A STUDY OF SERUM LIPID PROFILE PART-1 : ESTABLISHMENT OF NORMAL REFERENCE VALUES OF SERUM LIPID LEVELS IN HEALTHY VEGETARIAN POPULATION OF GUJARAT.

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ABSTRACT

Fasting samples of 1329 apparently healthy vegetarian Gujarati population were tested for total cholesterol, triglycerides and three major fractions of lipoproteins, i.e. high density lipoproteins, low density lipoproteins and very low density lipoproteins. All the values showed marked increase with the age. Except for serum triglycerides, values differ in males and females in the age group of above 45 years. Compared to Northern Indian population low density lipoprotein and high density lipoprotein values were higher, but values of triglycerides and very low density lipoproteins were lower. There is no significant difference in total cholesterol values. Compared to Southern Indian population low density lipoprotein and very low density lipoprotein values were higher but values of triglycerides, total cholesterol and high density lipoprotein were lower. All serum lipid values were significantly lower than the Western population. The range of values for both the sexes is presented for different age groups.

KEY WORDS - Serum lipids, Lipoproteins, Gujarat population

INTRODUCTION

It has been hypothesized in Framingham study (1) that 1% rise in the serum total cholesterol (STC) level leads to 2 % increase in incidence of ischemic heart disease (IHD) (1). Recently it has been reported that raised STC level is the only direct risk factor for atherosclerosis (2). The other risk factors like smoking, hypertension etc. become operational, when STC level crosses the critical level (1). Some larger multi-centric studies (3-6) have been carried out in Western countries to establish reference values of their population. In India some studies have been carried out in a small number of populations (2,7,8). Since the serum lipid levels even in healthy normal population are affected by a number of factors

such as age, sex, racial differences and dietary factors like saturated and unsaturated fats in dietary contents (7), these values differ in different population groups. Normal lipid levels in control subjects can not have rigid cut off values because values obtained for one population need not necessarily be the same in other population, since factors like socio - economic status, geographic conditions, race and eating habits, as well as age and sex factors influence these values (7). It is therefore essential to establish reference range of the values of serum lipids and lipoproteins for a given population in order to evaluate the incidence of dyslipidemia as a risk factor of IHD. The present study was undertaken to study the serum lipid profile of healthy normal control subjects of Gujarat, in relation to the age and the sex differences so as to provide arbitrary limit of values for normal controls and form the basis to identify the hyperlipidemia as a risk factor of ischemic heart disease.

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MATERIALS AND METHODS

This report deals with the study in 1329 subjects in various age groups of vegetarian population of Gujarat, their serum levels of total cholesterol (TC), triglycerides (TG), high density lipoproteins (HDL), low density lipoproteins (LDL) and very low density lipoproteins (VLDL). These serum lipid levels have been studied in males & females, in the age groups of 0-15, 16 to 45 & above 45 years. Lipid analysis was performed at the pathology laboratory of Medical Research Center, Dr. Jivraj Mehta Smarak Health Foundation, Ahmedabad. The subjects for study comprised of individuals enrolling for the complete health check - up programs. Only those subjects were chosen for the study to establish normal reference values of serum lipid profile, who were found to be normal on clinical examination, without having risk factors of IHD i.e. obesity, hypertension, diabetes mellitus, tobacco & licorice habits etc. Laboratory studies included, complete blood counts, post glucose blood glucose levels, blood groups, serum glutamate pyruvate aminotransferase (SGPT), blood urea levels and routine stool and urine examinations. Radiological examination included plain x-ray chest & abdominal sonography. ECG examination was done in all the subjects. In addition, for the age group of 0-15 years, the samples were collected from children, either during house - to - house visit or who visited other field research programs, and were normal on clinical, laboratory & radiological examinations. Subjects selected for this project, belonged to middle & upper socio-economic groups. All lipid profile estimations were done on fasting morning samples of serum. Serum cholesterol was estimated by cholesterol liquicolor, CHOD - PAP method using diagnostic kit of Human Diagnostics (Germany). External quality control was maintained, using serum obtained under National Quality Control Programme of Institute of Medical Science of Banaras Hindu University, Varanasi. Internal quality control was used, using quality control sera of Human Diagnostics. For HDL-cholesterol, precipitant and standard, of the Human cholesterol liquicolor test kit, were used.

