LIFE STYLE RISK FACTORS FOR THE DEVELOPMENT OF CHRONIC DEGENERATIVE DISEASES IN AN INDUSTRIAL SET UP IN BARODA

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ABSTRACT

Chronic degenerative diseases (CDD) such as obesity, diabetes, hypertension and chronic heart diseases (CHD) are rapidly increasing to epidemic proportions and gaining their hold in the developing countries. It has therefore become essential to know the prevalence of these diseases along with the lifestyle related risk factors, which lead to the development of these diseases. Thus the objective of this study was to find out the prevalence of CDD and to analyze the risk factors in relation to the lipid profile of the subjects. The results indicated the prevalence of overweight to be 42.2%, obesity 8.0%, diabetes 7.4%, hypertension 5.1% and CHD 0.6%. The nutrient composition of the diets of the male and female subjects showed significant differences in the proximate principles as well as in fibre, iron and potassium content. General habits of individuals such as smoking, chewing tobacco and alcohol intake showed significant aberrations in the lipid profile. Further alterations in the lipid profile were also noticed in case of obesity, diabetes, hypertension and CHD. Statistically significant differences were noticed in the fasting blood glucose (FBG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), very low density lipoprotein cholesterol (VLDL-C), triglyceride (TG) and TC/LDL-C (TC/L) ratio of the obese subjects when compared with normal subjects (who were not suffering from any kind of diseases). Similar observations were seen when the lipid levels of diabetics and hypertensive subjects were analysed in comparison to the normal subjects. Thus, the present observations indicate that a variety of factors such as dietary and general habits, various diseases etc. influence the prevalence of CDD. Further, these studies indicate the need for large community based intervention programs, which lay emphasis on the modifiable risk factors in preventing the occurrence of these CDD.

KEY WORDS: Chronic degenerative diseases; Lifestyle risk factors; Prevalence; Dietary habits.

INTRODUCTION

Chronic degenerative diseases have been one of the leading causes of mortality and morbidity in the present century. Amongst the chronic degenerative diseases, the one which has been identified as a priority area by World Health Organization (WHO) for research in the developing countries, is cardiovascular disease/chronic heart disease. It has been predicted that by the year 2015, CHD will be the most important cause of fatality in India (1). The prevalence of CHD appears to depend on combination of lifestyle, dietary, environmental and population specific risk factors. Studies have shown that elevated levels of blood lipids (TC and TG) are one of the major risk factors for heart disease. Numerous epidemiological studies (2,3,4) have shown that hypercholesterolemia when present for a longer duration leads to atherosclerosis, which in turn may precipitate cardiovascular disease. The incidence of CHD in adults is related positively to levels of low density lipoprotein cholesterol (LDL-C) and negatively to HDL-C (5,6). High levels of LDL-C and low HDL-C may be related more strongly to anatomic lesions of coronary atherosclerosis, in later life. In addition, studies have shown that HDL-C and LDL-C / HDL-C ratio (L/H) is more predictive of CHD than is either LDL-C or TC alone. Thus, serum lipid levels play an important role in the prediction of risk factors for CHD. Interventions for reducing the mortality and risk factors of CDD have been carried out in many countries, especially the Western nations viz. the Stanford Five City Study and the North Karelia Project, that showed reduction in the CHD risk factors by using mass media to educate the people (7). Also, the Malmo feasibility study and the Oslo diet and exercise study, demonstrated that dietary interventions and exercise resulted in a reduction in body mass index (BMI), a significant fall in insulin resistance etc. (8,9). Very few studies have been conducted in India concerning the same. As the geographical and ethnic diversity plays an important role in determining the lipid profile and that causative factors vary from region to region, the

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present study was designed to study the effects of various risk factors in relation to the lipid profile of the subjects.

MATERIALS AND METHODS

Eight hundred and thirty seven subjects in the age group of 20-60 years (mean age 42 ± 8 years, 520 males and 317 females) were enrolled from an industrial set up in Baroda, Gujarat. The dietary information.of the subjects was collected using the 24-hour dietary recall method and the nutritive value of the foods consumed was calculated by using the values given in the 'Nutritive Value of Indian Foods' (10). Information regarding general habits and medical history was obtained through a structured questionnaire. Standing height, weight and circumferences of the waist and hip were measured without shoes. BMI and the waist to hip ratio (WHR) were calculated as a measure of fat distribution.

