THE EFFECT OF DIETARY ADVICE ON NUTRIENT INTAKE FOR THE PREVENTION OF MYOCARDIAL INFARCTION

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dedicated

to

my **PARENTS**

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

Word		Symbol
Body mass index	...	BMI
Carbohydrate	...	CHO
Cardiovascular disease	...	CVD
Coronary artery disease	...	CAD
Coronary heart disease	...	CHD
High-density lipoprotein	...	HDL
Intermediate-density lipoprotein	...	IDL
Low-density lipoprotein	...	LDL
Myocardial infarction	...	MI
Total cholesterol	...	TC
Triglyceride	...	TG
Very low-density lipoprotein	...	VLDL

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ABSTRACT

Myocardial infarction is the second major cause of death in our country. High cholesterol level is common among the myocardial infarct patients. Modification of dietary habits plays a pivotal role in the therapy for all types of hyperlipidemia. The objectives of the study were to estimate the change of total, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) cholesterols, triglycerides and glucose levels of myocardial infarct patients after three months dietary intervention.

The study was carried out between 1st October 1993 and 30th December 1995. Among the 300 myocardial infarct patients interviewed, 60 patients successfully completed their third visits. The age range of our subjects were between 40-60 years. The subjects were grouped into study and control groups. Their height, weight, body mass index and blood pressure were measured and biochemical analysis of the blood samples were done. Patients history and normal food habits were taken by 24 hours recall method. Study group received a diet sheet with advice to increase fiber intake (mainly soluble fiber) and, control group received none except the

advice given by the cardiologist. After 1 and 3 months interval, blood lipids were estimated by standard method.

Mean age of the study and control groups were 50.43±5.90 and 49.73±6.40 years, respectively. Eighty-three percent of the subjects were male. Most of our subjects had higher educational background, and half of them were business people, 43.3% were overweight, 61.7% were hypertensive and 46.7% were smokers. All of our subjects were hyperlipidemic.

After intervention, both the groups were found to have reduced total cholesterol, LDL-cholesterol and triglyceride significantly. Study group reduced 14.5% (P=<0.001), 16.3% (P=<0.001) and 29% (P=<0.001), respectively. HDL-cholesterol increased 8.6% (P=<0.05) in the study group. The total cholesterol to HDL-cholesterol ratio decreased in study group significantly 20.6% (P=<0.001). There was significant weight reduction in study group (P=<0.001). The increment of fiber intake by study group was 13±2.2 g (83.9%).

The dietary advice reduces the serum lipids risk of myocardial infarct subjects.

CHAPTER ONE

INTRODUCTION

Coronary heart disease (CHD) is the commonest form of heart disease and the single most important cause of premature death in the developed and developing countries. Throughout the world about 12 million people die from myocardial ischemia (MI) each year. With the improvement of socioeconomic status, urbanization and changes of dietary habits and lifestyle, the incidence of ischemic heart disease (IHD) is also increasing in the developing countries, including Bangladesh[1]. Regarding the affected persons, a concrete data in our country is not available. But from some epidemiological studies, it has been seen that trend of CHD amongst our population is increasing. Presently there are 2 million CHD patients in Bangladesh (survey report 1994-95). Myocardial infarction is the leading cause of death and the most frequent cause of early invalidism. It affects middle-aged persons and one-fourth of them die within 24 hours. Those who have survived an attack, more than 80% live for a further year, about 75% for 5 years, 50% for 10 years and 25% for 20 years[2]. So, MI is becoming a serious public health problem in Bangladesh. The way out for surviving MI patients are lifelong adherence to drugs and diet.

The association between the incidence of coronary artery disease (CAD) and total plasma cholesterol is well established[3-5]. The low-density lipoprotein (LDL) subfraction is mainly incriminated for the development

of myocardial infarction in this relation. While values of high-density lipoprotein (HDL) are inversely related[6-8]. There is another strongest determinant of CHD risk is the LDL-HDL ratio[9]. It is essential to keep LDL-cholesterol down and to raise HDL-cholesterol as much as possible. Low level of HDL-cholesterol is associated with a high risk of CHD[9]. The Framingham heart study suggests to pay close attention to the ratio of the total cholesterol to the HDL-cholesterol[10]. Leiden Intervention Trial has confirmed the importance of this total cholesterol/HDL-cholesterol ratio[11]. Triglycerides are also powerful risk factors for CHD[12].

Results from cross-cultural and experimental studies suggest that diet plays an important role in the etiology of CHD[13-15]. Earlier research in the development of the classic diet-heart hypothesis focused on the effect of saturated and polyunsaturated fat and cholesterol intake on serum total cholesterol levels[14]. The diet-heart hypothesis has depended primarily on the role of dietary lipids in the development of atherosclerosis, and various subsequent studies have supported this hypothesis. The Ireland-Boston diet-heart study found an association between dietary lipids and the risk of CHD[13]. Geographical studies have shown that consumption of saturated fatty acids is a major correlate of serum cholesterol level and CHD[14]. These observations have been reinforced by the strong relations between dietary lipid and serum cholesterol levels seen in metabolic-ward studies[17-19]. In addition, intervention trials on the effect of dietary change

on CHD have suggested that altering the fatty acid composition of the diet may lower the risk that CHD will subsequently develop[20]. Morris *et al.*[21] reported an inverse association between the ratio of polyunsaturated to saturated fatty acids and the risk of CHD. Studies in Puertorico[22] and Hawaii[23] have reported positive associations between the percentage of calories accounted for by saturated fatty acids and MI and death from CHD.

Trowell and Burkitt[24] suggested that fiber may also play an important independent role in the prevention of cardiovascular disease (CVD). Previus prospective studies suggesting that dietary fiber may reduce the risk of MI[13,15,20,25,26]. Several studies have reported inverse association of the intake of starch or complex carbohydrates with the risk of death from CHD[22,23,27,28].

Morris *et al.*[21] have also reported an inverse association of fiber intake with the risk of such deaths. The health professionals study[29] found that MI risk was reduced by 30% for each 10 g increase in cereal fiber intake per day. A prospective study of a community of retired people in California found that a high intake of fiber gave a strong protection against the disease[26]. Likewise, the Ireland-Boston diet-heart study showed that intake of fiber had an independent effect on mortality from CHD with relative risks around 0.6 for the upper third of intake[13]. Garmenzi *et al.*[30] found that the risk of acute myocardial infarction (AMI) was directly

associated with frequency of consumption of meal, ham, salami, butter and total fat added to food, and coffee. Significant inverse relations were observed for fish, carrot, green vegetables and fresh fruits.

Current dietary recommendations to decrease CHD risk in the general population inclined reduction of total fat intake to less than 30% of energy[31]. The available evidence suggests that saturated fatty acids (specifically lauric, myristic and palmitic acids)[32] are the major factors that cause an increase in plasma cholesterol, particularly LDL-cholesterol[33], carbohydrate and monounsaturated fatty acids lower plasma cholesterol when they replace saturated fatty acids. Polyunsaturated fatty acids of 18-C chain length have a greater cholesterol-lowering effect than can be accounted for by replacement of saturated fatty acids[32]. Trowell hypothesized that dietary fiber protects against hyperlipoidemia and IHD[34]. Rimm *et al.*[29] suggested that diets high in fiber, especially from cereal sources, significantly reduce the risk of CHD. Results from the prospective Rancho Bernardo[25] study of 859 men and women, also suggest that fiber intake reduces CHD. Evidence from experimental studies suggest that fiber (mainly soluble) may reduce risk of CHD through cholesterol reduction from increased bile acids excretion and decreased hepatic synthesis of cholesterol[35,36]. A prospective study among 337 middle-aged men in London found that high intake of dietary fiber from cereals was associated with a low risk of CHD.

Albrink *et al.*[37] found that very-high-carbohydrate low-fiber diet caused a prompt rise in fasting plasma triglyceride concentration. By calculating normal food habit of our subjects, we found that more than 65% of their calories come from carbohydrate and hypertriglyceridemia is an undesirable side-effect of low-fat high-carbohydrate diets. Number of studies found that prevalence of conventional risk factors, such as smoking, hypertension and hypercholesterolemia are not higher in South Asians than in other ethnic groups[38-42]. But high-triglyceride concentration, low concentrations of HDL-cholesterol, increased visceral fat, and insulin resistance are more prevalent among South Asians, and these factors have been proposed as reasons for the higher risk of IHD[38,40,41,43,44]. From our pilot program, it was found that dietary advice has an advantage over dietary supplementation on lowering serum lipids. Hjermann *et al.*[45] study also showed that informative advice can bring about significant changes in serum lipid levels. And our present study is based on this hypothesis.

OBJECTIVES

General

To study the effect of dietary advice about low-fat and high-fiber diet on blood lipids of the myocardial infarct patients.

Specific

1) To estimate the change of total cholesterol, low-density lipoprotein, high-density lipoprotein, triglyceride and glucose levels of myocardial infarct patients after one and three months interval among study and control groups.

2) To observe the incidence of myocardial infarction in respect of age, sex, education, occupation, nutritional status, hypertension and smoking habits.

3) To observe the total cholesterol to high-density lipoprotein ratio among myocardial infarct patients.

HYPOTHESIS

Coronary heart disease (CHD) could, at least partly, be a nutritional determinants. Diet is the primary treatment for elevated blood cholesterol levels.

1) Consumption of saturated fatty acids is a major correlate of serum cholesterol level and coronary heart disease, and altering the fatty acid composition of the diet may lower the risk of CHD that may subsequently develop.

2) Increased consumption of total dietary fiber may reduce risk of CHD through reduction in cholesterol level.

3) Modification of dietary habits plays a pivotal role in the therapy for all types of hyperlipidemia.

4) Dietary advice could translate scientific evidence into practice and encourage the public to modify their eating habits to reduce their serum cholesterol levels and other diet-related risk factors associated with CHD.

CHAPTER TWO

LITERATURE REVIEW

RISK FACTORS FOR CORONARY HEART DISEASE

A risk factor for coronary heart disease (CHD) has been defined as a trait that increases the probability that some manifestation of cardiovascular disease (CVD) will develop[46]. Coronary risk factors are both statistically and causally related to CHD. Thus, identified CHD risk factors are: (a) statistical correlates of CHD, (2) factors that cause CHD, and/or (3) personal characteristics that predispose a person to CHD.

Coronary risk factors have been identified through evidence derived from an enormous number of studies that used many different scientific approaches. The research conducted involved studies of animal models, epidemiological and observational studies, and clinical investigations. Coronary risk factors are frequently classified into two groups: well-established risk factors and "other" risk factors[47]. Well-established risk factors are cigarette smoking, high blood cholesterol, high blood pressure, and diabetes mellitus[47]. Other factors that may affect CHD risk include physical inactivity, obesity, stress, and certain drugs[47].

Coronary risk factors can be classified as either unmodifiable or modifiable. Unmodifiable risk factors include genetic predisposition (family history), gender, hormonal factors, and age. Modifiable risk

factors include plasma lipids, blood pressure, weight, diabetes, cigarette smoking, physical activity, stress, personality type, and oral contraceptive use.

UNMODIFIABLE RISK FACTORS

Family history and genetic predisposition

The risk of CVD is two to five times higher in people with familial hyperlipoidemia and a family history of premature CHD than in people without such family histories[48,49].

The presence of CHD in grandfathers was correlated to the grandchildren's plasma total cholesterol, LDL-cholesterol and HDL-cholesterol levels[49].

Gender and hormonal factors

From the Framingham Study, it has been established that CHD develops in men 60 years of age or younger at approximately twice the rate as that of women. Postmenopausal women have a higher incidence of CHD than premenopausal women of the same age. Women in their childbearing years are at lower risk for CHD[50]. This could be related to the influence of female hormones on lipoprotein levels. Levels of HDL-cholesterol, which is protective against CHD, and LDL-cholesterol, which is associated with increased CHD risk, differ between men and women[51].

Age

For both men and women, the incidence of CVD increases with advancing age. In men, the highest incidence of clinical manifestations of CVD occurs between the ages of 50 and 60. In women, the highest incidence of CVD is between 60 and 70[52]. Correspondingly, rates of death due to atherosclerosis increase with age[53].

MODIFIABLE RISK FACTORS

Plasma lipids

Epidemiological evidence has demonstrated that total serum cholesterol and triglycerides, as well as their lipoprotein fractions, including VLDL-cholesterol, LDL-cholesterol, and HDL-cholesterol, have both positive and negative associations with the development of CVD, especially atherosclerosis[48,49,53-57].

An elevated serum cholesterol is a major independent risk factor for CHD[54-56]. Some, in fact, believe that serum cholesterol is the single most important risk factor in the development of CHD. Risk of CHD increases steadily, particularly for plasma total-cholesterol levels greater than 200 mg/dl.

Desirable plasma cholesterol levels have been defined by various groups. According to the American Heart Association in 1982, the ideal adult plasma total-cholesterol level is 130 to 190 mg/dl[57]. The National Cholesterol Education Program (NCEP) defines a desirable blood cholesterol level as less than 200 mg/dl. A borderline-high blood cholesterol is 200 to 240 mg/dl and a high blood cholesterol level is greater than 240 mg/dl[31].

The level of LDL-cholesterol is positively correlated with the serum total-cholesterol level and CHD, and LDL is considered to be the most atherogenic lipoprotein.

HDL-cholesterol appears to be protective against CHD, and evidence has shown that for every 10 mg/dl increase in the HDL-cholesterol level there is a 50% difference in CHD[54-56,58-61]. HDL-cholesterol is inversely associated with CHD incidence and mortality.

In the Framingham Study[7], the incidence and mortality rates from CHD were approximately twice as great in men with baseline HDL-cholesterol levels under 40 mg/dl than in men with baseline HDL-cholesterol levels of 50 mg/dl or higher. Men with HDL-cholesterol levels between 40 and 49 mg/dl had an intermediate incidence of CHD. In the Framingham Study, HDL-cholesterol was the most powerful single lipid indicator of risk for CHD, at least in people older than 50.

The ratios of LDL-cholesterol to HDL-cholesterol and total cholesterol to HDL-cholesterol are used as predictors of CHD risk. Ratios of total cholesterol to HDL cholesterol greater than 4.5 are considered to place a person at high risk for CVD. An optimal total-cholesterol/ HDL-cholesterol ratio for low CVD risk is less than 3.5[54,60,61].

The role of plasma triglycerides as a risk factor for CHD is controversial. In an extensive review of the literature, Hully *et al.*[68] found a significant association between triglyceride levels and CHD; however, plasma triglycerides were not predictive of CHD when other risk factors were accounted for[68]. Based on the Framingham Study, it appears that elevations in plasma triglyceride levels in the presence of a high total-cholesterol to HDL-cholesterol ratio (>3.5) increases CHD risk. Recent evidence suggests an inverse relationship between plasma triglyceride levels and HDL-cholesterol levels; hence, people with low plasma triglyceride levels and high HDL-cholesterol levels are at lower risk of CHD[69].

Acquired factors that influence plasma total- and lipoprotein-cholesterol levels include: (1) diet, (2) smoking and exercise, (3) hypertension, (4) obesity, and (5) diabetes[54,60,62,63].

Diet

Diet is included in the category of modifiable risk factors because of its effects on primary CHD risk factors. Many epidemiological, animal, human-migration, clinical, and human-pathology studies consistently demonstrate a relationship between diet, plasma cholesterol, and CHD.

The positive relationships of saturated-fat intake and dietary cholesterol to CHD and mortality have been well documented. The Seven Countries Study, a cross-population study that included men from Finland, the United States, the Netherlands, Italy, Japan, Yugoslavia, and Greece, showed a positive association between saturated-fat intake (expressed as percentage of calories) and CHD[70,71].

The Western Electric Study found a positive relationship between serum cholesterol levels and CHD deaths and the intake of both saturated fat and cholesterol[72]. Stamler and Shekelle[73] reviewed clinical and epidemiological data relating dietary cholesterol to its effects on serum cholesterol level. The authors concluded that dietary cholesterol is an independent risk factor for CHD. Dietary cholesterol and saturated fat are hypercholesterolemic in humans. Dietary fiber intake may protect from coronary heart disease. Epidemiological studies[11] found an inverse correlation between dietary fiber intake and CHD. Kushi *et al.*[13] found in their prospective epidemiologic study that death rate was high among those who eat more saturated fat and cholesterol and less dietary fiber.

Recent studies suggest an inverse association between the consumption of both fish and omega-3 fatty acids and CHD. Kromhout[74] also found an inverse relationship between fish consumption and risk of CHD in the Zutphen, Netherlands Study of 852 middle-aged men participating in the Seven Countries Study.

Calorie intake (both total and expressed per kilogram of body weight) is another variable shown to be inversely related to CHD (perhaps because of its obvious association with physical activity level). Those with a high calorie intake had a lower risk of CHD[75].

Other dietary constituents (i.e. total fat, animal products, sources of protein, alcohol, starch, coffee, and others) have been related to CHD. Stamler reviewed the results of data from the United Nations Food and Agriculture Organization (FAO) and the World Health Organization (WHO) and found that lipid-rich diets derived largely from animal products were associated with high CHD mortality[63].

Diabetes mellitus

Diabetes mellitus is a strong CVD risk factor. Both CVD morbidity and mortality are increased in people with both type I and type II diabetes mellitus. In fact, CVD is the leading cause of death in persons with type I diabetes.

People with diabetes have elevated plasma total-cholesterol and LDL-cholesterol levels and low HDL-cholesterol levels, both of which are major risk factors for CHD[54,66].

Physical factors

Numerous social and psychological factors, such as socioeconomic status, social mobility, anxiety, and neuroticism, and their relationship to CHD risk have been studied.

Some research indicates that suppressed hostility, excessive workload, job responsibility, and job dissatisfaction may increase CHD risk[76,77]. More recent evidence, however, has shown that those who react quickly to various situations with anger and frustration are more prone to CHD[78].

Smoking

Cigarette smoking is a major risk factor for CHD[79]. Cigarette smoking increases the risk of nonfatal myocardial infarction in young men[80]. HDL-cholesterol is lower in smokers than in nonsmokers (43.5 versus 46.8 mg/dl, respectively). Smokers had a higher plasma total-cholesterol level than nonsmokers (227 versus 217 mg/dl or approximately 5% difference). LDL-cholesterol is also higher in smokers than in nonsmokers (153 versus 140 mg/dl, respectively)[81].

