

Fasting and Non-Fasting Lipid Profile among Health Care Workers at Teaching Hospital Batticaloa SriLanka

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Abstract

Requesting patients to come with long fasting state (12 - 14 hours) for lipid profile measurements are a major inconvenience. However, most blood tests, even glycemic management, can be done in a non-fasting state, for example by requesting an HbA1C. It is understandable that when we order lipid profile test, laboratories are very rigid on fasting (12 - 14 h) or refuse to do the test if fasting is not enough. To answer these delusions, we conducted a cross-sectional study among the health care workers at Teaching Hospital Batticaloa, SriLanka, after an overnight fast (12 - 14 hours) blood taken for lipid profile. Following weeks, we collected blood from the same healthcare workers, after breakfast (2 - 4 hours after meal). In this study, measurements of fasting lipid profile, including high-density lipoproteins (HDL), low-density lipoproteins (LDL), total cholesterol (TC), triglyceride (TG) and non-HDL significantly ($p < 0.05$) differ from non-fasting lipid profile measurement. The mean difference in lipid profile in fasting versus non-fasting among healthcare workers was 34.13 mg/dl for TG, -5.65 mg/dl for total TC, -1.94 mg/dl for HDL-cholesterol, 3.71 mg/dl for non-HDL and 12.3 mg/dl for LDL-cholesterol. This momentous change of different meanings does not play any significant role in cardiovascular risk assessment. However, a patient with a family history of the premature atherosclerotic cardiovascular disease (ASCVD), or familial hyperlipidemia, screening and follow-up should preferably be performed with fasting.

Keywords

Non-Fasting Lipid Profile, Fasting Lipid Profile

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1. Introduction

Lipids are a group of fats and fat-like substances that are a vital ingredient of our cells. It is also main sources of energy. Measuring lipid profile is a routine test to evaluate the cardiovascular risk, given the high correlation of hypercholesterolemia and cardiovascular risk. There are two main types of lipids, total cholesterol (TC) and triglyceride (TG) which are combined with transport protein called lipoprotein. These particles measured with lipid profile and classified based on these densities called, low-density lipoproteins (LDL), high-density lipoproteins (HDL) and very low-density lipoproteins (VLDL). However, in most of the laboratory, LDL-cholesterol is calculated from the Friedewald equation ($LDL = \text{Total cholesterol (TC)} - \text{HDL} - \text{TG}/5$). This finding is well connected with a standard test of LDL by ultracentrifugation when TG is less than 400 mg/dl [1].

This Friedewald equation method is unacceptable if TG values are above 400 mg/dL. In such circumstances, direct quantity of LDL is indicated. In addition, this is only applicable for calculating LDL cholesterol in an overnight fasting specimen. In real clinical scenario calculated LDL cholesterol may not reflect true LDL cholesterol levels. If there is a discrepancy between measured LDL cholesterol level and calculated LDL cholesterol level, it indicates that there is a modification of lipoprotein metabolism [1].

However, measuring lipid profile in the non-fasting state becomes popular among clinical practice, in part because 12 - 14 hours fasting is uncomfortable especially, the elderly and patients who had diabetes. Moreover, a prandial state lipid profile is more honest for calculating total atherogenic lipoproteins because it includes the hepatic origin in the fasting state and intestinal origin in the non-fasting state. Supplementary, data has aroused in recent years that most conspicuously from Scandinavian countries, there is not much difference between fasting and non-fasting lipid values. As a result, increasing number of professional societies and organizations now recommend using non-fasting lipid profile levels to establish the cardiovascular risk state [2]. The aim of this study is to critically evaluate the clinical implications of the use of non-fasting rather than fasting lipid profiles.