Venous blood sample was collected after an overnight fast of 12 hours and the serum was used for estimation of various parameters like fasting blood glucose (FBG), TC, TG and HDL-C. The analysis of the parameters was done using the Boehringer Mannheim enzymatic kits on a Boehringer Mannheim autotek instrument. LDL-C and VLDL-C were calculated using the Friedewald's formula (11).

Statistical Analysis: Students 't' test was used for finding out the significant difference between the two means.

RESULTS

The clinical profile of the subjects shows an average age of 42 ± 8 years. Mean height was 160.6 cms (males 165.1 ± 6.8, females 152.9 ± 5.7 cms) and the mean weight was 63.8 ± 11.4 Kg (males 66.9 ± 10.7, females 58.5 ± 10.7 Kg). The mean BMI of male subjects was 24.5 ± 3.6 m/kg^2 and that of females was 25.0 ± 4.3 m/kg^2 (average 24.7 ± 3.9 m/kg^2). WHR of the male and female subjects was 0.93 ± 0.06 and 0.87 ± 0.05 respectively.

Table 1 presents the lipid profile and serum glucose levels of the enrolled subjects. The TG, TC, VLDL-C values were significantly higher in male subjects than in female subjects, while the HDL-C and LDL-C were almost similar in both the groups.

Table 1: Fasting Blood Sugar and Lipid Profile of Male and Female Subjects (mg/dl) (Mean ± SD)

	MALES	FEMALES	TOTAL
n	392	235	627
FBS	98.8 ± 36.3	87.4 ± 21.3 ***	94.5 ± 32.0
TC	200.8 ± 39.5	189.6 ± 34.3***	196.6 ± 38.0
HDL-C	38.7 ± 8.1	37.6 ± 8.3	38.3 ± 8.2
LDL-C	124.8 ± 42.8	127.34 ± 29.9	124.6 ± 40.3
VLDL-C	30.0 ± 16.1	24.1 ± 13.2***	27.3 ± 15.3
TG	151.8 ± 79.9	120.6 ± 65.4***	140.1 ± 75.6
TC/H	5.3 ± 0.9	5.16 ± 0.91	5.24 ± 0.9
L/H	3.51 ± 0.87	3.5 ± 0.88	3.51 ± 0.8
TC/L	1.57 ± 0.35	1.52 ± 0.3	1.5 ± 0.33

**** Significantly different from males at P < 0.001*

Table 2: Dietary Analysis of Subjects (Mean ± SD)

	MALES	FEMALES	TOTAL
ENERGY (Kcal)	1964 ± 582	1516 ± 333***	1792 ± 545
PROTEIN (g)	58.7 ± 17.1	44.3 ± 11.4**	53.2 ± 16.7
FAT (g)	87.6 ± 65.4	52.83 ± 18.4**	74.2 ± 55.1
CARBOHYDRATE(g)	252.4 ± 86.7	208.7 ± 54.6*	235.6 ± 78.6
FIBRE(g)	7.3 ± 2.4	5.8 ± 2.3*	6.7 ± 2.4
IRON(mg)	17.8 ± 13.2	10.4 ±4.4*	13.9 ± 10.3
SODIUM (mg)	174.9 ± 165.3	105.3 ± 53.8	138.7 ± 124.5
POTASSIUM (mg)	1598.1 ± 801.3	1122.2 ± 388*	1350.2 ± 659.6
CAROTENE (mg)	1409 ± 1778.4	937 ± 1310	1163.2 ± 553.6
VITAMIN C (mg)	74.7 ± 57.1	59.2 ± 49.7	66.5 t 53.3
% CALORIES			
CARBOHYDRATE	51.3	5.1	52.8
PROTEIN	12.0	11.6	11.8
FAT	40.3	31.5	37.2

** Significantly different from males at P < 0.05. **Significantly different from males at P < 0.01. *** Significantly different from males at P < 0.001.*

The dietary intake of the subjects is given in Table 2. The mean caloric intake of the male and female subjects was 1964 ± 582 Kcal and 1516 ± 333 Kcal respectively. The percent calories coming from carbohydrates, protein and fat was found to be 52.7 %, 11.8 % and 37.2 %. Significant differences were observed amongst the males and females in case of energy, protein, fat, carbohydrate, fibre, iron and potassium intake.

