Journal of Pharmaceutical Research International

Volume 36, Issue 6, Page 21-34, 2024; Article no.JPRI.116064
ISSN: 2456-9119, NLM ID: 101716968
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

The Invstigation of Lipid Profile in Saudi Healthy Population and the Effects of Lifestyle

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JPRI/2024/v36i67519

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/116064

Original Research Article

Received: 14/02/2024
Accepted: 18/04/2024
Published: 24/04/2024

ABSTRACT

In this study differences in the response of plasma total cholesterol, triglycerides, Low Density Lipoprotein Cholesterol and High Density Lipoprotein Cholesterol were investigated in normal healthy Saudi population according to sex, age and lifestyle (rural and urban). This study was carried out for a total of (873) subjects (475 males and 398 females). Each of these two sex groups is classified into six subgroups according to ages ([0-14],[15-24],[25-40],[41-55],[56-69],[70+]).
For the all tested people the blood was drawn after overnight fasting period (12-14hrs) using heparinized tubes. For all the required parameters (total cholesterol, triglycerides, LDL-C, HDL-C) enzymatic colorimetric method is used and the mean values were obtained accordingly.
For plasma total cholesterol, triglycerides, HDL-C and LDL-C, the results showed lower Total Cholesterol, Triglycerides and Low Density Lipoprotein Cholesterol levels through childhood group (0-14) in both males and females. However HDL-C remains high in children with similar values as in adults in both males and females between city and village population. Neonatal and children plasma contains proportionately higher HDL-C than that of adult, decreases during adolescence to a constant value and remains constant up to the age of 55 years in both sexes, then it starts to rise to a constant level and remain constant throughout life. For both males and females at birth and

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through early years of life (infants and children) there were no considerable differences in all parameters (T.C, HDL-C, LDL-C, TG) tested and that is may be due to absolute and close similarity of dietary habits and lifestyle between villagers and city populations for infants and children respectively. These levels increase with increasing of age for both sexes depending deeply upon the diet, and the increase of total cholesterol is significant or close to significant up to the age of 69 years in males, then it starts to fall, but it continued to rise in women. Similarly LDL-C level increases up to the age of 69 in males and then it remains constant through all the rest of the life, but for females it continues on increasing throughout life. Triglyceride levels increase up to the age of 55 in males where it started to fall throughout life, whereas in females it follow the same manner as T.C and LDL-C since it increases throughout life. The increasing of LDL-C is quite obvious throughout life in females, whereas it remains constant after the age of 69 in males.
On the other hand it seems that differences of dietary habits and lifestyle are much more effective in the adult groups of age (15-24), (25-40), (41-55), (56-69), (70+), since there are significant or nearly significant differences between villagers and city populations in plasma total cholesterol, LDL-C, HDL-C and triglycerides.
It is quite obvious that the variability in plasma lipids and lipoproteins (T.C, TG, HDL-C and LDL-C) among populations precludes the establishment of universally acceptable limits. What may be considered "normal" for one populations group may not necessarily be applicable to another. Even within a country, these reference intervals may vary from a city to a village due to differences in dietary habits and lifestyle and also markedly age and sex.

Keywords: Lipid profile; cholesterol; steroids.

1. INTRODUCTION

Cholesterol is a member of the class of lipids called steroids. Although every living organism examined has been found to contain steroids, cholesterol is found exclusively in animals and humans. Virtually all cells and body fluids contain some cholesterol, a solid alcohol of high molecular weight, and it is the initial starting point in many metabolic pathways.

Cholesterol present in the intestinal wall comes from three sources: the diet, bile and intestinal secretions and cells. Animal products, especially meet, egg yolk seafood and whole fat-diary products, provide the bulk of dietary cholesterol. A similar amount of cholesterol is present in the gut from biliary secretion, and the turnover of mucosal cells. Practically all cholesterol in the intestine is present in the unesterified (free) form.

In the cholesterol synthesis, although a portion of the body's cholesterol is derived from dietary intake, the liver and other tissues from simpler molecules, particularly acetate, synthesize most tissue and plasma cholesterol endogenously.

Although essentially all cells have the capacity to synthesize cholesterol from acetyl-CoA, almost 90% of synthesis occurs in the liver and gut [1], Cholesterol is the most prominent member of the steroid family and is famous among the public because of the relationship between an elevated level of serum cholesterol and an increased risk of cardiovascular disease.

Cholesterol and other fats cannot dissolve in the blood; they have to be transported to and from the cells by special carriers called lipoproteins.

Cholesterol is the essential nutrient necessary for many functions including the following:

- Producing and repairing cell membranes.
- Manufacturing vitamin D on the skin's surface.
- Production of hormones, such as estrogen and testosterone.
- Possibility helping cell connections in the brain that are important for learning and memory.
- Cholesterol is also the precursor for other steroids in animals such as bile acids.

Approximately 1100 mg of sterol is exerted each day from a normal human adult. In a typical American diet, this replaced by 250 mg in the diet and 850 mg by means of biosynthesis [2]. The average adult male, if such existed, would weigh approximately 70Kg, of which just over 0.2% or about 0.140Kg, would be cholesterol, with approximately 5.5% of this amount, or 8g, contained in his Plasma. This average man, if he lived in North America, Western Europe, or Australia, would consume every day close to

0.5g of cholesterol, plus assorted amounts of related sterols. His average daily synthesis of cholesterol, working at only a fraction of full capacity, might be another 1.0g, giving a total each day of 1.5g. His average daily metabolic requirement should be no more than 350mg, even less if he recycled efficiently [3].

