Calculating Serum Low-Density Lipoprotein Cholesterol: Comparison Of LDL-C Measured by Direct Assay With Various Formulae by Combination of Ages, Genders and Triglycerides

Authors: Joana Menezes Nunes[1,2,3], Elisabete Rodrigues[1,2,3], Davide Carvalho[1,2,3], João Tiago Guimarães[2,3,4,5]

1 – Endocrinology, Diabetes and Metabolism Department, Centro Hospitalar São João, Porto; 2 – Faculty of Medicine, University of Porto; 3 – Instituto de Investigação e Inovação em Saúde, University of Porto; 4 – Clinical Pathology Department, Centro Hospitalar São João, Porto; 5 - EPIUnit-Institute of Public Health, University of Porto. **Portugal**

OBJECTIVES

Low-density cholesterol (LDL-C) is a major risk factor for atherosclerosis. The Friedewald formula (FF) is used for its calculation but is limited by hypertriglyceridemia (TG > 4.5 mmol/L = 400 mg/dL)

We aimed to correlate serum LDL-C measured by direct assay with serum LDL-C estimated by several formulas and compared them by combination of age, gender and triglycerides (TG):

- **Friedewald (FF):** LDL-C= CT – HDL - TG/5
- **Tsai (TsaiF):** LDL-C= TC – HDL – TG/8 (TG/8 represents VLDL-C)
- **DeLong (DeLongF):** LDL-C= TC – HDL – TG * 0.16
- **Chen (ChenF):** LDL-C= non-HDL –C * 0.9 – TG * 0.1

METHODS

Statistical analysis of **52 925 lipid profiles** performed in our laboratory (SPSS®, version 21 for Mac®).

Data are expressed in means ± standard deviations.

Student *t* test, Pearson correlation and linear regression were used for a statistical significance <0.01.

RESULTS

SAMPLE CHARACTERISTICS

TG ≤ 4.5 mmol/L *n*= 51 975 — ♀ 27 196 (52.3%) ♂ 24 779 (47.7%)

TG > 4.5 mmol/L *n*= 950 — ♀ 523 (51.1%) ♂ 427 (44.9%)

	AGES (years)	*n*	%
TG ≥ 4.5 mmol/L	≤ 17	1 777	3.4
	18 – 44	15 082	29.0
	45 – 64	19 560	37.6
	65 – 79	12 046	23.2
	≥ 80	3 510	6.8
TG > 4.5 mmol/L	≤ 17	29	3.1
	18 – 44	284	29.9
	45 – 64	319	33.6
	65 – 79	237	24.9
	≥ 80	81	8.5

LDL-C MEASURED BY DIRECT ASSAY AND ESTIMATED BY FORMULA

	LDL-C VALUES mmol/L (mg/dL)	
	TG ≤ 4.5 mmol/L	**TG > 4.5 mmol/L**
Direct assay	**3.12 ± 0.96** (120.8 ± 37.0)	**3.88 ± 1.32** (150.1 ± 51.1)
FF	**3.07 ± 1.11** (118.6 ± 42.8)	**2.39 ± 2.50** (92.4 ± 96.8)
TsaiF	**3.32 ± 1.13** (128.3 ± 43.6)	**3.62 ± 2.01** (140.2 ± 77.8)
DelongF	**3.20 ± 1.11** (123.8 ± 43.1)	**3.05 ± 2.20** (117.9 ± 85.1)
ChenF	**3.26 ± 1.14** (126.2 ± 44.2)	**4.13 ± 1.93** (159.8 ± 74.8)

LINEAR REGRESSION, BY GENDER AND TG (p value < 0.01)

	PEARSON CORRELATION (R^2)		PEARSON CORRELATION (R^2)	
	TG ≤ 4.5 mmol/L	**TG > 4.5 mmol/L**	**TG ≤ 4.5 mmol/L**	**TG > 4.5 mmol/L**
FF	0.920 (0.846)	0.786 (0.618)	♀ 0.921 (0.848) ♂ 0.919 (0.845)	♀ 0.788 (0.620) ♂ 0.786 (0.617)
TsaiF	**0.939 (0.882)**	**0.849 (0.720)**	♀ **0.939 (0.881)** ♂ **0.931 (0.882)**	♀ **0.832 (0.692)** ♂ **0.873 (0.763)**
DelongF	0.932 (0.868)	0.831 (0.691)	♀ 0.932 (0.869) ♂ 0.904 (0.868)	♀ 0.827 (0.684) ♂ 0.838 (0.703)
ChenF	**0.947 (0.897)**	**0.840 (0.760)**	♀ **0.946 (0.896)** ♂ **0.939 (0.898)**	♀ **0.948 (0.646)** ♂ **0.891 (0.795)**

LINEAR REGRESSION, BY AGE AND TG (p value < 0.01)

For TG ≤ 4.5 mmol/L, ChenF revealed more accurate results for all age groups.

For TG > 4.5 mmol/L, ChenF revealed significant better correlations for children and elderly and **TsaiF** for adults from 18-64 years.

CONCLUSIONS

- FF underestimates LDL-C and the other formulas overestimate it.
- For patients with TG ≤ 4.5mmol/L, ChenF provided more accurate for all studied groups.
- For patients with TG > 4.5mmol/L, TsaiF showed better correlation.
- Regarding age, ChenF revealed to be better for children and elderly and TsaiF for middle age patients.
- Our results suggest that TsaiF and ChenF may be more suitable for LDL-C estimation, even in the presence of moderate to severe hypertriglyceridemia and so also in a non-fasting state.

REFERENCES

Chen Y et al. A modified formula for calculating low-density lipoprotein cholesterol values. Lipids in Health and Disease 2010; 9:52-6

Kheng et al. Low-density lipoprotein cholesterol levels in adults with type 2 diabetes: an alternative equation for accurate estimation and improved cardiovascular risk classification. Diabetes & Vascular Disease Research 2014; 11(6): 431-9

Tsai CH et al. Comparison of various formulae for estimating low-density lipoprotein cholesterol by a combination of ages and genders in Taiwanese adults. BMC Cardiovascular Disorders 2014; 14: 113-20

17 ECE 545--EP

Obesity and cardiovascular endocrinology

Joana Menezes Nunes

DOI: 10.3252/pso.eu.17ece.2015

Poster presented at: ECE2015 16-20 May 2015 DUBLIN, IRELAND 17th EUROPEAN CONGRESS OF ENDOCRINOLOGY