ORIGINAL ARTICLE

Biochemical Effects of Statins on Lipid Parameters among Newly Diagnosed Dyslipidaemia Subjects in Primary Care

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ABSTRACT

Introduction: Statins have several pleiotropic effects including its primary effect of lipid lowering that is important to prevent cardiovascular disease (CVD). Subjects often have heterogeneous responses to statin. This study aims to determine the biochemical effects of statins on lipid parameters among newly diagnosed dyslipidaemia subjects. **Methods:** This was a prospective observational study involving 118 newly diagnosed adults with dyslipidaemia from three government health clinics in Selangor, Malaysia. Biochemical analyses including fasting lipid profile [triglyceride (TG), total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C)] and apolipoproteins (apoA1, apoB) were taken at baseline and follow-up after a month on statin. **Results**: Majority of subjects (61.9%) were prescribed with lovastatin, with the rest on simvastatin. At baseline, the median values for all lipid profile parameters (TC, LDL-C, HDL-C) and non-conventional lipid parameters (LDL-C:HDL-C ratio, non-HDL-C, TC:HDL-C ratio, apoB:apoA1 ratio) were deranged except for TG and apoA1. On follow up, all parameters showed median values within the reference range except for HDL-C, non-HDL-C and TC:HDL-C ratio. There was significant difference in the effect of statins on lipid parameters including predictors of cardiovascular risk, simvastatin having better effects. **Conclusions:** Different statins have varying effects on lipid parameters. Simvastatin showed significantly better effects compared to lovastatin. Non-HDL value should be included in the standard lipid profile report given its ease of use and implementation as it's both a marker of coronary artery disease (CAD) risk stratification as well as an established determinant of goal attainment during therapy.

Keywords: Dyslipidaemia, Statin, Lipid parameters, Non-HDL, Cardiovascular risk

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INTRODUCTION

Statins, 3-hydroxy-3-methylglutaryl coenzyme A (HMG CoA) reductase inhibitors, have several pleiotropic effects including its primary effect of lipid lowering that is important to prevent cardiovascular disease (CVD) (1). There are various types of statins prescribed worldwide such as atorvastatin (Lipitor and Torvast), simvastatin (Zocor and Lipex), lovastatin (Mevacor, Altocor and Altoprev), pitavastatin (Livalo and Pitava), rosuvastatin (Crestor), fluvastatin (Lescol) and pravastatin (Pravachol, Lipostat and Selektine) (1). Subjects often have heterogeneous responses to statin. This suggests the possibility of interindividual variability in response to statin treatment.

Accordingly, this study aimed to determine the biochemical effects of statins prescribed in primary health care setting on lipid profile [triglyceride (TG), total cholesterol (TC), low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C)] and non-conventional lipid parameters namely LDL-C:HDL-C ratio, non-HDL-C, TC:HDL-C ratio, apolipoproteins (apoA1, apoB) and apoB:apoA1 ratio. ApoB has been proven to be highly correlated with the number of LDL-C particles, including very low density lipoprotein cholesterol (VLDL-C). Thus, an

elevated apoB has been shown to be the best prognostic factor of acute coronary events and deaths due to CVD (2, 3). Non-HDL-C is a result of TC minus HDL-C. There is a 1:1 correlation between the 1% non-HDL-C lowering effect and coronary artery disease (CAD) risk reduction by statin, which indicates that non-HDL-C plays an important role in the prevention and treatment of CVD (4). The TC:HDL-C ratio, which is also known as the atherogenic or Castelli index has a greater predictive value for CVD events compared to isolated parameters alone (3). ApoB:apoA1 ratio is a stronger CVD risk predictor compare to the TC:HDL-C ratio and LDL-C:HDL-C ratio (5). The apoB:apoA1 ratio reflects the balance between two completely opposite processes; the transport of cholesterol to peripheral tissues, with its subsequent arterial internalisation, and reverse transport to the liver. Therefore, both of these apolipoproteins will separately provide information for detecting high-risk individuals (3, 6, 7).

