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Effect of Age, Sex and Life Styles on CHD Risk Factors : Influence of Obestiy and Body Fat Distribution

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ABSTRACT South Asian Countries have high prevalence of coronary heart disease (CHD) in parallel with economic development. Thus India is facing the high burden of CHD. Hence, the present study is aimed to assess CHD risk factors like serum lipids and lipoproteins in relation to obesity and distribution of body fat with reference to age, sex and life styles in an Indian population (Tirupati, Chittoor District, Andhra Pradesh). Information was collected on physical exercise, habits of smoking and alcoholism, body mass index (BMI), waist hip ratio (WHR), percent fat besides estimation of serum cholesterol (SC), high density lipoprotein cholesterol (HDLC) and triglycerides (TG) from a volunteer sample of 190 males and 140 females with an age range of 20-70 years. The age pattern show increased serum cholesterol, low density lipoprotein cholesterol (LDLC), TG with age, and major increase occurs earlier in men than women. Differences in mean lipid levels and body fat distribution are observed within groups of BMI and physical exercise in both sexes and, smoking and alcoholism in males. Obesity Grade I and II equally associated with low physical exercise exhibited rise in lipid pattern and higher exercise reduced the lipid levels even in the presence of smoking and alcoholism. Partial correlation coefficients between BMI and body fat distribution and within body fat distribution are distinctly higher in females than males. In both sexes lipid pattern found good association with BMI. Multiple regression analysis reveals that variance in lipid levels is explained by age and obestiy. The study concludes that most powerful correlates of CHD risk factors were age and body mass, with physical exercise and fat distribution in females serving as moderate predictors of CHD.

INTRODUCTION

Relationship between serum cholesterol and coronary heart disease (CHD) and the role of hyperlipidemia in the atherosclerosis have been well defined during the past two decades (Mailander et al., 1993 and Lavie et al., 1991). A positive correlation was characterised between serum cholesterol and the risk of CHD and a negative correlation with high density lipoprotein cholesterol (Schaefer et al., 1989 and Simons et al., 1991). Dyslipidemia, diabetes, hypertension and family history have been recognised as potential factors for CHD (Castelli et al., 1986). Individuals having higher body mass index (BMI) had an increased risk factor profile for CHD (Dennis and Goldberg, 1993). Intermediary mechanisms *i.e.*, by which dyslipidemia increase risk for CHD seem linked to distribution of body fat than obesity (De Fronzo and Ferrannini, 1991). Research results characterise, men as having an abdominal fat distribution and women as having gluteofemoral body fat distribution confirmed gender differences in the relation of obesity to CHD (Dennis and Goldberg, 1993). Upper body fat distribution is associated significantly with high blood pressure, cholesterol, low density lipoprotein cholesterol (LDLC), triglycerides (TG) and lower high density lipoprotein cholesterol (HDLC) (Wing et al., 1991). Neverthless, the strong relation between upper body fat (waist hip ratio-WHR) and degree of obesity make it difficult to ascertain whether obesity per se or the distribution of body fat is the major determinant affecting the risk factors for CHD.

South Asian Society on atherosclerosis and thrombosis (SASAT) in its first international symposium "Atherosclerosis, Thrombosis and Transfusion Medicine" in Bombay, Dec.15-18, 1994, stressed the need of conducting research on fat distribution pattern in relation to obesity and lipid parameters, in view of the increasing CHD in India, based on the findings of WHO (1991) that 15% of deaths in developing countries were due to CHD. Many developing nations acquire the life styles seen in industrialised societies and experience a high prevalence of non-communicable diseases (Mckeigue et al., 1991). Among these societies most affected are those that have become rapidly industrialised over a short time. India is currently in the process of transition. A large section of its population faces the risk of cancer, coronary heart disease and hypertension. In light of this information the present study has been undertaken (i) to ascertain the influence of body mass index and body fat distribution on lipids and lipoproteins (ii) to know the effect of age, sex and lifestyles on CHD risk factors.