Since fat intake is known to influence the lipid parameters, the data on lipid profile were analysed looking specifically into the fat intake (Table 3). Table 4 depicts the lipid profile of the subjects based on the type of diet consumed, which indicated that the non-vegetarians had significantly higher levels of TG, LDL-C and VLDL-C in comparison to vegetarians.

Table 3: Lipid Profile of the Subjects in Relation to the Fat Intake (mg/dl) (Mean ± SD)

	FAT INTAKE	
	30-60 g/day	**> 60 g/day**
FBG	100.2 ± 51.4	100.0±40.7
TC	179.3 ± 35.2	188.6 ± 39.5
TG	123.6 ± 55.0	126.5 ± 64.8
HDL-C	35.5 ± 7.9	36.9 ± 7.5
LDL-C	119.0 ± 33.0	126.5 ± 32.9
VLDL-C	24.7 ± 11.0	25.3 ± 14.0
TC/H	5.2 ± 1.03	5.21 ± 0.95
L/H	3.45 ± 1.01	3.52 ± 0.93
TC/L	1.57 ± 0.35	1.53 ± 0.27

Table 4: Lipid Profile of the Subjects based on the Type of Diet Consumed (mg/dl) (Mean ± SD)

	VEGETARIANS	NON-VEGETARIANS
n	365	118
FBG	98.6 ± 34.9	99.5± 40.5
TC	201.8 ± 38.6	198.6 ± 41.7
HDL-C	38.7 ± 8.1	38.8 ± 8.2
LDL-C	97.4 ± 60.9	118.9 ± 44.3*
VLDL-C	28.6 ± 14.3	32.9 ± 19.3*
TG	144.9 ± 69.6	165.9 ± 95.7*
TC/H	5.32 ± 0.93	5.22 ± 0.82
L/H	3.57 ± 0.88	3.36 ± 0.85
TC/L	1.54 ± 0.28	1.63 ± 0.48

** Significantly different from vegetarians at P < 0.05.*

The lipid profile of the subjects was also compared taking into consideration the smoking habits, tobacco chewing and alcohol intake. In the present study, none of the female subjects smoked, chewed tobacco or consumed alcohol. The impact of smoking on lipid profile revealed that the TG levels were significantly higher amongst smokers than the non-smokers (162.4 ± 75.8 versus 137.2 ± 69.3 mg/dl respectively, $p < 0.05$). The TC levels were lower in non-smokers but they were not statistically significant (205.7 ± 35.2 versus 199.9 ± 40.2 mg/dl respectively). With regard to tobacco chewing habbit of the subjects, the TG levels were higher in those chewing tobacco, but the difference was not statistically significant (163.7 ± 96.1 versus 148.9 ± 73.9 mg/dl). The lipid profile of subjects consuming

Table 5: Prevalence of Chronic Degenerative Diseases amongst the Subjects Enrolled from the Industrial Setup (Figures in brackets are percentages).

	MALE	FEMALE	TOTAL
n	520	317	837
OVERWEIGHT	214 (41.1)	139 (43.8)	353 (42.2)
OBESE	30 (5.8)	37 (11.7)	67 (8.0)
DIABETES	48 (9.2)	14 (4.4)	62 (7.4)
HYPERTENSION	38 (7.3)	5 (1.5)	43 (5.1)
CHD	5 (1.0)	nil	5 (0.6)

Table 6: Lipid Profile of Normal and Overweight + Obese Subjects (Obese) (mg/dl) (Mean + SD)

