Impact of Supplementation of Vitamin - C on Hypercholesterolemic Patients

BY

P. Uma

A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN (DEEMED UNIVERSITY) COIMBATORE - 641 043

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN FAMILY AND COMMUNITY SCIENCE

MAY 1995

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Certified as bonafide research work

Signature of the Head of the Department	Signature of the Dean of the Faculty	Signature of the Guide

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Introduction

I. INTRODUCTION

Health is a basic human right and a world wide social goal; that is essential to be satisfied. In 1977, the World Health Assembly decided that the main social target of governments and WHO in the coming decades should be "the attainment by all citizens of the world by the year 2000 of a level of health that will permit them to lead a social and economically productive life" (Park and Park, 1991).

In recent years there has been an alarming increase in the incidence of heart disease. Cardiovascular disease is the world's foremost public health enemy (ICMR Bulletin, 1992). Cardiovascular disease and cancer accounts for two - thirds of all deaths and the two main causes are cigarette smoking and poor diet. When it comes to diet the three main problems are too much fat especially animal fat, obesity, lack of fibre and a diet with considerable animal product affects (John, 1994).

Today, when researchers look at heart attacks, strokes, senility and a host of other crippling or life - threatening ills, they see them mainly as symptoms of a single underlying disease - the narrowing and blocking

of blood vessels. In general the closing of blood vessels is attributed to atherosclerosis. Cholesterol is one of the important fatty substances involved in the roughening and build-up of the artery wall. The corrosion begins with the accumulation of fat factors found in the food we eat and also made by the body itself. There are many fatty substances, cholesterol is only one of them. But since cholesterol is the easiest to measure, it is used as an index to how much of such fatty substances are in the blood stream (John, 1994).

A heart attack represents the death threos of oxygen-starved heart muscle. Risk of having an attack depends on factors influencing fatty plague build-up in the coronary artery wall, formation of artery-clogging blood clots and the strength of the heart muscle itself.

Total cholesterol of more than 240 mg/dl increases heart attack risk, and a level between 200 and 239 mg/dl is considered borderline high. But one type of cholesterol high density lipoprotein actually helps keep arteries clear, so an ample HDL supply (above 60 mg/dl) is a positive factor, while too little (below 35 mg/dl) boosts coronary risk (Yonkers, 1995).

The major reason for the greater heart attack risk among non-vegetarians is because of cholesterol and

saturated fat. All cholesterol and 70% of saturated fat in the average diet comes from animal products. Our bodies make cholesterol in sufficient amounts so we don't need it in our diet.

The work load on the heart increases with body weight. Obese person is two to five times more likely to have or develop high blood pressure. High blood pressure greatly increases the risk of heart trouble. The ability to handle sugar is impaired and the person is two to four times likely to develop diabetes (Deutsch, 1991).

Extra weight magnifies the chance of developing undesirable cholesterol levels, hypertension and diabetes. The most reliable criterion for obesity is a Body Mass Index of 30 or more, at which point the risk of heart disease rises sharply. A BMI from 27 to 29 indicating moderate overweight has been associated with a slightly increased risk of heart attack (Yonkers, 1995).

Pekkanen (1990) opines that men aged 25 to 55 are at high risk of coronary heart disease if their cholesterol level is 240 mg/dl or above. While those with lower cholesterol readings have less risk, the possibility of disease increases with the addition of a

risk factor such as smoking or high blood pressure. If they have two additional risk factors the prospect of getting coronary heart disease is significantly greater.

Mayor (1994) reveals that a number of risk factors for CHD have been identified like elevated plasma TG and LDL - C, a low concentration of HDL - C and diabetes mellitus. The increased risk of CHD in individuals with non-insulin dependent diabetes mellitus (NIDDM) is due to plasma lipid alterations that have been reported by numerous investigators. Plasma TC, LDL - C and TG concentrations are elevated and HDL - C concentrations are low in people with NIDDM.

According to Stamler (1994) there are numerous dietary factors that influence blood cholesterol level. These include the amount and type of dietary fat, the PUFA to saturated fatty acid ratio, dietary cholesterol amount and type of dietary fibre, source of dietary protein, alcohol and perhaps sugar and less well studied non-nutritive components of food.

Gey et al., (1993) opines that for the prolongation of life expectancy and reduction of CHD, recommends lowering turated mammalian fat with partial replacement by vegetable oils, increasing the consumption of vegetables, legumes and fruits that

provide more essential antioxidants. Many epidemiological studies all over the world had led to the assumption that vegetable rich diets are associated with a higher life expectancy and antioxidants could be principle importance for the benefit of the vegetable rich diet. Dietary surveys conducted in America revealed that the calculated dietary intake of essential antioxidants such as vitamin - C and beta - carotene and vitamin - A and E is inversely related to the risk of CHD as it is for cancer (Geyet al.,1993).

"Protective" diets for example of the vegetarian or mediterranean types certainly contain many health promoting components besides the antioxidants. Mentioned example - fibres, complex carbohydrates, plant phenols of lower molecular weight, polyphenols, bioflavinoids and anthocyanins which are not easily differentiated. Thus the factors in plants that contribute most clearly to the protection of exogenous radical damage are the antioxidant vitamins and carotenoids which are easily absorbed and delivered to extrohepatic tissues. It may be these factors that are mainly responsible for beneficial properties of plant enriched diet such as increasing life expectancy and decreasing the risk of IHD (Gey et al., 1993).

Low density lipoprotein in plasma is protected from oxidation by the presence of aqueous antioxidants such as ascorbic acid and urate. It has been suggested that in the sub-endothelial space the aqueous antioxidants are consumed and there is minimal oxidation of LDL. This minimally modified LDL can then trigger a series of events that results in macrophage activation which in turn produces reactive species with further oxidation of LDL. LDL modified in this way is recognized by the scavenger receptor or macrophage leading to increased delivery of cholesterol and the conversion of macrophages into foam cells. Delaying oxidation with lipid soluble antioxidant supplements may help to reduce the production of minimally modified LDL and thus the development of atherosclerosis (Abbey et al., 1993).

The importance of antioxidants in protecting against oxidation of LDL and therefore in protecting against coronary artery disease is suggested by epidemiological studies that have shown that there is an inverse correlation between plasma vitamin - E concentration and mortality from CHD (Marti, 1993). Bates et al., (1991) reported a strong positive correlation between ascorbic acid concentration and plasma HDL cholesterol in men.

A recent study has demonstrated that vitamin - C is the most effective aqueous phase antioxidant in human plasma. This is of interest because vitamin - C besides being a water soluble antioxidant is apparently able to delay the onset of LDL oxidation by sparing the fat soluble antioxidant resident in the LDL particles (Monsen, 1994).

By keeping all these scientific facts in mind the investigator took interest and initiated this study with the following objectives:

1. To study the socio-economic, dietary pattern and health status of the selected hypercholesterolemic patients.
2. Analysis of the blood profile and study the risk factors of hypercholesterolemia.
3. To study the impact of antioxidant supplementation on hypercholesterolemic patients.
4. To study the change in the blood profile of the heart patients due to ascorbic acid intake. .pa

Review of Literature

II. REVIEW OF LITERATURE

Review of literature pertaining to the topic "Impact of Supplementation of Vitamin - C on hypercholesterolemic patients" was discussed under the following heads :

1. Incidence of heart diseases
2. Etiology of heart diseases
3. Hypercholesterolemia and heart diseases
4. Nutrition related factors in preventing heart diseases
5. Role of Vitamin - C in lowering serum lipid levels
6. Impact of other nutrients in altering the serum lipid levels

1. Incidence of heart diseases :

Cardiovascular diseases have become number one killer in western countries but ranks third in India (Peter, 1993). Cardiovascular diseases and cancer accounts for two thirds of all deaths (John, 1994).

In India, coronary heart disease accounts for 10 to 15 % of all cardiovascular disease (Sucheta et al., 1992). According to ICMR (1992) it is estimated that there are nearly 20 million hypertensive and 15 million cases of coronary heart disease in India and a few epidemiological studies have indicated a higher

prevalence in urban than in rural areas. Presently 10% of mortality in India is due to heart disease.

CHD is one of the disease associated with affluence and is more prevalent in population with a high standard of living than those with a low standard. This is reflected in the higher prevalence of CHD in countries where cigarette smoking is high and where many people have motor cars, radios and television (Yudkin, 1992).

2. Etilogy of heart diseases :

New guidelines have recently been released by the Adult Treatment Programme (ATP) of the National Cholesterol Education Programme. Risk factors for CHD in addition to elevated LDL - C now include

1. Male 45 years or older.
2. Female 55 years or older or with premature menopause and not an estrogen replacement.
3. HDL - C less than 35 mg/dl.
4. Hvpertension.
5. Cigarette smoking.
6. Diabetes mellitus.
7. Family history of premature CHD.

There is significant evidence that increased intake of saturated fat and cholesterol elevate, monosaturated

fats neutralise and PUFA decrease the serum TC and LDL - C levels. The effect of the saturated fat in causing higher serum cholesterol is more pronounced than that o dietary cholesterol (Stamler, 1994).

There is an overwhelming evidence that men aged 25 to 55 are at high risk for CHD when their cholesterol level is 240 mg/dl or above. While those with lower cholesterol readings have less risk. The possibility of disease increases with addition of a risk factors such as smoking or high blood pressure. If they have two additional risk factors the prospect of getting CHD is significantly greater. Pre-menopausal women with cholestero levels above 240 mg/dl develop CHD unless they have additional risk factors (Pekkanen, 1994).

Hypertensive patients have a greater than expected prevalence of high blood cholesterol level and conversely patients with high blood cholesterol levels have a higher than expected prevalence of high blood pressure (Gilbert et al., 1991).

