Seasonal Variations of Lipid Profile

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ABSTRACT:

BACKGROUND:

Cardiovascular and cerebrovascular disorders have been the most prevalent cause of death and morbidity in the world over the last decades. Seasonal differences in blood lipids have recently raised interest in this area of lipid metabolism. In the current study

OBJECTIVE:

To determined if changes in weather having effect on lipid profile readings

METHODS:

Eighty five subjects, forty males and fort five females were included with age range of (22-85) years. Two serum samples were investigated in hospital lab for lipid profile for every participant from outpatient clinic/Baghdad teaching hospital, in 12 months' period. Other clinical data and some modifiable risk factors were also obtained.

RESULT:

The results showed that a significant increase in winter was shown in LDL and total cholesterol among males only (*P* value 0.011, and 0.012), respectively, but no changes in HDL, triglyceride and LDL/HDL were found. Systolic blood pressure was also found increased in winter significantly (*P*=0.008), while diastolic pressure, FBS and BMI did not change significantly.

CONCLUSION:

The present study concludes that there are significant changes of lipid parameter in male sex may affect assessment of risk of cardiovascular disease.

KEY WARDS: hyperlipidemia, seasonal changes, risk factors.

INTRODUCTION:

Cholesterol is a critical constituent of eukaryotic cell membranes and the precursor for the synthesis of steroid hormones such as cortisol, estradiol, and testosterone. Triglycerides carry fatty acids, nutrients utilized preferentially by muscle tissue and especially important as an energy source in the fasting state. Both cholesterol and triglycerides are regularly consumed in the diet and are essentially insoluble in water[1]. Total cholesterol (TC) is carried on three lipoproteins in the blood, resulting in three separate cholesterol fractions with differing prognostic significance:- very-low-density lipoprotein (VLDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and HDL cholesterol. LDL_C is positively related and HDL_C is inversely related to CVD incidence. VLDL cholesterol is a close surrogate for serum triglycerides when the triglyceride level is less than 400 mg/dL[1].

Lipids are transported and metabolized by apolipoproteins, which combine with lipids to form spherical or disc-shaped lipoproteins, consisting of a hydrophobic core and a less hydrophobic coat [2].

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The density of a lipoprotein is determined by the amount of lipid per particle. HDL is the smallest and most dense lipoprotein, whereas chylomicrons and VLDLs are the largest and least dense lipoprotein particles. Most plasma triglyceride is transported in chylomicrons or VLDLs, and most plasma cholesterol is carried as cholesteryl esters in LDLs and HDLs [3]. increased LDL, increased lipoprotein, and decreased (HDL) all confer an increased risk of atherosclerotic vascular disease[4-6]. the total cholesterol is reasonably stable over time; however, measurements of HDL and especially triglycerides may vary considerably because of analytic error in the laboratory and biologic variation in a patient's lipid level. Thus, the LDL should always be estimated as the mean of at least two determinations; if those two estimates differ by more than 10%, a third lipid profile is obtained. The LDL was estimated by using formula of friedwald[5]:-

LDL(mg/dL) = Total cholesterol(mg/dL) – HDL(mg/dL) – TG (mg/dL)/5

An analysis of data from four large studies concluded that each increase of 1 mg per deciliter (0.03 mmol per liter) in HDL cholesterol is associated with a decrease of 2 to 3% in the risk of future coronary heart disease [8].

Numerous studies have demonstrated total cholesterol to be higher in the winter than the summer by an average of about 4% [9]. Additionally, low density lipoprotein (LDL) cholesterol (or apolipoprotein B) appears to increase in the winter[9]. as does high density lipoprotein (HDL) cholesterol[9]. Although triglycerides may vary seasonally and may be less in the winter than the summer[10]. the variation in triglycerides does not appear to be related to the variation in cholesterol[11]. The mechanism for these lipid changes with season is unknown. Since the mid-1920 there have been a number of reports about seasonal variation of serum lipid profile[12]. Seasonal variation of serum lipids biases physicians toward the management of dyslipidemia in different seasons, till now there is no standard guideline through it has been justified[13].The Seasonal Variation of Blood Cholesterol Study (SEASON) was a longitudinal study of 641 healthy adults designed to quantify the magnitude and timing of seasonal changes in blood lipid levels and to identify the major factors contributing to this variation[14]. These factors included dietary fat intake, physical activity, exposure to light, psychological variables, weather patterns, and changes in body mass[16].