Man's plight is even worse than this many-fold excess of intake plus production over requirement. Not only does every cell of his body both contain cholesterol and have ready access to a large extra cellular supply, but every cell (with the possible exception of the mature blood cell) can also make cholesterol. In other words every cell contains, and therefore must synthesize and maintain control over, the some 26 enzymes responsible for converting acetyl-CoA to cholesterol. Such extravagance on so grand a scale, is virtually unknown elsewhere in the mammalian world.

And finally, all this cholesterol may mean the death of our average man, or at least of our average eastern man.

At the end of his three score years and ten, or very often much sooner, his blood will somewhere contain more cholesterol than it should, and the excess may kill him.

In The Laboratory there is also too much work on cholesterol but the majority of which, are flatly contradicted, or at least provide an alternative observation to or explanation. The number research findings that are relevant to cholesterol metabolism is huge, because the rewards are very great and the basic technology very simple. If you can maintain an animal, and if you can bleed it, then you can do cholesterol research. And the prizes for obtaining the right answer, e.g., to why does blood cholesterol go up? And why won't it come down? Are very substantial indeed.

But the number of irrelevant works is likewise huge, only marginally less than the total number, since all but a very few are asking questions to which there is really only one answer. It all depends on the species, the strain on age or gender, nutritional status, the temperature, the time of day, the season of the year, or on a dozen other variables [3].

As the cholesterol story unfolds in this research it should become obvious that some great work has been done. The structure and biosynthetic derivation of the cholesterol molecule, the basic enzymes pathways leading to cholesterol and from it to bile salts and the steroid hormones, the physicochemical explanation for the formation of cholesterol gallstones, and the distribution patterns of cholesterol in human blood: these are areas in which the broad patterns are clear, even though all the finer details might not be. But beyond these and a few others there is as yet no hint, no semblance of a pattern and the vast to uncover a pattern.

In the Role of Cholesterol In Mammalian System we can say Cholesterol is both an end and a beginning product. As an end product of along and intricately regulated biosynthetic pathway, its predominant role appears to be as a constituent of membranes.

In any attempt to unravel the mysteries of cholesterol's function in the body one can well begin by asking three questions, where is the cholesterol located ? what can increase this cholesterol content ? What are the consequences of any such alternation in cholesterol content ?

Table1 below shows the approximate content and tissue distribution of cholesterol in man, assuming a standard man under standard metabolic conditions.

These figures indicated that under normal conditions the highest concentrations in soft tissue are found in the adrenals and the nervous system, and the lowest surprisingly in the heart. But since the total mass of the various tissues differs greatly, the largest absolute amounts of Cholesterol are contained in muscle, nervous and connective tissues (65% of the total). The tissue likely to vary most in mass in any individual is the adipose tissue and thus, although the proportion of Cholesterol in fat is generally small, a grossly obese person can store significant amounts of total Cholesterol in his or her body fat. The fate of this Cholesterol is an important consideration in any program of dieting.

Tissue levels of Cholesterol are not necessarily consistent between genders, or certainly between species. All evidence indicates that the synthesis of this complex molecule from smaller fragments, there is only one major pathway, with a number of minor alternatives. No matter where in the body this synthesis takes place.

Table 1. Approximate distribution of cholesterol in a 70 kg man

System		Cholesterol		
	Weight (g)	Concentration (%wet weight	Amount (g)	Percentage of total body Cholesterol
Brain and nervous system	1600	2.0	32.0	22
connective tissue and body fluids	12100	0.25	31.3	22
Muscle	30000	0.1	30.0	21
Skin	4200	0.3-0.7	16.0	11
Blood	5400	0.2	10.8	8
Bone marrow	3000	0.25	7.5	5
Liver	1700	0.3	5.1	4
Alimentary tract	2500	0.15	3.8	3
Lungs	950	0.2	1.9	1
Kidneys	300	0.25-0.34	0.9	1
Adrenal glands	12	2.6-15	1.2	1
Other glands	100	0.2	0.2	
Heart	350	0.09-0.18	0.6	
Spleen	200	0.16-0.34	0.5	
Blood vessels	200	0.25	0.5	
Skeleton	7000	0.01	0.7	
			143.0	

Khan. [4]. (1983); Cook.[5]. (1958)

Cholesterol is taken up by absorption and returned through digestive juices (mainly bile) and also deguamated cells. The principle in metabolic state that total in circulation remains constant, the additions from the diet and synthesis exactly balancing the losses by metabolism and excretion. Any one cholesterol molecule travels this circuit n times a day. Would it really matter if absorption went up or down, so that any molecule went around n+1 times or n-1 times? This is not known, but no absorption at all would certainly complicate matters!

Dietary cholesterol: Many facets of cholesterol absorption the vary with varying of level of cholesterol fed, not only the absolute or relative amount absorbed, but the reason and effect here are very difficult to distinguish among many other variables, such as Species and amount and type of dietary fat. As might be expected, the proportion of plasma chylomicrons and VLDL increase and LDL and HDL decrease, as cholesterol absorption increase [6].

Cholesterol in the Blood: It is very important to consider and study the factors that put cholesterol into the blood, the factors that keep it there, and those take it out. Many questions immediately rises from this consideration, some of these questions are not yet answerable , and all of fundamental unknown that ‘’ why is cholesterol in the blood ‘ .The answer at the opposite extreme would be more complex, that the blood cholesterol is an obligatory component of circulation, necessary for both transport of the other components, and for the structural and functional completeness of cellular membranes. From the previous point perhaps the real answer is a mixture of both extremes.