MATERIALS AND METHODS

The study population consisted a volunteer healthy sample of 190 males and 140 females from a defined electoral area (Tirupati, Chittoor District, Andhra Pradesh, India) aged 20 to 70 years. Strict precautions were taken to avoid related individuals. The participants were interviewed covering items such as age, habits of smoking and usage of alcohol besides information on physical exercise. People involved in: office work, research, business and housewives were categorised under sedentary or low physical activity. Cultivation + employee/business, house wife help in agriculture, house wife + employee was categorised as medium physical activity. Labour, agriculture labour + cultivation were categorised as high physical activity. The subjects were divided into 10 year age groups for comparison in both sexes *i.e.*, 20-29, 30-39, 40-49, 50-59 and > 60 Years.

Height, weight, circumferences of waist and hip, triceps and subscapular skinfold measurements were taken for each subject according to the method described by Shimokata et al. (1989). The body mass index (BMI) was calculated as BMI = weight in kg/height in metres^2 (kg m^{-2}). Obesity was defined as BMI>25. WHR from the

Table 1: Mean values by age group in men

S. No.	*Parameter*	*20-29 y n=40 Mean±SD*	*30-39 y n=40 Mean±SD*	*40-49 y n=40 Mean±SD*	*50-59 y n=40 Mean±SD*	*60 > y n=30 Mean±SD*	*F- Value*
1.	Age y	25.44 ±2.92	33.84 ±3.10	44.09 ±2.41	52.90 ±2.85	64.40 ±3.67	
2.	Height cm	164.20 ±6.64	164.70 ±6.29	164.20 ±6.41	163.00 ±6.07	164.7 ±5.03	0.89
3.	Weight kg	54.74 ±6.58	60.90 ±9.31	61.22 ±11.22	56.55 ±10.31	55.72 ±7.47	0.71
4.	Body mass index kg/m^2	20.32 ±2.41	22.43 ±3.13	22.69 ±3.75	21.25 ±3.19	20.53 ±2.46	0.48
5.	Waist circumference cm	72.21 ±2.95	78.64 ±3.77	85.13 ±6.16	84.14 ±4.63	82.67 ±5.07	6.36*
6.	Hip circumference cm	86.99 ±3.93	90.52 ±3.51	90.64 ±6.11	90.11 ±4.64	88.52 ±5.06	1.24
7.	Triceps skinfold thickness mm	8.12 ±4.03	11.07 ±5.16	10.98 ±4.87	10.40 ±3.83	9.4 ±3.53	1.08
8.	Subscapular skinfold thickness mm	11.12 ±3.79	14.32 ±5.28	14.42 ±5.93	13.20 ±5.79	12.56 ±4.08	0.63
9.	WHR	0.83 ±.03	0.86 ±.02	0.94 ±.02	0.93 ±.02	0.93 ±.02	15.89*
10.	Percent fat	14.85 ±6.69	20.14 ±8.08	20.12 ±8.99	18.67 ±8.01	17.27 ±6.18	1.18
11.	Cholesterol mg/dl	138.40 ±36.90	163.50 ±43.92	179.50 ±36.76	189.10 ±51.61	185.90 ±39.36	1.99*
12.	HDL-cholesterol mg/dl	39.15 ±11.18	42.15 ±13.33	41.17 ±12.65	40.20 ±10.50	35.30 ±6.97	0.70
13.	LDL-cholesterol mg/dl	76.69 ±31.41	94.35 ±39.10	106.90 ±39.36	119.10 ±50.64	125.70 ±38.75	1.95*
14.	Triglycerides mg/dl	114.40 ±43.42	135.50 ±49.22	160.20 ±49.67	148.30 ±61.79	126.50 ±44.18	2.06*
15.	HDLC/TC ratio	0.29 ±0.08	0.27 ±0.08	0.24 ±0.08	0.23 ±0.08	0.20 ±0.05	1.59

F - Values were calculated by/one way analysis of variance n = sample size

* Significant at 5% level

circumferences of waist and hip and percent fat from triceps and subscapular skinfold thickness (SFT) was calculated as per the formula given by Slaughter et al. (1988).

Fasting venous blood samples were collected with disposable syrenges from 190 men and 140 women. Blood was poured into dry test tubes pack in a flask with ice cubes and allowed to clot. The samples were processed immediately following collection. The serum was seperated on centrifugation at 5000 rpm and the analysis of serum cholesterol, HDL-cholesterol and Triglycerides were estimated according to the procedures of Zlatkis et al. (1953), Burnstein et al. (1970) and Foster and Dunn (1973). LDLC was calculated as LDLC = total cholesterol - (TG/5+HDLC) according to Friedwald et al. (1982) formula. Data were processed for statistical analysis including multiple regression analysis, partial correlation, one-way analysis of variance. P values below 0.05 were regarded as statistical significant.