One below 35 mg/dl increases the risk of coronary disease. And for every one mg/dl drop in HDL, the risk of heart disease rises two to three percent. HDL level of 60 or above actually protects against heart disease. On average, women especially pre-menopausal women have

higher HDL levels than men, which explain why women tend to develop heart disease a decade or so later than men do. (Rubin, 1993).

With higher coffee intake more than 400 ml/day higher TC, LDL - C and lower triglycerol rich lipoprotein and triacylglycerol values in blood were observed and compared with lower coffee intake less than 200 ml/day. Results demonstrated an increase in LDL - C of 1.66 mg/100 ml per cup of coffee consumed daily for women (Sucheta et a;., 1992).

A combination of high coffee intake, smoking and no oral contraceptive use was associated with higher total and LDL - C and lower triglycerol values (Lernat et al., 1993).

Studies conducted by Maiz et al., (1992) proved a significant correlation between BMI and B.P, TC and HDL - C, TG and B.P. Changes in body weight were correlated to changes in TC, TG and diastolic B.P. Obesity is correlated to the presence of cardiovascular risk factors and its modifications influenced the development of atherosclerosis.

Increased BMI and obesity have been associated with an increased likelihood of CHD and of an atherogenic plasma profile. It has been proposed that central

obesity, more than general obesity is important in determining susceptibility to CHD glucose tolerance and alterations in lipid metabolism. Both genetic and environmental factors such as diet and fitness influence one's BMI and body fat distribution. In addition aging is associated with a redistribution of subcutaneous fat to abdominal compartments. In elderly free living subjects BMI was negatively associated with HDL - C and positively associated with plasma triglycerides, TC and LDL - C (Steffania, 1994).

According to Ramussen (1994) obese subjects frequently lose and regain body weight because of their failure to maintain a reduced weight. Recent studies indicate that this process which is called weight cycling have lead to an increased risk for morbidity and mortality primarily from CHD. The increased risk of CHD may partly be a consequence of a preferential accumulation of abdominal fat after repeated weight cycles. An enlargement of the visceral abdominal fat depot is associated with CHD.

According to Croft et al., (1995) abdominal obesity is measured as the waist-to-hip ratio which is the ratio of obesity in the upper trunk to that in lower trunk. A high WHR is associated with increased risk of death due

to CVD, diabetes and high levels of blood pressure, lipids and insulin.

Type -A behaviour characterized by "Extreme competetiveness, impatience, aggressiveness and hostility, combined with time urgency and excessive involvement with work, with the person appearing chronically tense, hurried, restless, speaking in an accelerated manner, continually interrupting the person speaking to them" has been linked with CHD (Sucheta et al., 1992).

Hypothyroidism is a cause of secondary hyper - lipidaemia. The lipid profile usually seen is an increased TC and LDL - C and plasma TG. Such a profile is likely to increase the risk of CHD.

Hypercholesterolemia secondary to hypothyroidism increases the CHD risk. It is also interesting that thyroid antibodies are common in people with CHD than in the general population and there are also significant associations between thyroid antibodies, obesity, hypertension and diabetes (Ball et al., 1991).

People who watch two or more hours of television daily are more likely to have elevated levels of blood cholesterol than people who watch less. Heavy television watching not only increases cholesterol

levels by discouraging exercise but also by promoting unhealthy foods in commercial advertisements (Gold, 1993).

Constant worry and tension stimulates the adrenal glands to produce more adrenaline and cortisone. This contributed to constricted arteries, high B.P. and increased work for the heart (Sucheta et al., 1992).

3. **HYPERCHOLESTEROLEMIA AND HEART DISEASE :**

According to Paul (1991) in both affluent and developing countries the dietary pattern associated with an increased risk of chronic heart disease is characterised by high concentration of sugar rich foods, meat and other animal products rich in saturated fat and dietary cholesterol. These foods now fill up the space in the diet previously and historically held by the starchy complex, complex carbohydrates.

Not all saturated fatty acids increase the blood cholesterol, some are thought to be beneficial and many are neutral with respect to heart disease. The unsaturated fatty acids have been given an almost clean bill of health. Monosaturated fatty acids have been shown to reduce serum cholesterol under some circumstances and are thus considered beneficial. PUFA have been favourably presented for many years and people

with heart problems have been encouraged to eat vegetable products and margarine because of their polyunsaturated fat content (Paul, 1991).

The considerable risk in CHD mortality in affluent countries during the past 50 years or so is due to the considerable increase in sucrose consumption (Yudkin, 1992).

Dumas (1991) suggests that many of the dietary factors are presumed to influence cholesterol level and tend to cluster together in certain typical diets. Thus when an "Affluent diet" rich in foods of animal origin and refined cereals is compared with more vegetarian diet found in many developing countries the affluent diet contains more total fat, saturated fat and cholester The intake of PUFA as a proportion of total fat is less and the content of dietary fibre is less. Since all these factors influence serum cholesterol it is likely their combined effects are operating to accelerate the progression of atherosclerosis.

The Framingham (1994) data showed an unquestionable link between high blood cholesterol and heart disease. The study showed that people with high cholesterol were 3 to 4 times more likely to have a heart attack or chest

pain than those with low cholesterol. However there was also a significant amount of heart disease among men with average cholesterol levels of 200 to 239. Even those with levels under 200 showed evidence of disease.

4. Nutrition Related Factors in preventing heart diseases :

Exercise leads to lower blood pressure during moments of peak stress and to a lower level of blood fats such as cholesterol and triglycerides which have been implicated in artery disease. It lengthens blood clotting time and increases the endurance of the heart muscle. It also reduces excess weight and fat (Albert, 1993). Anderson (1991) stresses that a balanced diet, relatively low in saturated fats and cholesterol combined with regular exercise is the best strategy against heart disease.

Moderate intake of alcohol is frequently associated with an elevated concentration of HDL and decreased cardiovascular risk (Marti, 1992).

Cod and halibut liver oil capsules have been long established as health foods. Fish oils are broken down by the enzymes of the body, the resulting chemicals act a lot like aspirin painkiller, anti-inflammatory agents, antihypertensives and anticoagulants (Carper, 1991).

Blood cholesterol levels are a major marker for heart attack risk but clinical studies on EPA's ability to lower blood cholesterol levels have been extremely positive (Polunin, 1993).

Protein from soyabean has a dramatic impact on people with extra-high blood cholesterol and helps to reverse damage already done to arteries. Soya protein actually counteracts the effects of a high fat diet.

Chemicals that help to lower cholesterol have been detected in apples, barley, carrots, brinjal, spinach, skim milk and yogurt. (Anderson 1991).

Eating 2 or 3 unpeeled apples/day for a month resulted in pushing down the blood cholesterol by more than 10%. Good HDL cholesterol went up while destructive LDL - C went down.

Grapefruit contains an amazing anticholesterol substance for the heart. People with high blood cholesterol who ate 15 gm of grapefruit pectin capsules a day for four months had a average cholesterol drop of about 8 %.

Half a medium sized raw onion a day has been shown to trigger shifts in the ratio of good to bad cholesterol, replacing a significant amount of destructive LDL - C with heart protective HDL. The HDL

boost is greatest from raw white and yellow onion (Carper, 1991).

Anderson (1991) found that for 85% of the U.S. population who consumed about 40 gm a day of dry oat bran, quickly lowered LDL - C the type that clogs arteries by about 20%. At a slower rate the bran usually raised 15% the level of beneficial HDL - C which helps flush harmful cholesterol out of the blood.

According to a new study walnuts are good for the heart because they lower artery clogging cholesterol. Nuts are a good source of healthful PUFA and monounsaturated fats. When volunteers substituted walnut, the consumption of undesirable saturated fats dropped by 1/3 rd even though the total amount of fat in both diet was similar (Haney, 1995).

Another interesting note is that men who ate nuts daily had only half the fatal heart attack rate as those who rarely ate nuts (Scaffenberg, 1994). A study conducted by Perry (1994) showed that in cities where the water is hard, there are fewer deaths from cardiovascular disease.

Devi (1994) opines that drinking of coffee is positively associated with lifestyle factors that promoted CHD. Whereas drinking tea is associated with a

preventive lifestyle. Therefore investigation on the health effects of coffee and tea must be controlled for confounding behavioural parameters.

5. **Role of Vitamin-C in lowering serum lipid levels :**

The important initial step in human atherogenesis is the sub-endothelial transformation of LDL into oxidatively modified LDL. The latter in contrast to normal LDL, results in unregulated lipid accumulation in monocyte derived macrophages to form foam cells that become visible as fatty streak.

Therefore recent research has concentrated heavily on Steinberg's LDL oxidation theory. The early fatty streak formation can be prevented by antioxidant protection of LDL against radical injury. But in the aqueous phase of plasma or for isolated LDL, the first and the major line of antioxidant defense is vitamin - C. This is consistent with the inverse correlation between vitamin C and IHD (Gey et al., 1993).

Oxidized LDL has been implicated in the development of atherosclerosis. Oxidation of LDL is the result of a free radical chain reaction in which PUFA are degraded in a process of lipid peroxidation. The highly reactive breakdown products interact with apolipoprotein - B on the surface of LDL and cause changes in receptor

recognition, which results in LDL being recognized and taken by macrophage scavenger receptors leading to the production of lipid laden foam cells. LDL particles contain many natural antioxidants able to trap free radicals that can prevent or limit the extent of the chain reaction. These natural antioxidants which include vitamin - E, beta - carotene and ubiquinol are preferentially oxidized before oxidation of the PUFA. Vitamin-C has antioxidant properties and demonstrates a synergistic interaction with the tocopheroxyl radical resulting in the regeneration of tocopherol. This synergistic interaction has also been demonstrated between ascorbic acid and the prubucol phenoxyl radical. The antioxidant activities of alpha - tocopherol and prubucol therefore are enhanced in the presence of ascorbic acid (Abbey et al.,1993).