Chylomicrons: Chylomicrons are large particles produced by the intestine; consist predominantly of triglycerides (80% - 95%), with smaller amounts of phospholipids (3% - 6%), cholesterol (3% - 7%, mostly esterified) and protein (0.5% - 2.5%) [7].

Very Low Density Lipoproteins (VLDL): These particles are roughly spherical and smaller than chylomicrons, Mostly they consist of triglycerides (50% 70%), with smaller amounts of phospholipids (15% - 25%), cholesterol (15% - 20%, half of which is esterified), and protein (7% - 12%) [6].

Low Density lipoproteins (L D L): This class of lipoproteins called the bad cholesterol. The particle size is much smaller than that of the triglyceride – rich lipoproteins. For human, LDL represents the most lipoprotein class, unlike most other mammals, where high-density lipoprotein predominates [8].

High Density Lipoproteins (HDL): This class of lipoproteins called the good cholesterol. HDL is small particle mostly consisting of protein (50 per

cent), 20 per cent cholesterol, 30 per cent phospholipids [9], and only traces. HDL often subdivided into HDL_2 and HDL_3 with variation in density, particle size and composition and may vary also in physiological role. HDL appears to benefit the body in two ways: It removes cholesterol from the walls of the arteries and returns it to the liver, and also helps prevent oxidation of LDL in fat; it appears to have antioxidant properties on its own. HDL then helps keep arteries open and reduces the risk for heart attack. High levels of HDL, above 60 mg /dl important for the heart as low levels of LDL. HDL levels below 40 mg /dl are considered to be harmful. In one study, for each 4 mg /dl decrease in HDL levels there was 10% increase in coronary disease [5]. LDL can be calculated by subtracting HDL levels from total cholesterol. (LDL = TOTAL CHOLESTEROL – HDL – TRYGLYCERIDES/5)

Age: Plasma cholesterol levels at birth are generally low in man. Virtually in many human studies cord blood show a cholesterol level at birth of about 70 to 80 mg/ dl, irrespective of race .[10] Neonatal plasma contains proportionately more HDL than that of adults . Young and Middle – Aged Adults: The strongest evidence of unhealthy cholesterol levels and heart disease is in middle – aged adults over 40. However, it is now strongly suggesting that the younger a person is unhealthy cholesterol levels develops the greater chance for serious heart and blood vessel problems in the future. In one important study [11]. young men who had cholesterol level at or above 240 mg/dl had two to four times the risk of dying from heart attack or other cardiac problems than did men whose cholesterol was lower than 200 mg/dl.

Gender: At birth and during their early years females may have slightly higher levels of plasma cholesterol. During childhood, adolescence, and young adulthood, there is little difference, but later in life males tend to have a higher concentration due to higher level of VLDL and LDL, although after so years of age this trend may be reversed [12,13,14].

Genetic Influences: Genetic plays a major role in determining a person's blood levels and children from families with a history of premature heart disease should be tested for cholesterol level after age two. Genes may influence whether one has low HDL levels, high LDL levels, triglycerides, or high levels of other lipoproteins [15].

The genetic influences operating to determine differences between population and within populations are not easy to measure. Most human studies depend on statistical analysis of parent- child and child -child relations; generally, cholesterol levels in children are positively correlated with those of their parents and their relatives [16,17].

Exercise and Lifestyle: One interesting observation is that the exercise lowers plasma cholesterol in general. Inactivity is one of the four major risk factors for coronary artery disease, equally with smoking, unhealthy cholesterol, and high blood pressure.

1.1 Objectives

As it is known that the cholesterol is essential for human health. On the other hand the high levels of cholesterol, particularly LDL-C cholesterol, causes many difficulties for human health (ischemic disease) and too much LDL-cholesterol can clog the arteries and thus increases the risk of heart attack and stroke. The aim of this study is to investigate the lipid profile (total cholesterol, triglycerides, HDL-cholesterol, LDL-cholesterol) in healthy normal people throughout life from two different groups based on namely rural and urban populations of different ages and sexes, in order to find out the effects of each of these three factors. Evaluation and effects of diet, physical activities and other possible environmental factors, inherent to these groups, on the incidence of ischemic heart disease and stroke will be done.

2. MATERIALS AND METHODS

This study was conducted at Alqunfudah region for rural and urban populations. The study comprised investigations for total of (873) healthy subjects of which (430) were urban subjects from Alqunfudah city and (443) from rural areas from (8) randomly chosen villages (Alsuffa, Sabt Shumran, Doaga, Khamis Harb, Aal Tarig, Albirk, Almudailif, Alhabil), illustrated by sketch map in Fig. (1). All the investigated people are normal healthy, they were not on any treatment for high cholesterol or other lipids at the time of study. Most of the investigated adult subjects are officers following sedentary lifestyle, some are students, few of them only with free-lance. The questionnaire included socio-demographic data in the form of age, gender, lifestyle and educational level. Education level was categorized as low (primary and intermediate schooling), average (secondary schooling), and