The exact mechanism of seasonal changes is unknown, some reference suggested that it may be due to increase hepatic production of LDL-C or reduction in the efficacy of LDL receptors during winter, another suggestion was the increasing in activities of lipoprotein lipase which plays a role in metabolism of TG containing particles in cold seasons[15]. During summer, increase temperature, body activities, or both of two, could be due to hemodilution effect in summer and hemoconcentration in winter that affect plasma volume leading to change of serum lipid level accordingly[15]. Plasma hypervolemia associated with two factors:- 1-increase renin activity and vasopressin levels especially during activities, in turn facilitates sodium and water retention with ongoing elevation in plasma albumin content, which increased blood binding capacity[16]. HDL-C concentration does not affect with changes in plasma volume due to the complex interaction of seasonal changes and physical activities. Decrease in HDL-C in the warmer periods as a result of hypervolemia may have been counter regulated by increased HDL-C concentration as more physical activity in summer season[13]. The current work aimed to study the effect of the seasonal variability of blood lipid parameters, as well as on discussing its significance in clinical diagnoses and management decisions.

PATIENTS AND METHODS:

This prospective study is conducted in Baghdad teaching hospital over 15 months (Dec 1st 2016 – Feb 28th 2018).Two morning blood samples (after 14 hours fasting) were obtained from each participant in two different occasions; one during winter months (Dec, Jan, Feb) and another during summer months (Jun, Jul, Aug) those who are on anti-hyperlipidemia drugs or couldn't be followed up for the second assessment were excluded. Also, Patients with T2DM, heart disease, history of alcohol intake, and chronic high cholesterol were excluded from the current study. The following parameters were tabulated for each participant age, gender, smoking status and any history of hypertension and/or diabetes mellitus. Blood pressure on each occasion was also measured, and body mass index was calculated, fasting blood sugar was measured in addition to serum lipid profile assessment. Serum cholesterol, TG, level was measured by enzymatic end point method supplied by Giesse Diagnostic. The chylomicrons and lipoproteins of VLDL and LDL contained in the sample are precipitated by the addition of phosphotungistic acid in the presence of magnesium ions. The supernatant obtained after centrifugation contains HDL. From which the cholesterol can be determined using the cholesterol enzymatic reagent and by following the same method for total cholesterol estimation. Low-density lipoprotein-cholesterol was estimated by using formula as above.

RESULTS:

A total of 85 subjects, 40 males (47.1%) and 45 females (52.9%) with female to male ratio is 1.13:1 were included in this study, age range was 22-85year with a mean of 48.1 ± 13.8. BMI range was (17.3-41.7)kg./m2 with mean of (27.4 ± 4.6). The 15 (17.6%) participant were smoking at time of evaluation (Tab.1).

Blood pressure measured at two occasion at different seasons showed significant increase of systolic blood pressure in winter (p=0.015), but no change was found in diastolic pressure, FBS and BMI (Table2).

Both LDL and cholesterol significantly increased in winter with (P value 0.011, and 0.012) respectively while HDL, triglyceride and LDL/HDL ratio did not change significantly as shown in (Table3 and figure1).Concerning gender the above seasonal changes were significant among males only (Tab. 4-7)

Table 1: Demographic data of the subjects.