RESULTS

Effects of age on Anthropometric measurements and lipid variables were tested by one way analysis of variance and presented in tables 1 and 2 for males and females respectively. Anthropometric measurements were not significantly related to age in both sexes except waist circumference and WHR in males and WHR in females. Lipid pattern *i.e.*, cholesterol, LDLC and TG found significant association, while, HDLC and HDLC/TC ratio failed to be significant with age in men and women. The age patterns for anthropometry and lipid levels were varied in both sexes. Height was nearly constant across the entire age span in both sexes. Weight and BMI increases in men from age 20

Table 2: Mean values by age group in women

S. No.	Parameter	20-29 y n=30 Mean±SD	30-39 y n=30 Mean±SD	40-49 y n=30 Mean±SD	50-59 y n=30 Mean±SD	60 > y n=20 Mean±SD	F- Value
1.	Age y	22.46 ±1.78	32.80 ±2.94	44.44 ±3.67	52.60 ±2.27	63.50 ±5.05	
2.	Height cm	153.40 ±5.40	151.60 ±6.24	149.30 ±3.35	148.10 ±6.35	148.70 ±4.32	1.04
3.	Weight kg	50.34 ±7.42	50.60 ±8.78	50.89 ±6.11	48.50 ±7.87	47.17 ±5.27	0.72
4.	Body mass index kg/m^2	21.36 ±2.84	21.88 ±2.65	22.85 ±2.91	22.18 ±3.78	21.32 ±2.08	0.54
5.	Waist circumference cm	66.25 ±5.53	71.40 ±3.10	70.78 ±2.33	70.80 ±4.13	70.00 ±2.61	1.76
6.	Hip circumference cm	89.57 ±3.16	90.82 ±2.58	89.22 ±2.17	89.90 ±3.17	90.83 ±2.48	0.4
7.	Triceps skinfold thickness mm	11.06 ±4.19	13.80 ±3.99	11.44 ±3.94	10.90 ±2.96	8.00 ±1.27	0.80
8.	Subscapular skinfold thickness mm	13.80 ±4.19	16.80 ±4.87	16.22 ±3.03	15.00 ±3.19	12.17 ±2.79	1.64
9.	WHR	0.74 ±0.04	0.78 ±0.03	0.79 ±0.02	0.79 ±0.03	0.77 ±.02	2.13*
10.	Percent fat	21.05 ±5.34	25.87 ±4.78	23.72 ±3.92	22.82 ±3.91	18.89 ±2.90	1.61
11.	Cholesterol mg/dl	135.10 ±29.48	146.80 ±33.00	157.45 ±24.13	167.60 ±44.75	175.50 ±29.37	2.51*
12.	HDL-cholesterol mg/dl	40.82 ±7.49	43.20 ±5.45	38.76 ±5.57	37.75 ±9.36	36.61 ±6.37	1.45
13.	LDL-cholesterol mg/dl	75.61 ±30.56	82.90 ±33.53	86.42 ±23.78	104.55 ±42.44	111.20 ±27.65	1.98*
14.	Triglycerides mg/dl	95.22 ±23.75	103.40 ±30.15	111.40 ±25.43	116.49 ±26.84	138.33 ±23.63	1.63
15.	HDLC/TC ratio	0.32 ±0.10	0.31 ±0.09	0.25 ±0.06	0.24 ±0.08	0.21 ±0.04	1.40

F-Values were calculated by one way analysis of variance n = sample size
* Significant at 5% level

to 50 and then constant, whereas no major changes observed in females. The circumferences of waist and hip tend to fall in the late years in men and stable in women. Age patterns for SFT shows sex differences. In men a 14% increase in triceps and subscapular SFT and a 35% decrease of these two in women observed with aging. Peak values were at age 40 in both sexes. Waist-Hip ratio show a progressive increase upto 50 years in males and 60 years in females, while the increase in percent fat is upto 40 years only in both sexes. In these two ratios, as calculated, WHR in men and percent fat in women were higher than other sex. Age differences in lipid pattern show a 26% and 40% increase in SC and LDLC while HDLC and HDLC/TC significantly dropped in 70 years in both sexes. Triglycerides appreciably increased from 20 to 50 years with a later decrease in men, and a 30% increase was observed in women. Although males were represented by higher mean lipid pattern, HDLC/TC ratio was higher in females.