		NORMALS	OBESE
n	Males	136	62
	Females	132	63
	Total	268	125
FBG	Males	91.0 ± 20.5	107.9 ± 47.1***
	Females	83.5 ± 16.8	90.1 ± 23.7**
	Total	87.3 ± 19.2	98.9 ± 38.1***
TC	Males	175.6 ± 27.6	210.8 ± 43.5***
	Females	173.7 ± 27.3	199.8 t 36.1***
	Total	174.7 ± 27.4	205.2 ± 40.2***
TG	Males	118.9 ± 46.3	172.1 ± 55.4***
	Females	103.4 ± 52.4	141.3 ± 67.0***
	Total	111.3 ± 49.9	156.6 ± 89.2***
HDL	Males	34.4 ± 7.6	39.6 ± 9.8***
	Females	34.7 ± 7.0	39.1 ± 8.1***
	Total	34.6 ± 7.3	38.3 t 9.0***
LDL	Males	117.7 ± 21.2	136.8 ± 36.0***
	Females	117.5 ± 23.8	132.6 ± 27.6***
	Total	117.6 ± 22.5	134.7 t 31.9***
VLDL	Males	23.8 ± 9.3	34.4 ± 21.1***
	Females	20.7 ± 10.5	28.6 ± 13.3***
	Total	22.5 ± 10.0	31.5 ± 17.8***
TC/H	Males	5.3 ± 0.9	5.5 ± 0.9
	Females	5.1 ± 0.9	5.2 t 0.8
	Total	5.2 ± 0.9	5.3 ± 0.9
L/H	Males	3.6 ± 0.9	3.6 ± 1.0
	Females	3.5 ± 0.8	3.5 ± 0.8
	Total	3.5 ± 0.8	3.5 t 0.9
TC/L	Males	1 .5 ± 0.2	1.6 ± 0.5*
	Females	1.5 ± 0.2	1.5 ± 0.2
	Total	1.5 ± 0.2	1.6 ± 0.3*

** Significantly different from normals at P < 0.05. *** Significantly different from normals at P < 0.001.*

alcohol showed a significant rise of TG (170.3 ± 95 vs 145.8 ± 72.1 mg/dl, p < 0.01), TC (205.6 ± 41 .8 vs 196.1 ± 38.6 mg/dl, p < 0.05) and VLDL-C (33.7 ± 19.2 vs 28.8 ± 14.7 mg/dl, p < 0.01) levels. The LDLC levels showed a statistically insignificant rise amongst alcohol consumers (129.4 ± 36.9 vs 123.8 ± 44.0 mg/dl). No significant difference was observed in the HDL-C. Lipid parameters were also analysed taking into consideration the exercise regime of the subjects. No alteration in the lipid profile was observed in those who exercised versus those who did not.

Diseases related to lifestyle such as obesity, diabetes, hypertension and chronic heart disease are rapidly increasing not only in the developed countries, but are also gaining their hold over the developing countries. The prevalence of these diseases in the present study is, 7.4% diabetics, 5.1% hypertensives and 8.0 % are obese (Table 5). Significant differences were observed in the lipid profile when the normal subjects were compared HDL-C with overweight + obese, diabetics and hypertensives (Table 6-9).

Table 7: Lipid Profile of Normal and Diabetic Subjects (mg/dl) (Mean t SD)

		NORMALS	DIABETICS
n	Males	136	39
	Females	132	12
	Total	268	51
FBG	Males	91.0 ± 20.5	167.9 ± 58.6 ***
	Females	83.5 ± 16.8	142.3 ± 38.4***
	Total	87.3 ± 19.2	161.5 ± 55.6 ***
TC	Males	175.6 ± 27.6	212.9 ± 53.0 **
	Females	173.7 ± 27.3	196.5 ± 24.5***
	Total	174.7 ± 27.4	209.0 ± 48.2 ***
TG	Males	118.9 ± 46.3	194.5 ± 116.7 ***
	Females	103.4 ± 52.4	178.5 ± 128.0 ***
	Total	111.3 ± 49.9	190.8 ± 118.3***
HDL-C	Males	34.4 ± 7.6	39.4 ± 10.4 **
	Females	34.7 ± 7.0	37.6 ± 8.0
	Total	34.6 ± 7.3	39.0 ± 9.9***
L.DL-C	Males	117.7 ± 21.2	134.6 ± 36.6***
	Females	117.5 ± 23.8	124.5 ± 33.0
	Total	117.6 ± 22.5	129.6 ± 41.9**
VLDL-C	Males	23.8 ± 9.3	38.9 ± 23.3***
	Females	20.7 ± 10.5	37.6 ± 24.6***
	Total	22.5 ± 10.0	37.8 ± 23.8***
TC/H	Males	5.3 ± 0.9	5.5 ± 1.0
	Females	5.1 ± 0.9	5.4 ± 0.9
	Total	5.2 ± 0.9	5.5 ± 1.0*
L/H	Males	3.6 ± 0.9	3.5 ± 1.0
	Females	3.5 ± 0.8	3.3 ± 1.1
	Total	3.5 ± 0.8	3.5 ± 1.0
TC/L	Males	1.5 ± 0.15	1.6 ± 0.4**
	Females	1.5 ± 0.2	1.8 ± 0.9***
	Total	1.5 ± 0.2	1.7 ± 0.6***