The serum LDL cholesterol concentration was calculated from the serum concentrations of total cholesterol HDL cholesterol & triglycerides using the following formula. $LDL = HDL - TG / 5$

(mg/dl). The VLDL - cholesterol concentration was calculated from the values of the other cholesterol levels by the following formula. $Non-HDL\ cholesterol = TC - HDL - C$. $VLDL - C = Non\ HDL\ cholesterol - LDL - C$. For estimation of serum triglycerides, colorimetric enzymatic test procedure, using diagnostic kit of Human Diagnostics was used. The laboratory values of serum lipids, were entered in to computer (FOX-PRO programme) and computer analysis of the data was obtained for various statistical indices, e.g. mean value, standard deviation (SD), standard error (SE), and confidence intervals at 90, 95 and 99 percentile values. All these indices were calculated separately for each age and sex groups.

RESULTS AND DISCUSSION

Mean values, Standard deviation (SD), Standard error (SE), of total cholesterol, serum triglycerides, HDL, VLDL and LDL cholesterol for all 1329 subjects is shown in table 1. National Cholesterol Education Programme of USA (9) has recommended that all the laboratories should standardize in their measurement of serum lipid levels. Standardization should be accompanied by adoption of meaningful reference values. Such reference values should be based on percentiles determined from a well defined population sample (9). Comparison of the values of serum total cholesterol (TC) triglycerides (Tg), low density lipoproteins (LDL), high density lipoproteins (HDL), very low density lipoproteins (VLDL), of different age groups of both sexes has been made with the other Indian studies and shown in table 2.

The present study shows, an increase in all the serum lipid values with age, for both the sexes. Similar pattern was observed in other Indian studies (2,7,8). There was significant difference in values of all serum lipids and lipoproteins except for serum triglycerides, between males and females above 45 years of age. Gandhi et al (7), however observed no such significant difference. Mean value of serum cholesterol in the present study is 181.44 ± 40.47 mg/dl in the males and 194.87 ± 37.63 mg/dl in the females in the age group of above 45 years. These values were comparable to those in other studies of Northern Indian population (2,7) but significantly lower than those of other studies of Southern Indian population (8).

Table 1 : Mean values, standard deviation(SD), standard error(SE) of serum lipids and lipoproteins*(All values in mg/dl)*

Age groups (Years)		Total cholesterol**	HDL-C	LDL-C	VLDL-C	triglycerides
		Mean $\pm$ SD/SE	Mean $\pm$ SD/SE	Mean $\pm$ SD/SE	Mean $\pm$ SD/SE	Mean $\pm$ SD/SE
0 - 15	Male(16*)	150.31 $\pm$ 25.68/6.42	45.00 $\pm$ 25.68/6.42	90.69 $\pm$ 25.68/6.42	90.69 $\pm$ 25.68/6.42	74.81 $\pm$ 19.78/4.95
	Female(55)	143.61 $\pm$ 25.08/3.38	36.71 $\pm$ 25.08/3.38	82.51 $\pm$ 25.08/3.38	18.87 $\pm$ 25.08/3.38	94.69 $\pm$ 33.95/4.98
16-45	Male(482)	179.27 $\pm$ 37.5/1.71	44.07 $\pm$ 37.5/1.71	109.28 $\pm$ 37.5/1.71	37.5 $\pm$ 23.33/1.71	119.56 $\pm$ 62.75/2.86
	Female(252)	170.46 $\pm$ 30.66/1.93	48.74 $\pm$ 30.66/1.93	101.13 $\pm$ 30.66/1.93	19.91 $\pm$ 30.66/1.93	100.19 $\pm$ 46.91/2.96
Above 45	Male(341)	181.44 $\pm$ 40.47/2.19	44.25 $\pm$ 40.47/2.19	114.32 $\pm$ 40.47/2.19	40.47 $\pm$ 25.02/2.19	122.08 $\pm$ 61.2/3.31
	Female (183)	194.97 $\pm$ 37.63/2.78	49.74 $\pm$ 37.64/2.78	121.26 $\pm$ 37.64/2.78	25.11 $\pm$ 37.64/2.78	121.52 $\pm$ 58.26/4.31

*Figures in brackets indicate numbers ** serum total cholesterol.