Grouped by BMI: Men and women were divided ino 4 groups *i.e.*, < 20, 20-24.9, 25-29.9 and 30 above considering 25-29.9 and 30 and above as obese Grade I and II respectively. Mean values were calculated for body fat distribution and lipid levels (Tables 3 and 4). There were significant differences in mean levels of body fat distribution and lipid pattern within groups of BMI in both sexes. In men and women obese (Grade I and II) subjects had larger WHR, percent fat and lipid levels than lower groups (<20, and 20-24.9).

Grouped by Physical Exercise: Men and Women were divided into 3 groups *i.e.*, Low or sedentary, Medium and high exercise groups and results were presented in tables 3 and 4. In males sedentary individuals possess higher fat distribution and lipid pattern, and with some fluctuations these levels were increased in medium exercise group. High exercise reduced fat distribution, SC, LDLC, TG and increased HDLC/

Table 3: Mean values by body mass index, physical exercise and habits of smoking and alcoholism in men

Parameter	*WHR*	*Per cent fat*	*Cholesterol*	*HDLC*	*LDLC*	*TG*	*HDLC/TC Ratio*
Body Mass Index							
< 20	0.88	12.52	145.60	37.34	85.37	116.40	0.26
n = 69	±0.05	±4.14	±35.17	±10.18	±32.70	±42.69	±0.08
20-24.9	0.89	19.14	169.50	41.55	100.00	141.20	0.26
n = 95	±0.05	±6.54	±41.73	±12.72	±42.07	±53.17	±0.09
25-29.9	0.90	28.85	202.00	41.46	127.80	163.60	0.22
n = 22	±0.04	±5.66	±42.97	±10.48	±42.04	±41.69	±0.07
30 <	0.96	35.66	251.40	41.96	170.20	196.50	0.20
n = 4	±0.02	±7.07	±20.90	±14.95	±41.1	±49.74	±0.05
F-Value	1.99*	12.99*	1.57	1.19	1.34	0.69	1.00
Physical Exercise							
Low	0.90	20.13	168.30	40.64	99.46	142.80	0.26
n = 53	±0.05	±9.08	±51.71	±12.43	±45.71	±46.84	±0.10
Medium	0.91	17.66	175.00	39.93	108.30	137.40	0.24
N = 89	±0.05	±7.58	±42.49	±11.07	±42.54	±51.91	±0.07
High	0.83	17.11	148.00	39.52	83.42	125.80	0.28
n = 48	±0.04	±7.14	±34.15	±12.43	±31.28	±53.63	±0.08
F-Value	1.43	1.01	1.25	0.95	1.17	0.87	1.41
Smokers	0.90*	17.86	170.00	38.24*	103.00	143.90*	0.24*
n = 87	±0.05	±8.34	±44.02	±9.36	±42.30	±49.07	±0.08
Non-Smokers	0.88	18.50	163.20	41.53	96.40	129.30	0.27
n = 103	±0.05	±7.68	±45.04	±13.27	±41.63	±52.11	±0.09
Alcoholics	0.89	17.60	167.70	36.29*	104.30	135.90	0.23
n = 33	±0.06	±8.9	±48.84	±10.07	±43.56	±50.79	±0.08
Non-Alcoholics	0.89	18.34	166.00	40.81	98.36	136.00	0.26
n = 157	±0.05	±7.79	±43.80	±11.93	±41.68	±51.36	±0.09

F-values were calculated by one way analysis of variance among groups of BMI and physical exercise. Students 't' test was applied between smokers vs. non-smokers and alcoholics vs. non-alcoholics.
n = Sample size; * Significant at 5 % level.