Variables	Value
Number	85
Age (age), mean ± SD (range)	48.1 ± 13.8 (22 – 85)
BMI (kg/m^2), mean ± SD (range)	27.4 ± 4.6 (17.3 – 41.7)
Gender (Female to male ratio)	1.13:1
Female	45 (52.9%)
Male	40 (47.1%)
Smoking	15 (17.6%)
Hypertension	25 (29.4%)
DM	23 (27.1%)

Table 2: Seasonal variation of clinical parameters in all participants. Significant at *P* value< 0.05 using paired t-test .

Variables	Summer	Winter	P value
Number	85	85	-
SBP (mmHg)	126.24 ± 14.56	129.88 ± 12.68	0.015 [S.]
DBP (mmHg)	80.12 ± 8.93	80.82 ± 7.59	0.470
FBS (mg/dL)	127.93 ± 65.50	130.80 ± 55.37	0.619
BMI (kg/m^2)	29.82 ± 21.79	27.10 ± 4.48	0.255
Temperature	46.3 ± 2.8	11.8 ± 3.2	<0.001
Paired t -test			

Table 3:Seasonal variation of lipid profile in all participants. Significant at *P* value<0.05 using paired t-test.

Variables	Summer	Winter	% change	*P* value
	85	85	-	-
LDL(mg/dL)	100.84 ± 53.88	115.64 ± 53.15	14.7%	0.011 [Sig.]
HDL(mg/dL)	43.65 ± 16.52	43.55 ± 13.07	-0.2%	0.956
Cholesterol (mg/dL)	180.00 ± 63.83	196.81 ± 64.04	9.3%	0.012 [Sig.]
Triglyceride(mg/dL)	179.22 ± 98.84	189.47 ± 105.70	5.7%	0.332
LDL/HDL ratio	2.82 ± 2.90	2.99 ± 2.38	6.2%	0.528
Paired t – test				

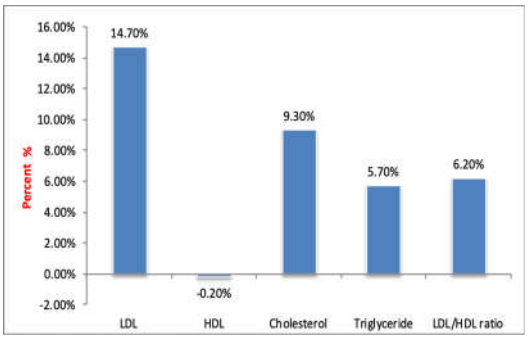

Figure 1: Seasonal variation of lipid profile in all participants.

Table 4:Seasonal variation of clinical parameters in males. Significant at *P* value < 0.05 using paired t-test.

	Summer	Winter	*P* value
	40	40	-
SBP (mmHg)	124.50 ± 12.39	130.25 ± 12.91	0.008 [Sig.]
DBP (mmHg)	80.50 ± 8.15	80.25 ± 7.68	0.844
FBS (mg/dL)	115.53 ± 39.80	122.53 ± 40.22	0.124
BMI (kg/m^2)	26.55 ± 4.11	26.79 ± 4.55	0.404
Temperature	46.65 ± 2.57	11.90 ± 3.29	<0.001 [Sig.]
Paired t – test			

Table 5: Seasonal variation of lipid in males. Significant at *P* value < 0.05 using paired t-test.

Parameter	Summer	Winter	% change	*P* value
Number	40	40	-	-
LDL (mg/dL)	94.25 ± 46.82	109.65 ± 50.05	16.3%	0.054
HDL (mg/dL)	38.43 ± 12.93	39.64 ± 11.91	3.1%	0.569
Cholesterol (mg/dL)	167.16 ± 53.38	186.72 ± 61.65	11.7%	0.024 [Sig.]
Triglyceride(mg/dL)	173.88 ± 83.20	190.43 ± 109.61	9.5%	0.197
LDL/HDL ratio	2.79 ± 2.41	3.20 ± 2.98	14.9%	0.158
Paired t – test				

Table 6:Seasonal variation of clinical parameters in females.

