsDCSG** 1.00^{NS}

** p<0.01; *p<0.05; NS-Not significant

The initial total cholesterol levels among the adults were 257.23 mg per dl in DCG, 259.23 mg per dl in DCSG and 256.5 mg per dl in control group. All the three groups had high levels of total cholesterol as classified by the NCEP (2002).

Combined effect of diet counselling and supplementation resulted in a much greater reduction in total cholesterol levels by 25.8 mg per dl compared to the group with diet counselling alone which recorded a reduction of 18.47 mg per dl. The control group showed a negligible reduction by 2.43 mg per dl in total cholesterol levels. Capewell *et al* (2010) reported that slight reduction in cholesterol concentrations translate into substantial reductions in cardiovascular events and deaths. An office based long term counselling programme by Fillippi *et al* (2009) resulted in clinically significant reduction in total cholesterol and global cardiovascular disease risk among subjects with cardiovascular risk.

2. Changes in triglyceride levels of the adults

The serum triglyceride levels of the adults both before and after diet counselling is presented in Table LXXIV.

TABLE LXXIV

MEAN TRIGLYCERIDE LEVELS OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	Triglyceride (mg/dl)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	168.5 ± 10.86	156.3 ± 10.39	12.2 ± 4.71	14.19**	DCGvsCG 3.52**
DCSG	165.7 ± 10.24	142.07 ± 9.58	23.63 ± 3.19	40.59**	DCSGvsCG 9.13**
CG	162.2 ± 11.84	157.37 ±14.79	4.83 ± 10.28	2.58**	DCGvsDCSG 12.24**

** p<0.01; NS-Not significant

The initial serum triglyceride levels among all the three groups ranged between 160 to 170 mg per dl, being categorised as border line high by the NCEP (2002). Diet counselling resulted in a reduction of triglyceride levels by 12.2 mg per dl whereas diet counselling coupled with supplementation resulted in a reduction of 23.63 mg per dl, two times greater than the first group. This suggested that effective supplementation coupled with conscious efforts from the part of the participants can yield best results in cardiovascular disease management. Studies by Imai and Kajiyama (2010) reported a significant reduction in triglyceride levels after a nutritional education programme among adults with type II diabetes.

It was further seen that diet counselling along with supplementation resulted in a greater reduction in the serum triglyceride levels than diet counselling alone which was significant at one per cent level.

3. Changes in LDL cholesterol levels of the adults

Table LXXV depicts the changes in the mean LDL cholesterol levels of the adults at the initial and final period of diet counselling.

TABLE LXXV
MEAN LDL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	LDL cholesterol (mg/dl)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	185.17 ± 11.17	166.31 ± 14.31	18.86 ± 6.46	15.99**	DCGvsCG 11.62**
DCSG	185.43 ± 10.18	160.52 ± 42.93	24.90 ± 40.01	3.41**	DCSGvsCG 2.98**
CG	184.31 ± 14.23	182.42 ± 14.95	1.84 ± 5.60	1.80^{NS}	DCGvsDCSG 0.83^{NS}

** p<0.01; NS-Not significant

The initial mean LDL cholesterol levels of the adults were 185.17, 185.43 and 184.31 mg per dl among DCG, DCSG and control groups respectively which were found to be very high, indicative of the poor management of lipid profile.

Both the experimental groups DCG and DCSG evidenced a remarkable reduction in LDL cholesterol levels by 10.86 and 24.90 mg per dl respectively which were both statistically significant at one per cent level. The mean LDL cholesterol levels of the adults decreased by 18.86 and 24.9 mg per dl among the two experimental groups DCG and DCSG respectively. However, there was only an insignificant reduction in the LDL profile of adults in the control group. Statistical analysis between the groups DCG and DCSG revealed no significant difference due to counselling.

LDL particles contain about 2700 fatty acids of which approximately half are polyunsaturated and are susceptible to oxidation enabling plaque progression (Honarbakhsh and Schachter, 2009). A similar study by Jenkins *et al* (2011) stated that six months dietary advice resulted in a reduction in LDL cholesterol levels between 26 and 21 mg per dl among hyperlipidimic adults.

4. Changes in VLDL cholesterol levels of the adults

The impact of diet counselling on the VLDL cholesterol levels of the adults is presented in Table LXXVI.