Oxidation of LDL induced by free radical proceeds by a chain mechanism to give phosphatidylcholine hydroperoxides and cholesteryl ester hydroperoxide as the major primary products. Water soluble radical scavenging antioxidants such as Vitamin - C and uric acid act as the first defence to supress the chain initiation. Lipophilic radical scavenging antioxidants in LDL such as Vitamin - E and ubiquinol scavenge

radicals attacking from outside and also with the LDL. The overall importance and potency of antioxidants depend not only on chemical reactivity but also on the physical factors such as location and mobility at the microenvironment in LDL (Niki et al., 1993).

Vitamin - C has a role in cholesterol metabolism, maintenance of vascular integrity and synthesis of prostacylcin by the vessel wall endothelium and that the vitamin functions as a plasma antioxidant (Simon et al., 1992). Muller (1995) opines that plasma Vitamin - C concentrations was found to be directly associated with plasma levels of HDL - C. Therefore high levels of plasma Vitamin - C lowers the risk of CVD.

Ascorbic acid helps to reduce free radical damage and atheroma formation in blood vessels. (Hume, 1993). Vitamin - C is essential as it protects against spontaneous breaches in capillary walls which can lead to heart attacks. It also guards against high blood cholesterol. The stress of anger, fear, disappointment and similar emotions can rise blood fat and cholesterol level immediately but this reaction to stress can be little harm if the diet is adequate in vitamin - c and pantothenic acid. The richest sources of vitamin - C

are citrous fruits (Bukhru, 1987).

Mostafa et al., (1989) in his investigation ha supplemented vitamin - C (500 mg/day) to 37 CVD patients for 6 months and had another 30 as placebo. The data supported the beneficial effects of vitamin - C on atherosclerosis process, that is it reduced significantly body fat, systolic blood pressure and pulse and increased significantly the HDL - C.

IMPACT OF OTHER NUTRIENTS IN ALTERING THE SERUM LIPID LEVELS :

Vitamin - E is the major antioxidant in the lipid phase of t ues. In the LDL particle, vitamin E is the first line of defense against oxidation of its PUFA component. On an average about one molecule of vitamin - E is present for every 200 molecule of PUFA. In vivo model of induced LDL peroxidation show sequential consumption of the antioxidant constituents of the LDL particle in this order, vitamin E is consumed foll wed by beta carotene before the PUFA is oxidised. When vitamin - C is added to the solution the lag time between the start of oxidation and the consumption of both vitamin -E and beta carotene is delayed approximately ten-fold (Monsen, 1994).

The combined supplement contained alpha - tocopherol, ascorbic acid and beta carotene, the single supplement contained alpha - tocopherol only. Compared with placebo combined antioxidant there by significantly increased plasma level of ascorbate, alpha - tocopherol and beta-carotene and decreased the rate of LDL oxidation by 40%. Although men receiving the combined antioxidant supplement had significantly higher plasma level of ascorbate and beta carotene than men receiving alpha - tocopherol alone, there were no significant differences between the 2 groups with respect to LDL oxidation kinetics (Nestel, 1993).

A low fat (28% of energy) high fibre (3.3 g/MJ) diet according to Nordic Nutrition Recommendations resulted in lower serum cholesterol concentration of LDL - C and higher fasting triglycerides than high fat diet (39% of energy). The findings indicate that a low fat, high fibre diet not only reduces the atherogenic but also the thrombogenic tendency compared with a high fat diet (Marckmann et al., 1994).

Recently there has been much publicity about the omega - 3 - series of PUFA and their apparent ability to protect against heart diseases. The Omega - 6 PUFA are in some respect the antagonists for the Omega - 3 -

series in that they evidently promote conditions that can lead to heart disease (Paul, 1991).

According to Korpela et al., (1992) a high stored iron level as assessed by elevated serum ferritin concentration is a risk factor for CHD. Men with serum ferritin concentration greater than 200 ug/l had 2.24 fold risk of acute myocardial infarction compared with men having low serum ferritin.

Magnesium has been found to reduce deaths from heart attacks. It dilates the blood vessels reducing the chances of blood platelets clumping together and forming clots (Celia, 1995).

Methodology

III. METHODOLOGY

The experimental procedure followed for the study entitled "Impact of supplementation of Vitamin - C on hypercholesterolemic patients" is discussed under the following heads:

A. Selection of the venue

B. Selection of patients

C. Formulation of interview schedule and conduct of the study

D. Conducting the food weighment survey

E. Analysis of lipid profile for the selected patients

F. Supplementation of vitamin - C tablets to the hypercholesterolemic patients

A SELECTION OF THE VENUE

The venue selected for the conduct of the study were K.G. Hospital and Kugan's Hospital at Coimbatore. These hospitals were selected because the chief cardiologist Dr.J.K. Periasamy of Kugan's Hospital (Plate I) and Dr. N. Bhaskar of K.G. Hospital were very helpful and interested in the conduct of this study.

The hospital staffs and patients were very co-operative and investigator could establish rapport with them easily. Moreover, the hospitals had a well

equipped bio-chemistry laboratory where the blood and urine analysis were done regularly for all the inpatients and outpatients (Plates II & III).

The supplementation part of this study was done with the approval of the chief doctors. The patients rendered their fullest co-operation and were willing to accept thc pplementation given to them.

B. **SELECTION OF PATIENTS**

From the above mentioned hospitals 70 patients were interviewed using the random sampling method. Among the 70 patients surveyed 13 were in the age group of 31 - 40 among whom 8 were males and 5 were females. Fifteen patients were in the age group 41 - 50 of which 10 were males and 5 were females. Twenty patients were in the age group 51 - 60 of which 10 were males and 10 were females. About 22 patients were above the age of 61 among whom 8 were males and 14 were females.

The patients who were supplemented with vitamin - C tablets were selected by purposive sampling method based on the results obtained from the lipid profile tests conducted in the laboratory. Fifteen patients were supplemented with Vitamin - C tablets (Plate IV).

C. FORMULATION OF INTERVIEW SCHEDULE AND CONDUCT OF THE STUDY

According to Gupta (1991) an interview schedule has the advantage of being administered to any population as it calls for direct contact with the interview thus eliciting maximum reliable response.

A specially designed interview schedule (Appendix I) included a series of questions to elicit information with regard to the socio-economic status, family history, dietary habits, smoking, alcoholism, exercise and health details. The outpatients at the hospitals were contacted and the survey was conducted using the above schedule.

D. CONDUCTING THE FOOD WEIGHMENT SURVEY

Diet is a major link between the individual and environment. It varies between individuals and population groups. The role of diet in the occurence of heart disease was studied by assessing the diet history of the patients. A three day food weighment survey was conducted on six randomly selected patients. The average nutrient intake of these patients were calculated. A record of their food consumption pattern was also maintained for three days and the mean nutrient and food intake (Appendices II and III) were compared

with the recommended dietary allowances.

E. ANALYSIS OF LIPID PROFILE FOR THE SELECTED PATIENTS

Analysis of lipid profile was carried out regularly for the inpatients and outpatients.

Five cc of the blood sample was taken and used for the lipid profile estimation. The five parameters such as total cholesterol, triglyceride, low density lipoprotein, high density lipoprotein and very low density lipoprotein were analysed.

The lipid profile were estimated using the kits and the methods given below :-

a) Total cholesterol - ortho cholesterol method suggested by ortho diagnostic systems.

b) Triglyceride - GPO - PAP method given by Bucolo et al, a Werner et al.

c) High density lipoprotein - Ethno test. Suggested by ortho diagnostic system.

d) Low density lipoprotein and very low density lipoprotein were calculated from the above lipid profile value.

Fifteen patients with blood cholesterol of 210 mg/dl and above were selected as the control group.

F. SUPPLEMENTATION OF VITAMIN - C (CELIN) TABLETS TO THE HYPERCHOLESTEROLEMIC PATIENTS

Ginter et al., (1993) has suggested that the most effective treatment for patients with hypercholesterolemia is dialy intake of vitamin - C upto 900 mg.

Mostafa et al., (1989) in his investigation had supplemented vitamin - C (500 mg/day) to CVD patients for 6 months. The data supported the beneficial effects of vitamin - C on atherosclerosis.

Grundy et al., (1994) suggested a supplement containing ascorbic acid (1g/day) inhibits oxidation of LDL.

The patients with blood cholesterol level of 210 mg/dl and above were selected for the supplementation.

Thus, it was decided to supplement celin tablet containing 500 mg of ascorbic acid. The patients were advised by the doctors to take one tablet per day for a period of two months.

After the period of supplementation the lipid profile analysis was repeated to see the effect of supplementation and was compared with the control group.