Physical activity

Epidemiological studies during the past 30 years have provided strong evidence that physical activity plays a protective role in the etiology of CHD. Investigators from the Framingham Study found in a population of 1,909 men and 2,311 women that risk associated with a sedentary lifestyle was modest compared with other, more powerful, risk factors studied (such as cigarette smoking, blood pressure, and serum cholesterol). However, physical inactivity in combination with these risk factors led to an overall greater CHD risk.

Tran *et al.*[82] found that plasma total cholesterol and LDL-cholesterol, total triglycerides, and the ratio of total cholesterol to HDL-cholesterol were significantly decreased, and HDL-cholesterol was insignificantly increased by exercise. Exercise is associated with both a reduction in the incidence of CHD and favorable changes in plasma lipids and lipoproteins. In addition, exercise has been shown to affect favorably other cardiovascular risk factors such as blood pressure, weight, and cigarette-smoking habit.

Body weight and fat distribution

According to the National Institutes of Health Consensus Development Conference[83], obesity has been defined as "an excess of body fat frequently

resulting in a significant impairment of health". The most widely used definition of obesity is body weight greater than 120% of desirable weight for height. Obesity is an independent risk factor for CHD.

Numerous cross-sectional investigations have examined obesity and plasma lipid relationships. In general, obesity is associated with a more atherogenic lipoprotein profile. Assessed by relative weight or body mass index, obesity was positively correlated with plasma total-cholesterol, LDL-cholesterol, and triglyceride levels and negatively correlated with HDL-cholesterol levels[62,84,85].

Hypertension

With normal blood pressure currently defined as $<140/<85$ mmHg[86], hypertension is a significant independent risk factor for CHD[4,87]. The Veterans Administration Cooperative Study Group on Antihypertension Agents clearly demonstrated positive benefit of controlling blood pressure[88].

CORONARY RISK-FACTOR MODIFICATION

Evidence from numerous randomized clinical trials has shown that cholesterol lowering, especially in men at high risk of CHD, reduces the incidence of CHD. In the studies reported, cholesterol lowering has been

achieved by either diet or drug therapy. The Lipid Research Clinics Coronary Primary Prevention Trial (LRC-CPPT) showed a 19% lower incidence of CHD in cholestyramine/diet-treated men versus placebo/diet-treated group. Total plasma cholesterol and LDL-cholesterol were 8% and 12% lower in the cholestyramine/diet-treated group compared with the placebo/diet-treated group[66,67].

The magnitude of the reduction in CHD has been defined for people with initial serum cholesterol levels in the 250 to 300 mg/dl range. For each 1% reduction in the serum cholesterol level, a 2% reduction in the incidence of CHD is expected[66,67]. Therefore, a 10-15% reduction in the serum cholesterol level (a reduction that could be reasonably achieved by the American population) should reduce CHD risk by 20-30%.

Persons with other risk factors (such as cigarette smoking and hypertension) will probably benefit the most from cholesterol lowering. Both intervention and longitudinal studies have shown beneficial effects of both raising HDL-cholesterol levels and even small elevations in HDL-cholesterol levels. For every 1 mg/dl increment in baseline HDL-cholesterol, a 3.5 to 5.5% decrease in CHD was reported in the LRC-CPPT, LRC Prevalence Study, and Framingham Study[89]. Each 1 mg/dl increase in HDL-cholesterol from baseline was associated with a 4.4% reduction in CHD risk[89].

The Veterans Administration Cooperative Study Group on Antihypertensive Agents clearly demonstrated the positive benefits of controlling blood pressure[88]. In middle-aged men with mean diastolic levels of 115 to 129 mmHg, there was a 93% reduction in the rate of nonfatal plus fatal complications of CHD. For those with a diastolic blood pressure of 105 to 14 mmHg, the reduction was 69%.

Castelli[90] has noted that in most of the antihypertensive trials, the treated group, in the short-term, has had a significant reduction in the incidence of stroke. In many trials, there was a reduction in the incidence of a number of CHD endpoints, even though the comparisons failed to reach statistical significance.

As noted, cigarette-smoking cessation improves CHD risk status[91]. Even after one or more myocardial infarctions, cessation of cigarette smoking improves the long-term prognosis of fatal and nonfatal CHD[92].

In summary, elevated plasma total-cholesterol and LDL-cholesterol levels are major CHD risk factors. An elevated level of HDL-cholesterol is protective against atherosclerosis. Modification of abnormal serum lipids due to genetic or acquired factors can reduce the risk of CHD[48,49,54-63] as can the management of hypertension.

DIET AND CORONARY HEART DISEASE

Epidemiological, clinical and laboratory investigations have established that diet plays a critical role in the prevention and treatment of coronary heart disease (CHD). Early studies clarified the roles of dietary fat quality and cholesterol on plasma lipid and lipoprotein levels. Recently, the role of other dietary factors on CHD risk status has been addressed. Ongoing investigations are studying the effects that diet and dietary factors have on plasma lipoprotein subfractions and composition, apolipoprotein concentration, mechanistic actions, hemostasis, and thrombosis. The effects of specific fatty acids and other dietary constituents on atherosclerosis are being studied extensively. Results from these studies are advancing our understanding of how diets can be most effectively modified to prevent and treat CHD.

DIETARY FACTORS THAT AFFECT PLASMA LIPIDS

Fat quality - saturated fatty acids

Numerous epidemiological studies demonstrated a strong relationship between saturated-fatty-acid intake and plasma total-cholesterol and LDL-cholesterol levels as well as the incidence of CHD.

Certain saturated fatty acids, such as lauric ($C_{12:0}$), myristic ($C_{14:0}$), and palmitic ($C_{16:0}$), are hypercholesterolemic. A recent study by Bonanome and Grundy[93] indicates that stearic acid ($C_{18:0}$) has no effect on plasma total-cholesterol and LDL-cholesterol levels. Saturated fatty acids can also be reduced by decreasing total fat intake.

Predictive equations have been developed by Keys *et al.*[94] and Hegsted *et al.*[14] to determine the magnitude of change in plasma cholesterol in response to changes in the fatty-acid composition of the diet. Both equations predict that the plasma cholesterol-raising effect of saturated fatty acids is approximately twice the cholesterol-lowering effect of polyunsaturated fatty acids (omega-6).

Saturated fatty acids raise and omega-6 fatty acids lower LDL-cholesterol levels. Most often, investigators have found that diet high in saturated fatty acids (and cholesterol) raise HDL-cholesterol levels[95]. Diets high in omega-6 fatty acids often lower HDL-cholesterol levels[96,97].

Fat quality - unsaturated fatty acids

Chemistry of unsaturated fatty acids: There are four different classes of unsaturated fatty acids found in mammals: omega-3, omega-6, omega-7 and omega-9. The distinction among these classes is the position of double bonds relative to the CH_3 end group.

Omega-6 fatty acids (polyunsaturated fatty acids): Traditionally, a diet high in polyunsaturated fatty acids, especially omega-6 fatty acids, was recommended to reduce CHD risk. Omega-6 fatty acids elicit a direct hypocholesterolemic effect[98,99]. In addition, omega-6 fatty acids replace saturated fatty acids in the diet[96]. A diet high in fatty acids has a greater lowering effect on plasma total cholesterol than does manipulation of dietary cholesterol[100]. The hypocholesterolemic effects of the omega-6 fatty acids are the result of changes in VLDL-cholesterol and LDL-cholesterol levels (and sometimes HDL-cholesterol levels)[100].

There is no specific P/S (omega-6 fatty acids to saturated fatty acids) ratio recommended. A very high P/S ratio does not provide additional hypocholesterolemic benefits and may cause a decrease in HDL-cholesterol levels[96,98,99].

Omega-3 fatty acids: There was not a great deal of interest in the effect of fish oils on plasma lipids until the 1970s, when epidemiological studies suggested that marine lipids have a protective role against CHD.

In recent review, Harris[101] summarized the effect of fish oil on plasma lipids and lipoproteins. Studies have shown little effect of fish oil on the plasma total-cholesterol level. Hypertriglyceridemic persons have even experienced increases in LDL-cholesterol levels of 10 to 20% during omega-3 fatty-acid supplementation. Some studies have also found that HDL-cholesterol may increase (about 5 to 10%) when fish oil is consumed.

The mechanism by which fish oil affects plasma triglyceride levels is primarily by inhibiting VLDL production[102]. Omega-3 fatty acids are also antithrombotic. There is some evidence that these effects are due to the changes that omega-3 fatty acids have on platelet and endothelial-cell function.

Monounsaturated fatty acids: Fifteen-year data from the Seven Countries Study indicate that relationships between death rates and dietary factors were positive for saturated fatty acids and negative for monounsaturated fatty acids, and that death rates were not related to omega-6 fatty acids, protein, carbohydrate, and alcohol[103]. Death rates were negatively related to the ratio of monounsaturated fatty acids to saturated fatty acids.

Fat quantity

A reduction in total fat is recommended for the prevention and treatment of CHD to facilitate reducing saturated fatty acids and calories, both of which affect blood lipid levels. Diets lower in fat (and, likely, in calories) are beneficial for long-term weight control[104].

It is well accepted that fat quality has a more significant effect on the plasma lipid response than fat quantity.

Vegetarianism

It is evident that the consumption of a vegetarian diet (which is typically low in total fat, saturated fatty acids, and cholesterol) is associated with a favorable plasma lipoprotein profile[105,106]. Furthermore, population studies have shown that vegetarians have a reduced risk of CHD[107]. In addition to the reduction in plasma total-cholesterol and LDL-cholesterol levels, vegetarianism has been associated with lower concentrations of apolipoprotein A-1, B, and E[105,108]. In addition, LDL production rates have been reported to be lower in vegetarians[109].

Carbohydrate

Since fat and carbohydrate (CHO) are inversely related to the diet, recommendations to lower total fat are also recommendations to increase carbohydrate.

Interpopulation studies have established that high-carbohydrate diets are associated with a lower risk of CHD[110]. The consumption of a diet that contains approximately 80% of calories as carbohydrate (i.e. a very-high-carbohydrate and very-low-fat diet) is associated with low plasma total-cholesterol, LDL-cholesterol, and HDL-cholesterol levels[111,112].

Protein

Dietary protein is thought to be a minor risk factor for CHD. Residents of the Untied States consume about 16% of their calories from protein. Protein intake remains rather constant despite large changes in fat and carbohydrate intake. Epidemiological studies have shown that consumption of animal protein is positively correlated with CHD mortality, whereas vegetable protein is negatively correlated[110].

Dietary cholesterol

Dietary cholesterol has been shown to raise plasma total-cholesterol and lipoprotein-cholesterol levels[113-115]. It is half as potent as saturated fatty acids in raising the plasma cholesterol level (S. Connor, University of Oregon, personal communication). It has been recommended that intake not exceed 300 mg/day[104].

Fiber

Dietary fiber refers to nonstarch polysaccharides and lignin in the diet that are not digested by the secretions of the human digestive tract. Fiber is composed of cellulose, hemicellulose, mucilages, pectins, gums, waxes, and lignin. Among the isolated sources of fiber, cellulose, some hemicellulose, and lignin are generally considered to be water-insoluble

molecules, while pectins, gums, mucilages, and mixed linkage betaglucans are considered soluble sources of dietary fiber.

The hypotheses of Burkitt and Trowell[116] - that many diseases of industrialized societies are associated with diets high in fat and low in fiber - have been the impetus for many studies designed to examine the physiological effects of dietary fiber. Much of this research in the heart-disease area has focused on the effect of dietary fiber on plasma lipid levels.

It has become apparent that the different types of dietary fiber have varying physiological effects and that this is especially true with respect to their effect on plasma lipid levels. Differences in the effects of various fibers on plasma lipid levels appear to be due to physiochemical properties, such as water-holding capacity, ionic charge, gel-forming characteristics, and solubility.

Insoluble dietary fiber sources are generally considered to be ineffective in reducing serum lipid levels in humans. Cellulose has been reported to have little or no effect on serum total-cholesterol and triglyceride levels when added to the diets of normocholesterolemic subjects at a level of 15 d/day[117,118]. Wheat bran, a source of insoluble dietary fiber, has been used in many studies designed to examine the effect of fiber on various blood lipids. These studies are difficult to interpret and compare due to

differences in subjects' initial serum lipid profiles and to poorly defined types and amounts of dietary fiber in the experimental diets. From some studies it was found that wheat-bran reduced blood cholesterol and triglyceride[36,119,120].

In contrast to the results found for insoluble-dietary-fiber sources, the significant lowering of certain plasma lipids has been reported for soluble or viscous fibers. The purified water-soluble fiber sources that have been studied includes pectin, psyllium, guar, gum arabic, and locust bean gum. Food sources of soluble fiber have also been examined for their potential as hypocholesterolemic agents and include oatmeal, oat bran, barley, and legumes.

LIPOPROTEIN METABOLISM

There are five major classes of lipoproteins: chylomicrons, very-low-density lipoproteins (VLDL), intermediate-density lipoproteins (IDL). low-density lipoproteins (LDL) and high-density lipoproteins (HDL). As is LDL, HDL is further subfractionated into small and large particles, HDL_2 and HDL_3.

Lipoproteins have a hydrophobic core consisting of nonpolar lipids (triglyceride and cholesterol esters) coated with surfactants (phospholipids and unesterified or free cholesterol) and proteins that are referred to as *apolipoproteins*. The proportions of triglyceride, cholesterol, phospholipid, and protein differ among the specific lipoprotein classes. Chylomicrons and VLDL are triglyceride-rich lipoproteins, and LDL, the major cholesterol-transport particle in plasma, carries 70% of the plasma total cholesterol. HDL is a protein-rich particle; 50% of its mass is protein.

Conceptually, there are three lipoprotein metabolic systems: exogenous fat transport, endogenous fat transport, and reverse cholesterol transport.

Dietary triglycerides are package into chylomicrons in the intestine. They enter the circulation through the thoracic duct and acquire apolipoproteins C and E from HDL. During removal of triglyceride from the core of the

chylomicron, some surface material (primarily phospholipids, cholesterol, and apolipoproteins) is transferred to HDL. Chylomicron remnants are efficiently removed by the hepatic apolipoprotein E receptor, internalized via endocytosis, and translocated to the lysosomes where the remnant lipid and protein constituents are catabolized.

Endogenous fat transport refers to the synthesis and catabolism of VLDL and LDL. VLDL is hydrolyzed to IDL lipoprotein lipase (LPL). Surface material from IDL is transferred to HDL. Unesterified cholesterol is esterified in HDL via the action of the enzyme lecithin-cholesterol acyltransferase (LCAT). The esterified cholesterol is transferred back to IDL leading to a cholesterol-ester enrichment of IDL. Some IDL is cleared from plasma by hepatic LDL receptors that bind apolipoprotein E. The remainder undergo rapid continued lipolysis probably by hepatic triglyceride lipase, during which time all apolipoproteins except B-100 are transferred to other lipoproteins. The result is the formation of LDL with apolipoprotein B-100 on its surface. This form of apolipoprotein B is recognized by the hepatic and extrahepatic high-affinity LDL receptors. Approximately 70% of LDL is removed from plasma via this mechanism, principally by the liver. The remaining LDL is modified in plasma and remove by scavenger receptors on macrophages and endothelial cells. Plasma LDL levels are influenced by LDL receptor number, which, in turn, is regulated by the cell's need for cholesterol. When the need is low, cells make fewer receptors and remove LDL at a reduced rate. As a result

of these cellular events, the rate with which LDL is removed from the plasma decreases and there is a corresponding rise in plasma LDL[121]. In summary, the steady-state plasma LDL-cholesterol concentrations are determined by four factors: (1) the rate of LDL production, (2) the rate of receptor-dependent LDL clearance, (3) LDL receptor affinity, and (4) the rate of receptor-independent LDL clearance. When LDL-cholesterol levels increase because of some perturbation in the above scenario, there occurs a series of events that lead to and cause atherosclerosis.

Arterial uptake of LDL appears to be mediated by a receptor-independent mechanism. It has been proposed that in response to oxidative modification, LDL are removed by macrophages via the acetyl-LDL or scavenger-receptor pathway[122]. Other modifications in LDL (e.g. chemical alteration, such as acetoacetyl LDL and malondialdehyde-conjugated LDL) are recognized, and the modified LDL are removed by the acetyl-LDL receptor or the scavenger receptor. A biological modification, cell-induced oxidation of LDL, may be similar to chemically modified LDL[122].

Oxidized LDL are highly cytotoxic[122]. It has been postulated that oxidized LDL could cause functional changes in endothelial cells that favor fatty-streak formation (by causing penetration of circulating monocytes into endothelial cells or movement of LDL into the subendothelial space). Steinberg and colleagues[122] speculated that the loss of endothelial cells may not be an initiating factor in the development of atherosclerosis. Rather,

injury to the arterial wall may occur after the lipid-laden macrophages become nonfunctional or die, and release cytotoxic, oxidized LDL, which could cause the loss of endothelial cells overlying the fatty streak.

HDL transport approximately 25% of circulating cholesterol. HDL functions in reverse cholesterol transport. This system provides a mechanism by which cholesterol in peripheral tissues can be excreted. Nascent HDL, produced in the liver and intestine, accepts unesterified cholesterol from extrahepatic cells. The free cholesterol is esterified via the enzyme LCAT, using apolipoprotein A-I as a cofactor, and moves to the core of HDL. The accumulation of cholesterol esters by nascent HDL leads to the formation of HDL_3, the predominant form of circulating HDL. Continued uptake of the cholesterol by HDL_3 leads to the production of HDL_{2a}. Through a series of exchange reactions, VLDL triglycerides are transferred to HDL_{2a} and, concurrently, HDL_{2a} cholesterol esters are translocated to VLDL. The resultant triglyceride-rich cholesterol-depleted HDL_{2b} is further catabolized back to HDL_3 by hepatic triglyceride lipase. HDL_2 is negatively associated with CHD risk, whereas HDL_3 seems to be unrelated.

Factors affecting plasma lipids and lipoproteins

a) **Age:** Increases plasma total-cholesterol levels, increases LDL-cholesterol levels.

b) **Gender:** Premenopausal women have higher HDL-cholesterol levels and lower LDL-cholesterol levels.

c) **Diet:** Saturated fatty acids and cholesterol increase plasma total-cholesterol levels and increased LDL-cholesterol levels.

Monounsaturated and omega-6 fatty acids decrease plasma total-cholesterol levels and decreased LDL-cholesterol levels.