This may be due to environment, temperature, and or diet intake. Gujaratis as well as Northern Indian population in contrast to Southern population consume more ghee but in fresh unheated form. The fatty acid composition of ghee shows that it contains 62% saturated fat, 35% mono saturated fat and 2% trans fatty acid. Trans fatty acid has atherogenic effects(10). Heating under pressure converts cis-fatty acid into trans fatty acid which is more harmful. Ghee in unheated form is less harmful than heated form, and even has less effect on serum cholesterol level(10). Mean value of serum triglycerides (mg/dl) in the present study is 122.08 $\pm$ 61.20 in the males and 122.52 $\pm$ 58.26 in the females in the age group above 45 years. These values were significantly lower than those from persons of Northern India (2,7). This may be due to less consumption of carbohydrates especially sweets in the studied population compared to Northern Indian population. Greater availability of carbohydrates allows higher production of gamma glycerophosphates required for synthesis of triglycerides (7,11). High triglycerides level if associated with high TC/HDL-C ratio has high risk of IHD(12). Mean value of serum LDL cholesterol (mg / dl) in the present study in the males is 114.32 $\pm$ 40.47 and in the females is 121.26 $\pm$ 37.64 in the age group above 45 years. These values were significantly higher than those in other Indian studies (2,7,8). High level of LDL in the present study in Gujarati population

could be due to less physical activity in relation to the caloric intake(6). LDL cholesterol is an important prognostic factor for ischaemic heart disease than total cholesterol(7). Mean value of HDL-cholesterol levels (mg/dl) in the present study in the males is 44.25 $\pm$ 40.47 & in the female is 49.74 $\pm$ 37.64 in the age group above 45 years. These values were higher than those of Northern Indian population (2,7) but lower than those of Southern Indian population(8). HDL cholesterol level is more of a protective factor against ischaemic heart disease (12). HDL cholesterol is the major potent lipid risk factor having an inverse relation with the incidence of IHD both in men and women(12,13). In the present study HDL-C in females is higher than males. Similar findings were observed by Gandhi et. al.(7), who stated that higher HDL-C in females makes them more protective against IHD in comparison to males.

Mean value of VLDL cholesterol in the present study in the males is 40.47 $\pm$ 25.02 and in the females is 37.64 $\pm$ 25.11 in the age group above 45 years. These values were significantly higher than those of Southern Indian population but lower than those of Northern Indian population (2,7,8). High VLDL-C may be due to the high triglycerides in the studied population(7). Like LDL-C, VLDL is atherogenic (8).

In comparison to the other Western studies (6,13), values of the present study are significantly

TABLE 2 : Comparative values of serum lipids and lipoproteins with other Indian studies

(All values in mg/dl)

Lipid	Sex	Present study		Data from Southern Indian study				Data From Northern Indian study	
		Age group	Mean $\pm$ SD	Gupta et. al. (11)		Shanmugasundaram et. al. (8)		Gandhi et. al. (7)	
				Age group	Mean $\pm$ SD	Age group	Mean $\pm$ SD	Age group	Mean $\pm$ SD
Serum cholesterol	M	00 - 15	150.31 $\pm$ 25.68	20 - 29	157.6 $\pm$ 29	Mean 40 217.7 $\pm$ 41.9 years		00 - 20	133 $\pm$ 20
		16 - 45	179.27 $\pm$ 37.50	30 - 39	177.6 $\pm$ 40			21 - 30	129 $\pm$ 15
		45 +	181.44 $\pm$ 40.47	40 - 49	181.0 $\pm$ 43			31 - 40	170 $\pm$ 21
				50 - 59	171.0 $\pm$ 53			41 - 50	178 $\pm$ 22
				60 +	167.9 $\pm$ 34			51 - 60	181 $\pm$ 20
								60 +	187 $\pm$ 17
	F	00 -15	143.16 $\pm$ 25.08	20 - 29	157.6 $\pm$ 29	Mean 40 211.5 $\pm$ 34.8 years		00 - 20	129 $\pm$ 15
		16 - 45	170.46 $\pm$ 30.66	30 - 39	177.66 $\pm$ 40			21 - 30	152 $\pm$ 21
		45 +	194.87 $\pm$ 37.63	40 - 49	181.0 $\pm$ 43			31 - 40	161 $\pm$ 20
				50 - 59	171.0 $\pm$ 53			41 - 50	162 $\pm$ 26
				60 +	167.9 $\pm$ 34			51 - 60	181 $\pm$ 20
								60 +	187 $\pm$ 17
Serum triglyceride	M	00 -15	74.81 $\pm$ 19.78	20 - 29	106.9 $\pm$ 45	Mean 40 NA years		00 - 20	119 $\pm$ 24
		16 - 45	119.56 $\pm$ 62.75	30 - 39	122.4 $\pm$ 46			21 - 30	126 $\pm$ 85
		45 +	122.08 $\pm$ 61.20	40 - 49	138.8 $\pm$ 47			31 - 40	124 $\pm$ 20
				50 - 59	145.3 $\pm$ 60			41 - 50	139 $\pm$ 29
				60 +	126.4 $\pm$ 55			51 - 60	143 $\pm$ 28
								60 +	145 $\pm$ 28
	F	00 -15	94.69 $\pm$ 33.95	20 - 29	106.9 $\pm$ 45	Mean 40 NA years		00 - 20	091 $\pm$ 22
		16 - 45	100.19 $\pm$ 46.91	30 - 39	122.4 $\pm$ 46			21 - 30	118 $\pm$ 29
		45 +	121.52 $\pm$ 28.26	40 - 49	138.8 $\pm$ 47			31 - 40	129 $\pm$ 18
				50 - 59	145.3 $\pm$ 60			41 - 50	128 $\pm$ 22
				60 +	126.4 $\pm$ 55			51 - 60	
								60 +	
Serum HDL	M	00 - 15	45.00 $\pm$ 25.68	20 - 29	42.5 $\pm$ 13	Mean 40 63.1 $\pm$ 10.2 years		00 - 20	26 $\pm$ 11
		16 - 45	44.07 $\pm$ 37.50	30 - 39	45.0 $\pm$ 11			21 - 30	29 $\pm$ 14
		45 +	44.25 $\pm$ 40.47	40 - 49	43.2 $\pm$ 11			31 - 40	32 $\pm$ 10
				50 - 59	43.6 $\pm$ 17			41 - 50	31 $\pm$ 11
				60 +	43.1 $\pm$ 12			51 - 60	37 $\pm$ 11
								60 +	32 $\pm$ 10
	F	00 -15	36.71 $\pm$ 25.08	20 - 29	42.5 $\pm$ 13	Mean 40 66.4 $\pm$ 11.1 years		00 - 20	29 $\pm$ 07
		16 - 45	48.74 $\pm$ 30.66	30 - 39	45.0 $\pm$ 11			21 - 30	31 $\pm$ 11
		45 +	49.74 $\pm$ 37.64	40 - 49	43.2 $\pm$ 11			31 - 40	27 $\pm$ 08
				50 - 59	43.6 $\pm$ 17			41 - 50	30 $\pm$ 05
				60 +	43.1 $\pm$ 12			51 - 60	_____
								60 +	_____