2. Methods

This is a cross-sectional study conducted among health care workers, in which random non-fasting lipid profile have been compared with their fasting condition, at Teaching Hospital Batticaloa, Sri Lanka. Approval was taken from the director, Teaching Hospital Batticaloa to conduct this study. As a part of the non-communicable screening programme, almost all health workers were screened for risk assessment, including fasting blood sugar and lipid profile test. Healthcare workers were explained the advantages and disadvantages of non-fasting lipid profile test. Those who were voluntarily participated for both fasting and non-fasting lipid tests were included in this study. Health workers with age of 25 to 60-year were included in this study. The written consent was taken from all the participants. After an overnight (12 - 14 hours) fast, blood

samples were taken for lipid profile. Within a week, we collected non-fasting blood samples (2 - 4 hours) after breakfast. Time since last meal was gained by self-administered questionnaire from the patients at the time of testing. Fasting with less than 12 hours or more than 14 hours was excluded from this study. Similarly, non-fasting with less than 2 hours or more than 4 hours were excluded. All blood samples were analyzed at Teaching hospital Batticaloa, Sri Lanka where, using standard laboratory protocol. High-density lipoprotein cholesterol, total cholesterol and triglyceride levels were measured directly; LDL cholesterol levels were estimated using the Friedewald equation.

The data were analyzed for normality using Anderson-darling, Kolmogorov-Smirnov and Shapiro-Wilk tests. The TC, HDL and LDL followed the normal distribution for all normality test ($p > 0.05$), while TG level did not follow the normal distribution for all normality test ($p < 0.05$). Therefore, the parametric analysis (paired t-test) was performed to total cholesterol (TC), HDL and LDL and non-parametric analysis (Wilcoxon Signed Ranks Test) was performed to triglyceride (TG) to compare them before and after a meal. All the analysis was done in 95% of confidence interval. The outliers of the parameters were removed before the significant test. All the analysis was performed using R statistical software.

3. Results

Total 84 health works participated in both fasting and non-fasting lipid profile test. Of these, 54 (64.28%) were male and 30 (35.71%) were female. The mean fasting TC, HDL, LDL, non-HDL cholesterol measurements are higher than non-fasting measurements, the fasting measurements are 194.99 mg/dl for TC, 46.05 mg/dl for HDL, 123.43 mg/dl for LDL, and 148.94 mg/dl for non-HDL cholesterol (Figure 1). The mean non-fasting measurements are 189.34 mg/dl for TC, 44.11 mg/dl for HDL, 111.13 mg/dl for LDL, and 145.23 mg/dl for non-HDL cholesterol. However, mean non-fasting TG is higher than fasting measurements, 176.53 mg/dl, and 132.40 mg/dl respectively (Table 1) (Figure 1).

Random non-fasting lipid profile have been compared with their fasting condition in which the TC, HDL-cholesterol, and non-HDL cholesterol showed the significant ($P < 0.05$) difference with the mean difference of -5.65 mg/dl, -1.94 mg/dl, and -3.71 mg/dl, respectively but with moderate effect (Figure 1).

Table 1. Non-fasting and fasting lipoprotein value and significant test of different lipoprotein components.

Cholesterol	Fasting(mg/dl)	Non-fasting(mg/dl)	T value	p-Value	Effect size*
TC	194.99	189.34	t (70) = 4.3295	$p < 0.05$	Moderate (0.58)
HDL	46.05	44.11	t (81) = 5.2829	$p < 0.05$	Moderate (0.58)
LDL	123.43	111.13	t (76) = 8.734	$p < 0.05$	Large (0.99)
Non-HDL	148.94	145.23	t (82) = 3.405	$p < 0.05$	Moderate (0.58)

*Effect size of difference was calculated using Cohen's d with Hedges correction.