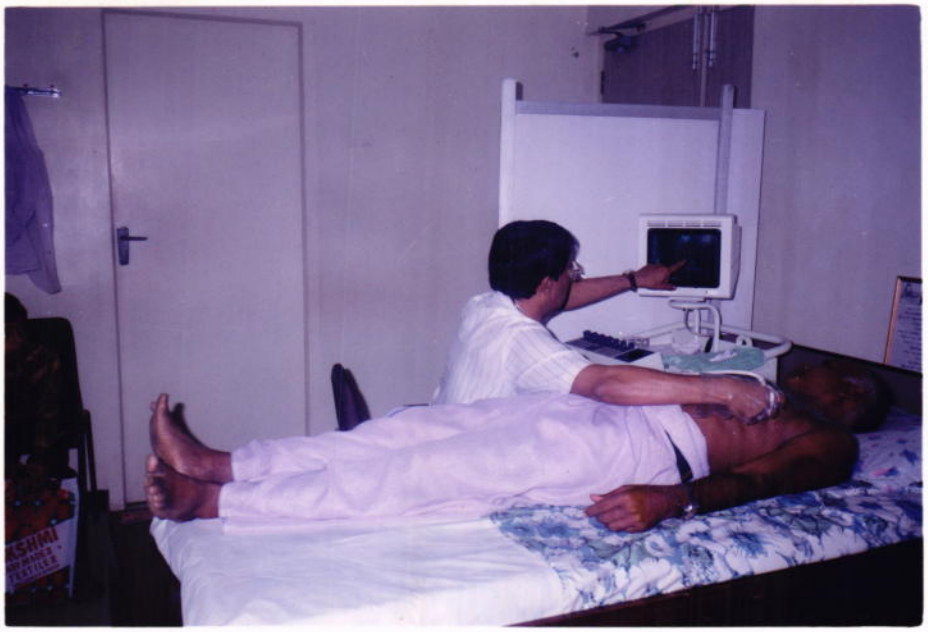


PLATE I

INVESTIGATION OF THE PATIENT USING SONOGRAPHY

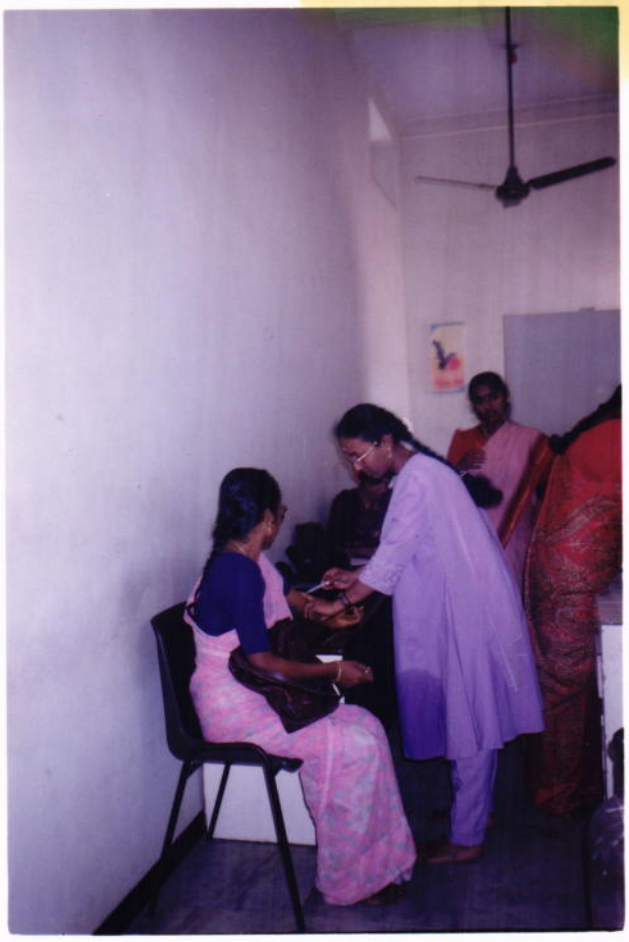


PLATE II

COLLECTION OF BLOOD FOR ANALYSIS

PLATE III

ANALYSIS OF LIPID PROFILE

PLATE IV

VITAMIN - C TABLETS

Results and Discussion

IV. RESULTS AND DISCUSSION

The results and discussion pertaining to the study "Impact of supplementation of Vitamin - C on hypercholesterolemic patients" is depicted under the following aspects :

A. BACKGROUND INFORMATION OF THE SELECTED PATIENTS :

1. Age and Sex of the Patients.
2. Weight of the patients.
3. Educational qualification of the patients.
4. Activity pattern of the patients.
5. Family income of the patients.
6. Type of family.
7. Size of the family.

B. DIETARY DETAILS OF THE PATIENTS :

1. Meal consumption pattern.
2. Consumption pattern of Non-vegetarian foods.
3. Intake of vegetables by the patients.
4. Intake of salad by the patients.
5. Intake of fruits by the patients.
6. Consumption pattern of prepared foods.
7. Type of oil used.
8. Intake of coffee by the patients.
9. Smoking pattern of the patients.

10. Alcohol consumption pattern.

11. Diet modification.

C. **HEALTH RECORDS OF THE PATIENTS :**

1. Details of other ailments.
2. Symptoms associated with heart disease.
3. Familial hypercholesterolemia.
4. Causes of hypercholesterolemia.
5. Exercise performed by the patients.

D. **DETAILS REGARDING FOOD AND NUTRIENT INTAKE OF THE SELECTED PATIENTS :**

1. Average food intake of the patients.
2. Average nutrient intake of the patients.

E. **LIPID AND LIPOPROTEIN PROFILE OF THE PATIENTS :**

1. Average lipid profile of the selected patients.
2. Initial and final lipid profile of the control group.
3. Lipid profile of the experimental group (Initial and final values).
4. Comparison of lipid profile of the experimental with control group (Final values).

F. **CORRELATION ANALYSIS :**

1. Cholesterol level and income of the patients.
2. Cholesterol level and weight of the patients.

A. **BACKGROUND INFORMATION OF THE PATIENTS :**

1) **AGE AND SEX OF THE PATIENTS :**

The age and sex of the patients are presented in the following Table I.

TABLE I

AGE AND SEX OF THE PATIENTS

AGE IN YEARS	MALE		FEMALE	
	NUMBER	PERCENT	NUMBER	PERCENT
31 - 40	8	11.4	5	7.1
41 - 50	10	14.3	5	7.1
51 - 60	10	14.3	10	14.3
61 - 70	8	11.4	14	20
TOTAL	36	51.4	34	48.4

Among the 70 patients surveyed 18.5 percent of the patients were in the age group 31 - 40 years of which 11.4 percent were males and 7.1 percent were females. About 21.4 percent of the patients were in the age group 41 - 50 years of which 14.3 percent were males and 7.1 percent were females. Among 28.6 percent of the

patients between the age group 51 - 60 years, 14.3 percent were males and 14.3 percent were females. The number of patients above 61 years were 31.4 percent of which 11.4 percent were males and 20 percent were females.

2. WEIGHT OF THE PATIENTS

Table II gives a clear picture of the weight of the patients.

TABLE II

WEIGHT OF THE PATIENTS

WEIGHT IN KGS.	MALE		FEMALE	
	NUMBER	PERCENT	NUMBER	PERCENT
50 - 60	6	8.6	20	28.5
60 - 70	8	11.4	10	14.3
70 - 80	12	17.2	4	5.7
80 - 90	10	14.3	-	-
TOTAL	36	51.5	34	48.5

Among the 70 patients selected 37.1 percent of the patients weight ranged between 50 - 60 Kg of which 8.6 percent were males and 28.5 percent were females. About 25.7 percent of the patients weight ranged between 60 - 70 Kg of ch 11.4 percent were males and 14.3 percent were females. Among 22.9 percent of patients

weight ranged between 70 - 80 Kg of which 17.2 percent were males and 5.7 percent were females. About 14.3 percent of males had their weight ranged between 80 - 90 Kg.

3. EDUCATIONAL QUALIFICATION OF THE PATIENTS :

The educational qualification of the patients are presented in Table III.

TABLE III

EDUCATIONAL QUALIFICATION OF THE PATIENTS

EDUCATIONAL QUALIFICATION	NUMBER	PERCENT
Illiterate	8	11.4
Primary School	7	10.0
High School	8	11.4
Higher Secondary	11	15.8
Collegiate	36	51.4
TOTAL	70	100.00

Of the 70 patients surveyed 11.4 percent of the patients were illiterate. Ten percent had completed upto primary school, 11.4 percent had passed their high school education, 15.8 percent had studied upto higher secondary school and about 51.4 percent had completed their degree.

4. **ACTIVITY PATTERN OF THE PATIENTS :**

The following Table IV depicts the activity pattern of the selected patients.

TABLE IV

ACTIVITY PATTERN OF THE PATIENTS

TYPE OF ACTIVITY	NUMBER	PERCENT
Sedentary	47	67.1
Moderate	18	25.7
Heavy	5	7.2
TOTAL	70	100.00

Among the 70 patients interviewed 67.1 percent of the patients were sedentary workers, 25.7 percent of the patients were moderate workers and 7.2 percent of the patients were heavy workers.

5. **FAMILY INCOME OF THE PATIENTS :**

The income pattern of the patients are presented in Table V.

TABLE V

FAMILY INCOME OF THE PATIENTS

INCOME/MONTH IN RS.	NUMBER	PERCENT
Below 2000	5	7.1
2001 4000	11	15.7
4001 - 6000	26	37.2
6001 - 8000	28	40.0
TOTAL	70	100.00

From the above table it was inferred that about 7.1 percent of the families had their monthly income below Rs. 2000, 15.7 percent of the families had their monthly income range between Rs. 2001 - Rs. 4000, 37.2 percent of the families had their monthly income range between Rs. 4001 - Rs. 6000 and 40 percent of the families had their monthly income range between Rs. 6001 - 8000.

6. **TYPE OF FAMILY**

The following Table VI indicates the type of family of the patients.

TABLE VI

TABLE OF FAMILY

TYPE OF FAMILY	NUMBER	PERCENT
NUCLEAR	49	70
JOINT	21	30
TOTAL	70	100

The table above shows that 70 percent of the families selected were nuclear family and 30 percent of families were in the joint family system.

7. **SIZE OF THE FAMILY :**

The family size of the patients are presented in the Table VII.

TABLE VII

SIZE OF THE FAMILY

FAMILY SIZE	NUMBER	PERCENT
2	7	10
3	23	32.8
4	25	35.7
5 and above	15	21.5
TOTAL	70	100

The above table depicts that 10 percent of the families had 2 members, 32.8 percent of the families had 3 members, 35.7 percent of the families had 4 members and 21.5 percent had 5 and more than 5 members in their families.