Soluble fiber decreases plasma total-cholesterol levels, decreases LDL-cholesterol levels, and decreases plasma triglyceride levels.

e) **Obesity:** Increases plasma total-cholesterol levels, increases LDL-cholesterol levels, increases triglyceride levels, and decreases HDL-cholesterol levels.

f) **Diabetes:** Increases plasma total-cholesterol levels, increases LDL-cholesterol levels, increases triglyceride levels, and decreases HDL-cholesterol levels.

g) **Smoking:** Decreases HDL-cholesterol levels.

h) **Antihypertensive drugs:** May increase plasma total-cholesterol levels, increase LDL-cholesterol levels, increase plasma triglyceride levels, and decreased HDL-cholesterol levels.

i) **Exogenous hormones:** May decreased HDL-cholesterol levels.

j) **Exercise:** Increases HDL-cholesterol levels and decreases LDL-cholesterol levels.

HIDDEN RISK FACTORS AND MYOCARDIAL INFARCTION

Our knowledge whatsoever it may be give us limited access to the innumerable problems faced by mankind everyday. Among the manifold misfortunes that befall humanity in the form of the disastrous disorder, sudden CHD like myocardial infarction is one of the severest. Sudden death occur to persons without having any previous history of chest pain, angina or elevated lipid profile. Hidden risk factors may be considered also in the light of the admitted myocardial infarction patients in the hospital almost half of whom have no previous evidences of CHD, previous irregularity in his lifestyle or plasma biochemical risk factors or previous history of chest pain.

Dr. Daniel Rader, Director of the University of Pennsylvania Preventive Cardiology Program, says that testing for hidden risks is 'most important for people with an aminos family history of at least one-third of the population'. 'That means, a heart attack or chest pain in a male relative by age 60 or a female relative by age 70, including grandparents, aunts and uncles'. Researchers throughout the world have identified a few more risk factors of CHD. These are:

- Lp(a)
- Homocysteine

- Fibrinogen
- Calcium deposit
- Leg blockages
- C-reactive protein

La(a)

Until now, we are concerned of LDL-cholesterol most responsible for clogging of coronary artery with its higher blood serum level.

Recently researchers from various parts of the world have begun to identify a new member of LDL family known as Lp(a). This carries an additional risk of myocardial infarction. A Framingham Study on women showed that higher the level of Lp(a), double the risk of CHD. A study at Tufts University Cardiac Center and New England Medical Center Hospital on admitted patients with premature coronary artery disease observed that 19% of the cohort had elevated level of Lp(a). Higher level Lp(a) is considered above 20. B vitamin, Niacin, can dramatically lower this level.

Homocysteine

A higher homocysteine level is considered above 14 and may be responsible for more than 15% of total number of CHD. About three

decades before McCully thought that persons with high serum level of homocysteine may have a high risk of CHD. A major study at Harvard and Brigham on 15,000 persons were furnished. Only 271 from them suffered from CHD. But 570 of the men with the highest homocysteine had a three-fold greater risk of having an attack. But good news followed. B vitamin folic acid, B-6 and B-12 corrects the higher blood level of homocysteine.

Fibrinogen

It has also been found by the researchers and scientists that with a fibrinogen level in the upper third have an 84 percent increased risk of IHD over those in the lower third of the blood serum level of fibrinogen.

Calcium deposit

Dr. Bruce Brundage, a cardiologist at Bend Memorial Clinic in Oregon, says, 'A lot of calcium in a patient's arteries, that person was at increased risk of having dangerous obstructions'. CAT scanner can take an X-ray in between heart beats and calcification of the artery may be observed. Scanner can spot calcium blockage long before an angiogram.

Leg blockers

Detection of blockages of leg arteries may be considered as a sign of blockage in the coronary artery. Half of the patients of leg blockage have intermittent claudication. We can have information by taking a blood pressure reading at ankle which is divided by arm reading. Any number equal to or below is a danger sign. Those with an anile/arm index of 0.8 or less are five times likelier to die of cardiovascular disease than people with higher index.

C-reactive protein

A substance considered responsible for inflammation of blood vessel walls. Researchers say that inflammation, possibly contributes to the clogging of the arteries. It raises the prospect of treating heart disease with antibiotic and vaccines.

RESULTS FROM OUR PILOT PROGRAMS

Before we started our present study, we conducted a pilot program to find out the effect of dietary fiber advice and dietary fiber supplementation on the lipid levels of myocardial infarct subjects. For fiber supplementation, we used high-fiber biscuits made by wheat-bran that is generally regarded as lipid neutral[123]. And from some other study, it was found that wheat-bran reduced blood cholesterol and triglyceride[36,119,120]. High-fiber biscuit was made by the help of Dr. Khaleque of BCSIR, Dhaka, as a National Science and Technology (NST) Fellow of the Department of Science and Technology, Ministry of Education, Bangladesh. On that pilot program, we studied 21 (11 biscuit and 10 advice groups) myocardial infarct patients for three months. We supplied high-fiber biscuits to biscuit group. They had to eat 8 biscuits/day which contained 17 g of fiber. And advice group was advised to increase intake of fruits, vegetables and cereals. Both the groups received regular drug treatment as advised by the cardiologist.

From that program, it was found that both the groups reduced total cholesterol, LDL-cholesterol and triglyceride. The reduction of biscuit group was for total cholesterol 13%, LDL-cholesterol 13.7% and triglyceride 13.2%, and the advice group had reduced total cholesterol

11%, LDL-cholesterol 14% and triglyceride 20.7%. The reduction of LDL and triglyceride was more in advice group than biscuit group.

The disadvantage of biscuits group was complain about flatulence and diarrhea from 3 subjects, and it was also found difficult to continue dietary supplement for long time. And high-fiber biscuits are not readily available in our market. So we found that dietary advice has an advantage over dietary supplementation on lowering serum lipids of myocardial infarct subjects.

The increased intake of fiber appear to decrease absorption of energy, fat, nitrogen and mineral[120,124-127]. Decreased absorption may not be a problem when the intake of these nutrients in the diet is sufficiently high. But in respect of our country, it may be of concern because our diet may not be sufficiently high in these nutrients.

So, our study found dietary advice more acceptable from dietary supplementation. Table in the next page shows results from our pilot program.

Change in blood lipids from 1st to 3rd visits of the advice and biscuit groups

Parameters	Advice group (n=11)				Biscuits group (n=10)			
	1st visit Mean ±SD	3rd visit Mean ±SD	Mean difference	Change %	1st visit Mean ±SD	3rd visit Mean ±SD	Mean difference	Change %
Total cholesterol	248.8 ±38.9	220.9 ±32.2	-17.9	11.0	231.2 ±39.2	201.1 ±22.9	-30.1	13.0
LDL-cholesterol	204.4 ±51.6	175.7 ±42.3	-28.7	14.1	157.5 ±38.8	136.0 ±43.4	+21.5	13.7
HDL-cholesterol	36.4 ±4.6	39.8 ±3.7	+3.4	9.1	37.0 ±10.5	41.7 ±12.2	+4.7	12.7
Triglyceride	367.2 ±127.2	291.0 ±77.7	-75.6	20.7	199.6 ±74.0	173.3 ±47.1	-26.3	13.2
Glucose	131.1 ±48.4	129.6 ±23.7	-1.5	1.2	112.1 ±17.5	112.8 ±22.3	+0.7	0.6

CHAPTER THREE

MATERIALS AND METHODS

The study was carried out between 1st October 1993 and 30th December 1995 among the hospitalized subjects who had a diagnosis of acute myocardial infarction (AMI). Subjects were included in this trial if they were aged between 40-60 years, myocardial infarction occurred one week back, non-diabetic, must not have chronic liver disease, malignant disease, or renal failure, who live in Dhaka city and have an intention to enter this trial. Subjects were divided into two groups: (1) study group (experimental group), and (2) control group.

Subjects were contacted initially in the National Institute of Cardiovascular Diseases (NICVD) hospital and asked to come to the Institute of Geriatric Medicine for follow-up investigation. First, their body weight, height and blood pressure were measured, and a sample of blood was taken for the test. By fulfilling a proforma, patient's history and normal dietary habits were taken by 24 hours recall method. All smokers were advised to give up the habit. All hypertensive subjects were asked to avoid taking extra salt.

Study group was given a diet-sheet, where, according to their energy requirement, 60% of calories came from carbohydrate, 20% from protein, 20% from fat and total dietary fiber was about 30 g/day. Their dietary

fiber came from vegetable, fruits and cereal foods, which were high in soluble fiber which have been reported to lower serum lipid levels[123,128,129]. The subjects were advised to use only vegetable oil for cooking, not to eat ghee, butter, egg-yolks, cheese, whole-milk or whole-milk products, shrimp, but they could eat seafish, poultry meat without skin, citrus fruits, tomato, apple, green leafy vegetables and non-fat milk, yogurt, small fish and limit eggs to two per week. Advised to walk half an hour every day.

The control group received none except the advice given by the cardiologist.

Both the groups received normal or regular drug treatment as advised by the cardiologist.

After one month and three months interval, all the subjects' weight and blood pressure were measured, and blood sample was drawn to assess changes in levels of serum lipids. Biochemical factors were estimated in the laboratory of the Institute of Geriatric Medicine situated at Dhaka.

Blood was collected for determination of total cholesterol, LDL, HDL, TC and glucose by standard method.

Advice given to the study group

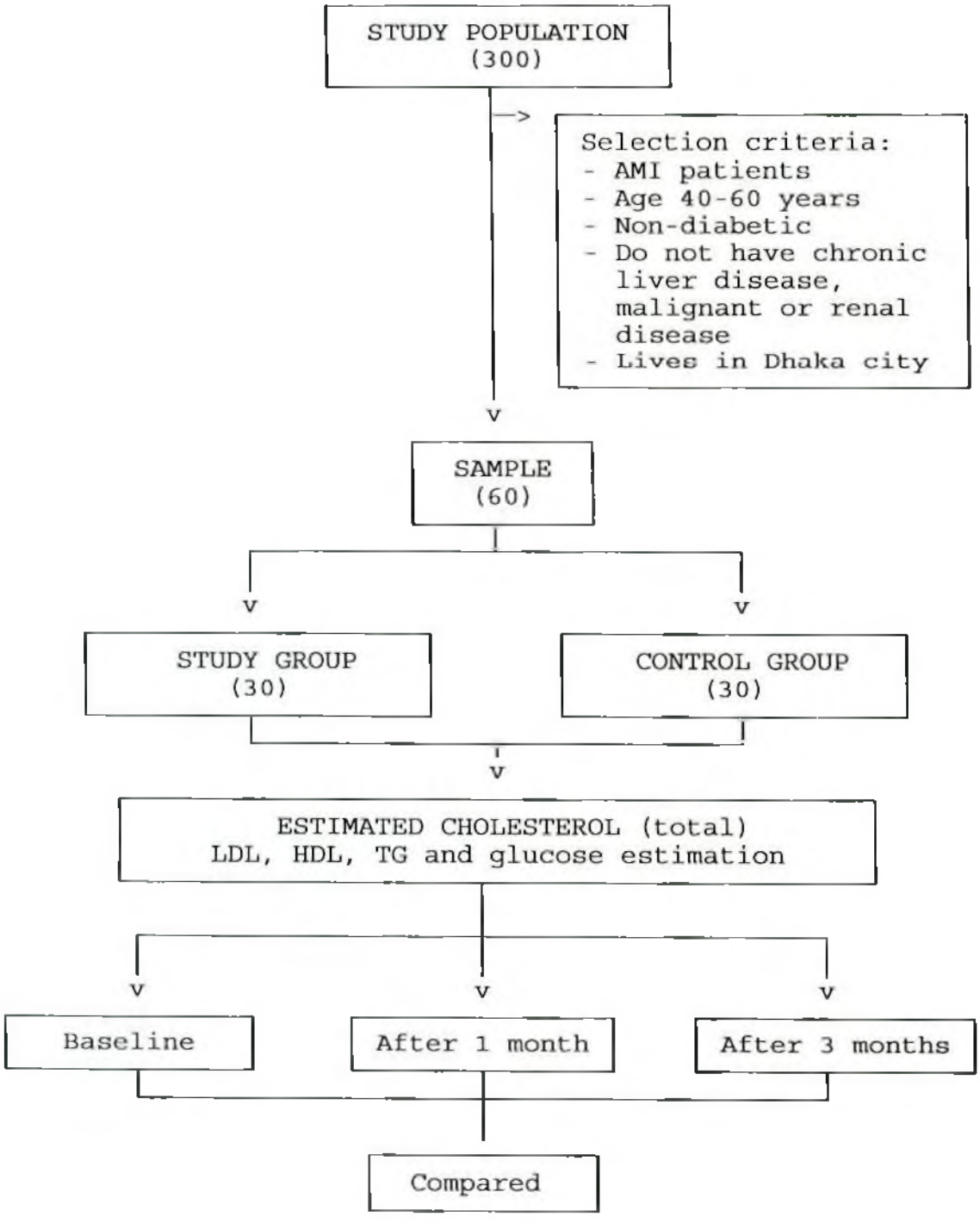
a) Not to eat/drink

1) Ghee, butter, cheese, egg-yolks
2) Whole-milk or whole-milk products
3) Fatty meat

b) Asked to do/not to do

1) Give-up smoking habits
2) Avoid taking extra salt
3) Eat more sea-fish and small fish
4) Eat poultry meat without skin
5) Eat more fruits, citrus and others
6) Increase intake of vegetables
7) Eat non-fat milk yogurt
8) Limit eggs to two per week
9) Walk half-an-hour every day
10) Use only vegetable oil for cooking

FLOW CHART



CHOLESTEROL ESTIMATION

Method

Total cholesterol was measured by using a kit reagent (Monstet Cholesterol, Boehringer-Mannheim, Germany)[130].

The cholesterol is determined after enzymatic hydrolysis and oxidation. The indicator quinoneimine is formed from hydrogen peroxide and 4-aminophenazone in the presence of phenol and peroxidase.

Reaction principle

$$\text{Cholesterol} + H_2O \xrightarrow{\text{CHE}} \text{Cholesterol} + \text{Fatty acid}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\text{CHO}} \text{Cholesterol-3-one} + H_2O$$

$$2H_2O_2 + \text{4-aminophenazone} + \text{Phenol} \xrightarrow{\text{POD}} \text{Quinoneimine} + 4H_2O$$

Contents and reagent composition of the test

1) 4 x 30 ml, 3 x 250 ml or 4 x 100 ml enzyme reagent

Phosphate buffer (pH 6.5)	...	100.00 mmol/l
4-aminophenazone	...	2.50 mmol/l

	Phenol	...	25.00 mmol/l
	Peroxidase	...	>5.00 KU/l
	Cholesterolesterase	...	>150.00 U/l
	Cholesteroloxidase	...	>100.00 U/l
	Sodium azide	...	0.05%
2)	3 ml cholesterol standard	...	200.00 mg/dl or 5.17 mmol/l

Reagent preparation

The enzyme reagent and the standard are ready for use.

Reagent stability

The reagents are stable up to the given expiry date, even after opening, when stored at 2-8°C. The opened reagent is stable for 2 weeks at 15-25°C. Contamination must be avoided.

Specimen

Serum, heparinized, or EDTA-plasma: 5 cc of venous blood is drawn and taken in a germ-free sterilized test tube. For separation of serum, the drawn blood is kept for at least 30 minutes in normal room temperature.

After 30 minutes, supernatant fluid is separated from solid one. Specimen is now ready for use.

Serum is taken and centrifuged. Now, 1 ml of reagent is taken in one tube to be examined and another 1 ml in another tube to be used as standard. Now, (a) tube to be examined contains 1 ml of reagent, and (b) tube to be used as standard also contains 1 ml of reagent.

One milliliter of serum is taken in the tube to be examined, i.e. tube No. 1 and 10 μl of (10 microliter) serum taken in tube No. 2 to be used as standard. Now, both the tubes are incubated for 20 minutes at 20-25°C or 10 minutes at 30°C. Then the absorbance of the sample/standard is measured against the reagent blank within 60 minutes.

Calculation of the cholesterol concentration

1) **With factor**

Wavelength	c (mg/dl)	c (mmol/l)
Hg 546 nm	840 x A	21.7 x A
500 nm	553 x A	14.3 x A

2) With standard

Only the standard recommended by HUMAN (enclosed in kit or separately available, Cat. No. 10015) should be used.

$$c = 200 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mg/dl} \quad \text{or}$$

$$c = 5.17 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mmol/l}$$

HDL-CHOLESTEROL ESTIMATION

Serum HDL-cholesterol was separated by a commercially available kit (HDL-cholesterol, precipitant, Boehringer-Mannheim, Germany) according to the method of Furstein and Lopek Virella (Burstein, Scholneik, Mortin. Rapid method for the inodation of lipoprotein from human serum by precipitation with polyamines. J Lipid Res 1970; 11:583), cholesterol in the HDL fraction was also measured with a kit (Montest Cholesterol, Boehringer-Mannheim, Germany).

Precipitant and standard for use with HUMAN cholesterol liquicolor test kit:

Package size:

Cat. No. 10018	...	4 x 80 ml precipitant 1 x 3 mol standard

Test principle

The chylomicrons, VLDL (very low-density lipoprotein) and LDL are precipitated by addition of phosphotungstic acid and magnesium chloride. After centrifugation, the supernatant fluid contains the HDL fraction, which is assayed for HDL-cholesterol with the HUMAN cholesterol liquicolor test kit.

Contents and reagent composition

1)	4 x 80 ml precipitant		
	Phosphotungstic acid	...	0.55 mmol/l
	Magnesium chloride	...	25.00 mmol/l
2)	1 x 3 mol cholesterol standard	...	50.00 mg/dl or 1.29 mmol/l

1a) Precipitant for macroassays

Use undiluted reagent.

1b) Precipitant for semi-microassays

Dilute the contents of one bottle precipitant (1) with 20 ml distilled water, or dilute 4 parts of the bottle contents with 1 part distilled water (4+1).

2) Cholesterol standard

The standard is ready for use and can directly be employed in the test. No precipitation is required.

Reagent stability

The HDL reagent is stable, even after opening, up to the stated expiry date when stored at 20-25°C. Contamination must be avoided.

Specimen

Serum, heparinized or EDTA-plasma.

Clinical preparation

1) HDL-cholesterol

	Men		Women	
	mg/dl	mmol/l	mg/dl	mmol/l
Prognostically favorable	>55	>1.42	>65	>1.68
Standard risk level	35-55	0.9-1.42	45-65	1.16-1.68
Risk indicator	<35	<0.9	<45	<1.16

5 cc of venous blood is drawn and taken in a germ-free sterilized test tube. For separation of serum, the drawn blood is kept for at least 30 minutes at normal room temperature. After 30 minutes, supernatant, fluid is separated from solid one. Specimen is now ready for use.