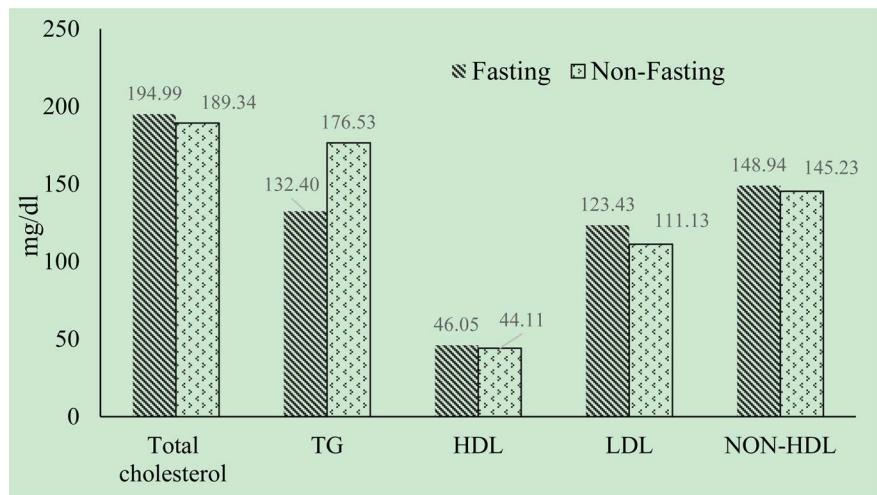


Figure 1. Compare the fasting and non-fasting mean value of Total cholesterol, Triglyceride (TG), high density lipoprotein (HDL), low density lipoprotein (LDL) and non-HDL.

However, the LDL also showed significant ($P < 0.05$) difference but with large effect size, and with the mean difference of -12.3 mg/dl (Table 1). Furthermore, Wilcoxon Signed Ranks Test showed that there was a significant difference in triglyceride measurements as well ($v = 191.5$, $p < 0.001$, Hedges correction = -0.89 , which is largest effect size). The mean difference of TG, between random fasting and fasting was $+34.13 \text{ mg/dl}$.

4. Discussion

Remarkably, the evidence is deficient that fasting is superior to non-fasting lipid profile tests. Fasting lipid profile is ideal to reduce the variability at the time of sample collection [3]. Quite a lot of studies suggest that the measurement of lipid profile test in non-fasting state is an acceptable substitute [4]. However, measurement of a random non-fasting lipid profile also able to divulge individual metabolic abnormalities in lipid clearance. Furthermore, there are advantages to using random non-fasting samples rather than fasting samples for measuring the lipid profile [5]. It is interesting that since 2009, non-fasting lipid profile test has been practicing as a standard blood test in Denmark. However, clinicians from Denmark agreed to re-check fasting triglyceride if non-fasting triglyceride measurement is more than 350 mg/dl (4 mmol/l) [6].

The foremost worry of physicians regarding random lipid profile test is the variable effect after a meal. It is obvious that several studies cited that increasing level of TG concentration has been seen after a meal [7]. A Similar pattern has been observed in our study as well. In fasting mean TC, HDL, LDL, Non-HDL cholesterol measurements are 194.99 mg/dl , 46.05 mg/dl , 123.43 mg/dl , and 148.94 mg/dl respectively (Figure 1). However, mean random non-fasting mean value of TC, HDL, LDL, non-HDL cholesterol measurements are slightly lower than fasting measurements. As this lipids fraction are normally distributed, we performed paired T-test which revealed that significant ($P < 0.05$) different has

been observed in the measurements of TC, HDL, LDL, and non-HDL cholesterol. Furthermore, in 2017, a similar study reported that mean difference in lipid profile measurements in non-fasting versus fasting patients are 26 mg/dL for TG, -8 mg/dL for TC, -8 mg/dL for LDL cholesterol, +8 mg/dL for remnant cholesterol, and -8 mg/dL for non-HDL cholesterol [8]. According to this study, non-fasting lipid profile has an equal prognostic ability for cardiovascular disease and should not affect treatment decision. In our study, even though significant difference observed both non-fasting and fasting lipid profile measurements, however mean difference in both non-fasting and fasting lipid profile are more or less similar to a study conducted by Nordestgaard, *BG* [8]. In our study, 34.13 mg/dl for triglyceride, -5.65 mg/dl for TC, -1.94 mg/dl for HDL-cholesterol, -3.71 mg/dl for non-HDL and -12.3 mg/dl for LDL-cholesterol. This mean different not causing any clinical significant, when we assess cardio vascular risk state.

However, triglyceride level (TG) more significantly ($P < 0.05$ and Hedges correction = -0.89) higher in random non-fasting than fasting state. A study conducted in China which revealed that postprandial TG level higher than fasting sample, however peak increment has been observed 0.5 hours after lunch and also stated that changes in TC, HDL, LDL and apo B were not significantly different from fasting lipid measurement [9]. A similar study stated that the variances in random non-fasting lipid changes were related to individual enzyme and hormone levels [2] [10]. However, most of the studies have shown that lipid profile levels minimally change with a meal including, tiny changes for HDL cholesterol, minor changes for TC, and non-HDL and modest changes for TG [11].

