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Comparison between fasting and non-fasting serum levels of cholesterol and lipoproteins, either high density or low density

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Abstract:*The study included 200 patients with an average age of 30 years. The mean fasting cholesterol level was 179 mg/dL. The mean non-fasting cholesterol was 190 mg/dL, with a difference of 11 mg/dL from the fasting level with P <0.001, meaning that the difference was statistically significant. The two measurements'correspondenceinpatients' clinical classification was 76.5% (K = 0.5).Mean fasting HDL 38.8 mg/dL and non-fasting HDL 39.7 m /dL with a difference of 0.9 m/dL with P = 0.127. The two measurements' correspondence in patients' clinical classification was 80% (K = 0.58). Mean fasting LDL 113 mg/dl and mean non-fasting LDL 121 with a difference of 8 mg/dL with P <0.001. The difference between fasting and non-fasting total cholesterol was statistically significant in Patients with high blood pressure, heart failure patients, diabetic patients, hypothyroidism patients, hyperthyroidism patients and renal impairment patients, while the difference was statistically insignificant in the age group of patients who included men over the age of 35 and women aged More than 45 years old, and in smokers, sports practitioners, and obese patients. The difference between fasting and non-fasting LDL was statistically significant in patients with diabetes, hypothyroidism, and renal impairment.*

While the difference was statistically insignificant in this age subgroup. In smokers, patients with hypertension, heart failure, hyperthyroidism, sports practitioners and obese patients, the difference between fasting and non-fasting HDL was statistically significant among smokers and patients with diabetes.

While it was not significant in the age subgroup and in patients with arterial hypertension, heart failure patients, patients with hypothyroidism, patients with hyperthyroidism, sports practitioners, obese patients and patients with renal impairment.

None of the following showed a significant difference between the fasting and non-fasting measurements of total cholesterol, HDL and LDL: patients above the age criterion and in both sports practitioners and obese patients.

Keywords: *non-fasting cholesterol, non-fasting LDL, non-fasting HDL.*

1. Introduction

High blood cholesterol is one of the most common health challenges in the world. The health complications associated with high cholesterol, such as cardiovascular diseases, lead to a decline in the lifespan and an increase in the economic burden on the individual and society directly and indirectly.

As the cholesterol is of a great importance, it is a common practice in most laboratories and doctors to ask the patients for absolute fasting before the calibration of cholesterol in the blood, which made such issue more complicated, as most of the time, the body is in the case of non-fasting.. In addition to the difficulty of fasting for some individuals (12 hours at least) and some of them have been affected such as diabetics who rely on drugs to lower the level of sugar in the blood. Recent recommendations recommend the following analysis cholesterol-LDL-HDL at any time of the day, without the need for the early withdrawal of blood or long fasting before analysis, and this is what made the situation better for both doctors and laboratory staff.And certainly for patients alike.

2. Research significance

To clarify the extent of the difference between fasting and non-fasting measurements of total cholesterol, LDL and HDL and the possibility of adopting non-fasting measurements for clinical evaluation of patients.

3. Research goals

Comparison between the fasting and non-fasting values of total cholesterol, LDL, HDL, and determining whether this difference is statistically and clinically significant, and study the effect of smoking, obesity and accompanying diseases on fasting and non-fasting measurements, making recommendations on the need for fasting before the analysis of total cholesterol and LDL and HDL and its relationship to the various factors and associated diseases.

4. Methodology

4.1 Study cases

The study included 200 patients from Aleppo University Hospital, for 12 months from August 2016 to July 2017. Their ages ranged from 18 to 58 years old.

4.2 Methods

Two blood samples were taken fromeach patient, one in the case of fasting for 12 hours, and the second without fasting. Total cholesterol, LDL, and HDL were measured.

Exclusion criteria included: taking cholesterol or lipid-lowering drugs, pregnancy, history of pancreatic injury, age under 18 years old.
All measurements were estimated at mg/dL.

The patient's research form was filled with information about the patient, smoking, obesity and accompanying diseases. After completing the data collection on paper, all data were periodically entered into the computer in the IBM® SPSS® Statistics program. This program was used to evaluate the statistical results.