Serum is taken and centrifuged. Now, 1 ml of reagent is taken in one tube to be examined and another 1 ml in another tube to be used as standard.

Then, (1) tube to be examined contains 1 ml of reagent, and (2) tube to be used as standard also contains 1 ml of regent.

One milliliter of serum is taken in the tube to be examined, i.e. tube No. 1 and 10 μl of (10 microliter) serum taken in tube No. 2 to be used as standard. Then both the tubes are incubated for 20 minutes at 20-25°C or 10 minutes at 30°C. Then the absorbance of the sample/standard is measured against the reagent blank within 60 minutes.

Assay

1) Preparation

Pipette into centrifuge tube	Macro (μ)	Semi-micro (μ)
Sample	500	200
Precipitant (undiluted)	1000	-
Precipitant (diluted)	-	500

Mix well, incubate for 10 minutes at room temperature, centrifuge for at least 2 minutes at 1000 X *g*, alternatively for 10 minutes at 4000 X *g*.

After centrifugation, separate the clear supernatant from the precipitate within 1 hour and determine the cholesterol concentration using the HUMAN cholesterol liquicolor reagent.

2) Cholesterol determination

Wavelength	:	500 nm, Hg 546 nm
Optical path	:	1 cm
Temperature	:	20-25°C
Measurement	:	Against reagent blank. Only one reagent blank per series is required.

Pipette into cuvettes	Reagent (μ)	Standard (μ)	Sample (μ)
Distilled water	100	-	-
Standard	-	100	-
HDL supernatant	-	-	100
Reagent	1000	1000	1000

Mix, incubate for 20 minutes at 20-25°C. Measure the absorbance of the sample and the standard, respectively, against the reagent blank within 60 minutes (ΔA).

Calculation of the HDL-cholesterol concentration with factor

	Men		Women	
Wavelength	c (mg/dl)	c (mmol/l)	c (mg/dl)	c (mmol/l)
Hg 546 nm	274 x ΔA	7.09 x ΔA	320 x ΔA	8.27 x ΔA
Hg 500 nm	180 x ΔA	4.65 x ΔA	210 x ΔA	5.43 x ΔA

1) Macro method

$$c = 150 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mg/dl}$$

$$c = 3.87 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mmol/l}$$

2) Semi-micro method

$$c = 175 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mg/dl}$$

$$c = 4.52 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mmol/l}$$

ESTIMATION OF TRIGLYCERIDES

Method

Serum triglyceride was measured with a kit[131]. The triglycerides are determined after enzymatic hydrolysis with lipases. Indicator is quinoneimine formed from hydrogen peroxide, 4-aminoantipyrine and 4-chlorophenol under the catalytic influence of peroxidase.

Reaction principle

$$\text{Triglycerides} \xrightarrow{\text{Lipases}} \text{Glycerol} = \text{Fatty acids}$$

$$\text{Glycerol} + \text{ATP} \xrightarrow{\text{GK}} \text{Glycerol-3-phosphate} + \text{ADP}$$

$$\text{Glycerol-3-phosphate} + O_2 \xrightarrow{\text{GPO}} \text{Dihydroxyacetone phosphate} + H_2O_2$$

$$2H_2O_2 + \text{Aminoantipyrine} + \text{4-chlorophenol} \xrightarrow{\text{POD}} \text{Chinoneimine} + HCl + 4H_2O$$

Contents and reagent composition in the test

1) 10 x 15, 3 x 100 or 3 x 250 ml buffer solution

PIPES buffer, pH 7.5	...	40.00 mmol/l
4-chlorophenol	...	5.00 mmol/l
Magnesium ions	...	5.00 mmol/l
ATP	...	1.00 mmol/l
Lipases	...	=150.00 U/ml
Peroxidasc	...	=0.50 U/ml
Glycerol kinase	...	=0.40 U/ml
Sodium azide	...	0.05%

2) 1 x 3, 3 x 1.7 or 3 x 4.1 ml enzyme reagent

4-aminoantipyrine	...	0.40 mmol/l
Glycerol-3-phosphate oxidase	...	=1.50 U/ml
Sodium azide	...	0.05%

3) 3 ml triglycerides standard	...	200.00 mg/dl or 2.28 mmol/

5 cc of venous blood is drawn and taken in germ-free sterilized test tube. For separation of serum, the drawn blood is kept for at least 30 minutes at normal room temperature. After 30 minutes, supernatant fluid is separated from solid one. Specimen is now ready for use.

Serum is taken and centrifuged. Now 1 ml of reagent is taken in one tube to be examined and another 1 ml in another tube to be used as standard. Then, (1) tube to be examined contains 1 ml of reagent, and (2) tube to be used as standard also contains 1 ml of reagent.

One milliliter of serum is taken in the tube to be examined, i.e. tube No. 1 and 10 μl of (10 microliter) serum taken in tube No. 2 to be used as standard. Now both the tubes are incubated for 20 minutes at 20-25°C or 10 minutes at 30°C. Then the absorbance of the sample/standard is measured against the reagent blank within 60 minutes.

Specimen

Serum, heparinized plasma or EDTA-plasma.

Note: Lipemic specimens usually generate turbidity of the sample reagent mixture which leads to falsely elevated results. The HUMAN TRIGLYCERIDES GPO liquicolor test avoids these falsely elevated results through its built-in lipid-clearing-factor (LCF). The LCF clears up totally a turbidity caused by lipemic specimens.

Assay

Wavelength	:	500 nm, hg 546 nm
Optical path	:	1 cm
Temperature	:	20-25°C or 37°C

Measurement : Against reagent blank (Rb).
Only one reagent blank per series is required.

Pipetting scheme

HUMAN triglycerides standard provided with the test kits or separately available (Cat. No. 10163) is only used.

Pipette into cuvettes	Rb	Sample or standard
Sample/Standard	-	10 µl
Working reagent	1000 µl	1000 µl

Mix and incubate for 10 minutes at 20-25°C or for 5 minutes at 37°C. Measure the absorbance of the sample (ΔA sample) and the standard (ΔA standard) against the reagent blank within 60 minutes.

Calculation of the triglycerides concentration

$$c = 200 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mg/dl} \times 5$$

$$c = 2.28 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mmol/l} \times 5$$

ESTIMATION OF GLUCOSE

Method

The glucose is determined after enzymatic oxidation in the presence of glucose oxidase. The formed hydrogen peroxide reacts under catalysis of peroxidase with phenol and 4-aminophenazone to a red-violet quinoneimine

Reaction principle

$$\text{Glucose} + O_2 + H_2O \xrightarrow{\text{GOD}} \text{Gluconic acid} + H_2O_2$$

$$2H_2O_2 + \text{4-aminophenazone} + \text{Phenol} \xrightarrow{\text{POD}} \text{Quinoneimine} + 4H_2O$$

Contents and reagent composition in the test

1) 4 x 1000 ml or 1000 ml enzyme reagent

Phosphate buffer (pH 7.5)	...	0.10 mol/l
4-aminophenazone	...	0.25 mmol/l
Phenol	...	0.75 mmol/L
Glucose oxidase	...	=15.00 KU/l
Peroxidase	...	=1.50 KU/l
Mutarotase	...	=2.00 KU/l
Stabilizers		

2)	3 ml glucose standard	...	100.00 mg/dl or 5.55 mmol/l

Reagent preparation

The reagent and the standard are ready for use.

Reagent stability

The reagents are stable up to the given expiry date when stored at 2-8°C.

When opened contamination must be avoided. At 15-25°C the enzyme reagent is stable for 2 weeks.

Specimen

Serum and plasma.

The glucose is stable for 24 hours at 2-8°C, if serum or plasma is prepared within 30 minutes after collection.

5 cc of venous blood is drawn and taken in germ-free sterilized test tube. For separation of serum, the drawn blood is kept for at least 30 minutes at normal room temperature. After 30 minutes, supernatant fluid is separated from solid one. Specimen is now ready for use.

Serum is taken and centrifuged. Then 1 ml of reagent is taken inside one tube to be examined and another 1 ml in another tube to be used as standard.

Assay

Wavelength	:	500 nm, Hg 546 nm
Optical path	:	1 cm
Temperature	:	20-25°C or 37°C
Measurement	:	Against reagent blank. Only one reagent blank per series is required.

	Macro		Semi-micro	
Pipette into cuvettes	Standard of sample	Reagent blank	Standard or sample	Reagent blank
Standard or sample	20 µl	- 10 µl	-	
Reagent	2000 µl	2000 µl	1000 µl	1000 µl

Mix, incubate for 10 minutes at 20-25°C or for 5 minutes at 37°C. Measure the absorbance of the standard and the sample against the reagent blank within 60 minutes (ΔA).

Calculation of the glucose concentration

$$c = \frac{100}{-} \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mg/dl or}$$

$$c = 5.55 \times \frac{\Delta A \text{ (sample)}}{\Delta A \text{ (standard)}} \text{ mmol/l}$$

Linearity

The test is linear up to a glucose concentration of 400 mg/dl or 22.2 mmol/l. Dilute the sample 1+2 with distilled water, and if the glucose concentration of the sample is over this limit, repeat the determination. Multiply the result by 3.

Normal values

Serum and plasma (fasting): 75-115 mg/dl or 4.2-6.4 mmol/l.

ESTIMATION OF LDL

LDL-cholesterol was calculated as total cholesterol (TC) minus [HDL-cholesterol + Triglyceride (TG)/5].

$$TC - \left(\frac{HDL + TG}{5}\right) \text{ mg/dl}$$

STATISTICAL ANALYSIS

Average daily intake of energy, carbohydrate, protein, fat and fiber was calculated from the food composition table of nutritive value of Bangladeshi common foods[132].

Results are expressed as mean±SD. Changes from baseline values observed with study and control were analyzed by computer-based software program.

Characteristics of study and control groups at baseline level, such as weight, BMI, total cholesterol, LDL-cholesterol, HDL-cholesterol, TC/HDL ratio and glucose were compared by group 't' test and changes from baseline values observed with study and control after intervention were compared by paired 't' test.

CHAPTER FOUR

RESULTS

Among the 300 myocardial infarct patients interviewed, 60 patients completed the trial.

Table 1 showed baseline parameters of the two groups. There was no significant difference among the groups in any of the parameters.

Table 2 showed the daily mean nutrients intake by study and control groups before and after intervention.

Fig. 1 showed % change of fiber intake by study and control groups after intervention. Their habitual fiber intake was about 15 g/day. After intervention study group increased fiber intake 13 g/day, whereas control increased only 3.3 g/day.

Fig. 2 showed the educational level of all. Thirty percent were graduates, followed by 28.3% HSC pass.

Fig. 3 showed the occupation of all the patients. Forty-five percent were businessmen, followed by 35% service-holders.

Table 3 showed the change of clinical factors among study and control groups. More positive changes were found in the study group than control.

Table 4 showed BMI among study and control groups at different follow-up visits.

Fig. 4 showed the number of patients change in their BMI at different visits by two groups.

Table 5 showed the mean change of weight between 1st and 3rd visit by age. Both the groups lost weight significantly. Study group loss more (3.2 kg) than control group (2.4 kg).

Fig. 5 showed the percent change of weight change in different groups. Age group <50 years of both groups showed much reduction than age group >50 years.

Table 6 showed the mean$\pm$SD change in total cholesterol at different visits. The mean total cholesterol concentration decreased significantly in both the groups. The mean total cholesterol concentration decreased more in the study group than in the control group.

Fig. 6 showed the percent change of total cholesterol among different groups and age groups from 1st to 3rd visit. Age group <50 years in the study group showed the highest reduction (15.2%).

Table 7 showed that mean$\pm$SD LDL-cholesterol concentration decreased significantly in both the groups.

Fig. 7 showed that in percentage, reduction of LDL was higher in study group (16.3%) than control (13.2%). Study-2 showed highest reduction 20.2% (P= <0.01).

Table 8 showed the mean±SD change of HDL in two groups. After intervention, both groups showed increase of HDL-cholesterol. The study group increased HDL-cholesterol significantly (P= <0.05), and the control also increased but not significantly.

Fig. 8 showed that the gradual increment of HDL percentage among the different age groups.

Table 9 showed mean±SD triglyceride level decreased significantly in both the groups. However, the decrease in the study group was higher (29%) than the control group (25.2%).

Fig. 9 showed that after intervention, age group 50+ years of study-2 and control-2 showed higher reduction (33% and 25.9%) than age group <50 years of study-1 and control-1 (23.% and 24.5%, respectively) of their TG level.

Table 10 showed that more study subjects reduced their total cholesterol to HDL-cholesterol ratio level than cntrol (23.3% and 16.6%, respectively).

Table 11 showed that after intervention, both the groups shows decreased glucose level, but not significantly. In the study group, the decrease was by 10.2% ($P = > 0.05$) and in the control group was by 8.8% ($P = > 0.10$).

Table 12 showed that in both the groups, the mean$\pm$SD systolic blood pressure decreased significantly, study group was 6.8% ($P = < 0.01$) and control was 4.6% ($P = < 0.01$), but not the diastolic pressure.

Table 1. Baseline parameters of two groups before trial

Parameters	Study (n=30)	Control (n=30)	P value
Age (years)	50.43±5.9	49.73±6.4	NS
Height (cm)	163.6±7.4	161.9±7.4	NS
Weight (kg)	64.8±7.9	63.6±9.3	NS
BMI (kg/m^2)	24.2±2.3	24.2±3.1	NS
Blood pressure (mmHg):			
Systolic	134.8±27.4	136.5±24.4	NS
Diastolic	89.8±27.4	90.7±10.7	NS
TC (mg/dl)	252.9±75.1	236.9±40.4	NS
LDL (mg/dl)	180.6±50.5	160.6±39.9	NS
HDL (mg/dl)	40.1±8.2	39.3±9.4	NS
TG (mg/dl)	293.0±177.3	217.1±96.4	NS
Glucose (mg/dl)	115.1±34.4	109.7±27.5	NS

NS = Not significant at >0.05 level

Table 2. Daily mean (±SD) nutrients intake by study and control groups before and after intervention

Groups/ Nutrients	Before intervention	After intervention	Difference Mean±SD	Change %
STUDY GROUP:				
Energy (kcal/day) Mean±SD	2084.7±247.1	1915.3±187.2	-169.4±201.2	8.1
Carbohydrate (g/day) Mean±SD	343.0±21.1	295.3±32.6	-47.7±26.5	5.8
%	65.8	60.0		
Protein (g/day) Mean±SD	73.4±10.5	95.8±9.4	+22.4±8.8	5.9
%	14.1	20.0		
Fat (g/day) Mean±SD	46.4±11.7	43.9±6.8	-2.5±7.2	0.1
%	20.1	20.0		
Fiber (g/day) Mean±SD	15.5±2.8	28.5±1.1	+13.0±2.2	83.9
CONTROL GROUP:				
Energy (kcal/day) Mean±SD	2080.0±262.5	2032.6±248.5	+47.4±252.2	2.3
Carbohydrate (g/day) Mean±SD	338.0±17.8	310.1±41.8	+27.9±35.1	4.0
%	65.8	61.0		
Protein (g/day) Mean±SD	77.0±12.7	94.3±12.2	+17.3±11.9	4.0
%	14.8	18.8		
Fat (g/day) Mean±SD	47.2±11.2	45.2±9.1	+2.0±11.0	0.2
%	20.2	20.0		
Fiber (g/day) Mean±SD	14.7±1.8	18.0±3.6	+3.3±2.2	22.4

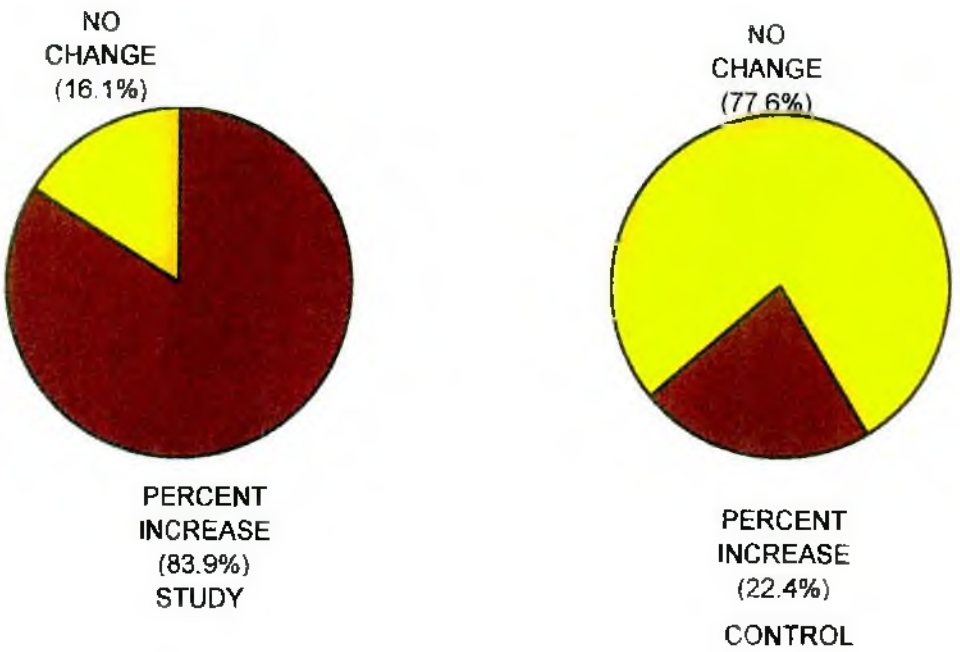


Fig. 1. Percentage change of fiber intake by study and control groups after intervention.