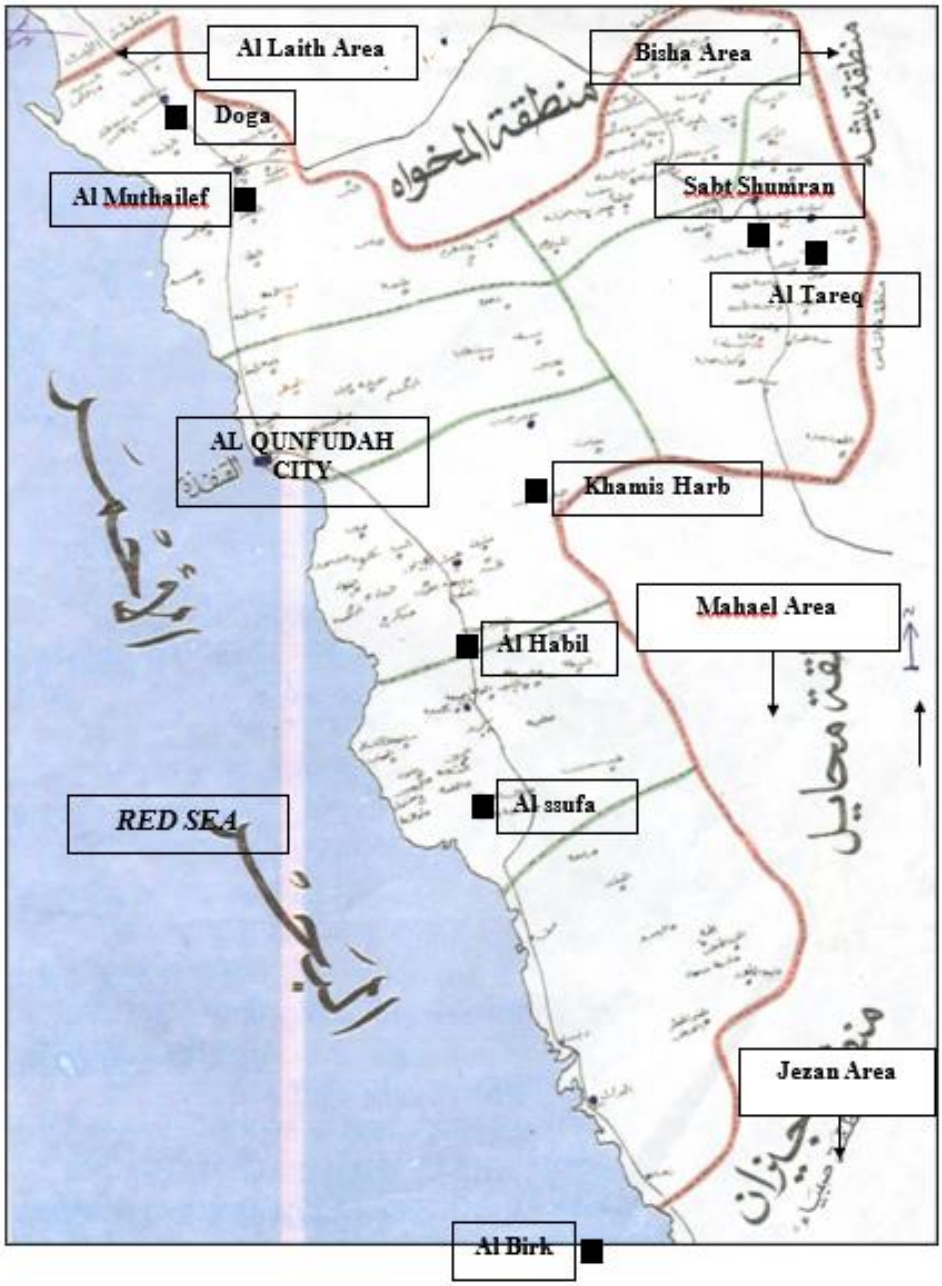

Fig. 1. Sketch map illustrated location of city and villages surveyed, Al Qunfudah region, Saudi Arabia

high (University and postgraduate). Blood was drawn after a 12-14 hours overnight fasting period and collected in tubes containing heparin (final concentration up to 75 U/ml). The blood centrifuged at 4000 rpm for 10-15 minutes by labofuge centrifuge, (model 400, Germany). The resulting plasma was kept on ice and the experiments were performed within a period not exceeding two hours. For all tests required (total Cholesterol, HDL-C, LDL-C triglycerides) enzymatic methods, and a Hitachi autoanalyser (model 911) instrument with ready to use Boehringer Mannhiem kits were used. The instrument is calibrated and controlled prerunning the samples.

Statistical analysis was performed using Statistical Package for Social Science (SPSS). The data for numerical values were expressed in mean ± standard deviation (SD). Differences between each parameter mean value of the age group and the next one were obtained, the

results were consider statistically significant when the differences show equal or more than (SD).

2.1 Calibration and Quality Control

Cholesterol and triglycerides were standardized using a calibrator for automated systems (c.f.a.s). For high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) c.f.a.s. lipids is used.

For plasma cholesterol (total) and triglycerides, two levels of controls often assayed at least once a day, Precinorm U as low control, and Precipath U as high control. Precinorm L and Precipath L were used as low and high levels respectively, for each HDL-C and LDL-C.

3. RESULTS

3.1 Interaction between Gender and Lifestyle and their Effect on Plasma Cholesterol and Lipoproteins

Table 2 shows the male lipid profile measurements for both city people and villagers in each group of age in order to find out the effects of lifestyle. The mean values of all lipid profile (T.C, HDL-C, LDL-C, TG) shows obvious differences between villagers and city population through all age groups, with obvious exception in childhood age group. Similar to males, mean values for all lipid profile in the female subjects shows considerable differences between villagers and city population through all age groups, except the childhood age group (0-14) wherein lower difference was observed Table 3.