Table 4: Mean values by body mass index and physical exercise in women

	WHR	*Per cent fat*	*Cholesterol*	*HDLC*	*LDLC*	*TG*	*HDLC/TC Ratio*
Body Mass Index							
< 20	0.74	119.85	19.80	41.99	60.72	89.29	0.36
n = 42	±0.04	±3.26	±18.47	±5.60	±16.91	±24.93	±0.07
20-24.9	0.76	22.28	149.04	40.80	86.07	108.60	0.28
n = 72	±0.04	±5.09	±27.33	±7.93	±28.21	±26.78	±0.08
25-29.9	0.80	27.67	188.2	35.09	122.50	122.3	0.20
n = 26	±0.03	±3.03	±29.83	±5.94	±33.22	±22.86	±0.04
F-Value	1.72	5.01*	1.97*	1.94	3.48*	0.69	2.71*
Physical Exercise							
Low	0.75*	21.82*	148.10	39.31	87.81	106.79	0.28
n = 82	±0.04	±5.12	±36.25	±7.21	±36.02	±28.91	±0.09
Medium	0.77	23.59	147.3	41.21	81.58	103.30	0.29
n = 58	±0.04	±4.60	±32.06	±7.36	±29.85	±26.52	±0.09

F-values were calculated by one way analysis of variance among groups of BMI.
Students 't' test was applied between low vs. medium exercise groups.
n = Sample size;
* Significant at 5% level

TC with no changes in HDLC. In females only two groups were available *i.e.,* sedentary and medium. The increase in fat deposition was found to be significant whereas increase in HDLC, and HDLC/TC ratio and decrease in the cholesterol, LDLC and TG levels were insignificant between the groups.

Grouped by habits of smoking and alcoholism: Males were divided into smokers and non-smokers, alcoholics and non-alcoholics (Table 3). The increase in WHR, TG and decrease in HDLC and HDLC/TC ratio were observed to be significant among smokers, while, HDLC only significantly decreased in alcohols, neverthless, both smokers and alcoholics possess a slight increase in SC, LDLC and TG and decrease in HDLC, fat distribution. Further the percentage distribution of physical exercise in both sexes and smokers and alcoholics in males were presented among groups of obesity in table 5. In males high percentage of individuals were observed to be either sedentary or medium exercise in grade I and II obese. On the other hand normals were observed to be medium to high exercise, whose smoking and alcoholic percentages were higher to obese Grade I and II. In females the percentage of sedentary was higher in normals as well as in Grade I.

Partial correlation coefficients for BMI, fat distribution and within fat distribution and to lipid levels were calculated independently and presented in tables 6 and 7 for men and women.

Table 5: Percentage distribution of physical exercise, smokers and alcoholics by BMI

Body mass index	*Physical Exercise*																	
	Men						*Women*											
	Low		*Med*		*High*		*Low*		*Med*									
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*								
< 20	21	30.43	28	40.58	20	28.99	26	61.9	16	38.09								
n = 69 for men		(38.09)		(64.29)		(50.0)												
n = 42 for women		[4.76]		[32.14]		[25.0]												
20 - 24.9	20	21.05	49	51.58	26	27.37	44	61.11	28	38.88								
n = 95 for men		(35.0)		(53.06)		(30.77)												
n = 72 for women		[15.0]		[10.2]		[15.38]												
25 - 29.9	9	40.91	9	40.91	4	18.18	12	46.15	14	53.85								
n = 22 for men		(44.44)		(55.56)		(25.0)												
n = 26 for women		[33.33]		[33.33]		–												
30 >	3	75.0	1	25.0	–	–	–	–	–	–								
n = 4 for men		(33.33)		–														
		[33.33]		–														

( ) Percentage of smokers [ ] percentage of alcoholics

In both sexes BMI was found to have positive relationship with WHR and per cent fat. Per cent fat in males and WHR in females were strongly related to BMI. This type of trend suggests that fat deposition in the several primary areas measured in this study shows that deposition of fat is not equal in all the sites. Further, the correlations between WHR and percent fat is weak in both sexes. Upper body fat distribution (WHR) or as indices of central (trunk) fat distribution should not be expected to have a strong correlation with percent fat based upon measurements that depend upon subcutaneous fat deposition.

The relationship of fat pattern to lipid levels was different (Table 7). BMI was positively related to SC, LDLC and TG in both sexes. The relationship between HDLC and BMI in males was insignificant, Whereas, both HDLC and HDLC/TC in females were negatively related to BMI. When age and BMI were controlled, both WHR and percent fat exhibited no correlation with lipid pattern. However, percent fat in females show a positive relation with LDLC and TG and a negative relation with HDLC/TC, and overall these correlations were stronger in females than males.

