International Journal of Medical Laboratory 2020;7(2):67-71.

International Journal of Medical Laboratory
Shahid Sadoughi University of Medical Sciences

Short Article

Prevalence of Elevated Non-HDL Cholesterol among Patients with Diabetes in An Iranian Population

Asma Kheirollahi [1] Ph.D., Azam Karkhaneh [2*] Ph.D.

[1]Department of Comparative Biosciences, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
[2]Reference Laboratory, Social Security Organization, Tehran, Iran.

Article history
Received 30 Jul 2019
Accepted 14 Jan 2020
Available online 30 May 2020

Key words
Cholesterol
Cardiovascular disease
Diabetes mellitus

A B S T R A C T

Background and Aims: Non-high density lipoprotein cholesterol (non-HDL-C), which reflects all cholesterol present in potentially atherogenic lipoprotein particles, might be a useful marker of atherosclerosis in diabetic subjects. In the present study, we evaluated the prevalence of high non-HDL-C in patients with dyslipidemia in diabetic and non-diabetic subjects following LDL-C assessment as the first goal of therapy.

Materials and Methods: A data set of 2142 individuals was included in the study. All values of lipid profile were compared between non-diabetic and diabetic groups and the prevalence of dyslipidemia was evaluated in two groups.

Results and Conclusions: According to the results, 48% of patients with diabetes achieved combined LDL-C ≤2.5 mmol/L and non-HDL ≤3.3 mmol/L targets, and 58.2% of diabetic patients achieved LDL-C goal while only 50.2% attained non-HDL-C goal. Also, the results indicated that non-HDL-C significantly heightened in patients with diabetes. Therefore, non-HDL-C needs to be calculated as a routine assessment in patients with diabetes.

***Corresponding Author:** Reference Laboratory, Social Security Organization, Tehran, Iran. **Tel:** +982166647243, **Fax:** +982166647243, **Email:** akbio89@gmail.com

[Downloaded from ijml.ssu.ac.ir on 2026-11-18]

[DOI: 10.18502/ijml.v7i2.2909]

Introduction

Diabetes mellitus is a common metabolic disorder impinging on people worldwide. It is well known that people with diabetes bear elevated cardiovascular risk, and the relative risk of death from cardiovascular disease (CVD) is about twice as high [1]. Dyslipidemia, which is common in diabetes, is associated with increased risk of CVD in diabetic patients [2]. Elevated triglycerides (TG), low levels of high density lipoprotein cholesterol (HDL-C), and increased presence of small dense atherogenic low density lipoprotein cholesterol (LDL-C) particles are the most common patterns of dyslipidemia in diabetic patients [3]. In the presence of hypertriglyceridemia, the exchange of TG and cholesteryl ester between LDL and VLDL and then lipolysis of triglyceride-rich LDL results in the formation of small and dense LDL particles. These LDL particles can be easily oxidized and thus penetrate the artery wall and increase the risk of CVD. Although small dense LDL particles are far more than normal-sized LDL, LDL-C value may be normal because small dense LDL particles are poor in lipid. Therefore, even though LDL-C levels are typically normal in patients with diabetes, they can produce highly atherogenic apoprotein-B containing particles such as very low density lipoprotein (VLDL), intermediate density lipoprotein (IDL) as well as small, dense atherogenic LDL particles [4]. Therefore, relying on LDL-C targets alone to identify patients at risk of CVD can be misleading in such patients. In this regard, finding other measurements can help identify diabetic people who are at increased risk of atherosclerosis. Recently, it has been found that non-high density lipoprotein cholesterol (non-HDL-C), which is obtained by subtracting the level of HDL-C from total cholesterol, has a distinct advantage over LDL-C in predicting CVD [5]. Indeed, non-HDL-C measurement provides a single index of all the atherogenic apolipoprotein-B containing particles such as LDL, VLDL, IDL and chylomicron remnants [5]. From a practical point of view, direct measurement of apo-B is not widely available in clinical laboratories while assessment of non HDL-C is practical, convenient, reliable, and cost-effective [6].

There are several reports from different populations that non-HDL-C has more predictive power than LDL-C in detecting CVD [7, 8]; however, no such trials can be found in the Iranian population as to the high prevalence of CVD. Hence, the aim of this study was to compare the novel risk factor non-HDL-C versus LDL-C parameter as the primary therapeutic target in the treatment of dyslipidemia, in diabetic and non-diabetic Iranian subjects.

Materials and Methods

Included in the study was a data set of 2142 individuals (consists of 1505 non-diabetics and 637 diabetics) from Tehran city. This research was approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1398.374). Blood samples were obtained at the Reference Laboratory of

[Downloaded from ijml.ssu.ac.ir on 2026-11-18]

[DOI: 10.18502/ijml.v7i2.2909]

Social Security Organization in Tehran city (Iran). The blood was collected in plain tubes after a 12-hour fast and then centrifuged at 3000 rpm for 15 min. All samples were analyzed in terms of lipid profiles comprising total cholesterol (TC), TG, HDL-C, and LDL-C. Lipid profiles were determined by the standard homogenous enzymatic method using an automatic chemistry analyzer (Hitachi 902, Roche®) and the calibrating and internal controls were provided by the Pars Azmon Company. Non-HDL-C values were calculated by subtracting the level of HDL-C from TC.