At birth and during early years of life (infants and children) in both males and females there were no considerable differences in all tested parameters (total cholesterol, HDL-C, LDL-C, triglycerides), and that is due to similarity in dietary habits and lifestyle between rural and urban populations for infants, and also due to close similarity of these two factors in childhood. On the other hand, in both sexes it is obviously seemed that differences of dietary habits and lifestyle were much highly effective in the adults groups: (15-24), (25-40), (41-55), (56-69), (70+) age, where there were considerable (significant or nearly significant) differences between villagers and city population in plasma total cholesterol, LDL-cholesterol, HDL-C and triglycerides.

Mean values for total cholesterol, TG , HDL- C and LDL- cholesterol are shown in Table (2).

Female groups were similarly classified, and the mean values for total cholesterol, HDL-cholesterol, LDL- cholesterol and triglycerides are given in Table 3

Table 4 showed a combined mean values for total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides for both males and females in different groups of age based on lifestyle.

4. DISCUSSION

Cardiovascular diseases might be classified like cancer and road accidents as a statistical ailment. For any one of us, the living of a normal life is accompanied by a certain risk, which can rise or fall in direct correlation with a large

Table 2. Plasma total lipids and lipoproteins in males, based on lifestyle

Age	Lifestyle	Mean (mg/dl)				No. of People Examined
		T.C.	HDL-C	LDL-C	TG	
0-14	City	146±16	54±4	82±9	62±12	39
	Village	142±14	56±4	78±7	58±10	42
15-24	City	170±11	50±4	98±7	100±12	36
	Village	160±13	56±3	90±8	84±11	37
25-40	City	191±11	49±4	119±7	128±17	40
	Village	179±10	57±3	111±6	108±15	42
41-55	City	206±11	48±5	130±7	150±18	42
	Village	194±13	58±3	120±6	130±16	45
56-69	City	220±12	55±3	140±7	142±15	41
	Village	210±11	59±3	130±7	118±12	41
70+	City	210±15	55±3	140±10	132±15	33
	Village	200±14	59±4	130±9	116±13	37

Values are mean ± SD

Table 3. Plasma Total Lipids and Lipoproteins in Females, based on Lifestyle

Age	Lifestyle	Mean (mg/dl)				No. of People Examined
		T.C	HDL-C	LDL-C	TG	
0-14	City	154±15	58±6	88±10	59±13	30
	Village	148±14	62±4	84±7	53±11	32
15-24	City	175±11	54±3	104±5	97±12	33
	Village	165±10	60±4	96±4	79±12	31
25-40	City	202±12	54±3	120±5	118±14	39
	Village	188±12	60±3	110±4	94±13	38
41-55	City	222±9	52±3	130±5	135±17	35
	Village	208±12	62±3	120±6	109±16	37
56-69	City	225±10	56±2	140±7	138±15	31
	Village	215±13	64±2	130±6	118±12	30
70+	City	230±13	57±3	150±8	142±15	31
	Village	220±14	63±4	140±10	126±14	31

Values are mean ± SD

Table 4. Combined results of total lipids and lipoproteins for comparison between males and females

Age	Lifestyle	Mean (mg/dl) Males				Mean (mg/dl) Females			
		T.C.	HDL-C	LDL-C	TG	T.C	HDL-C	LDL-C	TG
0-14	City	146±16	54±4	82±9	62±12	154±15	58±6	88±10	59±13
	Village	142±14	56±4	78±7	58±10	148±14	62±4	84±7	53±11
15-24	City	170±11	50±4	98±7	100±12	175±11	54±3	104±5	97±12
	Village	160±13	56±3	90±8	84±11	165±10	60±4	96±4	79±12
25-40	City	191±11	49±4	119±7	128±17	202±12	54±3	120±5	118±14
	Village	179±10	57±3	111±6	108±15	188±12	60±3	110±4	94±13
41-55	City	206±11	48±5	130±7	150±18	222±9	52±3	130±5	135±17
	Village	194±13	58±3	120±6	130±16	208±12	62±3	120±6	109±16
56-69	City	220±12	55±3	140±7	142±15	225±10	56±2	140±7	138±15
	Village	210±11	59±3	130±7	118±12	215±13	64±2	130±6	118±12
70+	City	210±15	55±3	140±10	132±15	230±13	57±3	150±8	142±15
	Village	200±14	59±4	130±9	116±13	220±14	63±4	140±10	126±14

** No. of people examined is the same as in Tables (2), (3)*

number of variables. For most populations it is a fairly simple to determine what is the relative morbidity or mortality rates of the disease, and it is very useful epidemiological exercise to correlate mortality or morbidity data with other measurable parameters of any population under study. These correlations endowed with the title "risk factors" which can be classified in several ways, but the more useful classification at least for coherent discussion is dividing the factors into primarily genetic, primarily behavioural and primarily nutritional [3].

This study comprised investigations for total of (873) healthy subjects of which (430) were urban individuals from Alqunfudah city and (443) from rural areas from (8) randomly chosen villages, illustrated by sketch map in the Appendix. All investigated people are normal healthy, they were not on any treatment for unhealthy cholesterol or other lipids at the time of study. Most of the investigated adult subjects are officers following sedentary lifestyle, some are students, few of them only with free lance. The questionnaire included data in the form of age, gender, lifestyle and educational level. The results showed considerable effects of age on plasma total lipids and lipoproteins in all samples studied.