***** Significantly different from normals at *at P < 0.05. **Significantly different from normals at P < 0.01. ***Significantly different from normals at P < 0.001.*

Table 8: Lipid Profile of Normal and Hypertensive Subjects (mg/dl) (Mean ± SD)

		NORMALS	HYPERTENSIVE
n	Males	136	31
	Females	132	4
	Total	268	35
FBG	Males	91 .0 ± 20.5	90.5 ± 15.6
	Females	83.5 ± 16.8	88.8 ± 16.3
	Total	87.3 ± 19.2	90.3 ± 15.5
TC	Males	175.6 ± 27.6	200.0 ± 34.5***
	Females	173.7 ± 27.3	175.5 ± 28.0
	Total	174.7 ± 27.4	197.2 ± 34.4***
TG	Males	118.9 ± 46.3	155.9 ± 82.0***
	Females	103.4 ± 52.4	176.5 ± 60.6**
	Total	111.3 ± 49.9	157.3 ± 79.4***
HDL-C	Males	34.4 ± 7.6	40.7 ± 6.2***
	Females	34.7 ± 7.0	32.5 ± 5.8
	Total	34.6 ± 7.3	39.8 ± 6.7***
LDL-C	Males	117.7 ± 21.2	128.1 ± 30.6*
	Females	117.5 ± 23.8	107.7 ± 31.4
	Total	117.6 ± 22.5	125.8 ± 31.0
VLDL-C	Males	23.8 ± 9.3	31.2 ± 16.4***
	Females	20.7 ± 10.5	35.4 ± 12.1**
	Total	22.5 ± 10.0	31.7 ± 15.9***
TC/H	Males	5.3 ± 0.9	4.9 ± 0.7
	Females	5.1 ± 0.9	5.4 ± 0.4
	Total	5.2 ± 0.9	5.0 ± 0.7
L/H	Males	3.6 ± 0.9	3.2 ± 0.8*
	Females	3.5 ± 0.8	3.3 ± 0.6
	Total	3.5 t 0.8	3.2 ± 0.8*
TC/L	Males	1.5 ± 0.2	1.6 ± 0.3**
	Females	1.5 ± 0.2	1.7 ± 0.3*
	Total	1.5 ± 0.2	1.6 ± 0.3***

** Significantly different from normals'at P < 0.05. " Significantly different from normals af P < 0.01. *** Significantly different from normals at P < 0.001.*

Table 9: Lipid Profile of Normal and Coronary Heart Disease (CHD) Subjects (mg/dl) (Mean ± SD)

	NORMALS	CHD
n	136 (Males)	5 (Males)
FBG	91.0 ± 20.5	138.2 ± 95.1***
TC	175.6 ± 27.6	214.4 ± 60.5**
TG	118.9 ± 46.3	226.4 ± 133.5***
HDL-C	34.4 ± 7.6	42.4 ± 15.1*
LDL-C	117.7 ± 21.2	126.7 ± 20.4
VLDL-C	23.8 ± 9.3	45.3 ± 26.7***
TC/H	5.3 ± 0.9	5.2 ± 0.7
L/H	3.6 ± 0.9	3.2 ± 0.9
TC/L	1.5 ± 0.2	1.7 ± 0.2 *

** Significantly different from normals at P < 0.05. **Significantly different from normals at P < 0.01. ***Significantly different from normals at P < 0.001.*

DISCUSSION

Chronic degenerative diseases are fast emerging as major cause of mortality in developing countries. Cardiovascular disease was the foremost among the

non-communicable diseases to be identified as a priority area for research in the developing countries, by the WHO Ad Hoc committee on Health Research (12). It is difficult to isolate any single risk factor for the development of CVD, but enough evidence has accumulated to suggest the high levels of cholesterol and its sub fractions, except HDL-C, can lead to atherosclerosis. Besides these, there are various exogenous and endogenous factors affecting lipid levels.