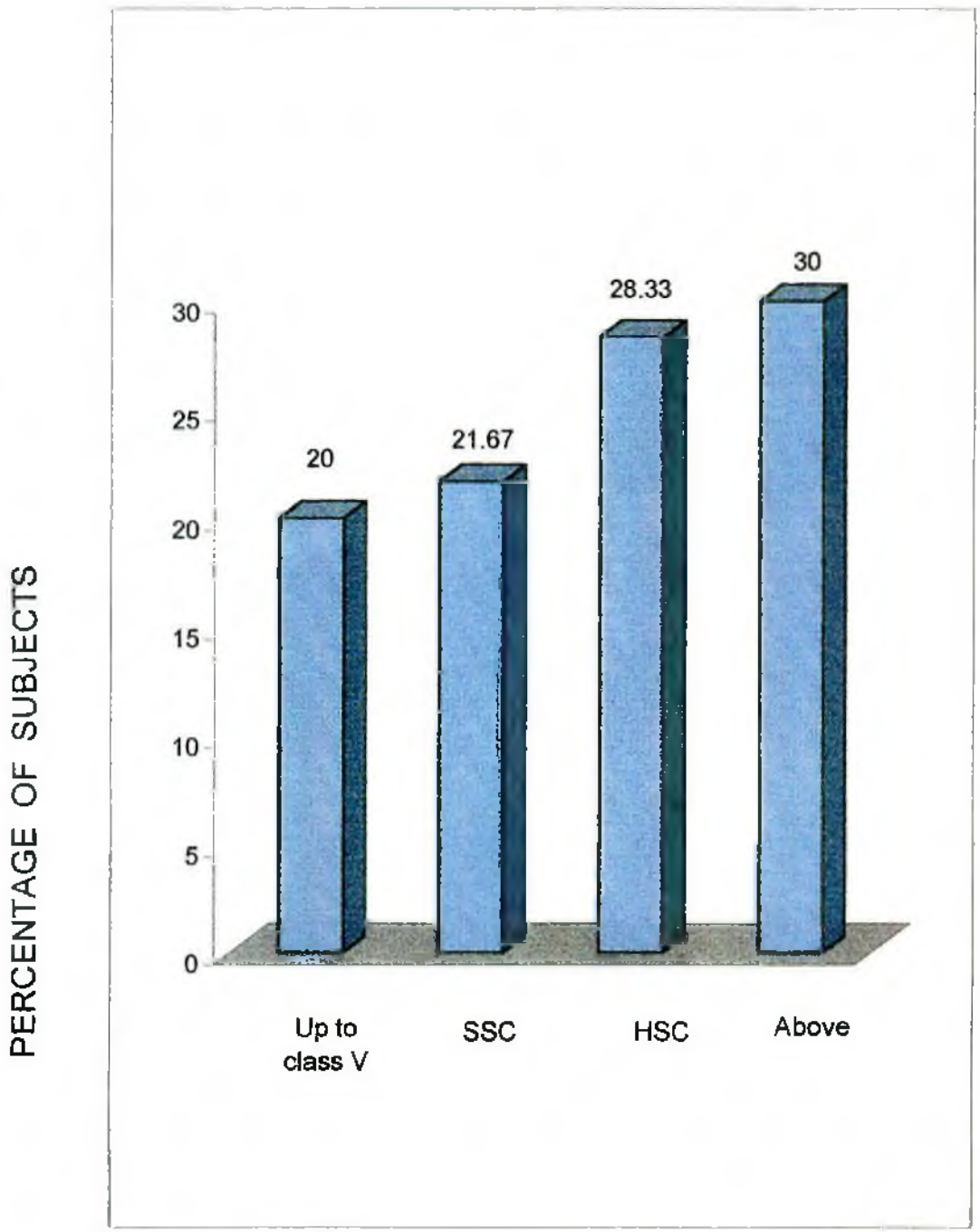


Fig. 2. Graphic reprsentation of education level of all the study subject (n= 60)

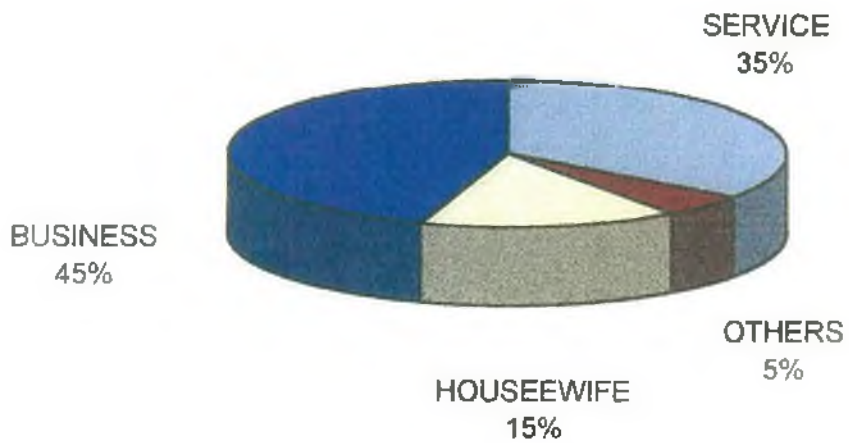


Fig. 3. Graphic representation of occupation of all the study subject (n= 60).

Table 3. Change of clinical factors among study and control groups

Parameters	Study group			Control group		
	1st visit n %	3rd visit n %	Change n %	1st visit n %	3rd visit n %	Change n %
Hypertension						
Systolic < 140 mmHg	20 66.7	24 80.0	4 20.0	19 63.3	22 73.3	3 10.5
Diastolic < 90 mmHg	7 23.3	10 33.3	3 42.8	7 23.3	8 26.7	1 14.3
Smoker ≥ 10 cigarettes/day	10 33.3	1 3.3	9 90.0	18 60.0	2 6.7	6 33.3
Overweight BMI > 25 kg/m^2	12 40.0	5 16.7	7 58.3	14 46.7	7 23.3	5 35.7

Table 4. Change of BMI among study and control groups at different follow-up visits

Visits/ group	Body mass index (BMI) (kg/m^2)					
	Underweight (<18.5)		Normal (18.5-24.9)		Overweight (>25.0)	
	No.	%	No.	%	No.	%
1st visit:						
Study	0		18	60.0	12	40.0
Control	2	6.7	14	46.7	14	46.7
2nd visit:						
Study	0		22	73.3	8	26.7
Control	2	6.7	18	60.0	10	33.3
3rd visit:						
Study	0		25	83.3	5	16.7
Control	2	6.7	19	63.3	9	30.0

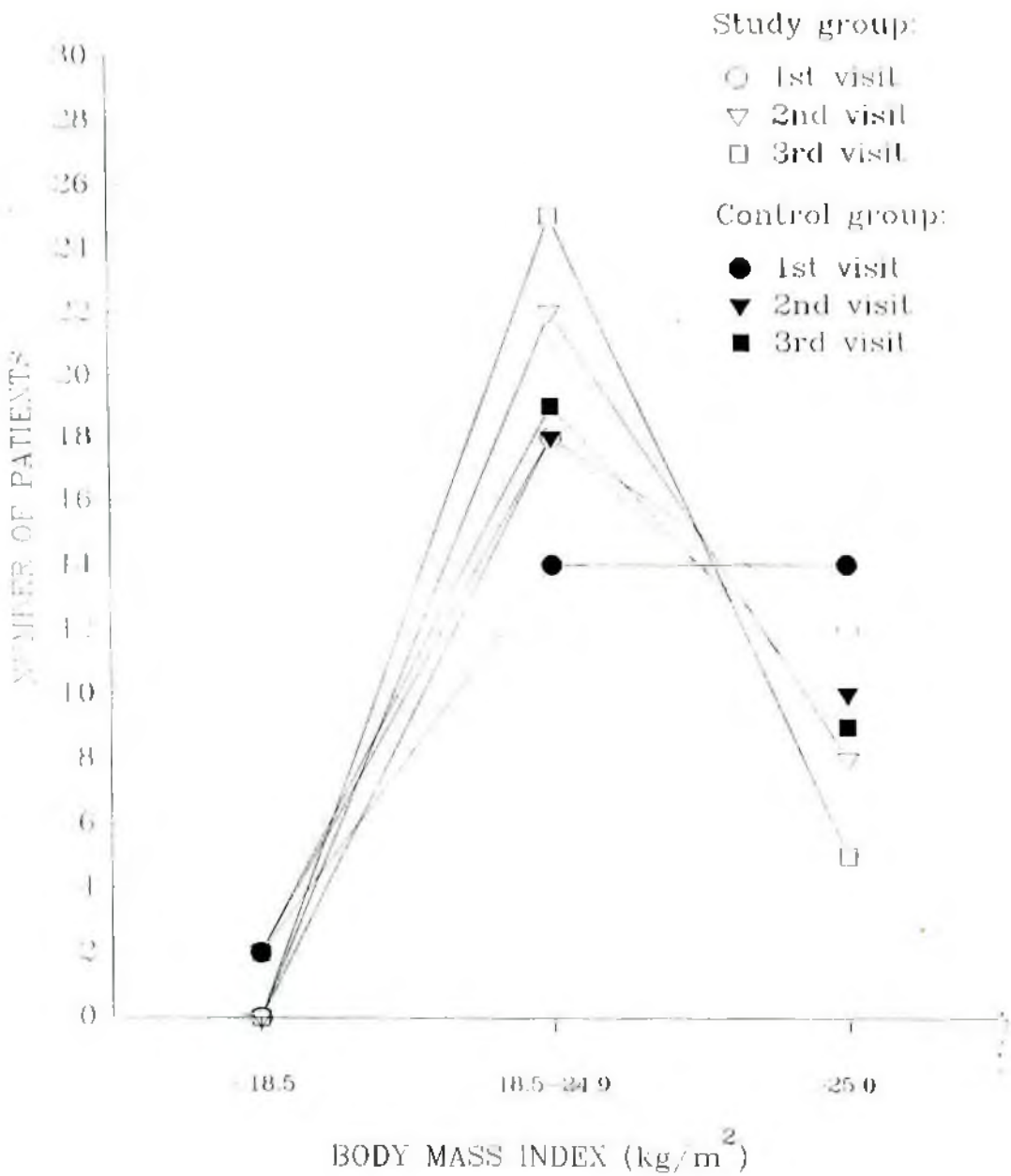


Fig. 4. Number of patients change in their BMI at different visits by two groups.

Table 5. Change in weight from 1st to 3rd visit by age

Study group	Age group (yrs)	Weight (kg) [mean±SD] 1st visit	3rd visit	Difference Mean±SD	Change %	P value
Study						
	<50 (n=13)	64.8 ±7.1	60.9 ±6.9	-3.9 ±1.9	6.0	<0.001***
	50+ (n=17)	64.8 ±8.6	62.1 ±9.0	-2.7 ±1.6	4.2	<0.001***
	Total (n=30)	64.8 ±7.9	61.6 ±8.0	-3.2 ±1.8	4.9	<0.001***
Control						
	<50 (n=15)	66.9 ±6.1	63.7 ±5.8	-3.2 ±2.0	4.8	<0.001***
	50+ (n=15)	60.3 ±10.8	58.7 ±9.4	-1.6 ±2.8	2.7	<0.05*
	Total (n=30)	63.6 ±9.3	61.2 ±8.1	-2.4 ±2.5	3.8	<0.001***

*Significant
***Highly significant

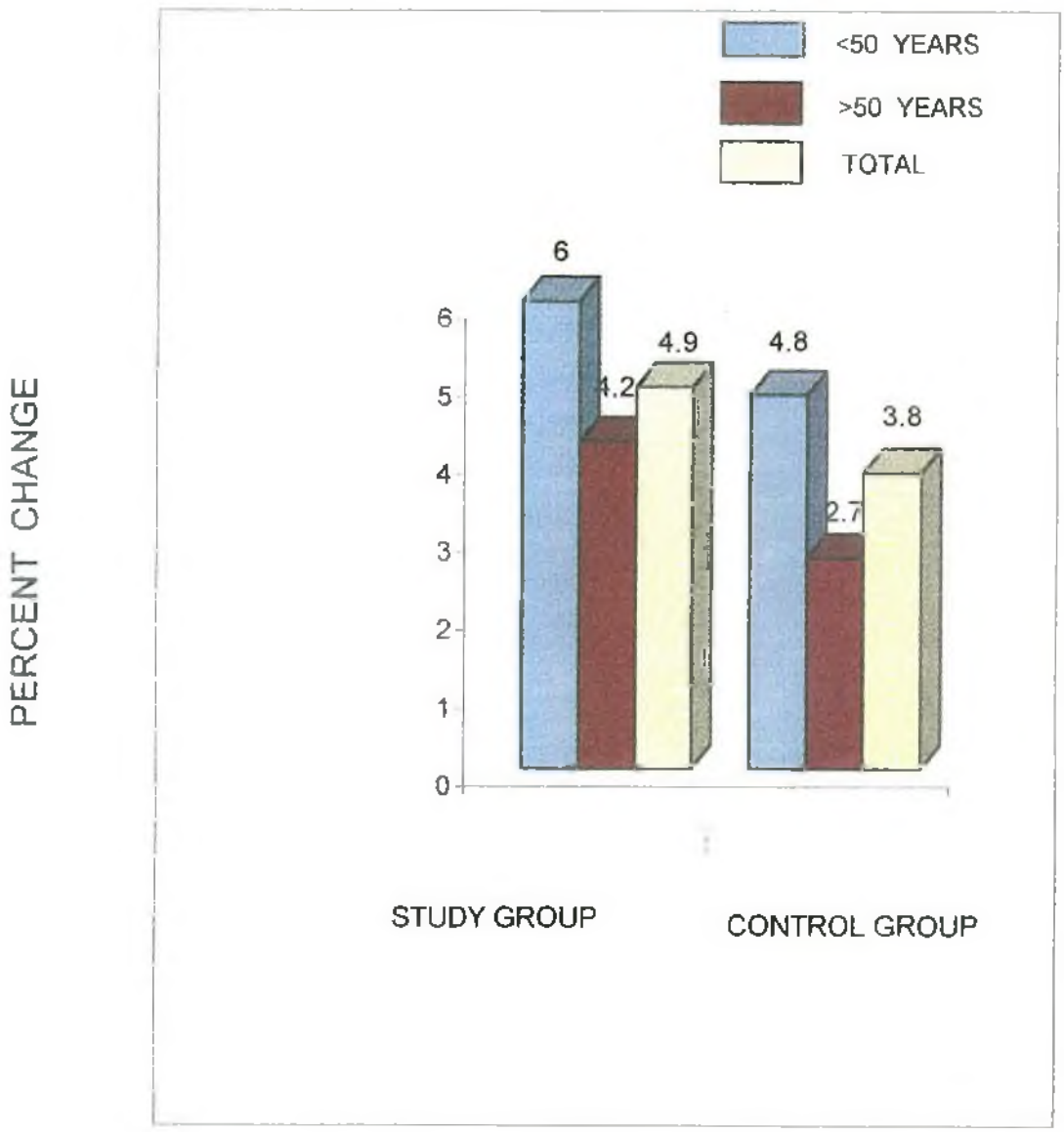


Fig. 5. Percent change of weight among different groups from 1st to 3rd visit

Table 6. Change in total cholesterol level from 1st to 3rd visit by age

Study group	Age group (yrs)	Total cholesterol (mg/100 ml) (mean±SD) 1st visit	3rd visit	Difference Mean±SD	Change %	P value
Study						
	<50 (n=13)	250.5 ±27.1	212.4 ±19.2	-38.1 ±25.3	15.2	<0.001***
	50+ (n=17)	254.6 ±98.3	219.2 ±57.9	-35.4 ±48.6	13.9	<0.01**
	Total (n=30)	252.9 ±75.1	216.3 ±44.9	-36.6 ±39.6	14.5	<0.001***
Control						
	<50 (n=15)	236.7 ±36.5	203.9 ±22.3	-32.7 ±25.9	13.8	<0.001***
	50+ (n=15)	237.1 ±45.2	202.9 ±21.1	-34.2 ±37.1	14.4	<0.01**
	Total (n=30)	236.9 ±40.4	203.4 ±21.4	-33.5 ±31.4	14.1	<0.001***

**Moderately significant
***Highly significant

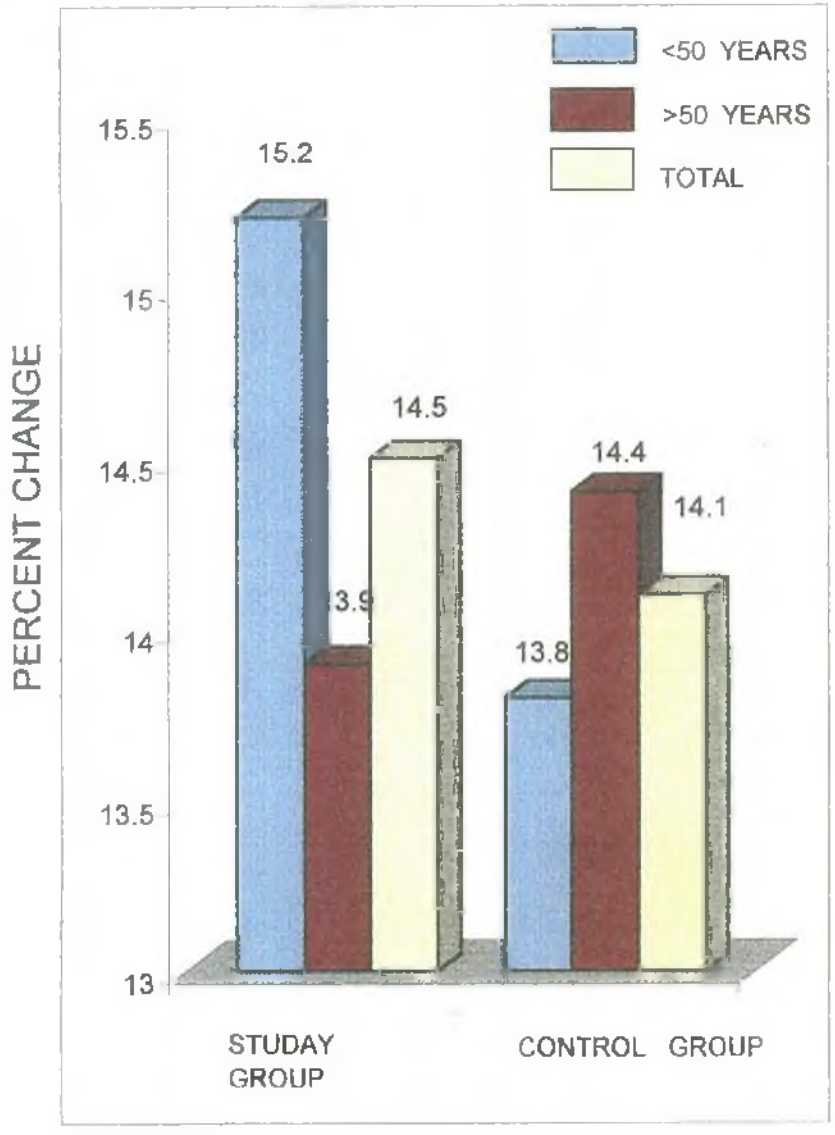


Fig. 6. Percent change of total cholesterol among different groups from 1st to 3rd visit.