At birth and during yearly of (childhood) results of investigated people indicated lower levels of total cholesterol, LDL-C and triglyceride than in adulthood, however HDL cholesterol showed the reverse through the same age group [18]. Plasma total cholesterol in male children was, on average of 21 mg/dl lower than in young adults (15-24), and continues to rise proportionately with increasing of age depending deeply upon the diet through the rest of the life, these levels

keep on increasing significantly with increasing of age through the first two adult groups [15-24], [25-40] and marginal significance within the next groups [41-55], [56-69]. The increase was (20 mg/dl) [SD=±18], (15 mg/dl) [SD=±16] and (15 mg/dl) [SD=±16] respectively. Whereas a decrease of 10 gm/dl (SD=±18) was observed in the older group (70+) age, which may be due to reverse tendency in old male adults to diet or at least to faty diet, and also due to age related changes in gender hormones. Plasma HDL-cholesterol in males was slightly higher by 2 mg/dl [SD=±8] in the first group (0-14) than the next three groups of age (15-24), (25-40), (41-56) which have the same levels of HDL-C, (53 mg/dl), whereas slight increase (4 mg/dl), [SD=±7] was observed between the two groups of age (41-55), (56-69), and remained constant in the last group of age, this is also reported earlier [19] that Neonatal plasma contains higher HDL-C, and lower total cholesterol than that of the adults.

Plasma LDL-C was significantly low during childhood and witnessed significant or nearly significant increase with increasing of age till the age of (69) years, the differences between each group and the next one showed 14, 21,10,10 and 10 mg/dl [SD=11-14] respectively, then remained at the same level in the older group of age (70+). Also plasma triglycerides follow the same manner as in total cholesterol and LDL-cholesterol, wherein the rising indicated differences of (32 mg/dl) [SD=±16], (26 mg/dl) [SD=±14] and (22 mg/dl) [SD=±19] respectively, whereas slight reduction was found in the level after the age of (55) years which indicated (10 mg/dl) [SD=±20] lower in (56-69) group of age and (6 mg/dl) [SD=±19] in elderly adults group. It is quite obvious that higher plasma cholesterol (total) was noticed up to 69 years, accompanied by relatively higher levels of triglycerides noticed up to 55 years, reversed after 69 years and 55 years respectively. However, LDL-C levels which also increased along with total cholesterol and triglycerides remained constant after 69 years of age.

Female lipid profile measurements generally show higher levels of plasma total cholesterol, HDL-C and LDL-C in comparison to male values, which indicated differences of (7, 5 and 6 mg/dl) respectively within the childhood age.

Similar to males, the plasma levels of total cholesterol for females increase with increasing of age, but through all studied groups of age. The increase indicated values of (20 mg/dl) [SD=±22], (25 mg/dl) [SD=±17], (20 mg/dl) [SD=±17], (5 mg/dl)[SD=±17] and (5 mg/dl)[SD=±18] respectively. As in males HDL-C in females started slightly higher (3 mg/dl) [SD=±17] in the first group of age (0-14) in comparison to next three groups of age (15-24), (25-40), (41-55) which have the same (57 mg/dl) same levels wherein the rise (3 mg/dl) [[SD=±5] was observed through (56-69) group of age and remains constant through the rest of life. LDL-C mean values in females increased significantly with increasing of age through all studied groups of age, the increase noticed average values of (12 mg/dl) through all age groups since the standard deviation values are (±11, ±8, ±9, ±8, ±8 and ±12) starting from childhood age group respectively. In females plasma triglycerides keep on increasing with increasing of age through all studied groups, but significant only through the first three groups of age, wherein the increase was on average of (22 mg/dl) for the first three groups of age and (6 mg/dl) for the next three groups, whereas standard deviation indicated values of (±15, ±14, ±18, ±21, ±20 and ±18) for all groups of age respectively.

It has been previously shown that plasma total cholesterol, LDL-C and triglycerides levels are generally low at birth and rises rapidly after birth, the rate of rise depending deeply upon the diet [20]. Saudi population in majority have strong desire and tendency to the animal products in their food and there is a general agreement that the amount and the degree of saturation of fat in the food are responsible for any effect on plasma cholesterol. This is because the intake of saturated fats elevates the plasma triglycerides, total and LDL- cholesterol . There is a fact that the bulk of dietary cholesterol is provided by animal products such as meat, egg yolk, whole fat-dairy products, butter, cheese, ram liver, calf liver, brains, chicken drumstick and several other common foods, that dominate the Saudi market. In addition, unhealthy lifestyle regarding daily life (sedentary lifestyle), few of the people only following a regular aerobic exercise program. All these factors makes middle age adults predominantly highly susceptible if proper precautions are not taken. Studied relationship between diet and plasma in pre and postmenopausal women, their study indicated that plasma total and LDL- C levels were directly associated with consumption of saturated fat and inversely associated with calorie intake, and this is strongly demonstrated the indication and results of the present study [21]. One study [9]

conducted at 10 Lipid Research Clinics in North America in 1980, which demonstrated the effects of age and gender indicated evidence of abnormal cholesterol levels in middle age adults over 40 to 45 years of age, and that virtually confirms the present study. Also another study reported the pattern of change for serum lipids from 1-15 years of age and they concluded that total cholesterol decreases after infancy, increased in early puberty and then decreases by 15 years of age, and reciprocal changes in high (HDL-C) and low (LDL-C) density lipoprotein cholesterol occurred during each interval [22].