TABLE LXXVI
MEAN VLDL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N-90)

Group	VLDL cholesterol (mg/dl)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	33.7 ± 2.17	31.26 ± 2.08	2.44 ± 0.94	14.19**	DCGvsCG 3.40**
DCSG	33.14 ± 2.05	28.41 ± 1.92	4.37 ± 0.64	40.59**	DCSGvsCG 9.06**
CG	32.39 ± 2.37	31.29 ± 2.91	1.09 ± 2.01	2.98**	DCGvsDCSG 12.24**

** p<0.01; NS-Not significant

The initial mean VLDL cholesterol levels of the adults of the three groups were very close to each other ranging from 32.39 to 33.7 mg per dl. Diet counselling along with supplementation of the food mixes in DCSG group resulted in a maximum reduction of VLDL cholesterol levels by 4.37 mg per dl, compared to the group with diet counselling alone which showed a reduction by 2.44 mg per dl only. The findings were statistically significant at one per cent level. The control group also showed a slight reduction by 1.09 mg per dl which can be attributed to the day to day dietary improvement of the adults.

It is further noted that diet counselling along with supplementation of basic food mix in group DCSG resulted in a greater reduction in VLDL cholesterol levels than diet counselling alone in group DCG.

5. Changes in HDL cholesterol levels of the adults

The impact of diet counselling and supplementation as evident from the initial and final HDL cholesterol levels are presented in Table LXXVII.

The initial HDL cholesterol levels of the three groups ranged from 38.37 to 40.67 mg per dl which was close to the optimal levels of 40 mg per dl suggested by NCEP (2002). The group with diet counselling and supplementation (DCSG) showed a maximum increment in the HDL cholesterol levels by 3.83 mg per dl, followed by the group with diet

counselling alone (DCG) with an increment of 2.83 mg per dl. The increase of both the groups was statistically significant at one per cent level. However, the increase in the control group was marginal (0.5 mg/dl) and statistically not significant.

TABLE LXXVII

MEAN HDL CHOLESTEROL LEVELS OF THE ADULTS BEFORE AND AFTER DIET COUNSELLING

(N=90)

Group	HDL cholesterol (mg/dl)			't' value	
	Initial	Final	Difference	I vs F	Between groups
DCG	38.37 ± 4.35	41.2 ± 3.76	2.83 ± 1.56	9.98**	DCGvsCG 6.16**
DCSG	40.67 ± 3.04	44.5 ± 2.80	3.83 ± 1.91	10.67**	DCSGvsCG 7.48**
CG	39.8 ± 4.95	40.3 ± 4.80	0.50 ± 1.53	1.79^{NS}	DCGvsDCSG 2.15*

** p<0.01; *p<0.05; NS-Not significant

Comparison between DCSG and DCG revealed a statistically significant difference at five per cent level. Experimental groups showed a statistically significant difference at one per cent level with control group.

E. Feedback from the adults of the study

All the adults included in the supplementation study were enthusiastic in consuming the food mixes throughout the study period. The adults reported that they felt more active throughout the day with lesser tiredness or weakness. The adults with diabetes mellitus reported a sense of fullness and satiety after meals and the absence of early hunger signs which is one of the symptoms of diabetes mellitus. Some of the adults also revealed that they had relief from constipation problems after consuming the food mixes. The adults also experienced lesser incidence of common illness such as cough and cold. Few adults also reported decreased congestion in the chest which was felt by them earlier. Many adults also reported that they could have better sleep in the nights with lesser sleep disturbances after consuming the food mixes. All the adults expressed that they were happy with the outcome of

supplementation with reference to their improvement in lipid profile and blood pressure levels and were eager to continue consuming the food mixes.

One note worthy observation was that these signs were experienced by the adults from as early as the third month of supplementation period. None of the adults reported the presence of any adverse effects such as vomiting, diarrhoea or nausea. The adults were therefore encouraged to prepare the food mixes at home and continue consuming them. Spouses and relatives of the adults visiting the hospital along with them also expressed encouraging comments that they could observe improvements in the physical activity among the supplemented adults and that they were more independent in fulfilling their daily works and required lesser help from others. They also observed an improved attitude and confidence towards the disease.

The adults included in the diet counselling study reported that they learnt many new concepts regarding cardiovascular disease of which they were earlier unaware of. The adults were more determined to make the necessary diet changes. They felt a greater confidence in discussing their illness with others due to the improvement in knowledge and attitude. They also reported that they recognized that medication and diet management have to go hand in hand for an effective disease management.

Diet and nutrition have a direct relationship with health and disease. It is further evident from the results of the present study that these functional food mixes can provide positive improvements in the health of adults with cardiovascular disease. At this period of age where the availability and utilization of reliable treatment and care show conspicuous variation by income classes, supplementing the diet with such functional foods can encompass these differences being a safe and cheap strategy. Introducing these foods in the diets of adults with cardiovascular disease with proper information concerning the effect of functional foods and their role in these diseases is the need of the hour.