Various studies carried out have shown that gender differences are seen in the case of lipid profile, i.e. the male subjects tend to have higher lipid levels in comparison to females (13-15). Similar observations have also been noticed in this study, which might be attributable to the favourable effect of estrogen.

The dietary analysis revealed that the fat intake amongst male subjects was more in comparison to female subjects. This might be due to the consumption of fried snacks available in the industrial canteen, at highly subsidized rates. The lipid profile, when analysed in relation to the amount of fat consumed daily, did not show a significant rise in the lipid levels of those who consumed more than 60 gms of fat daily in comparison to those who consumed between 30-60gms daily. When the lipid levels of vegetarians and non-vegetarians were compared, it showed significant rise in the TG, LDLC and VLDL-C levels of the non-vegetarians. This indicates that the intake of non-vegetarian food, which is rich in fats, led to an increase in the lipid levels.

Cigarette smoke is an important risk factor for premature or accelerated peripheral, coronary and cerebral atherosclerotic vascular disease. Cigarette smoke contains large amounts of free radicals that could directly initiate and propagate the process of lipid peroxidation (16). Elevated lipid profile in smokers has been observed in various studies (17-19). The results of the present study showed significant differences in the TG levels, with a non significant rise in the TC levels and no appreciable changes in the LDL-C and HDL-C. This maybe due to the fact that the subjects consumed only 4-5 cigarettes per day, which is much less in comparison to most active smokers.

The subjects chewing tobacco showed a significant increase in TG levels, with no appreciable changes in other lipid parameters. This might be due to the fact that the subjects were consuming only two to three packets of *gutkha* per day.

Adverse effect of alcohol consumption was observed in the TC, VLDL-C and TG levels amongst the subjects consuming alcohol. However, the HDLC did not show any statistical significant change in the present study. The results regarding TC and VLDL-C correlate well with various studies which have shown that consistent intake of alcohol, even at low to moderate levels, increases serum levels of lipids and lipoproteins other than HDL-C in men (20-22).

No changes in the lipid profile were observed in the subjects who exercised, because of irregularity in the exercise regime and as the majority of the subjects had started doing exercise recently.

Aberrations in the lipid profile were observed in case of obesity, diabetes and hypertension. Obesity, which is said to be the mother of most important degenerative diseases, predisposes an individual to the risk of development of diabetes, hypertension and chronic heart disease. The lipid profile showed significant differences amongst the overweight and obese individuals, when compared with normal subjects. The difference was also observed in the TC/LDL-C (TC/L) ratio. These results thus validate the fact that the overweight and obese subjects have an altered lipid profile and that they are at a higher risk of developing other degenerative diseases.

Diabetes mellitus is associated with increased mortality and a high risk of developing cardiovascular and other complications leading to premature disability and death (23). Impairment in insulin secretion leads to an excessive and prolonged rise in plasma glucose concentration. Similar results were seen when the FBG of the normal subjects were compared with that of diabetics. The frequency of elevated plasma lipid levels in diabetic patients is between 20-90% depending on the degree of diabetic control and the type of diabetes (24, 25). In this study, elevated TG and TC and its sub fractions was observed.

Hypertension has been accepted as the most important risk factor for the development of cardiovascular morbidity. Hyperlipidemia amongst the hypertensive subjects was observed in the study population and significant differences were noted when compared to normal subjects. Also, the ratio of LDL-C/HDL-C (L/H) showed significant difference amongst the two groups, indicating that they were at an excess risk of developing coronary heart disease (26).

The lipid profile of those who had already developed CHD was analysed and compared with those of normal subjects. Predictably, the results showed significant differences in the lipid profile, in spite of the number of subjects in the CHD group being small. Also amongst the subjects suffering from CHD (n=5), two were diabetics and two were hypertensives, which emphasizes the fact that one is at a higher risk of developing CHD, when one has any of the latter diseases. These diseases have been found to be the powerful contributors in the development of CHD in various studies (27, 28).

Thus, from the present study, it is clear that lipid levels are influenced by a variety of factors such as gender, dietary habits, general habits, various diseases etc. These risk factors are known to be interactive and any combination of risk factors has a greater impact on CHD risk, than the sum of their independent effects. Therefore, community based intervention approaches should lay emphasis on modifiable risk factors in preventing the aberrations in lipid profile, which in the long run would help in bringing down the prevalence of CDD in the population at large.

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