From this study it is quite obvious that the strongest evidence of abnormal cholesterol levels found in middle age adults over 40, and there is greater chance for developing ischemic heart disease and blood vessel problems.

The effect of gender on plasma lipids and lipoproteins and its interaction with age has been noticed. As mentioned before generally female lipid profile indicated slightly higher levels of total cholesterol, HDL-C and LDL-C in comparison to male gender. Total cholesterol mean values in females shows slightly higher levels than in males, with obvious exception in elderly adults which showed significantly higher levels, the differences between the levels in male and female for each two similar age groups showed values of (7,5,10,15,5 and 20 mg/dl) respectively [male SD=±16 - ±21], [female SD=±17 - ±22], this clear fall in plasma total cholesterol level in elderly male adults may be due to changes in sex hormones or due to reverse tendency in male elderly adults to rich fat diet or both.
Similarly HDL-C mean values for females showed slightly higher levels in comparison to males through all studied groups of age, whereas the differences gave values of (15,4,4,4,3 and 3 mg/dl) regarding all age groups respectively, [male SD between ±6 - ±8], [female SD between ±4 - ±7]. Also LDL-C in females follow the same pattern as in total cholesterol and HDL-C particularly through the first two groups (0-14), (15-24) and older age group (70+), which noticed a fewer values in males in comparison to female gender through both childhood and young adults, the differences were (6 mg/dl) in both [male SD between ±11 - ±13], [female SD between ±8 - ±11], whereas have the same levels of LDL-C within age of (25-69) years, but later in life (70+) females tend to have (10 mg/dl) higher than in male gender [male SD=±14], [female SD±12].

Plasma triglycerides mean values in females indicated lower levels in comparison to males with shamed exception during the last age group (70+) which shows the reverse, the results noticed differences of (4,4,12,18 and 2 mg/dl) within the first five groups of age [male SD between ±14 - ±20], [female SD between ±14 - ±20].

Comparingly, the study [9] which conducted in North America in 1980, highlighted the evidence of higher cholesterol levels in female gender than in male, and that strongly confirmed the present study. Also study gender differences in the response of serum cholesterol and lipoproteins to a decrease intake of dietary saturated fat and they concluded that men have larger response of total and low density lipoprotein cholesterol than women do [23]. Furthermore, and comparingly, Study the effect of a low saturated fat and low cholesterol diet on serum lipid and lipoproteins before school age, they reported that the intervention boys had significant difference (0.39 m mol/L) lower mean serum cholesterol values than the control boys, but among girls, the difference was of marginal significance (0.15 m mol/L), and the striction of saturated fat and cholesterol intake by repeated rounds, reported lower serum total and LDL cholesterol levels at 5 years of age in both genders, but the significant only in boys [23].

The effects of lifestyle on plasma lipids and lipoproteins also played a considerable role.

This work also focused on the male lipid profile measurements for both city people and villagers in each group of age in order to find out the effects of lifestyle. The mean values of all lipid profile (T.C, HDL-C, LDL-C, TG) shows obvious differences between villagers and city population through all age groups, with obvious exception in childhood age group.

Similar to males, mean values for all lipid profile in the female subjects showed considerable differences between villagers and city population through all age groups, except the childhood age group, wherein lower difference was observed.

At birth and during early years of life (infants and children) in both males and females there were no considerable differences in all tested parameters (total cholesterol, HDL-C, LDL-C, triglycerides), and that is due to similarity in dietary habits and lifestyle between rural and urban populations for infants, and also due to

close similarity of these two factors in childhood. On the other hand, in both genders it is obviously seemed that differences of dietary habits and lifestyle were much highly effective during adulthood (15-70+) years of age, where there were considerable (significant or nearly significant) differences between villagers and city population in plasma total cholesterol, LDL-cholesterol, HDL-C and triglycerides.

Plasma total cholesterol, LDL-C, HDL-C and T.G for the city population indicated higher levels than in villagers for adults age group (15-70+), on the average of (11 mg/dl) [SD between ±3 - ±4], for LDL-C average of (9 mg/dl) [SD between 6± - ±10], for T.G indicted difference of (19 mg/dl) [SD between ±11 - ±18].

Comparingly, studies and comparison of serum lipids between fathers and sons at middle age, fathers examined when they were at 50 years of age in (1963) and compared with their sons when they were also at 50 years of age (1993). They indicated that, there was moderately a strong association between serum cholesterol levels in fathers and sons at middle age, and they concluded that, secular trends were important in determining serum cholesterol levels for those born at a later period to indicate a major role of environmental factors. Also the present study had demonstrated the importance of environmental factors effect according to the location of the populations [24].

Total cholesterol levels for the city populations showed slightly higher levels in females through all age groups in comparison to males with obvious exception in older age group (70+), which showed significant higher levels in females. HDL-C showed approximately significant higher levels for females in comparison to males through the first four age groups and slightly higher during the last two age groups. Whereas LDL-C showed slightly higher levels during childhood, adolescence and young adulthood in females, although males and females tend to have the same levels of LDL-C between 56 and 69 years of age, and it showed considerable and significant higher levels for females compared to males in (70+) group of age.

As in city populations, female villagers showed slightly higher total cholesterol levels throughout their life with obvious exception at (70+) years of age, which indicated significant higher levels in females in comparison to males. HDL-C levels for villagers similar to those in the city populations, showed slightly higher levels in females through all age groups. Wherein female villagers LDL-C showed slightly higher levels in females during childhood and adolescence, and fell slightly in young adulthood females, then increased again to reach the same levels in males during old adulthood (41-69 years of age), and continue to rise significantly at (70+) group of age.