Table 7. Change in low-density lipoprotein (LDL) cholesterol level from 1st to 3rd visit by age

Study group	Age group (yrs)	LDL cholesterol (mg/100 ml) (mean±SD) 1st visit	3rd visit	Difference Mean±SD	Change %	P value
Study						
	<50 (n=13)	147.0 ±22.3	129.9 ±19.9	-17.1 ±22.6	11.6	<0.05*
	50+ (n=17)	178.3 ±47.6	142.2 ±38.5	-36.1 ±40.8	20.2	<0.01**
	Total (n=30)	162.7 ±39.9	136.1 ±30.7	-26.6 ±33.8	16.3	<0.001***
Control						
	<50 (n=15)	173.1 ±42.4	148.5 ±37.9	-24.5 ±27.7	14.2	<0.01**
	50+ (n=15)	186.3 ±56.6	163.1 ±48.1	-23.2 ±34.8	12.5	<0.05*
	Total (n=30)	180.6 ±50.5	156.8 ±43.9	-23.8 ±31.4	13.2	<0.001***

*Significant
**Moderately significant
***Highly significant

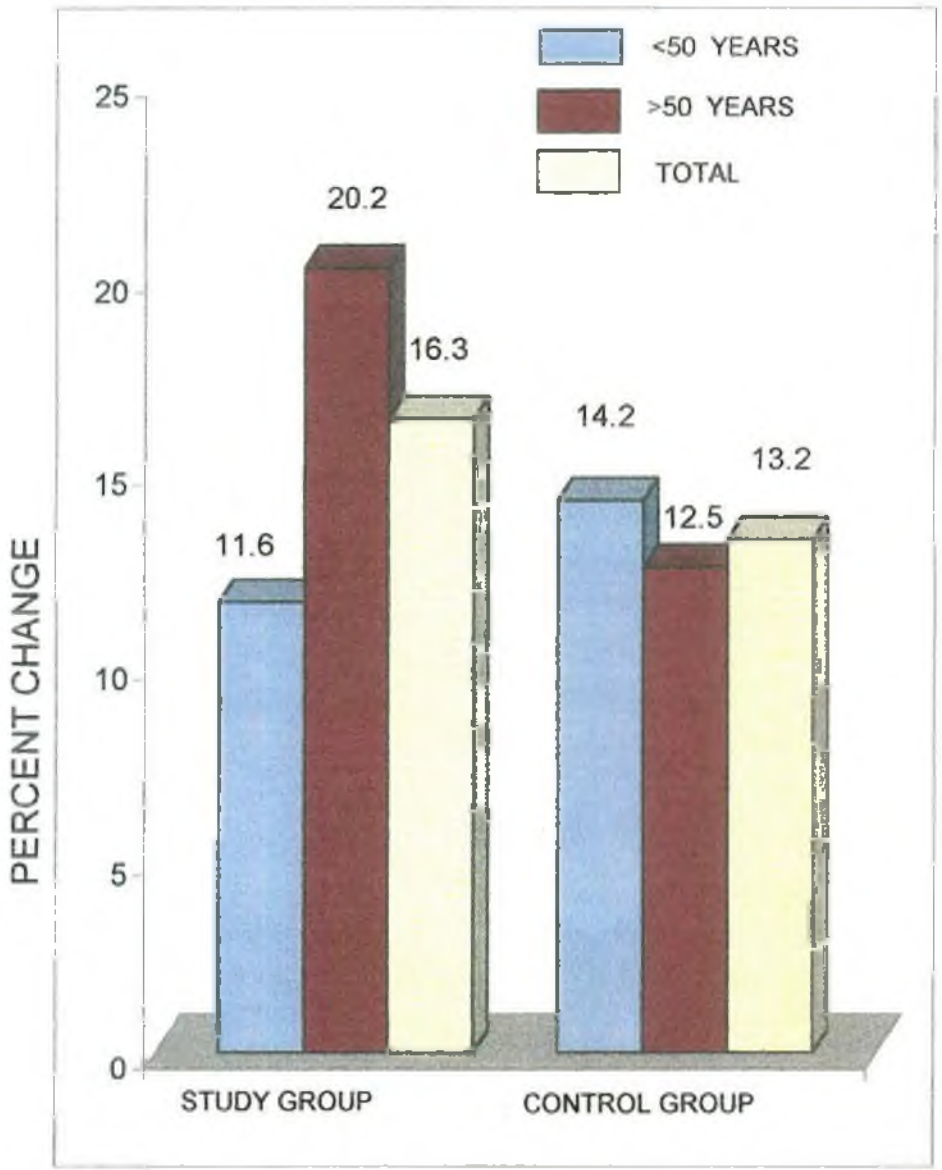


Fig. 7. Percent change of LDL- cholesterol levels among different goups from 1st to 3rd visit.

Table 8. Change (%) in high-density lipoprotein (HDL) cholesterol level between 1st and 3rd visit of the study and control groups of subjects according to age

Study group	Age group (yrs)	HDL cholesterol (mg/100 ml) (mean±SD) 1st visit	3rd visit	Difference Mean±SD	Change %	P value
Study						
	<50 (n=13)	42.5 ±10.2	44.9± ±12.2	+2.3 ±7.1	5.4	>0.10[NS]
	50+ (n=17)	36.1 ±7.5	40.7 ±8.6	+4.5 ±7.7	5.5	>0.10[NS]
	Total (n=30)	39.3 ±9.4	42.8.6 ±10.6	+3.4 ±7.4	8.6	<0.05*
Control						
	<50 (n=15)	41.2 ±7.8	40.6 ±6.4	-0.6 ±7.8	1.4	>0.10[NS]
	50+ (n=15)	39.3 ±8.7	44.8 ±9.2	+5.5 ±7.9	14.0	<0.05*
	Total (n=30)	40.1 ±8.2	43.0 ±8.2	+2.8 ±8.3	7.2	>0.05[NS]

*Significant
[NS]Not significant

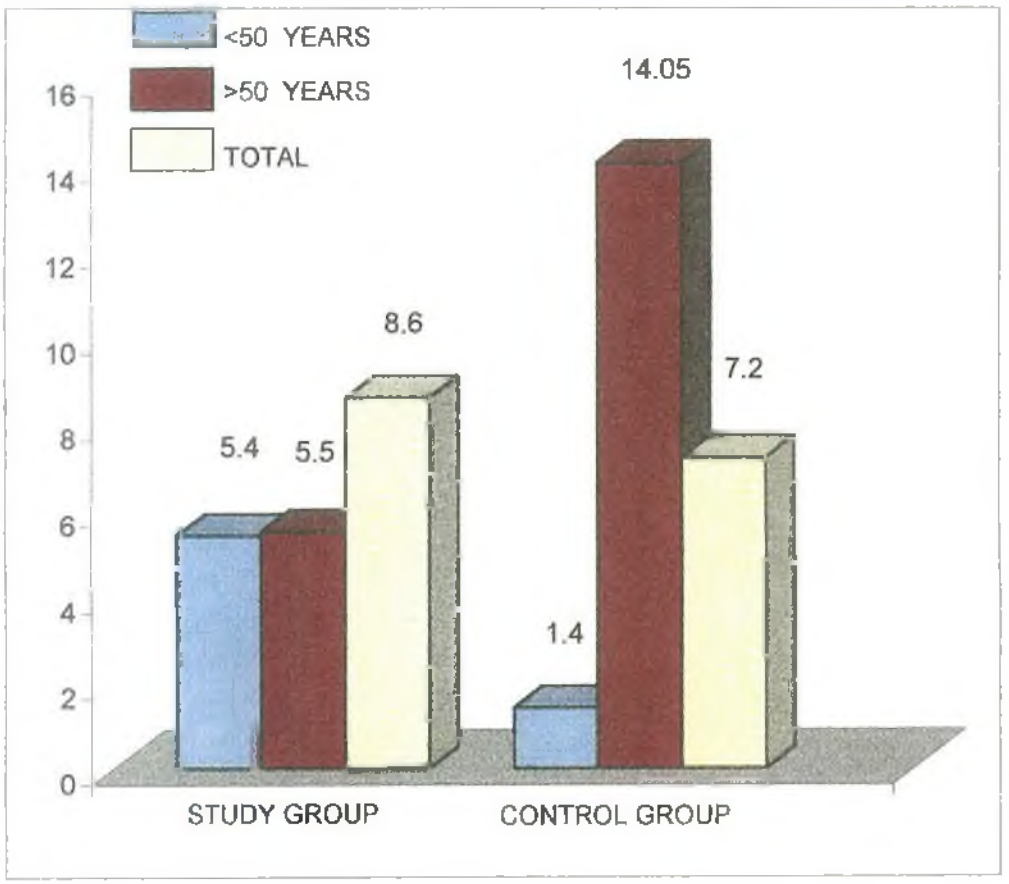


Fig. 8. Percent change of HDL - cholesterol levels among different groups from 1st to 3rd visit.

Table 9. Change in triglyceride (TG) level from 1st to 3rd visit by age

Study group	Age group (yrs)	Triglyceride (TG) (mg/dl) (mean±SD) 1st visit	3rd visit	Difference Mean±SD	Change %	P value
Study						
	<50 (n=13)	271.5 ±157.7	207.7 ±132.4	-63.8 ±79.2	23.5	<0.05*
	50 (n=17)	309.5 ±194.1	207.6 ±137.3	-101.9 ±110.5	33.0	<0.01**
	Total (n=30)	293.0 ±177.4	207.6 ±132.9	-85.4 ±98.5	29.0	<0.001***
Control						
	<50 (n=15)	206.9 ±105.8	156.1 ±94.5	-50.7 ±49.7	24.5	<0.001***
	50+ (n=15)	227.3 ±88.6	168.5 ±64.9	-58.8 ±79.7	25.9	<0.05*
	Total (n=30)	217.1 ±96.4	162.3 ±79.9	-54.8 ±65.4	25.2	<0.001***

*Significant
**Moderately significant
***Highly significant

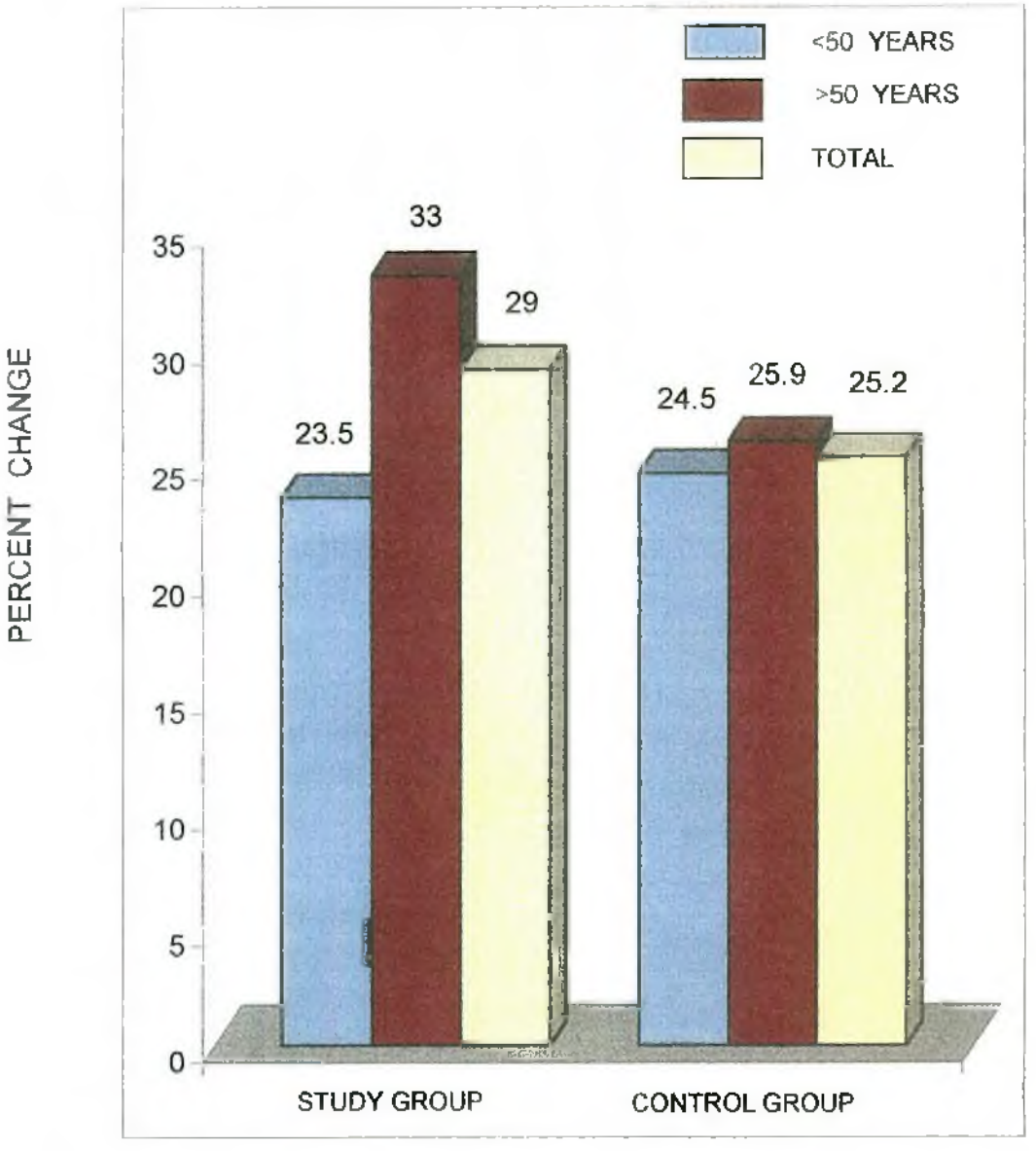


Fig . 9. Percent change of triglyceride levels among different groups from 1st to 3rd visit.

Table 10. Change in TC/HDL from 1st to 3rd visit by age

Groups	TC/HDL ratio level	1st visit n %	3rd visit n %	Difference	Change %
Study	<=4.5	1 (3.3)	8 (26.7)	7	23.3
	>4.5	29 (96.7)	22 (73.3)		
Control	<=4.5	2 (6.7)	7 (23.3)	5	16.6
	>4.5	28 (93.3)	23 (76.7)		

Table 11. Change in glucose level from 1st to 3rd visit by age

Study group	Age group (yrs)	Glucose (mmol/L) (mean±SD) 1st visit	3rd visit	Difference Mean±SD	Change %	P value
Study						
	<50 (n=13)	121.8 ±42.0	95.8 ±13.9	-26.0 ±42.2	21.3	$<0.05^{*}$
	50+ (n=17)	109.9 ±27.6	108.9 ±27.1	-1.0 ±19.2	0.9	$>0.10^{NS}$
	Total (n=30)	115.1 ±34.4	103.3 ±23.0	-11.8 ±33.1	10.2	$>0.05^{NS}$
Control						
	<50 (n=15)	113.2 ±33.8	97.1 ±13.4	-16.1 ±33.1	14.2	$>0.05^{NS}$
	50+ (n=15)	106.2 ±20.0	102.9 ±20.8	-3.3 ±26.2	3.1	$>0.10^{NS}$
	Total (n=30)	109.7 ±27.5	100.0 ±17.5	-9.7 ±30.4	8.8	$<0.10^{NS}$

*Significant
NSNot significant

Table 12. Change in systolic and diastolic blood pressure levels from 1st to 3rd visit by age

Study group	Age group (yrs)	Blood pressure (mmHg) (mean±SD) 1st visit Syst	1st visit Dias	3rd visit Syst	3rd visit Dias	Difference Mean±SD	Change % Syst/Dias	P value Syst/Dias
Study								
	<50 (n=13)	138.9 ±32.2	92.7 ±13.6	126.1 ±23.5	92.3 ±7.7	-12.7±21.9/ -0.4±11.6	9.0/ 0.4	>0.05^{NS}/ >0.10^{NS}
	50+ (n=17)	131.8 ±23.7	87.6 ±8.1	125.3 ±20.1	90.3 ±6.0	-6.5±6.8/ +2.6±7.1	4.9/ 3.0	<0.001***/ >0.10^{NS}
	Total (n=30)	134.8 ±27.4	89.8 ±27.4	125.7 ±19.5	89.3 ±7.2	-9.2±15.3/ -0.5±8.1	6.8/ 0.6	<0.01**/ >0.10^{NS}
Control								
	<50 (n=15)	136.7 ±27.4	92.7 ±13.0	127.7 ±20.5	90.7 ±7.0	-9.0±15.0/ -2.0±10.8	6.6/ 2.1	<0.05*/ <0.10^{NS}
	50+ (n=15)	136.3 ±21.9	88.7 ±7.2	126.3 ±16.7	90.0 ±9.0	-10.0±10.0/ +1.3±10.9	1.3/ 1.5	<0.01**/ <0.10^{NS}
	Total (n=30)	136.5 ±24.4	90.7 ±10.7	130.2 ±19.9	90.3 ±8.0	-6.3±10.3/ -0.4±10.8	4.6/ 0.4	<0.01**/ >0.10^{NS}

*Significant
**Moderately significant
***Highly significant
^{NS}Not significant

CHAPTER FIVE

DISCUSSION

Among the 300 patients interviewed, 69 patients were dropped because 39 of them died and 30 of them did not want to enter in this trial. In spite of repeated motivation, 241 patients entered initially, 120 of them were study and 121 were control. But 154 patients dropped out of the study after one month because they failed to comply with our instructions. Some of them did not come for follow-up and the others did not follow our instructions. Among the patients who successfully completed their third visit, 30 were in the study group and 30 were in the control group.

Our sample size was small because of the following limitations: (a) discontinuation, (b) death, and (c) migration of patients.

In our observation, age group 50+ years had the highest (53.3%) incidence of acute myocardial infarction (AMI) and is comparable with the findings of Faiz *et al.*[133]. They also found that the age group 51-60 years had the highest incidence of AMI.

Two groups had similar age, height, BMI, blood pressure and lipid concentrations (Table 1) at baseline level. They also consumed similar proportion of calories from each of the macronutrients (protein, fat, carbohydrates) and dietary fiber (Table 2).

After intervention, compliance with fiber intake was good in the study group, and a reasonable difference was achieved between daily fiber intakes of the study and control groups (28.5 g and 18.0 g, respectively, according to the questionnaires). Similar results were found by Burr *et al.*[134].

Most of our subjects had higher educational background and half of them were business people who had a tensed life.