5. What is cholesterol?

Cholesterol is a fatty substance that is not soluble in water but is soluble in organic solutions. Cholesterol is relatively polar in its free form and becomes non-polar when it is non-estrified[1]. Cholesterol accounts for about 25% of the overall fat in the serumas blood serum is consisted of 73% non-esterified cholesterol and 27% free cholesterol[1]. Cholesterol is synthesized inside the body by several types of cells.The most important cholesterol producing cells are those of the liver as the liver accounts for 80% of the intrinsic cholesterol. It is also synthesized in the intestine[3].

But the cholesterol in serumhas another source, which is food where cholesterol is high in some types of foodsuch as meat and whole fat dairy products, eggs and butter[3]. Cholesterol is transferred from peripheral tissues by an effective transfer system of free cholesterol within the cells to the circulation where it is esterified and transferred to the liver either directly or in the form of HDL or other lipoproteins[1].

6. Types of cholesterol

The average cholesterol in the body ranges from 140 to 200 mg/100 ml.
It is divided into three types;

Type I: High-density lipoprotein (HDL) cholesterol

It corresponds about 33% of the lipid proteins in the plasma. It is synthesized in the liver, containing the protein cores AI, CII and E. Additionally, a small amount of HDL is alsosynthesized in the intestine[1]. HDL contributes to the transfer of excess cholesterol from peripheral cell membranes to the surface of the HDL containersas they convert these free cholesterol particles to cholesterol esters in a reaction stimulated by the enzyme Lecithin–cholesterol acyltransferase(LCAT) [1]. HDL carries cholesterol esters to the liver, where it is transformed into fatty acids and triglycerides[1].The low level of HDL is considered a risk factor for atherosclerosis. Therefore,HDL should be of high levels in the blood. It should be higher than (40 mg/dL), as it transfers cholesterol away from the body cells and returnsit to the liver to be desynthesized [2].

Reference values for HDL are[2]:

For males: 41-59 mg/100 ml (1.06-1.53 mmol/L)

For females:49-75 mg/100 ml (1.30-1.94 mmol/L)

High risk is when the level of HDL cholesterol is less than 35 mg/100 ml and the total cholesterol is 200-300mg/100ml (mg/100ml x 0.0259 = mmol /L).

Type 2: Low Density Lipoprotein (LDL) cholesterol

It corresponds about 42% of lipoproteins and contains the protein core apo B-100. LDL is usually in the form of small droplets able to pass through the capillaries leaving the circulation to the cells of peripheral tissues[1].

LDL particles are found in different sizes and have been separated into 8 subgroups by ultracentrifugation orgel electrophoresis as their content differs in terms of essential fats from each other[3]. The main role of LDL is to supply tissues with cholesterol in certain conditions such as the growth spurtand in some tissues such as adrenal gland and injured tissues[1]. It is considered harmfultherefore, its amount in the blood must be less than (100/mg /dl) as the increased level of LDLinducesatherosclerosis. Its amount can be higher than normal because of genetic factors, lifestyle, or both.

Reference values for LDL are[1]:

For males: 50-172 mg/100 ml (1.30-4.45 mmol/L)

For females: 63-167 mg/100 ml (1.63-4.33 mmol/L)

LDL values are desirable if less than 100 mg/100 ml

High risk is when LDL cholesterol is more than 190 mg/100 ml

)mg/100 ml X 0.0259 = mmol/L(

Discussion of the study results

7.1 Study of the difference between the fasting and non-fasting measurements of total cholesterol, LDL and HDL statistically and its effect on clinical classification in all study patients.

Study of the difference between fasting and non-fasting measurements of total cholesterol, LDL and HDL in all study patients, the results were as shown in Table (1) and Diagram (1)

Table 1: summarizes the relationship between fasting and non-fasting measurement of total cholesterol, LDL and HDL in all study patients

Total study cases	Mean	Difference	P
Fasting cholesterol	179	11	< 0.001
Non-fasting cholesterol	190		
Fasting HDL	38.8	0.9	0.127