Statistical analysis

Statistical analysis was performed using SPSS Statistics 16.0. Continuous data were expressed as a mean and standard deviation. Statistical independent T-test was used to evaluate the significance of differences between diabetic and non-diabetic groups. The level of significance was considered as $p<0.05$.

Results and discussion

There is an association between abnormal lipid levels and cardiovascular risk in patients with diabetes [1]. Although LDL-C is the main therapeutic target (<2.5 mmol/L) in the treatment of dyslipidemia, several studies have shown that non-HDL-C is a better predictor of atherosclerosis [7, 8]. In this regard, the adult treatment panel III of National Cholesterol Education Program (NCEP) has recommended such use for non-HDL-C as a secondary treatment target (<3.3 mmol/L) in patients with elevated triglycerides [9]. The results of this study indicated non-HDL-C concentrations being approximately 0.7 mmol/L higher than LDL-C ones (mean non-HDL-C=3.3±0.93 mmol/L and mean LDL-C=2.5±0.64 mmol/L), as the NCEP guidelines have described (Table 1) [9]. Both LDL-C ≤2.5 mmol/L and non-HDL-C ≤3.3 mmol/L targets were achieved in 1095 (51%) subjects.

Several studies have examined the LDL-C and non-HDL-C goals in different patients. Malic et al found patients with diabetes not achieving LDL-C <2.5 mmol/L and non-HDL-C <3.3 mmol/L, 64.6% and 71.5% respectively [10]. In another study, 74% of coronary heart disease patients attained LDL-C goal while only 51% achieved both non-HDL-C and LDL-C targets [11]. In the present study, 48% of patients with diabetes were identified as achieving combined LDL-C ≤2.5 mmol/L and non-HDL-C ≤3.3 mmol/L targets. Whereas 50.2% of diabetic patients attained non-HDL-C goal (≤3.3 mmol/L), 58.2% achieved LDL-C one (Fig. 1). In other words, despite LDL-C level of ≤2.5 mmol/L, about 10% of diabetic patients had non-HDL-C above the target range. In addition, our study revealed non-HDL-C being significantly higher in diabetic subjects than non-diabetic subjects (P=0.0001) while no statistically significant difference was identified regarding LDL-C between the groups (P=0.179) (Table 1). These findings are in accordance with the findings of previous studies. Therefore, non-HDL-C might be a better predictor of vascular events than LDL-C.

[Downloaded from ijml.ssu.ac.ir on 2026-11-18]

[DOI: 10.18502/ijml.v7i2.2909]

Table 1. Characteristics of study subjects and comparison between diabetic and non diabetic subjects

Variable		Total (N=2142)	Non Diabetic (N=1505)	Diabetic (N=637)	P-value
Sex	**Female**	1492	1036	456	
	Male	650	469	151	
Age (year)		49.5±16.3	45.1±15.3	59.9±10	0.0001
Fetal bovine serum (mmol/L)		6.5±3.2	4.9±0.35	10.2±3.8	0.0001
Triglyceride (mmol/L)		1.6±1.1	1.4±0.98	2±1.2	0.0001
Total cholesterol (mmol/L)		4.7±1.0	4.6±0.96	4.7±1	0.007
High density lipoprotein (mmol/L)		1.3±0.28	1.3±0.28	1.2±0.27	0.003
Low density lipoprotein (mmol/L)		2.5±0.64	2.5±0.62	2.5±0.66	0.179
Non- High density lipoprotein (mmol/L)		3.3±0.93	3.3±0.91	3.5±0.99	0.0001