B. DIETARY DETAILS OF THE PATIENTS

1. MEAL CONSUMPTION PATTERN

Table VIII depicts the meal consumption pattern of the patients.

TABLE VIII

MEAL CONSUMPTION PATTERN

NUMBER OF MEALS PER DAY	NUMBER	PERCENT
3	52	74.3
4	18	25.7
TOTAL	70	100.00

The above table clearly elucidates that 74.3 percent consume 3 meals a day while 25.7 percent consume 4 meals a day.

The age adjusted total cholesterol concentration of subjects who reported eating three or more meals per day average 0.23 mmol/l lower than for those who reported

eating 1 or 3 meals per day. Similarly LDL concentration was 0.16 mmol/l lower in subjects who reported eating more frequent meals (Edelstein, 1992).

CONSUMPTION PATTERN OF NON - VEGETARIAN FOODS :

The Table IX depicts the consumption pattern of fleshy foods by the patients.

TABLE IX

CONSUMPTION PATTERN OF NON - VEGETARIAN FOODS

DURATION	CHICKEN	FISH	MUTTON	EGG	BEEF
		(IN PERCENT)			
Daily	5.25	-	-	33.3	-
Weekly	43.8	47.3	35	31.5	-
Once in a fortnight	8.7	14	12.2	8.7	5.2
Occasionally	8.7	52.6	6.1	-	5.2

Among the 70 patients selected 35.8 percent of the patients were vegetarians, 57.1 percent of them were non - vegetarians and 7.1 percent of them were ovo - vegetarians.

Of 1 percent of the patients who were non - vegetarians 5.25 percent of them consumed chicken daily, 43.8 percent consumed once in a week, 8.7 percent consumed once in a fortnight and 8.7 percent consumed

occasionally. About 47.3 percent patients consumed fish weekly once, 14 percent consumed once in a fortnight and 52.6 percent patients consumed occasionally. Mutton was consumed by 35 percent patients weekly once, 12.2 percent consumed once in a fortnight and 6.1 percent consumed occasionally. Egg was consumed by 33.3 percent daily, 31.5 percent of them consumed once in a week and 8.7 percent of the consumed once in a fortnight. Beef was consumed once in a fortnight by 5.2 percent of patients and 5.2 percent consumed occasionally.

A study conducted by Scaffenberg (1994) showed that total vegetarian men who do not consume animal products of any kind had only 14 percent of the expected heart attack rate, lacto - ovo vegetarian had 39 percent and non - vegetarians 50 percent.

3. **INTAKE OF VEGETABLES BY THE PATIENTS**

The Table X shows the type of vegetables consumed by the patients.

TABLE X

INTAKE OF VEGETABLES BY THE PATIENTS

TYPES OF VEGETABLES	DAILY	ALTERNATE DAYS	WEEKLY ONCE
Green Leafy Vegetables	26	15	29
Roots and tubers	18	30	22
Other vegetables	28	29	13

Out of the 70 patients selected green leafy vegetable was consumed by 26 patients daily, 15 patients on alternate days and 29 patients once in a week. Roots and tubers was consumed by 18 patients daily, 30 on alternate days and 22 once in a week. Other vegetable was consumed by 28 patients daily, 29 on alternate days and 13 once in a week.

Vegetable - rich diets are associated with a higher life expectancy and antioxidants is the principle importance for the benefit (Gey et al., 1993).

4. INTAKE OF SALAD BY THE PATIENTS

Table XI indicates the pattern of salad consumption by the patients.

TABLE XI

INTAKE OF SALAD BY THE PATIENTS

DURATION	NUMBER	PERCENT
Daily	10	14.3
Weekly once	17	24.3
Once in a fortnight	7	10.0
Rarely	6	8.6

Among the 70 patients interviewed 57.2 percent of the patients consumed vegetables in the form of salad while 42.8 percent of the patients did not consume salad.

Of the 57.2 percent of the patients who consumed salads 14.3 percent of them consumed daily, 24.3 percent of th m consumed once in a week, 10 percent of them consumed once in a fortnight and 8.6 percent of them consumed rarely.

5. INTAKE OF FRUITS BY THE PATIENTS

The following Table XII indicates the fruit consumption pattern of the patients.

TABLE XII

INTAKE OF FRUITS BY THE PATIENTS

DURATION	ORANGE	LEMON	MANGO	BANANA	PINEAPPLE
		(IN PERCENT)			
Daily	-	13.1	-	83.6	-
Fortnightly	42.6	36	18	26.2	11.4
Seasonally	47.5	37.7	73.7	-	36

Among the 70 patients surveyed 61 of them consumed fruits while 9 of them did not consume fruits.

Of the 61 patients who consumed fruits, 13.1 percent 8 of them consumed lemon and 83.6 percent of them consumed banana daily. About 42.6 percent consumed orange, 36 percent consumed lemon, 18 percent consumed mango, 26.2 percent consumed banana and 11.4 percent consumed pineapple once in a fortnight. About 47.5 percent consumed orange, 37.7 percent consumed lemon, 73.7 percent consumed mango and 36 percent consumed pineapple seasonally.

Fruits provide large quantities of vitamins and minerals which are increasingly considered to be protective factor against CHD (Monique, 1991). This study correlates with the above study.

6. **CONSUMPTION PATTERN OF PREPARED FOODS :**

The Table XIII shows the pattern of consumption of prepared foods by the patients.

TABLE XIII

CONSUMPTION PATTERN OF PREPARED FOODS

DURATION	.STRIES	SWEETS	ICE CREAMS (IN PERCENT)	SAVORIES	PAPPADS	PICKLES
Daily	-	21.4	-	11.4	30	47
Weekly	15.7	21.4	30	40	22.8	24.2
Fortnightly	17.1	25.7	15.7	14.2	24.2	5.7
Rarely	55.7	31.4	54.2	34.2	22.8	22.8

Among the 70 patients interviewed daily 21.4 %, 11.4 %, 30% and 47% of the patients consumed sweets, savories, pappads and pickles respectively. Weekly once 15.7%, 21.4%, 30%, 40%, 22.8% and 24.2% consumed pastries, sweets, ice-creams, savories, pappads and pickles. Once in a fortnight 17.1%, 25.7%, 15.7%, 14.2%, 24.2% and 5.7% of the patients consumed pastries, sweets, ice-creams, savories, pappads and pickles respectively. Rarely 55.7%, 31.4%, 54.2%, 34.2%, 22.8% and 22.8% of the patients consumed pastries, sweets, ice - creams, savories, pappads and pickles respectively.

7. **TYPE OF OIL USED**

The Table XIV below depicts the type of oil used by the patients.

TABLE XIV

TYPE OF OIL USED

TYPE OF OIL USED	NUMBER	PERCENT
Groundnut oil	13	18.5
Sunflower oil	10	14.3
Gingelly oil	10	14.3
Hydrogenated fat	5	7.2
Refined oil	6	8.6
Harvest oil	14	20.0
Coconut oil	12	17.2

Among the 70 patients surveyed 18.5 percent of the patients used groundnut oil, 14.3 percent of them used sunflower oil, 14.3 percent of them used gingelly oil, 7.2 percent of them used hydrogenated fat, 8.6 percent of them used refined oil, 20 percent of them used harvest oil and 17.2 percent of them used coconut oil.

It can be inferred that majority (20 %) of them use harvest oil which is considered to be rich in PUFA and low in cholesterol.

8. INTAKE OF COFFEE BY THE PATIENTS :

Table XV highlights the details regarding the coffee consumption of the patients.

TABLE XV

INTAKE OF COFFEE BY THE PATIENTS

QUANTITY	NUMBER	PERCENT
2 - 4 Cups	16	34.8
5 - 6 Cups	20	43.5
7 - 9 Cups	10	21.7

Of the 70 patients interviewed 65.7 percent of them consumed coffee while 34.8 percent of them did not consume coffee.

Out of the 65.7 percent of the patients who consumed coffee 34.8 percent of them consumed 2 - 4 cups of coffee daily, 43.8 percent of them consumed 5 - 6 cups of coffee daily and 21.7 percent of them consumed 7 - 9 cups of coffee daily.

Boston collaborative Drug surveillance programme (1990) indicated that persons who drink one to five cups of coffee a day have 50 percent greater chance of heart attacks than do non - coffee drinkers. The risk was found to be 110 percent greater for those drinking 6 or more cups per day.

9. SMOKING PATTERN OF THE PATIENTS :

The Smoking pattern of the patients are presented in the Table XVI.

TABLE XVI

SMOKING PATTERN OF THE PATIENTS

SMOKING	NUMBER	PERCENT
Yes	12	17.2
No	48	68.6

TYPE SMOKED	NUMBER OF PATIENTS	NUMBER SMOKED/ DAY
Beedi	2	1 - 5
Cigarette	8	5 - 10
Tobacco	2	1 - 5

From the above table it can be inferred that 17.2 percent of the patients smoked while 68.6 percent of the patients did not smoke.

Among 12 patients who smoke 2 of them smoked beedi (1 - 5 Numbers/Day), 8 of them smoked cigarette (5 - 10 number/day) and 2 of them smoked tobacco (1 - 5 number/day).

A person who abstains from smoking cigarette will live 7 years longer on an average than one who smokes a packet a day (Shryock, 1990).

10. ALCOHOL CONSUMPTION PATTERN

Table XVII gives a picture on the alcohol consumption pattern of the patients.

TABLE XVII

ALCOHOL CONSUMPTION PATTERN

TYPE OF ALCOHOL	NUMBER	PERCENT
Beer	2	13.3
Whisky	5	33.3
Brandy	8	53.4

Of the 70 patients interviewed 21.4 percent of the patients were alcoholics while 78.6 percent of them were non - alcoholics.