Non-fasting HDL	39.7		
Fasting LDL	113	8	< 0.001
Non-fasting LDL	121		

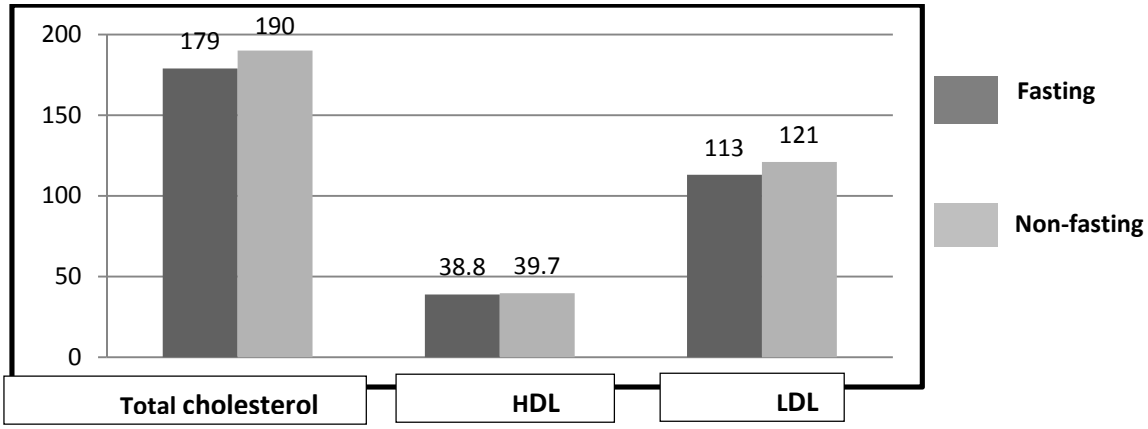

Diagram.1:Comparison of fasting and non-fasting measurements of total cholesterol, HDL, and LDL in total study patients

To determine whether the difference between fasting and non-fasting cholesterol levels was clinically significant, the participants in the study were divided into three groups:

- The acceptable measurement group of cholesterol where the measurement of cholesterol was less than 200.
- The high normal group where cholesterol was measured between 200 and 239.
- The high cholesterol group where the measurement of cholesterol was ≥ 240.

The results of the two measurements were compared, as shown in table (2) and diagram (2), where the correspondence of the two measurements in patients' clinical classification was 153 (115 + 28 + 10) from 200 by 76.5%, and the value of Kappa = 0.5, indicating an average correlation between the two measurements and the value of p < 0.001, meaning that this correlation is statistically significant.

Table 2: The classification of study patients is consistent between the fasting and non-fasting measurements of total cholesterol

Kappa = 0.5 P < 0.001			**Non-fasting cholesterol groups**			**Total**
			<200	**200-239**	**≥ 240**	
Fasting cholesterol groups	**<200**	**Number**	115	22	5	142
		Percentage of fasting cholesterol group	81%	15.5%	3.5%	100%
	200- 239	**Number**	4	28	11	43
		Percentage of fasting cholesterol group	%9.3	%65.1	%25.6	%100

	≥ 240	**Number**	0	5	10	15
		Percentage of fasting cholesterol group	%0	%33.3	%66.7	%100
Total		**Number**	119	55	26	200
		Percentage of fasting cholesterol group	%59.5	%27.5	%3	%100