Parameter	Summer	Winter	*P* value
Number	45	45	-
SBP (mmHg)	127.78 ± 16.22	129.56 ± 12.61	0.394
DBP (mmHg)	79.78 ± 9.65	81.33 ± 7.57	0.291
FBS (mg/dL)	138.96 ± 80.76	138.16 ± 65.59	0.937
BMI (kg/m^2)	32.73 ± 29.55	27.36 ± 4.45	0.236
Temperature	45.96 ± 2.98	11.73 ± 3.24	<0.001 [Sig.]
Paired t – test			

Table 7: Seasonal variation of lipid profile in females.

Parameter	Summer	Winter	% change	P value
Number	45	45	-	-
LDL (mg/dL)	106.70 ± 59.37	120.98 ± 55.77	13.4%	0.096
HDL (mg/dL)	48.29 ± 18.06	47.02 ± 13.21	-2.6%	0.666
Cholesterol (mg/dL)	191.42 ± 70.49	205.78 ± 65.47	7.5%	0.159
Triglyceride (mg/dL)	183.98 ± 111.66	188.62 ± 103.33	2.5%	0.779
LDL/HDL ratio	2.85 ± 3.30	2.81 ± 1.68	-1.4%	0.931
Paired t – test				

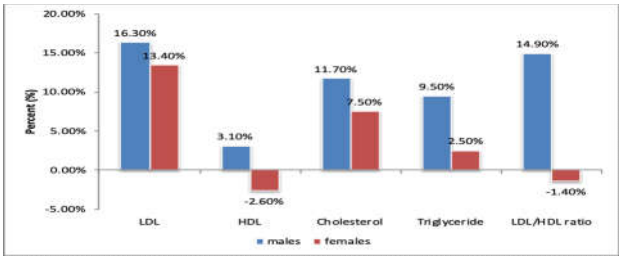

Figure 2: Seasonal variation in lipid profile according to gender.

DISCUSSION:

Dyslipidemia has long been considered to play a key role in the initiation and progression of cardio-cerebrovascular diseases, among all other risk factors [17,18]. This study shows seasonal changes in lipid profile; total cholesterol and LDL is more in winter compared to summer, while HDL and triglyceride shows no similar changes. These changes are more significant in males compared to females.

Similar findings were reported in a study conducted in Tehran-Iran on lipid and glucose included 6894 subjects (2890 males and 400 females) during 3 years that showed an obvious increase of cholesterol and LDL in winter in males, but it also reported a similar change in TG in females [17].

Another study conducted in London on 7000 males over 5 years, showed that cholesterol levels increased in winter[18]. And a third study in Midwestern u.s. state (Iowa) suggested that cholesterol variation could be sex related and the change was more in late winter and start of spring in males, while in females that effect of weather was reversed[19,20].

JC. Buxtorf[21] studied 34 Benedictine nuns live in monastery via twelve months and found cholesterol rate was raised in spring and autumn seasons and decreased during summer. In addition, he reported seasonal changes of HDL-C value, a finding not shown in this study and some other ones [15].

In study of the changes in air temperature have been noted to contribute to the seasonal variations in lipid levels. Different works reported the negative correlation of air temperature and cholesterol levels [22, 23]. Other studies found that the accomplishment rates for blood glucose, BP, and lipid target levels differed seasonally in patients with T2DM and that the accomplishment rates for these parameters were lowest in winter[24].

In our study the seasonal changes in total cholesterol and LDL were shown among males only probably due to the social influence as many females are housewife with minimal physical activities and less affected by change of outdoor weather.

CONCLUSION AND RECOMMENDATIONS:

1-Total serum cholesterol and LDL increase in cold weather, more markedly in males.

2-This change should be considered in managing hyperlipidemia.

3-This change should also be considered on assessing cardiovascular risk.

4-Large studies are required to confirm these recommendations.

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