Out of the 21.4 percent of alcoholics 13.3 percent of them consumed beer, 33.3 percent of them consumed whisky while 53.4 percent of them consumed brandy.

11. DIET MODIFICATION

From the data collected it is clearly depicted in the Table that 58.6 percent of the patients had modified their diets while 41.4 percent of them did not modify their diets.

The Table XVIII below shows the number of patients who modified their diet.

TABLE XVIII

DIET MODIFICATION

FOODS INCLUDED	NUMBER
Fruits	29
Other vegetables	10
Green leafy vegetables	2
FOODS RESTRICTED	**NUMBER**
Fried items	15
Fleshy foods	10
Sweets	3
Hydrogenated fat	9
Roots and tubers	3

It can be inferred from the above table that majority of them have included fruits and restricted fried items.

C. HEALTH DETAILS OF THE PATIENTS

1. DETAILS OF OTHER AILMENTS

The following Table XIX indicates the details of other ailments of the patients.

TABLE XIX

DETAILS OF OTHER AILMENTS

OTHER DISEASES	NUMBER	PERCENTAGE
DIABETES	30	42.8
HYPERTENSION	20	28.6
RENAL FAILURE	2	2.8
LIVER DISEASE	3	4.3

Among the 70 heart patients surveyed about 78.5 percent of them suffered from diseases like diabetes (42.8 percent), hypertension (28.6 percent) renal failure (2.8 percent) and liver disease (4.3 percent).

2. **SYMPTOMS ASSOCIATED WITH HEART DISEASE.**

The Table XX depicts the signs and symptoms associated with heart disease.

TABLE XX

SYMPTOMS ASSOCIATED WITH HEART DISEASE

SYMPTOMS	NUMBER	PERCENT
Chest Pain	40	57.1
Giddiness	25	35.7
Joint Pain	25	35.7
Palpitation	15	21.4
Breathlessness	12	17.1

Among the 70 patients selected 57.1 percent of them had chest pain, 35.7 percent had giddiness, 25 percent had joint pain, 15 had palpitation and 12 percent had difficulty in breathing.

3. **FAMILIAL HYPERCHOLESTEROLEMIA :**

The Table XXI below indicates the details about the familial hypercholesterolemia.

TABLE XXI

FAMILIAL HYPERCHOLESTEROLEMIA

HEREDITY	NUMBER	PERCENT
YES	26	37.2
NO	44	62.8
MEMBER		
FATHER	12	46.4
MOTHER	8	30.7
GRAND PARENTS	4	15.3
OTHERS	2	7.6

The table above shows that 37.2 percent had familial hypercholesterolemia while 62.8 percent had hypercholesterolemia due to other reasons.

Of the 37.2 percent of who had familial hypercholesterolemia 46.4 percent inherited from father, 30.7 percent inherited from mother, 15.3 percent inherited from grand parents and 7.6 percent inherited from others.

4. CAUSES OF HYPERCHOLESTEROLEMIA

Table XXI depicts the causes of the disease as indicated by the patients.

TABLE XXI

CAUSES OF HYPERCHOLESTEROLEMIA

CAUSES	NUMBER	PERCENT
IMPROPER DIET	19	27.1
IRREGULAR EATING HABIT	12	17.1
HEREDITY	11	15.7
SMOKING	12	17.1
ALCOHOLISM	15	21.4
LACK OF EXERCISE	17	24.2
NOT AWARE	11	15.7

Among the 70 patients interviewed majority of them 27.1 percent, 24.2 percent and 21.4 percent felt the causes as improper diet, lack of exercise and alcoholism respectively.

5. EXERCISE PERFORMED BY THE PATIENTS

The Table XXII indicates the exercise performed by the patients.

TABLE XXII

EXERCISE PERFORMED BY THE PATIENTS

EXERCISE	BEFORE	AFTER
Yes	22	40
No	48	30
Jogging	6	10
Walking	10	10
Yoga	6	18

From the above table it is known that 22 of them did exercise before the incidence of the disease and 40 of them did exercise after the incidence of disease. Yoga was the exercise that was performed by most of them after the incidence of the disease.

Devi (1994) indicated that exercise promotes increased production of HDL - C which removes the artery damaging olesterol and lessens the risk of heart attacks.

D. DETAILS REGARDING FOOD AND NUTRIENT INTAKE OF THE PATIENTS

1. AVERAGE FOOD INTAKE OF THE PATIENTS

Table XXIII depicts the actual food intake of the patients.

TABLE XXIII

AVERAGE FOOD INTAKE

FOOD	RDA ICMR 1981	ACTUAL INTAKE	PERCENT DEFICIT/EXCESS
Cereals	460	253	- 45
Pulses	40	62	+ 55
Green leaf vegetables	40	89	+ 123
Roots and Tubers	50	54	+ 8
Other Vegetables	60	52	- 13
Fruits	30	117	+ 290
Milk & milk products	150	470	+ 213
Sugar and Jaggery	30	35	+ 17
Fleshy foods	-	73	-
Nuts & oil-seeds	-	7.5	-
Fats and edible oil	40	20	- 50

The values given above are the 3 days average food intake of the 6 patients. From the table above it was determined that 45 percent of cereals 50 percent of fats and 13 percent of other vegetables were consumed below

the RDA while other foods that were consumed above the RDA were pulses (55 percent), green leafy vegetables (123 percent), roots and tubers (8 percent), fruits (290 percent), milk and milk products (213 percent), sugar and Jaggery (17 percent).

2. AVERAGE NUTRIENT INTAKE OF THE PATIENTS

The following Table XXIV depicts the actual nutrient intake of the 6 selected patients.

TABLE XXIV

AVERAGE NUTRIENT INTAKE

NUTRIENT	RDA ICMR 1992	ACTUAL NUTRIENT INTAKE	PERCENT DEFICIT/EXCESS
Energy (Kcal/day)	1500	2278	+ 52
Protein (g/day)	60	82	+ 37
Fat (g/day)	20	65	+ 225
Calcium (mg/day)	400	1157	+ 189
Iron (mg/day)	28	23	- 18
Retinol (ug/day)	600	863	+ 44
Thiamine (mg/day)	1.2	1.4	+ 17
Ribofalvin (mg/day)	1.4	1.4	-
Niacin (mg/day)	16	13.2	- 17.5
Vitamin - C (mg/day)	40	106	+ 165

The table above gives a clear picture of the 3 days average nutrient intake of 6 patients. From this table it was inferred that the energy intake of the patients were 52 percent above the RDA. The protein intake was

37 percent, fat intake was 225 percent, calcium intake was 189 percent retinol intake was 44 percent, thiamine intake was 17 percent and Vitamin - C intake was 165 percent above the RDA. While the iron intake was 18 percent and niacin intake was 17.5 percent below the RDA. Therefore it is well known that all the patients surveyed were following high calorie diet.

E. LIPID AND LIPOPROTEIN PROFILE OF THE PATIENTS

1. AVERAGE LIPID PROFILE OF THE SELECTED PATIENTS

Details regarding the average lipid profile of the 70 patients is given in Table XXV.

TABLE XXV

LIPID PROFILE OF THE SELECTED PATIENTS

S. No.	SERUM LIPID FRACTIONS (mg/dl)	DESIRABLE VALUE *	AVERAGE VALUE Mean ± S.D
1.	Total cholesterol	< 200	235.7 ± 29.95
2.	Triglyceride	< 150	158.8 ± 25.97
3.	High density lipoprotein	> 50	46.4 ± 3.46
4.	Low density lipoprotein	< 130	141.4 ± 19.85
5.	Very low density lipoprotein	30	32.2 ± 9.28

* National Cholesterol Education Programme (1988).

The mean cholesterol level of the 70 heart patients was (235.7 ± 29.95) and this was found to be higher than the desirable value. The mean triglyceride (158.8 ±

25.97), the mean LDL cholesterol (141.4 ± 19.85) and the mean VLDL cholesterol (32.2 ± 9.28) were found to be higher than the desirable value. While the mean HDL cholesterol (46.4 ± 3.46) was found to be lower than the desirable value.

2. **INITIAL AND FINAL LIPID PROFILE OF THE CONTROL GROUP**

The initial and final lipid profile of the control group is given in Table XXVI.

TABLE XXVI

INITIAL AND FINAL LIPID PROFILE OF THE CONTROL GROUP

S. No.	SERUM LIPID FRACTIONS (mg/dl)	MEAN ± S.D. VALUES (CONTROL) INITIAL	FINAL
1.	Total cholesterol	235.87 ± 24.25	251.33 ± 20.9
2.	Triglyceride	151.13 ± 9.71	163.13 ± 8.4
3.	High density lipoprotein	44 ± 4.47	45 ± 6.5
4.	Low density lipoprotein	154.4 ± 22.26	168 ± 40.2
5.	Very low density lipoprotein	30.33 ± 2.14	32.93 ± 1.6

NS - Not significant.

The above Table depicts that the mean initial cholesterol value of the control group (N = 15) was 235.87 mg/dl and was increased to 251.33 mg/dl.

The mean triglyceride value of the 15 patients selected for the control group was found to be 151.13 mg/dl before the study and it was increased to 163.13 mg/dl after two months.

The mean high density lipoprotein value of the control group was 44 mg/dl before and this was increased to 45 mg/dl after two months.

The initial low density lipoprotein value of the control group was found to be 154.4 mg/dl and the final value was found to be 168 mg/dl. The mean value of very low density lipoprotein of the control group was found to be 30.3 mg/dl before the study and it was increased to 32.93 mg/dl after the study.

The values were statistically analysed and it was found that none of the values were statistically significant.

3. LIPID PROFILE OF THE EXPERIMENTAL GROUP (INITIAL AND FINAL VALUES)

The Table XXVII gives a clear picture of the comparison of lipid profile values before and after the supplementation for the experimental group.