As it is clearly shown in this study that sufficient results to indicate and highlight the role of dietary habits along with lifestyle and indicated that people in susceplible age (41-69), particularly city population, both genders should change their dietary habits and lifestyle to prevent and avoid the risk of CHD. To resolve this dilemma and to improve the cholesterol levels by reducing their total and LDL cholesterol levels, there is a number of dietary approaches which all have benefits depending on specific risk factors. So to reduce total and LDL cholesterol levels, choose unsaturated fats, fiber-rich food such as whole grains, take vegetables and fruits, apples, carrots, artichoke, garlic, onion, ginseng, soybeans, oat bran, herps and mustard. In addition, exclude all animal products except low fat or skimmed yogurt, low fat or skimmed milk and egg whites. Furthermore, the experts also suggested that people who change their diet in order to improve cholesterol levels are quite successful in reducing their risk for heart diseases only when they also follow a regular aerobic exercise program. Furthermore, it is always important to emphasize that cholesterol-lowering medications are used along with healthy lifestyle, not instead of them.

5. CONCLUSION

At birth and during childhood generally the results showed low levels of plasma total cholesterol, triglycerides and LDL-C. At the opposite, HDL-C levels were slightly higher at birth and childhood than that of adulthood. The results also showed that there were no considerable differences through early years of life (infants, children) between males and females for any of the parameters tested. Furthermore the results did not report any significant differences between villagers and city population within the same age.

Through adults groups the results showed increasing of plasma total cholesterol, triglycerides and LDL-C levels by increasing of

age throughout life in females, increasing was significant up to the age of (55) for total cholesterol levels, up to the age of (40) for triglycerides and approximately throughout life for LDL-C.

In adult males, the results indicated also increasing of the three above parameters with increasing of age up to the age of (69) years for total and LDL cholesterol, then it started to reverse slightly and remains constant at the rest of the life for total and LDL cholesterol respectively, wherein increasing of triglycerides levels was significant up to (55) years and started to reverse the rest of life.

Generally in both sexes neonatal and children plasma contains higher HDL-C than of the adults, decreases during adolescence to a constant value and remains constant up to (55) years of age, then it started to elevate to a constant levels and be constant throughout life.

For both males and females it seems obviously that differences of dietary habits and lifestyle were much more effective in the adults groups of age ([15-24], [25-40], [41-55], [56-69], [70+]) and there were significant or nearly significant differences between villagers and city populations in plasma total cholesterol, LDL-C, HDL-C and triglycerides.

Additional value of apolipoprotiens A and B estimations in the diagnosis and prognostication in CHD needs to be investigated.

6. RECOMMENDATIONS

Lipid metabolism is directly related to coronary heart diseases although other contributory factors are also very important like familial history of CHD, lifestyle and dietary habits. As it is obviously shown in this study the following recommendations can be adopted to suit Saudi populations:

1. with the increase of age, total cholesterol, triglycerides and particularly LDL-C have the tendency to rise. So people at the age (41-69) are highly susceptible to CHD if proper precautions are not taken specifically by increasing the awareness to the risks.
2. Saudi diets are rich in saturated fats and the majority of susceptible age groups are obese with sedentary lifestyle. All these factors predispose any person within this group to CHD. So it is very important in Saudi population that people in susceptible age group (41-69) male and female should change their lifestyle and dietary habits to avoid the risk of CHD.
3. use of plant sterols and soluble fibre as therapeutic dietary options to enhance lowering of LDL- Cholesterol, are to be encouraged.
4. adherence to therapeutic lifestyle changes and drug therapies are to be promoted.
5. treatment for lowering LDL- Cholesterol for persons with high triglycerides (> 200 mg/dl) is recommended.
6. a complete lipid profile (total cholesterol, LDL-C, HDL-C, triglycerides) as the preferred initial test rather than screening for total cholesterol and HDL-C alone is required.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

Questionnaire on the study of cholesterol level in the blood

Peace, mercy and blessings of God :

Dear brother and sister, we would like to inform you that this questionnaire will be used for research purposes only, so please fill in the data contained in it accurately and carefully, taking into account filling out the questionnaire by the guardian for those under the age of perception or for those who need it.

This questionnaire is divided into two parts:

Part I : Personal Information

Tick (√) at your convenience for each item:

Name (optional):.....

* Age : ☐ 0-14 ☐ 15 to 24 ☐ 25-40 ☐ 41- 55 ☐ 56-69 ☐ 70 and above

* Gender: ☐ Male ☐ Female

* Place of residence: ☐ City ☐ Village

* Nature of work: Freelancer (specify.....)

☐ Businessman ☐ Student ☐ Under school age ☐ other (specify..... ..)

* Marital Status: ☐ Married, ☐single, ☐ divorced

* Educational level : ☐ primary or intermediate secondary ☐ Postgraduate

Part II:

• Do you practice any kind of sport? ☐ Yes ☐ No , If yes, mention how many times a week. ☐ Once ☐ two ☐ more times

• Are you a smoker ? ☐ Yes ☐ No

• Do you have high cholesterol ? ☐ Yes ☐ No

If yes, are you taking any cholesterol-lowering medication? ☐ Yes ☐No

• Do you suffer from any cardiovascular disease? ☐ Yes ☐ No

thanks and appreciation for your constructive cooperation.

Researcher / Muhamed Babiker

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/116064