After intervention, study group showed positive changes of factors associated with MI (Table 3). Our dietary advice showed favorable effect on blood pressure of the hypertensive patients. High fiber diet may be mildly hypotensive, vegetarians exhibited lower blood pressure than nonvegetarians[135]. DASH trial also demonstrated that increased intake of fruits and vegetables by Americans showed a significant favorable effect on blood pressure[136]. We found that 9 smokers out of 10 study smokers stopped smoking (by questioning them). With the doctors advice to stop smoking, our advice may emphasized the advice. The Oslo study also found consumption of tobacco fell about 45% more in the intervention group than in the controls[45]. The Coronary Drug Project reported that after one or more MI, cessation of cigarette smoking improved long-term prognosis[137].

Significant weight losses were shown in both of our groups (Table 5). Study group reduced 3.2±1.8 kg mean weight and control 2.4±2.5 kg. Similar weight reductions were found in studies conducted by Jenkins *et al.*[36].

We found that both the groups showed decrease in total cholesterol, LDL-cholesterol and triglyceride concentrations significantly. Study group showed more reduction in total cholesterol, LDL-cholesterol and triglyceride than that seen in control. Study group reduced total cholesterol 14.5%, LDL-C 16.3% and TG 29%, and control diet 14.1%, 13.2% and 25.2%, respectively. For each 1% reduction in the serum cholesterol level, a 2% reduction in the incidence of CHD is expected[66,67]. So, 14.5% reduction found by our study should reduce CHD risk by 29%. There was 13 g (83.9%) increase in fiber consumption in study group. It has been suggested that a 5 to 10 g increase in dietary soluble fiber will reduce serum total cholesterol by approximately 5%[138].

The lipid changes we observed provide additional support for dietary advice to increase the intake of foods high in soluble fiber. Similar lipid changes were noted in studies on the regression of human arteriosclerosis that incorporated dietary change[139-141].

Experimental studies suggested that fiber may reduce risk of coronary heart disease through cholesterol reduction from increased bile acid

excretion and decreased hepatic synthesis of cholesterols[35,36] slowed absorption of macronutrients[141] and increased satiety[143], leading to overall lower energy intake.

In our study, HDL-cholesterol increased in study group significantly, 8.6% ($P = < 0.05$). Some reduction in HDL-cholesterol was associated with many of the currently recommended dietary changes that reduce serum lipid levels[144]. A little elevation of HDL found in our study (Table 8) may be because most of our smokers gave up their smoking habits after intervention and we worked with myocardial infarct patients whose HDL decreased markedly after myocardial infarction[145]. Each 1 mg/dl increase in HDL-C from baseline was associated with a 4.4% reduction in CHD risk[89].

Total cholesterol to HDL-cholesterol ratio are used as predictors of CHD risk. Ratio of total cholesterol to HDL-cholesterol higher than 4.5 is considered to place a person at high risk of CHD. We observed that all the four age groups of our subjects had higher ratio at baseline levels. After intervention, all age groups had significantly reduced ratio (Table 10). After intervention, more study subjects reduced their TC/HDL ratio at $< = 4.5$ level than control (23.3% and 16.6%, respectively) (Table 11) and the reduction reduced their risk at a level of moderate risk.

The mean blood pressure and glucose level were not affected due to our intervention. Their systolic blood pressure decrease a little in both the groups ($P = < 0.01$) but diastolic blood pressure did not ($P = > 0.10$). And our subjects had normal glucose level when the study began.

Dietary advice after an attack of MI is well accepted by patients with benefit.

We can conclude that dietary advice can encourage the public to modify their eating habits and reduces the lipid risk of MI subjects.

So this study showed that informative advice can bring about significant changes on serum lipid levels and smoking habits of myocardial infarct patients for the secondary prevention.

SUMMARY AND CONCLUSION

Coronary heart disease (CHD) is the commonest form of heart disease and the single most important cause of premature death in the developed and developing countries. Myocardial infarction is the leading cause of death and the most frequent cause of early invalidism. MI is the second major cause of death in Bangladesh. Those who have survived an attack, live with the risk of further attack. The way out for surviving MI patients are: (a) drugs and (b) diet. High cholesterol level is common among MI patients and currently available cholesterol-lowering drugs are associated with considerable side-effects. So, more attention should be placed on nutritional measures for lowering serum cholesterol. Modification of dietary habits, therefore, plays a pivotal role in the therapy for all types of hyperlipidemia. Increased consumption of total dietary fiber may reduce the risk of CHD through cholesterol reduction. Patients who have just survived a MI are usually keen to help themselves and may be particularly receptive to any dietary changes. We took that opportunity to change the dietary habits of MI patients by dietary advice for secondary prevention. We tried to find out the effect of dietary advice about low-fat high-fiber diet on blood lipids of the MI patients.

Sixty patients of myocardial infarction were studied in National Institute of Cardiovascular Diseases (NICVD), Dhaka, between 1st October 1993 and 30th December 1995.

Subjects were randomly divided into two groups, study (n=30) and control (n=30). Study group received diet sheet where according to their energy requirement, 60% of calories came from carbohydrate, 20% from fat and 20% from protein, and total dietary fiber was about 30 g/day. For dietary fiber, study group depended on cereal, fruits and vegetable and control group received none except the advice given by the cardiologist. Both groups received regular drug treatment as advised by the cardiologist.

After intervention, both the groups were found to have reduced total cholesterol, LDL-cholesterol and triglyceride significantly. Greater decrease was seen in the study group than control. The total cholesterol reduced 14.5% and 14.1% (P=<0.001), LDL-cholesterol 16.3% and 13.2% (P=<0.001) and triglyceride 29% and 25.2% (P=<0.001), respectively. HDL-cholesterol increased by 8.6% (P=<0.05) in the study group. The ratio of TC/HDL decreased significantly in study and control groups by 20.6% and 20.3% (P=<0.001), respectively. There was significant weight reduction in study group (P=<0.001) and most of our smokers stopped smoking.

The cholesterol reduction in our study showed reduced CHD risk by 29%. The increase of HDL-cholesterol found in our study showed reduced CHD risk by 15.9%. The TC/HDL ratio, weight change, change of smoking habits all showed favorable change in our study.

Dietary advice after an attack of MI is well acceptable by patients with benefit. Dietary advice can encourage the public to modify their eating habits and reduce the serum lipid risk of myocardial infarct patients.

We conclude that modification of MI patients' diet by informative advice can bring about significant change on serum lipid levels and smoking habits for the secondary prevention of myocardial infarction.

REFERENCES

1. Rahman S, Rahmatullah, Wahab MA, Akanda MAK. Pattern of cardiovascular disease in hospitalized patients. A prospective study in NICVD, Dhaka. J Dhaka Med Coll 1997; 6:31-3.

2. Boon NA, Fox KAA. Diseases of the cardiovascular system. In: Edwards CRW, Bouchier IAD, Hasbell C, Chilves ER, editors. Davidson's Principles and Practie of Medicine. 17th ed. ELBS, London, 1995: 192-312.

3. Keys A, Aravanis C, Blackburn H, Buchem FSP, Bujina R, Djordjevic BS, *et al*. Probability of middle aged men developing coronary heart disease in five years. Circulation 1972; 45:815-28.

4. Pooling Project Research Group. Relationship of blood pressure, serum cholesterol, smoking habit, relative weight and ECG abnormalities to incidence of major coronary events. Final report of the Pooling Project. J Chronic Dis 1978; 31:201-306.

5. Levy RI. Cholesterol and oronary artery disease. What do clinicians do now? Am J Med 1986; 80:13-22.

6. Heis G, Johnson NJ, Reiland S, Davis CE, Tyroler HA. The epidemiology of plasma high density lipoprotein cholesterol levels. The Lipid Research Clinics Program Prevalence Study: Summary. Circulation 1980; 62(Suppl 4):116-36.

7. Gordon T, Castelli WP, Hjortland MC, Kannel WB, Dawber TR. High density lipoprotein as a protective factor against coronary heart disease: The Framingham study. Ann Intern Med 1977; 90:85-8.

8. Kannel WB, Castelli WP, Gorton T. Cholesterol in the prediction of atherosclerotic disease. New perspectives bases on Framingham study. Ann Intern Med 1979; 90:85-91.

9. Gordon DJ, Probstfield JL, Garrison RJ. High density lipoprotein cholesterol and cardiovascular disease. Four prospective American studies. Circulation 1989; 79:8-15.

10. Castelli WP, Garrison RJ, Wilson PWF. Incidence of coronary heart disease and lipoprotein cholesterol levels: The Framingham study. JAMA 1986; 256:2835-46.

11. Arntzenius AC, Kromhout D, Darth JD, Reiber JHC, Bruschke AVG, Buis B, *et al.* Diet, lipoprotein and the progression of coronary atherosclerosis. The Leiden Intervention Trial. N Engl J Med 1985; 312:805-10.

12. Carlson L, Abery H, Gustafson VK. Serum triglycerides: a risk factor for myocardial infarction but not for angina pectoris. N Engl J Med 1985; 312:1127-8.

13. Kushi LH, Lew RA, Stare FJ, Ellison CR, Lozy M, Bourke G, *et al*. Diet and 20-year mortality from coronary heart disease: the Ireland-Boston Diet Heart Study. N Engl J Med 1985; 312-811-8.

14. Hegsted DM, McGandy RB, Meyers ML, Stare FJ. Quantitative effects of dietary fat on serum cholesterol in man. Am J Clin Nutr 1965; 17:281-95.

15. Krombhout D, Borschieter EB, de Lezenne CC. Dietary fiber and 10-year mortality from coronary heart disease, cancer and all causes: the Zutphen Study. Lancet 1982; 2:518-21.

16. Armstrong BK, Mann JI, Adelstein AM, Eskin F. Commodity consumption and ischemic heart disease mortality, with special reference to dietary practices. J Chronic Dis 1975; 28:455-69.

17. Hegsted DM McGandy RB, Myers ML, Stare FJ. Quantitative effects of dietary fat on serum cholesterol in man. Am J Clin Nutr 1965; 17:281-95.

18. Keys A, Anderson JT, Grande F. Serum cholesterol response to changes in the diet. I. Iodine value of dietary fat versus 2S-P. Metabolism 1965; 14:747-58.

19. Keys A, Anderson JT, Grande F. Serum cholesterol response to changes in the diet. II. The effect of cholesterol in the diet. Metabolism 1965; 14:759-65.

20. Mieltinen M, Turpeinen O, Karvonen MJ, Elosuo R, Paavilainen E. Effect of cholesterol-lowering diet on mortality from coronary heart disease and other cause: a twelve-year cliical trial in men and women. Lancet 1972; 2:835-8.

21. Morris JN, Marr JW, Clayton DG. Diet and heart: a postscript. Br Med J 1977; 2:1307-14.

22. Garcia-Palmien MR, Sorline P, Tillotson J, Coastar R Jr, Cordero E, Rodriguez M. Relationship of dietary intake to subsequent coronary heart disease incidence: the Puerto Rico Hearth Health Program. Am J Clin Nutr 1980; 33:1818-27.

23. McGee DL, Reed DM, Yano K, Kagan A, Tillotson J. Ten-year incidence of coronary heart disease in the Honolulu Heart Program: relation to nutrient intake. Am J Epidemiol 1984; 119:667-76.

24. Trowell HC, Burkitt DP, editors. Western Disease: Their Emergency and Prevention. Edward Arnold Publishers, Ltd., London, 1981.

25. Khaw KT, Darrett-Connor E. Dietary fiber and reduced ischemic heart disease mortality rates in men and women: a 12-year prospective study. Am J Epidemiol 1987; 126:1093-102.

26. Fehily AM, Yarnell JWG, Sweetnam DM, Elwood DC. Diet and incident ischaemic heart disease: the Caerphilly study. Br J Nutr 1993; 69:303-14.

27. Gordon T, Kagan A, Garcia-Palmieri M. Diet and its relation to coronary heart disease and death in three population. Circulation 1981; 63:500-15.

28. Truslson MF, Clancy RE, Jenop WJE, Childers RW, Stare FJ. Comparisons of siblings in Boston and Ireland: physical, biochemical and dietary findings. J Am Diet Assoc 1964; 45:225-9.

29. Rimm EB, Ascherio A, Giovannucci E, Spiegelman D, Stampfer MJ, Willett WC. Vegetable, fruit and cereal fiber intake and risk of coronary heart disease among men. JAMA 1996; 275:447-51.

30. Gramenzi A, Gentile A, Fasoli M, Negri E, Parazzini F, Vecchia CL. Association between certain foods and risk of acute myocardial infarction in women. Br Med J 1990; 300:771-3.

31. National Cholesterol Education Program Expert Panel. Report on detection, evaluation and treatment of high blood cholesterol in adults. Arch Intern Med 1988; 148:36-69.

32. Key A, Anderson JT, Grande F. Serum cholesterol response to changes in the diet. IV. Particular saturated fatty acids in the diet. Metabolism 1965; 14:776-87.

33. Shepherd J, Packard CJ, Grandy SM, Yeshurum D, Gotto AMJ, Taunton OD. Effects of saturated and polyunsaturated fat diets on the chemical composition and metabolism of low density lipoproteins in man. J Lipid Res 1980; 21:91-9.

34. Trowell H. Ischemic heart disease and dietary fiber. Am J Clin Nutr 1972; 25:926-38.

35. Vahouny GV, Tomber R, Cassidy MM, Kritchevsky D, Gallo LL. Dietary fiber. V. Binding salts, phospholipids and cholesterol from mixed micelles by bile acid sequestrants and dietary fibers. Lipids 1980; 15:1012-8.

36. Jenkins DJ, Wolever TM, Rao AV. Effect on blood lipids of very high intakes of fiber in diets low in saturated fat and cholesterol. N Engl J Med 1993; 329:21-6.

37. Albrink MJ, Newman T, Davidson DC. Effect of high and low fiber diets on plasma lipids and insulin. Am J Clin Nutr 1979; 32:1486-91.

38. McKeigue PM, Miller GJ, Marmot MG. Coronary heart disease in South Asians: a review. J Clin Epidemiol 1989; 42:579-609.

39. Anon. Coronary heart disease in Indians overseas. Lancet 1986; 1:1307-8.

40. McKeigue PM, Adelstein AM, Shipley MJ, Butler SM, Riemersma RA, Turner PR. Diet and risk factors for CHD in Asian Indians in Northwest London. Lancet 1985; ii:1086-90.

41. Miller GJ, Kotecha S, Wilkinson WH. Dietary and other characteristics relevant for CHD in men of Indian, West Indian and European descent in London. Atherosclerosis 1988; 70:63-72.

42. Reddy S, Sanders TAB. Lipoprotein risk factors in vegetarian women of Indian descent are unrelated to dietary intake. Atherosclerosis 1992; 85:223-9.

43. Enas EA, Yusuf S, Mehta JL. Prevalence of coronary artery disease in Asian Indians. Am J Cardiol 1992; 70:945-9.

44. McKeigue PM, Ferrie JE, Pierpoint T, Marmot MG. Association of early onset coronary heart disease in South Asian men with glucose intolerance and hyperinsulinemia. Circulation 1993; 87:152-61.

45. Hjermann I, Byre KV, Holme I, Leren P. Effect of diet and somking intervention on the incidence of coronary yeart disease: report from the Oslo Study Group of a Randomised Trial in Healthy Med. Lancet 1981; 12:1303-10.

46. Kannel WB, Shatzkin A. Risk factor analysis. Prog Cardiovasc Dis 1984; 26:309-19.

47. American Heart Association. Dietary Treatment of Hypercholesterolemia: A Handbook for Counselors. Dallas: American Heart Association, 1988.

48. Morrison JA, Nambodiri K, Green P, Martin J, Glueck CJ. Familial aggregation of lipids and lipoproteins and early identification of dyslipoproteinemia: the Collaborative Lipid Research Clinics Family Study. JAMA 1983; 250:1860-68.

49. Moll PP, Sing CF, Weidman WH. Total cholesterol and lipoproteins in school children: prediction of coronary heart disease in adult relatives. Circulation 1983;67:127-32.

50. Hazzard WR. Atherogenesis: why women live longer than men. Geriatrics 1985; 40:42-50.

51. Kannel WB. High density lipoproteins: epidemiological profile and risks of coronary artery disease. Am J Cardiol 1983; 52:9B-15B.

52. Knipp M, Chattion M. Current Medical Diagnosis and Treatment. Los Altos: Lange Medical Publications, 1980: 195-205.

53. American Heart Association. 1989 Heart Facts. Dallas: American Heart Association, 1989.

54. Kannel WB, Doyle JT, Ostfeld AM. Optimal Resources for Primary Prevention of Atherosclerotic Disease. Dallas: American Heart Association, 1984.

55. National Institute of Health Consensus Development Conerence Statement, 1985: lowering blood cholesterol to prevent heart disease. JAMA 1985; 252:2080-90.

56. Dawber TR,Kannel WB. Susceptibility to coronary disease. Mod Concepts Cardio Dis 1961; 30:671-9.

57. Grundy SM, Bilheimer D, Blackburn H. Rationale of the diet-heart statement of the American Heart Association. Circulation 1982; 65:839A-54A.

58. Rifkind BM, Segal P. Lipid Research Clinics program referenc values for hyperlipidemia and hypolipidemia. JAMA 1983; 250:1869-72.

59. Newman WP, Freedman DS, Voors AW, Gard PD, Srinivasan SR, Cresenti JL, *et al*.. Relation of serum lipoprotein levels and systolic blood pressure to early atherosclerosis: the Bogalusa Heart Study. N Engl J Med 1986; 314:138-44.

60. Kannel WB. Lipids, diabetes and coronary heart disease: insights from the Framingham Study. Am Heart J 1985; 110:1100-20.

61. Reaven GM. Looking at the world through LDL-cholesterol glasses. J Nutr 1986; 116:1143-7.

62. Kannel WB, Gordon T, Bastelli WP. Obesity, lipids and glucose tolerance: the Framingham Study. Am J Clin Nutr 1979; 32:1238-45.

63. Stamler J. Research related to risk factors. Circulation 1979; 60:1575-89.

64. Meittinen TA, Huttunen JK, Naukkarinen V, Strandberg T, Mattila S, Kumlin T, *et al.* Multifactorial primary prevention of cardiovascular disease in middle-aged men: risk factors, changes, incidence and mortality. JAMA 1985; 254:2097-102.

65. Multiple Risk Factor Intervention Trial Research Group. Multiple Risk Factor Trial, risk factor changes and mortality results. JAMA 1982; 248:1465-77.