TABLE XXVII

LIPID PROFILE OF THE EXPERIMENTAL GROUP (INITIAL AND FINAL VALUES)

S. No.	SERUM LIPID FRACTIONS (mg/dl)	MEAN ± S.D. VALUES (EXPERIMENTAL) INITIAL	FINAL	" t " VALUE
1.	Total cholesterol	250.6 ± 17.82	213.1 ± 11.6	2.49 *
2.	Triglyceride	155 ± 26.26	142.7 ± 23.3	0.49 NS
3.	High density lipoprotein	49.8 ± 7.81	63.5 ± 6.27	1.94 NS
4.	Low density lipoprotein	169.8 ± 14	113.76 ± 28.49	2.50 *
5.	Very low density lipoprotein	31 ± 5.29	28.46 ± 4.67	0.51 NS

* Significant at five percent level.

NS - Not significant.

The results shown in the above table depicts that mean cholesterol value before the study was 250.6 mg/dl and it reduces to 213.1 mg/dl by the supplementation. When these values were statistically analysed it showed significant difference at five percent level. This proves that vitamin - C had an effective role to play in the reduction of cholesterol in the body.

The initial mean triglyceride value was 155 mg/dl while the final value was 142.7 mg/dl and this showed a slight reduction by the supplementation of Vitamin - C. But when statistically analysed the difference was not significant.

The mean high density lipoprotein value of the experimental group was 49.8 mg/dl which was increased to 63.5 mg/dl by the supplementation of Vitamin - C. When statistically analysed the difference was not significant.

The mean low density lipoprotein of the experimental group was 169.8 mg/dl and this was reduced to 113.76 mg/dl by the supplementation of Vitamin - C. When this was statistically analysed the difference was significant at five percent level ($t = 2.5$). Therefore it is proved that there is possibility to reduce LDL - C by consuming Vitamin - C.

The initial very low density lipoprotein was 31 mg/dl and was reduced to 28.46 mg/dl after two months of supplementation but the difference was not significant when statistically analysed.

The relationship of plasma ascorbic acid with cholesterol and B.P indicated that 4.1 percent lower levels of LDL - C and 1.9 percent to 5.5 percent, lower levels of blood pressure with each 30 u mol/l increment in plasma ascorbic acid (Jacques et al.,1992).

Correlation studies revealed an inverse relationship between intake of Vitamin - C and mortality of CVD. For the individuals with high cholesterol level 200 mg/dl and less than full tissue saturation, increasing the concentration of Vitamin - C, has a salutary effect on total cholesterol level (Simon et al., 1992).

4. COMPARISON OF LIPID PROFILE OF THE EXPERIMENTAL AND CONTROL GROUP (FINAL VALUES)

Table XXVIII shows the lipid profile of the experimental and control group.

TABLE XXVIII

LIPID PROFILE OF THE EXPERIMENTAL AND CONTROL GROUP

(FINAL VALUES)

S. No.	SERUM LIPID FRACTIONS (mg/dl)	MEAN + S.D. VALUES EXPERIMENTAL FINAL	CONTROL FINAL	" t " VALUE
1.	Total cholesterol	213.1 ± 11.6	251.3 ± 20.9	2.26 *
2.	Triglyceride	142.7 ± 23.3	163.1 ± 8.4	1.16 NS
3.	High density lipoprotein	63.5 ± 6.27	45 ± 6.54	0.57 NS
4.	Low density lipoprotein	113.7 ± 28.49	168 ± 40.25	1.55 NS
5.	Very low density lipoprotein	28.46 ± 4.67	32.9 ± 1.67	1.25 NS

* - Significant at five percent level.
NS - Non - significant

The table above shows that the mean total cholesterol value was 213.1 mg/dl and 251.3 mg/dl of the experimental and control group respectively. The mean values of the experimental and control groups for triglyceride was 142.7 mg/dl and 163.1 mg/dl, high density lipoprotein was 63.5 mg/dl and 45 mg/dl, low density lipoprotein was 113.7 mg/dl and 168 mg/dl and very low density lipoprotein was 28.46 mg/dl and 32.9 mg/dl respectively.

F. CORRELATIN ANALYSIS :

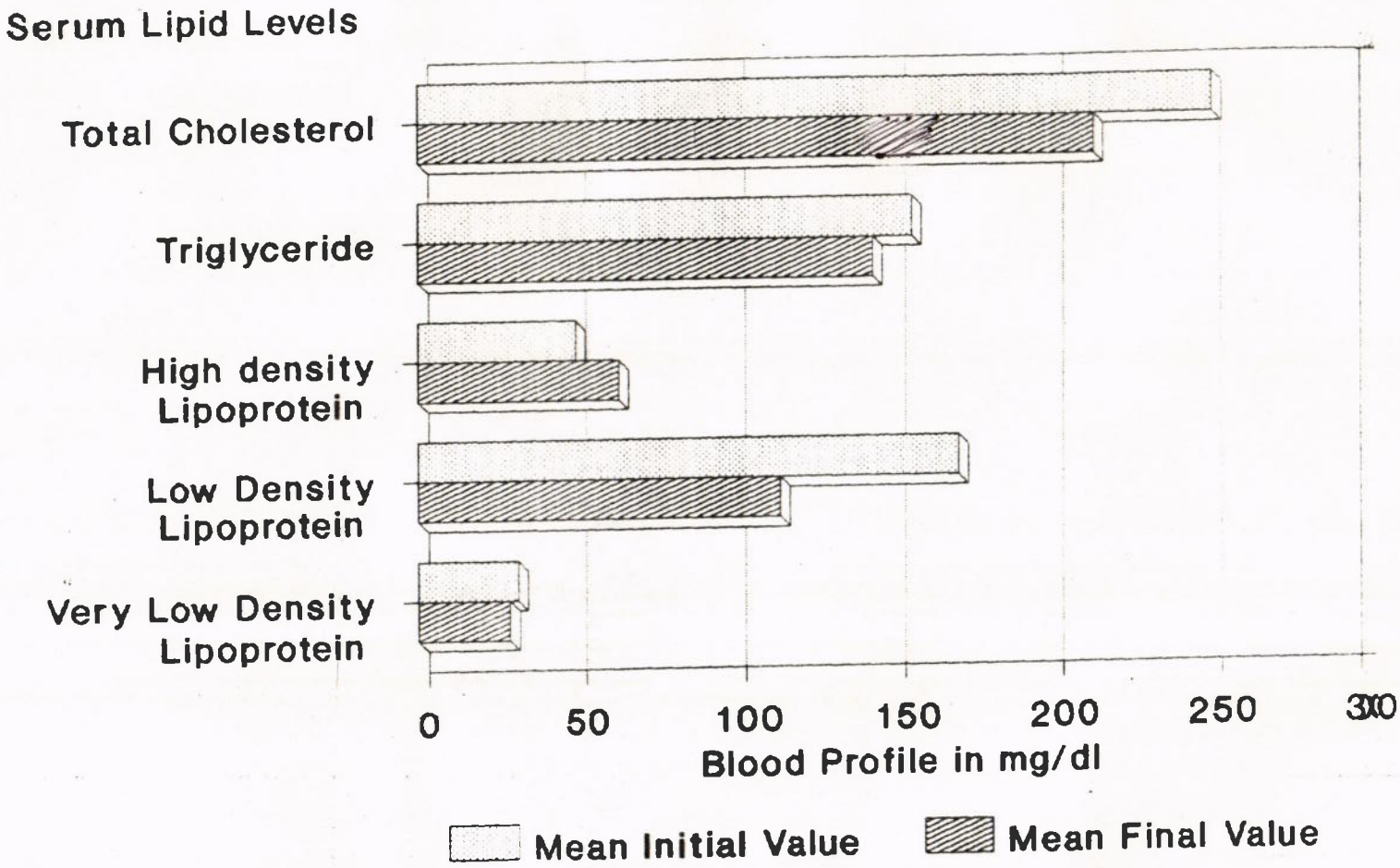
1. CHOLESTEROL LEVEL AND INCOME OF THE PATIENTS.

The correlation analysis done between cholesterol level and income of the patients indicaed to be positive ($r = 0.38$). Therefore as the income of the patients increased their blood cholesterol too increased.

2. CHOLESTEROL AND WEIGHT OF THE PATIENTS :

The analysis showed a positive correlation ($r = 0.35$) between cholesterol level and weight of the patients. Hence as the weight of the patients increased their cholesterol level also increased.

FIGURE I



SERUM LIPID LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH VITAMIN - C

Summary and Conclusion

V. SUMMARY AND CONCLUSION

The study entitled "Impact of supplementation of Vitamin - C on hypercholesterolemic patients" has the main objectives to observe the impact of supplementation of vitamin - C and to study the change in the blood profile of the heart patients.

Seventy heart patients (36 males and 34 females) in the age group of 30 - 70 years were selected for the study. General informations regarding socio-economic profile, educational status, dietary habits and personal and family health records of the patients were collected with the help of an interview schedule. From the seventy patients selected 15 of them served as control group and 15 others were supplemented with vitamin - C tablets for a period of two months.

The information with regard to the dietary details of the patients revealed that majority were non-vegetarians. Most of the patients used harvest oil for cooking and about 65.7 per cent of the patients consumed coffee regularly.

With regard to modification of diet about 58.6 per cent of the patients had modified their diet after the incidence of disease by including more of fruits, other

vegetables and green leafy vegetables. They had restricted certain foods like fried items, fleshy foods, sweets, roots and tubers and hydrogenated fats according to the doctor's advice.

Regarding the other complication of the patients majority (55 %) of them were suffering from diabetes and hypertension along with cardiovascular problems.