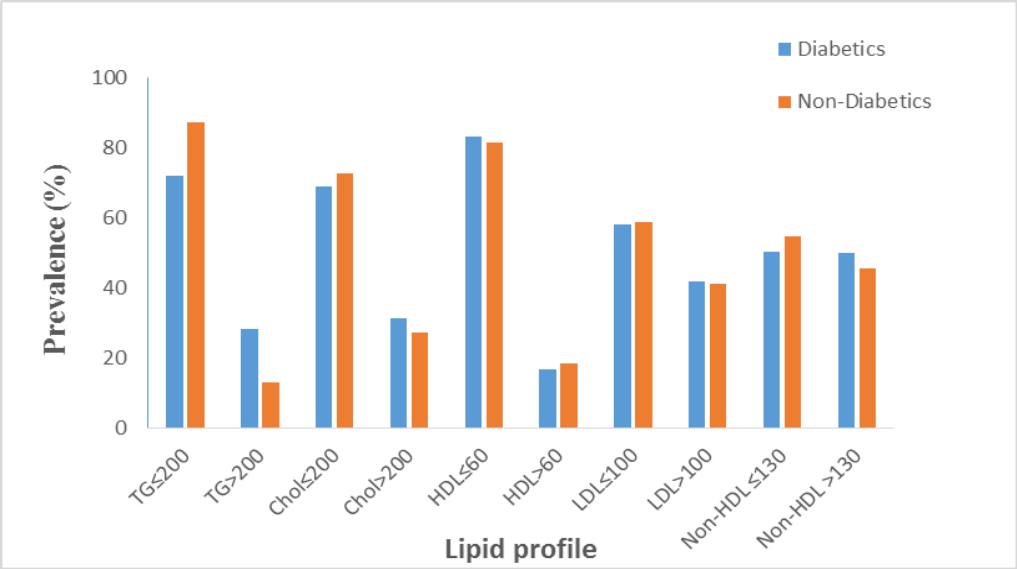


Fig 1. Prevalence of dyslipidemia in diabetic and non-diabetic subjects of the study. TG= Triglyceride; Chol= Cholesterol; HDL= High density lipoprotein; LDL= Low density lipoprotein; Non-HDL= Non- high density lipoprotein

Non–HDL-C has crucial preferences in comparison with other lipid parameters. Non–HDL-C has a specific pathophysiologic link to the atherosclerosis and predicts both subclinical atherosclerosis and adverse clinical outcomes. Moreover, non-HDL-C is a valid surrogate marker of Apo B in patients with diabetes which can be calculated from non-fasting serum samples [12]. Accordingly, it is a more practical, reliable and cost-effective value such that it reduces the risk of hypoglycemia in a diabetic patient [6]. Measuring and reporting non–HDL-C routinely can improve clinical outcomes through CVD risk identification, therapy decisions, and evaluation of response to treatment. All in all, this study indicated that non-HDL can be beneficial in assessing the risk of CVD in diabetic populations, therefore it can be included in the lipid profile for assessing the risk and thus guiding the treatment.

[Downloaded from ijml.ssu.ac.ir on 2026-11-18]

[DOI: 10.18502/ijml.v7i2.2909]

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgment

We thank the University of Tehran and Reference Laboratory of Social Security Organization for supporting this manuscript.

References

[1]. Liu J, Sempos C, Donahue RP, Dorn J, Trevisan M, Grundy SM. Joint distribution of non-HDL and LDL cholesterol and coronary heart disease risk prediction among individuals with and without diabetes. Diabet Care. 2005; 28(8): 1916-921.

[2]. Battisti WP, Palmisano J, Keane WF. Dyslipidemia in patients with type 2 diabetes. Relationships between lipids, kidney disease and cardiovascular disease. Clinic Chem Lab Med. 2003; 41(9): 1174-181.

[3]. Safo AS. Correlation between Non-high-density lipoprotein-cholesterol and the degree of glycemic control in type 2 diabetes mellitus. Med J Babylon. 2018; 15(2): 169-73.

[4]. Lu W, Resnick HE, Jablonski KA, Jones KL, Jain AK, Howard WJ, et al. Non-HDL cholesterol as a predictor of cardiovascular disease in type 2 diabetes: the strong heart study. Diabetes Care. 2003; 26(1): 16-23.

[5]. Virani SS. Non-HDL cholesterol as a metric of good quality of care: opportunities and challenges. Texas Heart Institute J. 2011; 38(2): 160.

[6]. Davidson MH, Maki KC, Pearson TA, Pasternak RC, Deedwania PC, McKenney JM, et al. Results of the national cholesterol education (NCEP) program evaluation project utilizing novel E-technology (NEPTUNE) II survey and implications for treatment under the recent NCEP writing group recommendations. Am J Cardiol. 2005; 96(4): 556-63.

[7]. Zabeen S, Rahman MR, Mustafa TG, Eusufzai NH, Shermin S. Non-HDL cholesterol and type 2 diabetes mellitus. Anwer Khan Modern Med College J. 2012; 3(2): 15-18.

[8]. Al-Daghri NM, Al-Attas OS, Al-Rubeaan K. The atherogenic and metabolic impact of non-HDL cholesterol versus other lipid sub-components among non-diabetic and diabetic Saudis. Lipids Health Dis. 2007; 6(1): 9.

[9]. Detection, evaluation and treatment of high blood cholesterol in adults. Executive summary of the 3rd report of The National Cholesterol Education Program (NCEP) Expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). JAMA. 2001; 285(19): 2486-497.

[10]. Malik S, Lopez V, Chen R, Wu W, Wong ND. Undertreatment of cardiovascular risk factors among persons with diabetes in the United States. Diabet Res Clinic Pract. 2007; 77(1): 126-33.

[11]. Virani SS, Woodard LD, Landrum CR, Pietz K, Wang D, Ballantyne CM, et al. Institutional, provider, and patient correlates of low-density lipoprotein and non–high-density lipoprotein cholesterol goal attainment according to the Adult Treatment Panel III guidelines. Am Heart J. 2011; 161(6): 1140-146.

[12]. Ram N, Ahmed B, Hashmi F, Jabbar A. Importance of measuring non-HDL cholesterol in type 2 diabetes patients. J Pakistan Med Associ. 2014; 64(2): 124.

[Downloaded from ijml.ssu.ac.ir on 2026-11-18]

[DOI: 10.18502/ijml.v7i2.2909]