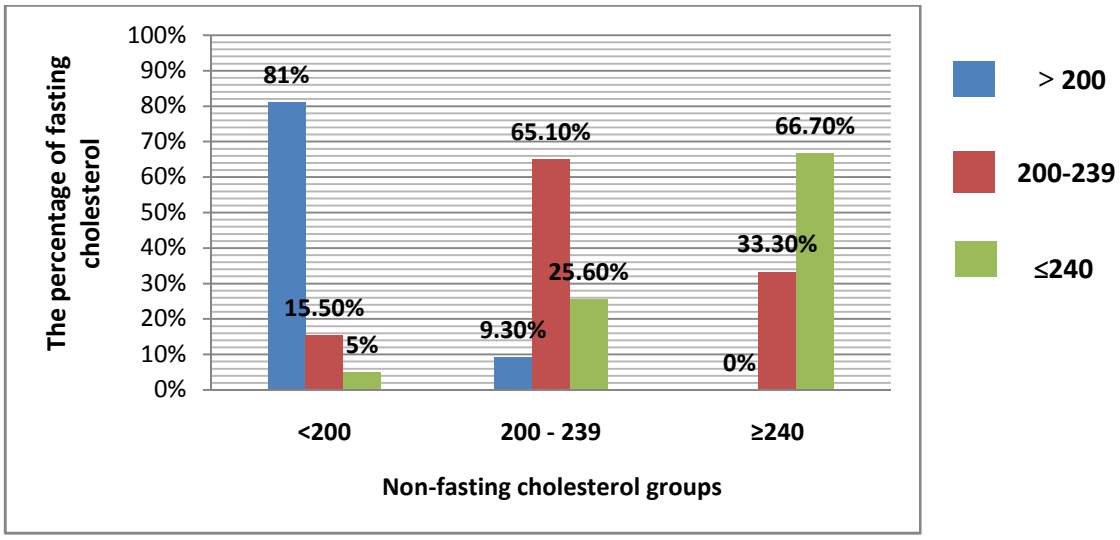

Diagram.2: The classification of study patients is consistent between the fasting and non-fasting measurements of total cholesterol

To study the effect of non-fasting HDL measurement on patients' clinical evaluation, the participants were divided into two groups according to their fasting and non-fasting HDL measurements:

- A group in which HDL measurement was greater than 35.
- A group with HDL of ≤ 35.

The results of the two measurements were compared, as shown in table (3) and diagram (3), where the correspondence of the two measurements in patients' clinical classification was 160 (102+58) from 200 by 80%, and the value of Kappa = 0.58, indicating an average correlation between the two measurements and the value of $p < 0.001$, meaning that this correlation is statistically significant.

Table 3: The classification of study patients is consistent between the fasting and non-fasting measurements of HDL

Kappa= 0.58 P < 0.001			**Non-fasting HDL groups**		**Total**
			≤ 35	**>35**	
Fasting HDL Groups	**≤ 35**	**Number**	**58**	**25**	**83**
		Percent of fasting HDL group	**%69.9**	**%30.1**	**%100**

	>35	**Number**	**15**	**102**	**117**
		Percent of fasting HDL group	**%12.8**	**%87.2**	**%100**
Total		**Number**	**73**	**127**	**200**
		Percent of fasting HDL group	**%36.5**	**%63.5**	**%100**

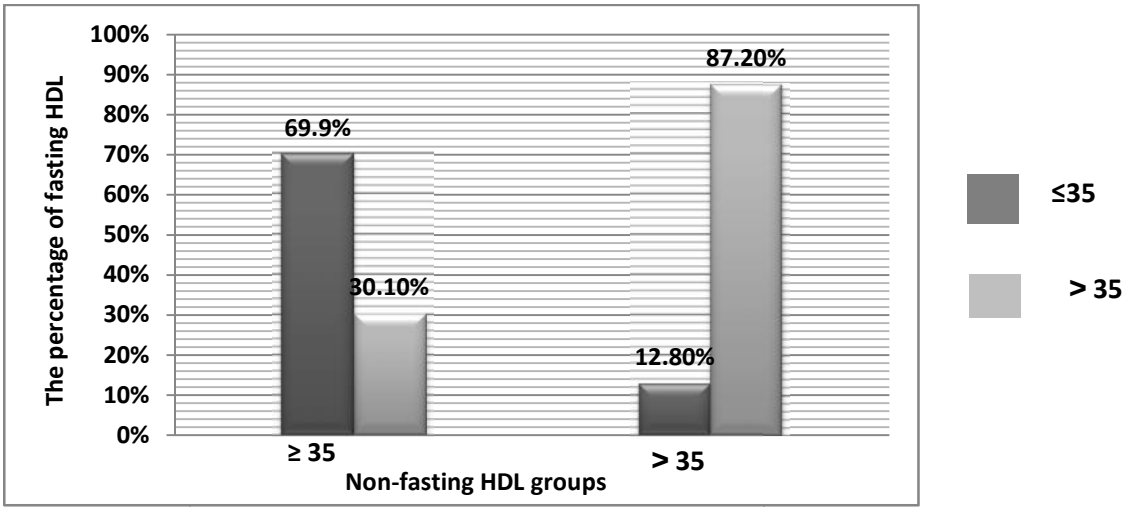

Diagram.3: The classification of study patients is consistent between the fasting and non-fasting measurements of HDL