Among the 70 heart patients majority (57.1 %) of them had chest pain occasionally and 37.2 per cent of them had familial hypercholesterolemia.

With regard to the exercise performed by the patients it was noted that only 22 of them did exercise before the incidence of the disease while the number of patients who did exercise after the incidence of the disease increased to 40.

In relation to the weight pattern of heart patients the mean weight of males was 72.2 Kg and that of females was 60.3 Kg which indicates that their body weights were greater than ICMR recommended body weight. Thus it was clear that there was a greater incidence of obesity in males than in females.

Supplementation of vitamin - C for hypercholesterolemic patients was found to be very effective. There was a striking decrease in

cholesterol, LDL - C, VLDL - C and an increase in HDL - C.

The correlation analysis showed a positive correlation (r = 0.38) between cholesterol level and income of the patients. Another correlation analysis was done between weight of the patients and cholesterol level, this also indicated a positive correlation (r = 0.35).

Recommendations

1. Public must be aware of the importance of vitamin - C and it's impact on lipid profile.
2. All patients with coronary heart disease should check their lipid profile periodically. Losing excess weight, exercising more and giving up cigarette can produce a small but worthwhile increase in HDL and they must follow a diet low in saturated fat and cholesterol.
3. The prudent course of reducing coronary disease risk is by consuming the RDA of all the major vitamins by eating at least five servings of fruits and vegetables daily.

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Appendices

APPENDIX I

IMPACT OF SUPPLEMENTATION OF VITAMIN - C ON HYPERCHOLESTEROLEMIC PATIENTS

Proform to elicit background information of the subjects :

SOCIO - ECONOMIC PATTERN

1. Name of the interviewer :

   Name of the interviewee :

   Address of the interviewee :

Age in years :

Weight :

Sex : Male : Female :

Total income of the family per month :

Type of family : Nuclear : Joint :

Occupation :

Sedentary work :

Moderate work :

Heavy work :

2. FAMILY HISTORY :

S.No.	Name of Members	Relation to the subject	Marital Status	Age in Years	Education	Occupation

DIETARY PATTERN

3. Are you a

Vegetarian : Non-vegetarian : Ovo-vegetarian :

4. If you are a non-vegetarian give the frequency of intake of Non-vegetarian foods.

Items	Daily	Weekly Once	Once in a Fortnight	Occasionally
Chicken				
Fish				
Mutton				
Egg				
Beef				
Pork				
Others				

5. Do you prefer to consume vegetables?

If yes, what type of vegetables do you consume?

Vegetables	Daily	Alternate days	Weekly once
Green leafy vegetables			
Roots and tubers			
Other vegetables			

6. Do you consume vegetables in the form of salads?

Yes No

If yes, how often do you consume?

Daily	Once in Week	Once in a Fortnight	Rarely

7. Are you in the regular habit of eating fruits?

Yes. No

If yes, what fruits do you prefer?

Fruits	Daily	Alternate days	Once in a Fortnight	Occasionally
Orange				
Lemon				
Mango				
Banana				
Pineapple				
Others				

8. Number of meals consumed per day
a) 3
b) 4
c) 5

9. How often do you consume preparede foods?

Items	Daily	Once in a week	Once in a fortnight	Rarely
Pastries				
Sweets				
Ice-creams				
Savories				
Pappad				
Pickle				

10. What oil do you use for cooking?

a. Groundnut oil
b. Sunflower oil
c. Gingelly oil
d. Hydrogenated fat
e. Refined oil
f. Harvest oil
g. Coconut oil
h. Any other specify.

11. Do you drink coffee often?

Yes No

If yes, specify the quantity

a. 2-4 cups
b. 5-6 cups
c. 7-9 cups

12. Do you smoke?

Yes No

If yes, specify the type used

Type	Total Number/Day
Beedi	
Cigarette	
Tobacco	
Pipe	

13. Do you consume alcohol?

Yes No

If yes, specify the type used

Type	Quantity/Day
Arrack	
Toddy	
Beer	
Whisky	
Brandy	

14. Have you adopted any dietary modifications after the heart problem?

Yes No

If yes, give the modifications :

Included	Excluded
1.	
2.	
3.	

Restricted	Reasons
1.	
2.	
3.	

HEALTH DETAILS

15. How long are you suffering from cardiovascular disease?

16. Do you have any disease other than hypercholesterolemia?

Yes No

If yes, which disease

a. Diabetes mellitus

b. Hypertension
c. Renal disorder
d. Liver disease
e. Others specify

17. Specify the signs and symptoms of the condition that are experienced by you

a. Chest pain
b. Guiddiness
c. Shoulder & Joint pain
d. Palpitation
e. Breathlessness

18. Does any one have cardiovascular disease in the family?

Yes No

If yes, who has?

a. Father
b. Mother
c. Grand Parents
d. Others specity

19. What are the causes that you think would have caused this disease?

a. Faculty dietary habits
b. Irregular eating habits
c. Heredity
d. Smoking
e. Alcohol
f. Lack of exercise
g. Nor aware

20. Did you do any exercise before you were aware of the disease?

Yes No

If yes, specify the type of exercise.

Type of	Duration	Frequency

exercise	Duration			Frequency		
	1/2 hour	1 hour	2 hours	Daily	Alternate Days	Weekly Once
Jogging						
Walking						
Yoga						
Games						
Others						

21. Do you do any exercise now?

Yes No

If yes, specify the type of exercise.

Type of exercise	Duration			Frequency		
	1/2 hour	1 hour	2 hours	Daily	Alternate Days	Weekly Once
Jogging						
Walking						
Yoga						
Games						
Others						

23. Lipid Profile		Before	After
Total cholesterol	-		
Triglyceride	-		
High density lipoprotein	-		
Low density lipoprotein	-		
Very low density lipoprotein	-		

APPENDIX II

AVERAGE FOOD INTAKE OF SIX PATIENTS

Foods (gms)	1	2	3	4	5	6	Mean intake
Cereals	200	400	275	230	210	200	253
Pulses	60	100	25	30	105	50	62
Green leafy Vegetables	100	100	75	30	150	80	89
Roots and Tubers	30	100	50	30	75	40	54
Other Vegetables	60	100	50	20	30	50	52
Fruits	150	50	50	150	200	100	117
Milk and Milk Products	475	425	500	475	450	500	470
Sugar and Jaggery	30	80	40	30	10	20	35
Fleshy foods	85	100	50	100	50	50	73
Nuts and oil seeds	5	5	5	15	10	5	7.5
Fats & Oil	10	50	20	10	15	15	20

APPENDIX III

AVERAGE NUTRIENT INTAKE OF SIX PATIENTS

Nutrients	1	2	3	4	5	6	Mean intake
Energy kcal/ day	2760	2636	1816	1916	1910	2635	2278
Protein g/day	104	101	68	56	64	101	82
Fat g/day	87	76	39	57	51	76	65
Calcium mg/d	1542	1372	843	1200	618	1372	1157
Iron mg/d	15	25	14	30	30	28	23
Retinol /d	764	1176	939	719	399	1176	863
Thiamine mg/day	1.4	1.7	1.4	1.4	1.1	1.7	1.4
Riboflavin mg/d	1.5	1.6	1.1	1.0	1.6	1.6	1.4
Niacin mg/d	18.4	13.9	7.7	11.5	13.6	13.9	13.2
Vitamin C mg/d	146	151	102	79	10	151	106

APPENDIX IV

INITIAL LIPID PROFILE OF THE CONTROL GROUP

Total Cholesterol	Triglyceride	High density lipoprotein	Low Density lipoprotein	Very Low Density lipoprotein
240	142	39	173	28
221	135	44	150	27
254	138	42	184	28
234	142	41	165	28
211	158	43	136	32
263	163	44	188	33
251	155	38	182	31
228	142	45	155	28
226	145	49	148	29
198	150	50	118	30
241	153	40	170	31
232	158	45	149	32
219	168	53	132	34
224	155	39	152	31
196	163	50	113	33

APPENDIX V

FINAL LIPID PROFILE OF THE CONTROL GROUP

Total Cholesterol	Triglyceride	High density lipoprotein	Low Density lipoprotein	Very Low Density lipoprotein
260	155	42	181	31
245	153	40	161	31
280	158	41	207	32
268	148	38	230	30
238	162	50	155	33
250	170	49	167	34
289	168	35	220	34
259	155	36	192	31
263	163	42	188	34
210	172	50	126	34
270	178	60	174	36
245	166	48	164	33
230	173	52	143	35
243	156	45	167	31
220	170	47	139	34

APPENDIX VI

LIPID PROFILE OF THE EXPERIMENTAL GROUP BEFORE SUPPLEMENTATION

o.	Total Cholesterol	Triglyceride	High density lipoprotein	Low Density lipoprotein	Very Low Density lipoprotein
	283	154	47	205	31
	260	163	51	176	33
	250	181	56	158	36
	283	210	56	185	42
	254	166	54	166	34
	240	118	48	168	24
	271	172	59	178	34
	234	184	48	149	37
	261	132	51	184	26
	251	142	56	167	28
	232	181	35	161	36
	248	132	54	168	26
	239	121	58	157	24
	232	129	32	174	26
	222	140	42	152	28

APPENDIX VII

LIPID PROFILE OF THE EXPERIMENTAL GROUP AFTER SUPPLEMENTATION

Total Cholesterol	Triglyceride	High density lipoprotein	Low Density lipoprotein	Very Low Density lipoprotein
233	132	65	142	26
220	142	70	122	28
201	167	68	100	33
226	190	75	113	38
214	154	70	113	31
213	100	63	130	20
232	165	65	134	33
209	170	55	120	34
223	125	63	135	25
210	135	69	114	27
202	160	50	120	32
218	125	63	130	25
213	121	58	121	24
198	120	60	114	24
195	135	59	109	27