66. Lipid Research Clinics Program. The Lipid Research Linic's Coronary Primary Prevention Trial Results. II. The relationship of reduction of incidence of coronary heart disease to cholesterol lowering. JAMA 1984; 251:365-74.

67. Lipid Research Clinics Program. The Lipid Research Clinic's Coronary Primary Prevention Trial Results. I. Reduction in incidence of coronary heart disease. JAMA 1984; 251:351-62.

68. Hully SB, Rosenman RH, Bawol RD, Brand R. The association between triglyceride and coronary heart disease. N Engl J Med 1980; 302:1383-9.

69. Brunzell JD, Austin MA. Plasma triglyceride levels and coronary heart disease. N Engl J Med 1989; 320:1273-5.

70. Keys A, Menotti A, Aravanis C. The Seven Countries Study: 2,289 deaths in 15 years. Prev Med 1984; 13:141-60.

71. Keys A. Coronary heart disease in seven countries: American Heart Association monograph 29. Circulation 1970; 41(Suppl):1-199.

72. Shekelle RB, Shryock AM, Paul O. Diet, serum cholesterol and death from coronary heart disease: the Western Electric Study. N Engl J Med 1981; 304:65-70.

73. Stamler J, Shekelle B. Dietary cholesterol and human coronary heart disease: the epidemiological evidence. Arch Pathol Med 1988; 112:1032-6.

74. Kromhout D, Bosschieter EB, Conlander L. The inverse relation between fish consumption and 20-year mortality from coronary heart disease. N Engl J Med 1985; 312:1205-33.

75. Little A, Graves K, Suchindran CM. Customary diet, anthropometry and dyslipoproteinemia in selected North American populations: the Lipid Research Clinics Program Prevalence Study. Circulation 1986; 73:1-11.

76. Haynes SG, Feinleib M, Kannel WB. The relationship of psychological factors to coronary heart disease. Am J Epidemiol 1980; 111:37-45.

77. Jenkins CD. Recent evidence supporting psychologic and social risk factors for coronary disease. N Engl J Med 1976; 294:987-94.

78. Kwiterovich P. Beyond Cholesterol. Baltimore: University Press, 1989; 77:149-52.

79. Arteriosclerosis 1981. US Department of Health and Human Services: June 1981; 1. NIH Publication 81-3034.

80. Kaufman DW, Helmrich SP, Rosenberg L, Mietlinen OS, Shapiro S. Nicotine and carbon monoxide content of cigarette smoke and the risk of myocardial infarction in young men. N Engl J Med 1983; 308:409-13.

81. Stamford BA, Matter S, Fell RD. Cigarette smoking, exercise and high density lipoprotein cholesterol. Atherosclerosis 1984; 52:73-8.

82. Tran ZV, Weltman A, Glass GV. The effects of exercise on blood lipids and lipoproteins: a meta-analysis of studies. Med Sci Sports Exer 1983; 15:393-7.

83. Burton BT, Foster WR. Health implications of obesity: a NIH Consensus Development Conference. J Am Diet Assoc 1985; 85:1117-21.

84. Glueck CJ, Taylor HL, Jacobs D. Plasma high-density lipoprotein cholesterol: association with measurements of body mass: the Lipid Research Clinics Programm Prevalence Study. Circulation 1980; 62(Suppl 4):62-75.

85. Brennan PJ, Simpson JM, Blacket RB. Effects of body weight on serum cholsterol, serum triglycerides, serum urate and systolic blood pressure. Aust NZ J Med 1980; 10:15-23.

86. The 1984 Report of the Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure. US Department of Health and Human Services, Public Health Service, National Institutes of Health: June 1984. NIH publication 84-1088.

87. Shurtleff D. Some characteristics related to the incidence of cardiovascular disease and death: the Framingham Study, 18-year follow up. In: An Epidemiological Investigation of Cardiovascular Disease. US Department of Health, Education and Welfare, February 1984. NIH publication 74-599.

88. Veterans Administration Cooperation Study Group on Antihypertensive Agents. Effects of treatment on morbidity in hypertension. II. Results in patients with diastolic blood pressure averaging 90 through 114 mmHg. JAMA 1970; 213:1143-52.

89. Gordon DJ. Ekelund LG, Karon JM. Predictive value of teh exercise tolerance test for mortality in North American men: the Lipid Research Clinics Mortality Follow-Up Study. Circulation 1986; 74:252-65.

90. Castelli WP. Epidemiology of coronary heart disease: the Framingham Study. Am J Med 1984; 76:4-12.

91. Stamler J. Lifestyles, major risk factors, proof and public policy. Circulation 1978; 58:3-19.

92. Stamler J. Introduction to risk factors in coronary artery disease. In: McIntosh HO, editor. Cardiology Series. Northfield: Medical Communications Inc., 1978: 1-11.

93. Bonanome A, Grundy SM. Effect of dietary stearic acid on plasma cholesterol and lipoprotein levels. N Engl J Med 1988; 318:1244-8.

94. Keys A, Anderson JT, Grande F. Serum cholesterol response to changes in the diet. IV. Particular saturated fatty acids in the diet. Metabolism 1965; 14:776-87.

95. Tan MH, Dickinson MA, Albers JJ, Havel RJ, Chevng MC, Vigne JL, *et al*. The effect of a high cholesterol and saturated fat diet on

serum high-density lipoprotein-cholesterol, apolipoprotein A-7 and apolipoprotein E levels in normolipemic humans. Am J Clin Nutr 1980; 33:2559-65.

96. Grundy SM, Nix D, Whelan MF. Comparison of three cholesterol-lowering diets in normolipemic men. JAMA 1986; 256:2351-7.

97. Shepherd J, Packard CJ, Patsch JR. Effect of dietary polyunsaturated and saturated fat on properties of high density lipoproetins and the metabolism of apoprotein A-1. J Clin Invest 1978; 61:1582-8.

98. Jackson RL, Kashyap ML, Barnhart RL, Allen C, Hogg E, Glueck CJ. Influence of polyunsaturated and saturated fats in plasma lipids and lipoproeins in man. Am J Clin Nutr 1984; 39:585-97.

99. Gustafson I, Vessby B, Karlstrom B. Effects on the serum lipoprotein concentrations by lipid-lowering diets with different fatty acid compositions. J Am Coll Nutr 1985; 4:241-4.

100. Oh SY, Monaco PA. Effects of dietary cholesterol and degree of fat unsaturation on plasma lipid levels, lipoprotein composition and fecal steroid excretion in normal young adult men. Am J Clin Nutr 1985; 42:399-413.

101. Harris WS. Fish oils and plasma lipid and lipoprotein metabolism in humans: a critical review. J Lipid Res 1989; 30:785-97.

102. Nestel PJ, Connor WE, Reardon MF. Suppression by diet rich in fish oil or very low density lipoprotein production in man. J Clin Invest 1984; 74:82-7.

103. Keys A, Menotti A, Karvonen MJ. The diet and 15-year death rate in the Seven Countries Study. Am J Epidemiol 1986; 124:903-9.

104. Ernst ND, Cleeman J, Mullis R, Sooter-Bochenck J, Horn LV. The National Cholesterol Education Program: implications for dietetic practitioners from the Adult Treatment Panel Recommendations. J Am Diet Assoc 1988; 88:1401-11.

105. Burselm J, Schonfeld G, Howald MA. Plasma apoprotein and lipoprotein lipid levels in vegetarians. Metabolism 1978; 27:711-9.

106. Gear JS, Mann JI, Thorogood M, Carter R, Jelfs R. Biochemical and hematological variables in vegetarians. Br Med J 1980; 280:1415.

107. Phillips RL, Lemon FR, Beeson WL. Coronary heart diease mortality among Seventh-Day Adventists with differing dietary habits: a preliminary report. Am J Clin Nutr 1978; 31(Suppl 10):S191-205.

108. Lock DR, Varhol A, Grimes S. Apolipopotein E levels in vegetarians. Metabolism 1982; 31:917-20.

109. Nestel PJ, Billington T, Smith B. Low density and high density lipoprotein kinetics and sterol balance in vegetarians. Metabolism 1981; 30:941-5.

110. Connor WE, Cerqueira MT, Connor R, Wallace RB, Mclinow MR, Casdorph HR. The plasma lipids, lipoproteins and diet of the Tarahaumara Indians of Mexico. Am J Clin Nutr 1978; 31:1131-42.

111. Keys A, Fidanza F, Scardi V. Studies on serum cholesterol and other characteristics of clinically healthy men in Naples. Arch Intern Med 1954; 93:328-36.

112. Keys A, Kumur N, Bronte-Stewart B. Lessons from serum cholesterol studies in Japan, Hawaii and Los Angeles. Ann Intern Med 1958; 48:83-7.

113. Roberts SL, McMurray MP, Connor WE. Does egg feeding (i.e. dietary cholesterol) affect plasma cholesterol levels in humans? the resuls of a double-blind study. Am J Clin Nutr 1981; 34:2092-9.

114. Chenoweth W, Ullmann M, Simpson R. Influence of dietary cholesterol and experimental conditions on serum lipids in men. J Nutr 1981; 111:2069-76.

115. Sacks FM, Salazar J, Miller L, Sutherland M, Albers JJ, Foster JM, *et al*. Ingestion of egg raises plasma low density lipoproteins in free-living subjects. Lancet 1984; 1:647-9.

116. Burkitt DP, Trowell HC. Refined Carbohydrate Foods and Disease: The Implications of Dietary Fiber. London: Academic Press, 1975.

117. Behall KM, Lee KH, Moser PB. Blood lipids and lipoproteins in adult men fed four refined fibers. Am J Clin Nutr 1984; 39:209-14.

118. Hillman LC, Peters SG, Fisher CA, Pomare EW. The effects of the fiber components pectin, cellulose and lignin on serum cholesterol levels. Am J Clin Nutr 1985; 42:207-13.

119. Kashtan H, Stern HS, Jenkins DJA, Jenkins AL, Hay K, Marcon N, *et al*. Wheat-barn and oat-bran supplements effects on blood and lipoproteins. Am J Clin Nutr 1992; 55:876-80.

120. Heaton KW, Pomare. Effect of bran on blood lipid and calcium. Lancet 1974; 1:49-50.

121. Brown MS, Goldstein JL. A receptor-mediated pathway for cholesterol homeostasis. Science 1986; 232:34-47.

122. Steinberg D, Parthasarathy S, Carew TE, Khoo JC, Witztum JL. Modifications of low density lipoprotein that increase its atherogenicity. N Engl J Med 1989; 320:915-24.

123. Federation of American Societies for Experimental Biology. Physiological effects and health consequences of dietary fiber. Washington DC: Department of Health and Human Services, 1987.

124. Jenkins DJA, Hill MS, Cummings JH. Effect of wheat fiber on blood lipids, facial steroid excretion and fecal iron. Am J Clin Nutr 1975; 28:1408-11.

125. Perssonj I, Ruby K, Fonns-Bech P, Jensen E. Bran and blood lipids. Lancet 1975; 2:1208-12.

126. Southgate DAT, Durnin JVGA. Calorie conversion factors: An experimental reassessment of the factors used in the calculation of the energy value of human diets. Br J Nutr 1970; 24:517-22.

127. Reinhold JG, Faradji B, Abadi P, Ismail-Beigi F. Decreased absorption of calcium, magnesium, zinc and phosphorus by human due to increased fiber and phosphorus consumption as wheat bread. J Nutr 1976; 106:493-8.

128. Anderson JW, Story L, Sieling B, Chen WJ, Petro MS, Story J. Hypocholesterolemic effects of oat-bran of bean intake for hypercholesterolemic men. Am J Clin Nutr 1984; 40:1146-55.

129. Bell LP, Hectorne KJ, Reynolds H, Balm TK, Hunninghake DB. Cholesterol lowering effects of psyllium hydrophilic mucilloid: adjunct therapy to a prudent diet for patients with mild to moderate hypercholesterolemia. JAMA 1989; 261:3419-23.

130. Sidel J. Hegele and Zeigenhorn. Reagents for the enzymatic determination of serum total cholesterol with improved lypolytic efficiency. Clin Chem 1983; 29:1025-30.

131. Possati P. Prencipe L. Serum triglyceride determined colorimetrically with an enzyme that produces hydrogen peroxide. Clin Chem 1982; 28:2077-81.

132. Nutritive values of Bangladeshi foods. Institute of Nutrition and Food Science, University of Dhaka, 1986.

133. Faiz MA, Ahmed T, Kamal MA. Myocardial infarction in a district (Cox's Bazar) hospital. Bangladesh Heart J 1988; 3:6-8.

134. Burr ML, Fehely AM, Gilbert JF, Rogers S, Holliday RM, Sweetnam PM, *et al*. Effects of changes in fat, fish and fiber intakes on death and myocardial reinfarction: Diet and Reinfarction Trial (DART). Lancet 1989; 30:757-61.

135. Sacks FM, Rosmer B, Kass EH. Blood pressure in vegetarians. Am J Epidemiol 1974; 100:390-8.

136. Zemel MB. Dietary pattern and hypertension: The DASH study. A review. Nutr Rev 1997; 55:303-8.

137. Coronary Drug Project Research Group. Cigarette smoking as a risk factor in men with a prior history of myocardial infarction. J Chronic Dis 1979; 32:415-25.

138. Brown WV. A review of the cholesterol-lowering effects of soluble fiber. Presented at the second international conference on preventive cardiology. Washington DC, June 18-22, 1989.

139. Ornish D, Brown SE, Scherwitz LW. Can lifestyle changes reverse coronary heart disease? The Lifestyle Heart Trial. Lancet 1990; 3369:129-33.

140. Blankenborn DH, Johnson RL, Mack WJ, el Zein HA, Vailas LI. The influence of diet on the appearnce of new lesions in human coronary arteries. JAMA 1990; 263:1646-52.

141. Watts GF, Lewis B, Brunt JHN. Effects on coronary artery disease of lipid-lowering diet, or diet plus cholestyramine, in the St. Thomas' Atherosclerosis Regression Study (STARS). Lancet 1992; 339:563-9.

142. Cara L, Dubois C, Borel P. Effects of oat-bran, rice-bran, wheat fiber and wheat germ on postprandial lipemia in healthy adults. Am J Clin Nutr 1992; 55:81-8.

143. Raben L, Christensen NJ, Madsen J, Holst JJ, Astrup A. Decreased postparandial thermogenesis and fat oxidation but increased fullness after a high-fiber meal compared with a low-fiber meal. Am J Clin Nutr 1994; 59:1386-94.

144. Schaefer EJ, Levy RI, Ernst ND, Van Sant FD, Brewer HB Jr. The effects of low cholesterol, high polyunsaturated fat, and low fat diets on plasma lipid and lipoprotein cholesterol levels in normal and hypercholesterolemic subjects. Am J Clin Nutr 1981; 34:1758-63.

145. Ryder REJ, Hayes TM, Mulligan IP, Kingswood JC, Williams S, Owens DR. How soon after myocardial infarction should plasma lipid values be assessed? Br Med J 1984; 289:1651-3.

Annexure-I

DATA COLLECTION SHEET

The effect of dietary advice on nutrient intake for the prevention of myocardial infarction

Date	:				
Name	:				
Address	:				
Telephone No.	:				
Sex	:	Male/Female			
Age (years)	:				
Educational level	:				
Occupation	:				
Height (cm)	:				
Number of family member	:				
Ideal weight (kg)	:				
		Present	Later	Later	
Weight (kg)	:				
Date	:				
Blood pressure (mmHg)	:				
Date	:				

When myocardial infarction occurred (date) :

Do you have any other disease : Yes/No
If yes, type :

Blood test reports		Present	Later	Later
Total cholesterol (mg/dl)	:			
HDL-cholesterol (mg/dl)	:			
LDL-cholesterol (mg/dl)	:			
Triglyceride (mg/dl)	:			
Glucose (mg/dl)	:			

Family history

Diabetes : Yes/No
Father/Mother/Both

Blood pressure : Yes/No
Father/Mother/Both

Myocardial infarction : Yes/No
father/Mother/Both

Smoking habit : Yes/No
If yes, sticks/day :
Duration of smoking (years) :

Normal food pattern:

Breakfast (_____a.m.)
1)
2)
3)
4)
5)
6)

Light refreshment (_____ a.m.)
1)
2)
3)
4)
5)
6)

Lunch (_____ p.m.)
1)
2)
3)
4)
5)
6)

Light refreshment (_____ p.m.)
1)
2)
3)
4)
5)
6)

Dinner (_____ p.m.)
1)
2)
3)
4)
5)
6)

Before going to bed (_____ p.m.)
1)
2)

Oil used for all kinds of cooking : Kg/month/week _____ _____ person

If you eat or drink more than above-mentioned :

Time :
What :

Time	:	
What	:	
Do you take table salt	:	Yes/No
Physical exercise	:	Yes/No
How much time do you walk every day (hours)	:	
Type of work	:	Light/Medium/Heavy
Drug advice	:	

Annexure-II

Steps followed for calculating individual diet for study group

1) Estimate energy requirements

Approximate energy needs:

- Weight maintenance (light work)
  30 calories/kg actual body weight
- Weight maintenance (medium work)
  35 calories/kg actual body weight
- Weight maintenance (heavy work)
  40 calories/kg actual body weight
- Weight reduction (gradual)
  10 calories/kg actual body weight

2) Distribute calories

Multiply calorie level by:

- Carbohydrate 60%
- Protein 20%
- Fat 20%

3) Convert calories to grams

Divide:
- Carbohydrate by 4 calories/g
- Protein by 4 calories/g
- Fat by 9 calories/g

4) Translate grams into exchanges

Begin with essential exchanges:

- Multiply the exchanges for each group by exchange-group nutrient values for carbohydrate, protein, fat, fiber and calories

5) Distribute exchanges into meals and snacks

Individualize according to diet history

Sample menu of a study subject

Contents:

Energy	2000 calories/day
Carbohydrate	60% of energy = 300 g
Protein	20% of energy = 100 g
Fat	20% of energy = 44.45 g
Fiber	30 g/day

Calculation of meal pattern:

Foods	No. of exch	CHO	Prot	Fat	Fiber
Milk (non-fat)	1	12	8	-	-
Fruits	2	10	-	-	7.5
Vegetables	6	30	12	-	12
Salads	2	-	-	-	4
Dahl (medium con)	2	12.8	5.4	1.4	0.5
		64.8 g	25.4 g	1.4 g	24.0 g

Dinner:	
Rice	3 cups
Fish	9 g
Vegetables	2 cups
Salad	1 cup
Dahl	30 g
Before going to bed:	
Milk	1 glass