NA : Not applicable

Table contd.

TABLE 2 (contd.)

Lipid	Sex	Present study		Data from Southern Indian study				Data From Northern Indian study	
		Age group	Mean $\pm$ SD	Gupta et. al. (11)		Shanmugasundaram et. al. (8)		Gandhi et. al. (7)	
				Age group	Mean $\pm$ SD	Age group	Mean $\pm$ SD	Age group	Mean $\pm$ SD
Serum	M	00 -15	90.69 $\pm$ 25.68	20 - 29	93.8 $\pm$ 28	Mean		00 - 20	86 $\pm$ 21
		16 - 45	109.28 $\pm$ 37.50	30 - 39	108.0 $\pm$ 38	40		21 - 30	99 $\pm$ 30
		45 +	114.32 $\pm$ 40.47	40 - 49	110.1 $\pm$ 42	years	118.3 $\pm$ 30.12	31 - 40	108 $\pm$ 20
LDL				50 - 59	98.3 $\pm$ 41			41 - 50	118 $\pm$ 22
				60 +	99.5 $\pm$ 30			51 - 60	116 $\pm$ 21
								60 +	118 $\pm$ 25
	F	00 -15	82.51 $\pm$ 25.8	20 - 29	93.8 $\pm$ 28			00 - 20	76 $\pm$ 15
		16 - 45	01.13 $\pm$ 30.66	30 - 39	108.0 $\pm$ 38	Mean		21 - 30	88 $\pm$ 16
		45 +	121.26 $\pm$ 64	40 - 49	110.1 $\pm$ 42	40	114.8 $\pm$ 30.6	31 - 40	97 $\pm$ 23
				50 - 59	98.3 $\pm$ 41	years		41 - 50	100 $\pm$ 27
				60 +	99.5 $\pm$ 30			51 - 60	
								60 +	
Serum	M	00 -15	25.68 $\pm$ 14.88			Mean		00 - 20	33 $\pm$ 17
		16 - 45	37.50 $\pm$ 23.33	NA	NA	40		21 - 30	51 $\pm$ 21
		45 +	40.47 $\pm$ 25.02			years	36.1 $\pm$ 20.0	31 - 40	40 $\pm$ 19
VLDL								41 - 50	44 $\pm$ 24
								51 - 60	44 $\pm$ 20
								60 +	48 $\pm$ 09
	F	00 -15	25.08 $\pm$ 18.87			Mean		00 - 20	20 $\pm$ 09
		16 - 45	30.66 $\pm$ 19.51	NA	NA	40		21 - 30	43 $\pm$ 20
		45 +	37.64 $\pm$ 25.11			years	32.1 $\pm$ 15.3	31 - 40	44 $\pm$ 06
								41 - 50	50 $\pm$ 21
								51 - 60	—
								60 +	—