2.7 Study the effect of the factors and diseases associated with the difference between the fasting and non-fasting measurements of total cholesterol, LDL and HDL statistically

The difference between fasting and non-fasting measurements of total cholesterol was statistically significant in patients with hypertension, heart failure, diabetes, hypothyroidism, hyperthyroidism, and renal impairment patients. However, in males over the age of 35 years and females over the age of 45, smokers, sports practitioners, and obese patients, such difference was statistically insignificant, as shown in Table 4**:**

Table 4: Summary of the effect of different factors on the difference between fasting and non-fasting measurements of total cholesterol

The affecting factors	**The difference between the mean fasting and non-fasting measurements of total cholesterol**	**P**
Sex	**Males = 13**	P<0.001
	Females = 9	P<0.001
Above the age criterion	**0**	0.977
Smoking	**12**	0.217
Arterial hypertension	**13**	0.04
Heart failure	**13**	0.01

Diabetes mellitus	**22**	P<0.001
Thyroid disorders	Hypothyroidism: 20 Hyperthyroidism: 10	P<0.001 P=0.001
Exercise	**3**	0.435
Obesity	**15**	0.149
Renal insufficiency	**16**	0.003

The difference between fasting and non-fasting measurements of LDL was statistically significant in patients with diabetes, hypothyroidism, and renal impairment. However, such difference was statistically insignificant in the age subgroup, smokers, hypertensive patients, heart failure patients, hyperthyroidism, sports practitioners and obese patients (Table 5).

Table 5: Summary of the effect of different factors on the difference between the fasting and non-fasting measurements of LDL

The affecting factors	The difference between the mean fasting and non-fasting measurements of LDL	P
Sex	**Males** = 11	P<0.001
	Females = 5	P=0.01
Above the age criterion	1	0.932
Smoking	12	0.085
Arterial hypertension	10	0.095
Heart failure	6	0.135
Diabetes mellitus	22	P<0.001
Thyroid disorders	**Hypothyroidism:** 21	P=0.001
	Hyperthyroidism: 21	P=0.55
Exercise	1	0.81
Obesity	10	0.341
Renal insufficiency	10	0.018

The difference between fasting and non-fasting measurements of HDL was statistically significant in smokers and diabetic patients. While it was not significant in the agesubgroup and in patients with arterial hypertension, heart failure patients, patients with hypothyroidism, hyperthyroidism patients, sports practitioners, obese patients and patients with renal impairment (Table 6).

Table 6: Summary of the effect of different factors on the difference between fasting and non-fasting measurements of HDL

The affecting factors	The difference between the mean fasting and non-fasting measurements of HDL	P
Sex	**Males** = 1	0.115
	Females = 1	0.339
Above the age criterion	0	0.945
Smoking	4	<0.001
Arterial hypertension	2	0.056
Heart failure	1	0.591
Diabetes mellitus	3	0.001
Thyroid disorders	**Hypothyroidism:** 1	0.563
	Hyperthyroidism: 2	0.184
Exercise	1	0.181
Obesity	4	0.410
Renal insufficiency	3	0.553

None of the followingshowed a significant difference between the fasting and non-fasting measurements of total cholesterol, HDL and LDL: patients above the age criterion and in both sports practitioners and obese patients.

Conclusions

Non-fasting measurement of total cholesterol, LDL and HDL can be adopted in clinical decisions related to treatment and prevention of different diseases since the difference between non-fasting and fasting measurements is small and clinically insignificant in general. Non-fasting HDL measurement can be adopted as it is not different from the fasting measurement.

Non-fasting measurements of total cholesterol, LDL and HDL may be adopted in patients above the age criterion (men over 35 years old and women older than 45 years old) and in sports practitioners and obese patients. Further studies on the effect of different diseases on the difference between fasting and non-fasting measurements of total cholesterol, LDL and HDL.

Further studies on a large number of patients and healthy individuals on a large scale, with clinical follow-up of the risk of cardiovascular diseases to determine the efficiency of non-fasting measurements of total cholesterol and LDL and HDL.

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