Table 6: Partial correlation coefficients among body mass index, WHR and percent fat for males and females

Males *Females*	*BMI*	*WHR*	*Per cent fat*
BMI	—	.2445+*	.7852+*
WHR	.5089+*	—	.0460++
Per cent fat	.6152+*	.2559++*	—

+ = Controlled for age; ++ = Controlled for age and BMI.
* Significiant at 5 % level

Regression equations for each of the lipid parameter for men and women may be used as predictions of the lipid pattern that takes age, BMI, fat pattern, physical exercise and habits of smoking and alcoholism into account (Table 8). 20 to 37% of the variance in lipid levels were explained by independent variables in males, and in females 20 to 70% of the variance in lipid levels were explained by independent variables, excluding smoking and alcoholism. In both males and females age and BMI account for a high percentage of variation in lipid levels. Effect of smoking and alcoholism were not observed in the study. Both fat pattern and physical exercise in males exhibit insignificant variation in lipid levels. In females, physical exercise shown a negative variation in SC, LDLC and HDLC/TC and positive variation in HDLC. The trend with percent fat was quite reverse, where fat increases SC, LDLC and TG and decreases HDLC and HDLC / TC ratio.

DISCUSSION

The pattern of lipid and fat distribution is of interest for its own sake. Differences between men and women and changes that occur with advancing age are apparent, but have not yet been confirmed. Furthermore, a number of studies examined fat pattern as a risk factor for lipid levels, but these were mainly focus on relations, not on the effects of body composition as well as life styles on CHD risk (Wood et al., 1991). Interest in fat patterning and its influence on lipid levels has increased remarkably in recent years because of rapid changes in life styles which inturn increases the burden of CHD mortality.

From the analysis of this work several interesting generalisations may be made: 1. Lipid and Fat pattern differ with age in both men and

Table 7: Partial correlation coeffcients for serum cholesterol, HDLC, LDLC and TG with BMI, WHR and per cent fat for males and females

	Males			*Females*		
	BMI	*WHR*	*Per cent fat*	*BMI*	*WHR*	*Per cent fat*
Cholesterol	.5049+*	.0202++	.0041++	.7285+*	-.0640++	.3104++*
HDLC	.0844+	.1261++	-.0618++	-.3087+*	-.0995++	-.0348++
LDLC	.4031+*	-.0211++	.0029++	.6773+*	-.0324++	.2287++*
TG	.3978+*	0386++	.0876++	.3555+*	-.0013++	.2384++*
HDLC/TC ratio	-.2207+*	.0859++	-.0500++	-.6612+*	-.0644++	-.2977++*

+ = Controlled for age;
++ = Controlled for age and BMI; *Significant at 5 % level

Table 8: Predictors of serum lipid pattern in Multiple Regression Analysis for males and females

Dependant variable	Coefficients								
	Intercept	*Age*	*Physical Exercise*	*Smoking*	*Alcoholism*	*BMI*	*WHR*	*Per cent Fat*	*Multiple* R^2
Males									
1. Cholesterol	-24.83	1.1788	-2.3889	-1.7676	1.8810	6.4433	9.9532	0.0063	0.03646
	(0.37)	(3.79)*	(0.63)	(0.29)	(0.24)	(4.65)*	(0.12)	(0.01)	
2. HDLC	-6.4055	-0.2001	-0.0636	1.0152	4.5011	0.5896	39.88	-0.1857	0.0657
	(0.30)	(2.02)*	(0.05)	(0.52)	(1.79)	(1.33)	(1.56)	(1.07)	
3. LDLC	-17.963	1.3142	-1.9338	1.6542	-5.3502	4.6998	-30.064	0.0624	0.2957
	(0.27)	(4.26)*	(0.52)	(0.27)	(0.69)	(3.42)*	(0.38)	(0.12)	
4. TG	-27.416	0.2065	-2.302	18.792	12.334	4.9909	51.027	0.719	0.2150
	(0.32)	(0.52)	(0.48)	(2.40)*	(1.23)	(2.82)*	(0.50)	(1.04)	
5. HDLC/TC ratio	0.2663	-0.0029	-0.0011	0.0056	0.0258	-0.0039	0.1774	-0.0011	0.2140
	(1.03)	(4.35)*	(0.14)	(0.42)	(1.50)	(1.29)	(1.01)	(0.88)	
Females									
1. Cholesterol	-10.356	1.0526	-13.26	--	--	6.5718	-61.753	1.9719	0.6992
	(0.23)	(5.54)*	(2.68)*	--	--	(6.01)*	(0.84)	(3.16)*	
2. HDLC	74.459	-0.0832	3.6191	--	--	-0.6291	-29.02	-0.039	0.2148
	(4.81)	(1.28)	(2.13)*			(1.68)	(1.14)	(0.18)	
3. LDLC	-77.809	0.8667	-18.122	--	--	6.2897	-18.194	1.5854	0.6337
	(1.60)	(4.24)*	(3.40)*	--	--	(5.34)*	(0.23)	(2.36)*	
4. TG	26.678	0.9200	-10.741	--	--	1.8349	-17.586	1.5739	0.3860
	(0.51)	(4.19)*	(1.88)			(1.45)	(0.21)	(2.19)*	
5. HDLC/TC ratio	0.8138	-0.0027	0.0463	--	--	-0.0142	-0.0992	-0.005	0.6519
	(6.25)*	(4.90)*	(3.25)*			(4.53)*	(0.47)	(2.78)*	