MATERIALS AND METHODS

Study design

This prospective observational data is part of a study (unpublished) where the main aim was to determine the association between *SLCO1B1* RS4363657 polymorphism and muscle aches and pains (a known side-effect of statins) in Malaysian dyslipidaemia patients prescribed with statins. This study was conducted from September 2013 to April 2015 involving 118 subjects from three government health clinics in the state of Selangor, Malaysia, namely Kajang Health Clinic, Bandar Baru Bangi Health Clinic and Dengkil Health Clinic. As such, sample size calculation for hypothesis testing purpose was done using the prevalence of muscle aches and pain (P1=0.07) and severe myopathy (P2=0.005) [8]. The determination of sample size for this study was based on the requirement to achieve 95% confidence level to detect muscle aches and pain and gave a final sample size of 104 subjects. Malaysian adult patients aged 18 years old and above were recruited into this study. These patients were newly diagnosed with dyslipidaemia and were prescribed with statin for the first time. Subjects excluded from the study were those i) with known dyslipidaemia and already on statin; ii) with known cause of secondary dyslipidaemia such as hypothyroidism, nephrotic syndrome, chronic kidney disease, cholestasis iii) with pre-existing musculoskeletal problems, neuropathy or neuromuscular disorders and iv) receiving any concomitant medications known to cause or exacerbate dyslipidaemia (thiazides, beta-blockers, corticosteroids, oral contraceptive pill) or cause myopathy (corticosteroids, penicillamine, lithium).

Data collection

Subjects were recruited on their first health screening visit at the clinics. Fasting blood investigations were taken at 8 am and reviewed in the afternoon on the same day. At baseline, statin commencement was based on the clinician's discretion, following a detailed clinical history, physical examination and review of blood results. Statins prescribed in the government health clinics were commonly lovastatin and simvastatin with other statins being restricted for specialist prescription. A detailed information sheet on the study and verbal explanation by the researcher were given to eligible subjects. Subjects who agreed to participate also provided written consent. Subject's sociodemographic details, medical history and type and dose of statin prescribed by the clinician were recorded into the proforma. Anonymity was maintained throughout the study. All subjects were then followed up at one (1) month for repeat blood investigations.

Biochemical analysis

At baseline and one month follow-up, five (5) mls of blood was withdrawn from the subject and analysed for fasting serum lipids (TG, TC, LDL-C, HDL-C), apoA1 and apoB. The biochemical analyses were performed on an automated biochemistry analyser, Cobas c311 Analyser (Hitachi Roche, Germany) in the Chemical Pathology Laboratory, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Calibration and quality control were done as per the manufacturer's instructions prior to each analysis.

Statistical analysis

As all data were not normally distributed, median and interquartile range (IQR) were calculated and non-parametric analysis was done. Chi-square test was used to determine the association between sociodemographic factors and clinical characteristics with statins. Lipid parameters on the first appointment and subsequent follow-up appointment for statins were analysed using Wilcoxon Signed Rank Test, which is designed for use with repeated measures (lipid profile numerical parameters), that is when subjects are measured on two occasions (first and follow up appointments). Finally, the median difference in lipid parameters between the first and follow up appointments for statins was analysed using Mann Whitney Test. A p value of less than 0.05 was considered to be statistically significant. Data analyses were completed using the standard statistical software package, IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corporation).

Ethics

Medical Research and Ethic Committee, Ministry of Health Malaysia ((NMRR-12-1307-13534) and the Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia (ref: UPM/FPSK/100-9/2-MJKEtika/JPAT Sept(12)05 dated 18th November 2012) approved the study.

RESULTS

A total of 136 eligible subjects were identified during the initial appointment. However, 18 subjects (13.2%)

dropped out for various reasons, resulting in a final number of 118 subjects (86.8%). The common reasons for drop out were refusal to continue with the study with no particular explanation or they had moved to another area. Majority of study population consists of Malay (72%), males (63%) in the age group of above 40 years old (73.7%). The mean age of subjects was 49.0 ± 12.2 years old. Almost half of the subjects were overweight with a mean BMI of 27.4 ± 4.6 kg/m^2 and were prehypertensive (Table I). There were significant differences between age group, ethnicity, blood pressure, medical history and smoker status between patients on lovastatin and simvastatin (Table II).

Table I. Sociodemographic factors and clinical characteristics of study population (n = 118).