NA : Not applicable

lower for all the fractions of serum lipids and lipoproteins, for both the sexes. The significant difference between these two population groups could be due to the environment, temperature difference and or different dietary habits. Western population possibly consumes more of animal fat, eggs, butter etc., while Indian diet is rich in carbohydrates from pulses & cereals (7,14).

In Indians, prevalence of IHD is increasing since last few years and it is fast becoming the greatest single cause of death(15). Our unpublished work shows that incidence of dyslipidemia as a

single risk factor for IHD is 23.55%. It indicates the importance of dyslipidemia as a causative risk factor of IHD.

The values established in the present study, derived from the comparatively large vegetarian population of Gujarat (1329 subjects), can be used as standard reference values for these population groups and as a guideline to detect dyslipidemia until, better values are available. Range at various confidence intervals is shown in table no.3.

TABLE 3: Reference values established in present study

(All values in mg/dl)

Serum lipids	Age (yrs)	Sex	Mean value	Range at confidence interval		
				95%	99%	99.9%
Total cholesterol	0-15	M	150.31	137.73 - 162.89	133.75 - 166.87	131.05 - 169.57
		F	143.16	136.53 - 149.79	134.43 - 151.89	133.01 - 153.31
	15-45	M	179.27	175.92 - 182.62	174.86 - 183.68	174.15 - 184.39
		F	170.46	136.53 - 174.25	134.43 - 175.44	133.61 - 176.25
	>45	M	181.44	177.14 - 185.74	175.79 - 187.09	174.87 - 188.01
		F	194.87	189.42 - 200.32	187.69 - 202.05	186.52 - 203.22
HDL	0-15	M	45.00	32.42 - 57.58	28.44 - 61.56	25.74 - 64.26
		F	36.71	30.08 - 43.34	27.98 - 45.44	26.56 - 46.86
	15-45	M	44.07	40.72 - 47.42	39.66 - 48.48	38.95 - 49.19
		F	48.74	30.08 - 52.53	27.98 - 53.72	26.56 - 54.53
	>45	M	44.25	37.60 - 48.55	38.60 - 49.90	39.95 - 50.82
		F	49.34	43.89 - 54.79	42.16 - 56.52	40.99 - 57.69
LDL	0-15	M	90.69	078.11 - 103.27	074.13 - 107.25	071.43 - 109.95
		F	82.51	075.88 - 089.14	073.78 - 091.24	072.36 - 092.66
	15-45	M	109.28	105.93 - 112.63	104.87 - 113.69	104.16 - 114.40
		F	101.13	075.88 - 104.92	073.78 - 106.11	072.36 - 106.92
	>45	M	114.32	110.02 - 118.62	108.68 - 119.97	107.75 - 120.89
		F	121.26	155.81 - 126.71	114.08 - 128.44	112.91 - 129.61
VLDL	0-15	M	14.88	23.00 - 27.46	14.38 - 31.44	11.68 - 34.14
		F	18.87	12.24 - 25.50	10.14 - 27.60	8.72 - 29.02
	15-45	M	23.33	19.98 - 26.68	18.72 - 27.74	18.21 - 28.45
		F	9.91	12.24 - 23.30	10.14 - 24.89	8.72 - 25.70
	>45	M	25.02	20.72 - 29.32	19.37 - 30.67	18.45 - 31.59
		F	25.11	19.66 - 30.56	17.93 - 32.29	16.76 - 33.46
triglycerides	0-15	M	74.81	065.12 - 084.50	062.05 - 087.57	59.88 - 089.65
		F	94.69	085.72 - 103.66	080.82 - 106.50	80.96 - 108.42
	15-45	M	119.56	113.96 - 125.16	112.19 - 126.93	110.99 - 128.13
		F	100.19	085.72 - 105.98	082.88 - 107.81	80.96 - 109.06
	>45	M	112.08	115.58 - 128.58	113.53 - 130.63	112.14 - 132.02
		F	121.52	113.08 - 129.96	110.81 - 132.63	108.60 - 134.44

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