Values within parenthesis are t-values; * Significant at 5 % level

women, but major increase generally occurs earlier in men than women and the sex differences varies widely among fat and lipid variables from small differences in BMI vs fat pattern to large differences in BMI to lipid pattern. 2. Body mas index has a variable influence on lipid levels in both sexes, and upper body fat and percent fat are not independently influencing lipid levels, and the relation is stronger for women than men. 3. Obesity (Grade I and II) equally associated with sedentary exercise exhibited significant rise in lipid pattern and the effect of higher exercise reduced the levels of lipid pattern even in presence of smoking and alcoholism. 4. In both sexes age and BMI account for larger variance in lipid pattern.

Few studies have examined the effect of age on anthropometric measurements (Weits et al., 1988), where older subjects have more intra-abdominal fat than younger and more accumulation of fat between the muscles of the lower extremity and of the abdomen wall. The results of the present study were in good agreement with earlier works, but the trend of increase towards older ages was not significant. Distinctly higher WHR ratio in males and percent fat in females cannot be explained and these two ratios were independently influenced by BMI. In women delayed changes tends to be a post menopausal acceleration. Similar results were published elsewhere (Kirschner et al., 1988; Evans et al., 1988).

Obesity and upper body fat distribution were considered to be risk factors for CHD (Dennis and Goldberg, 1993; Despres et al., 1990). The study of Wing et al. (1992) explained the changes in CHD risk factors were related to the changes in BMI, not to changes in WHR. The observed strong positive relation between BMI and SC, LDLC and TG and negative relation between BMI and HDLC, HDLC/TC in both sexes were attributable to the fact that increase in weight increases the risk for CHD. When BMI was controlled, both WHR and percent fat do not show such relation with CHD risk factors, but increase in BMI units elevated the fat pattern, suggesting that fat pattern in assnciaton with obesity were influencing lipid levels. Therefore, the effect of obesity was independent on CHD risk and this was supported by regression analysis, the results of which emphasized the importance of obesity on lipid risk factors. Thus, the potential interventions that change BMI on CHD risk factor can only be surmised by extrapolation. In many studies the high correlations between BMI and WHR, making it impossible to distinguish the effect of change in body weight from WHR. (Shimokata et al., 1989).

Age was also observed to have positive correlation with CHD risk factors. Earlier we have shown positive relation between age and lipid levels among industrial workers who were exposed to various contaminants as well as in aging rural populations (Reddy et al., 1990; Reddy et al., 1994). HDL-cholesterol does not vary with age. One might speculate that longevity is due to a positive synergism between environmental and genetic influences, amongst which HDL could be identified as a major discriminant (Laurenzi and Mancini, 1988; Postiglione et al., 1989). In the study population those subjects who were active, lacking the habits of smoking and alcoholism showed higher levels of HDLC. On the other hand the influence of smoking and alcoholism seem to have limited role on serum lipids and lipoprotein levels. High active group reduced the fat pattern as well as SC, LDLC and TG and increased HDLC/TC ratio indicating that physical exercise may reduce the CHD risk, even in the presence of smoking and alcoholism.

These results affirm the effect of age and body mass index on lipid and lipoprotein risk factors for CHD and effectiveness of weight reduction as a potentially effective intervention to ameliorate abnormalities. However, health benefits in preventing obesity, regardless of fat distribution cannot be ignored.

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