Though, cardiovascular risk assessment and monitoring of lipid-lowering based on LDL-cholesterol and TG should be performed in a blood sample collected after a period of 12 - 14 hours of overnight fasting without any caloric intake except for water and medications. The reason behind that is non-fasting lipid profile measurement show elevated TG, which in turn change the ratio of TG to total cholesterol and invalidate the Friedewald method, leads to overestimating the LDL-cholesterol. In this situation, a direct assay for LDL-cholesterol can be used. Moreover, weight has been placed on non-HDL-cholesterol, (TC-HDL) as a secondary target of therapy [12]. Introduce the lipid-lowering therapy mainly depends on the number of coronary heart disease (CHD) risk factors and baseline LDL and or Non-HDL cholesterol [13]. Though, non-fasting level of TG measurement is higher than fasting. In our study mean difference of TG was 34.13 mg/dl. However, the clinical point of view treatment should be started if TG more than 500 mg/dl. Random non-fasting elevation of TG, does not affect the treatment goal, however if non-fasting TG is more than 450 mg/dl, should be consider fasting test [9].

Most of the recently published studies emphasize that non-fasting blood sample is simple, safer, increasing efficiency and saves money. Also, number of stu-

died cited that, non-fasting lipid profile components are better at forecasting the risk of cardiovascular events [14]. Measurement of non-fasting lipid profile clearly reveals individual metabolic abnormalities in lipid clearance, elevated non-fasting TG associated with high risk of myocardial infarction and all cause of mortality [15]. It is facts that we should be careful about the certain type of patients, especially, diabetes where fasting may mask the abnormalities in TG metabolism [16]. Recently the joint consensus statement from the European Atherosclerosis Society and European Federation of Clinical Chemistry and Laboratory Medicine suggest that non-fasting lipids become the new standard for lipid measurement [10].

Non-fasting and fasting lipid measurements should be complementary but not mutually exclusive. Furthermore, the panel transcribed that non-fasting testing is generally appropriate in patients undergoing an initial lipid profile or cardiovascular risk assessment, those who are admitted with acute coronary syndrome, and for children, the elderly, and patients with diabetes. It is also appropriate if the patient prefers it. However, in certain conditions in which a fasting lipid profile may be favored such as non-fasting TG more than (0.5 mmol/l) 450 mg/dl, known hypertriglyceridemia, recovering from hypertriglyceridemic pancreatitis, starting medications that cause severe hypertriglyceridemia, screening and follow-up should ideally be performed with fasting or combined with apolipoprotein B (apo-B) [17] [18] [19].

5. Conclusion

In this study, significant differences were seen between non-fasting and fasting blood samples. However, more significant difference was observed in Triglyceride. There are several studies revealed that most of the lipid profile measurements are minimally changed with meal. When we consider a range of risk categories of lipid profile, this minimal change of fractions does not alter the management plan. However, non-fasting lipids are sufficient for general screening of cardiovascular risk. However, in certain conditions in which a fasting lipid profile may be favored such as non-fasting TG more than (0.5 mmol/l) 450 mg/dl, known hypertriglyceridemia, recovering from hypertriglyceridemic pancreatitis, starting medications that cause severe hypertriglyceridemia, screening and follow-up should ideally be performed with fasting or combined with apolipoprotein B (apo-B). In future, further prospective studies are required to compare the association of fasting and non-fasting lipid profile from the same individuals with subsequent cardiovascular outcomes.

6. Limitation of the Study

There are some limitations in this study, first non-fasting only restricted to 2 - 4 hours from the breakfast. The main meal of SriLanka people is lunch, but this study only compared the fasting lipid profile with random after breakfast. Only 84 health workers, participated both fasting and non-fasting lipid profile test, this

is fairly small sample to come to the decision. Furthermore we didn't compare the sex and ethnic group difference. Finally, familial hypercholesterolemia subjects are not excluded from this study.

Consent to Participate

Written consent was taken.

Consent for Publication

Consent was obtained from the health care workers, Teaching Hospital Batticaloa for publication of this article.

Availability of Data and Material

All data gathered during this study are included in this published article.

Conflict of Interest

None declared.

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