Variable	Number n = 118 (%)
Gender	
Male	74 (63)
Female	44 (37)
Ethnicity	
Malay	85 (72)
Indian	17 (14.4)
Chinese	16 (13.6)
Age Group (years old)	
18-40	31 (26.3)
>40	87 (73.7)
BMI*	
Underweight	2 (1.7)
Normal	32 (27.1)
Overweight	58 (49.2)
Obese	26 (22.0)
Blood Pressure**	
Normal	22 (18.6)
Prehypertension	58 (49.2)
Hypertension	38 (32.2)
Medical History	
No	46 (39)
Yes	72 (61)
HPT only	45 (38.1)
DM only	16 (13.6)
HPT and DM	11 (9.3)
Smoking History	
Smoker	24 (20.3)
Non-smoker	94 (79.7)
Type and Dose of Statin	
Lovastatin 20 mg	73 (61.9)
Simvastatin 20 mg	45 (38.1)

BMI = body mass index; HPT = hypertension; DM = diabetes mellitus; *Based on the International Classification of adult underweight, overweight and obesity according to BMI (kg/m^2) by World Health Organization (WHO): underweight (<18.5); normal (18.5-24.9); overweight (25-29.9); obese (≥30).**Based on recommendations of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7): Normal (Systolic: <120 and Diastolic: < 80); Prehypertension (Systolic: 120-139 and/or Diastolic: 80-89); Hypertension (Systolic: ≥140and/or Diastolic: ≥ 90)

Majority of subjects (61.9%) were prescribed with lovastatin, with the rest on simvastatin. At baseline for total study population, the median values for all lipid profile parameters (TC, LDL-C, HDL-C and non-HDL-C) were deranged except for TG, apoA1 and apoB (for males only) [Table III]. Deranged values here are defined as values not within the reference range for respective lipid parameters. It is not values that are not within therapeutic target levels as per clinical practice guidelines as 4 weeks may be too soon for values to change drastically. On follow up, all parameters showed median values within the reference range except for HDL-C, non-HDL-C and TC:HDL-C ratio (Table III). There was significant difference in these changes within the total study population as well as for lovastatin (Table IV) and simvastatin (Table V), respectively [$p < 0.05$] except for Apo A1. HDL-C showed no significant difference for total study population and lovastatin where it decreased further on follow up whereas it showed a significant increase for simvastatin at follow up. This data is further supported by significant median difference in lipid parameters between first and follow-up appointments for statins, with simvastatin showing better effects (Table VI).

DISCUSSION

Although these statins have been in the market for decades, there is limited data with respect to lovastatin and none for the Malaysian population, where it is still a first-line statin in primary care. However, it was towards the end of this study that lovastatin was withdrawn from the government health clinics but it is still prescribed at private general practice. This may be due to the improved cost of simvastatin and the greater effectiveness of simvastatin as compared to lovastatin, as found in this study, making it more feasible to be prescribed. Prices in Malaysia range for simvastatin from 0.21 - 0.50 cents/tablet (1000 tabs) to a slightly higher price for smaller packaging of 30s and 100s. For lovastatin only one dose is available (20 mg) and the prices are 0.57 cents/tab (500 tabs), 0.86 cents / tab (100 tabs) and 0.93 cents/tab (30 tabs) (9).

On follow up post one month on statin, though non-HDL-C and TC:HDL-C ratio median values were not within the reference range, it was of decreasing trend. Paradoxically, the HDL-C value decreased within a month on statin for total study population and lovastatin but this change was statistically not significant. Patients on simvastatin, however, showed a significant increase in HDL-C on follow-up but not to the target value of more than 1. This could probably be attributed to the short follow-up of 4 weeks.

Table II. Association between sociodemographic factors and clinical characteristics with statins

Variable	Lovastatin n=73	Simvastatin n=45	χ^2	*p* value
Gender n (%)				
Male	41 (55.4)	33 (44.6)	3.509	0.061
Female	32 (72.7)	12 (27.3)		
Ethnicity n (%)				
Malay	46 (54.1)	39 (45.9)	7.736	0.021*
Indian	14 (82.4)	3 (18.8)		
Chinese	13 (81.3)	3 (17.6)		
Age Group (years old) n (%)				
18-40	10 (32.3)	21 (67.7)	15.621	0.000*
>40	63 (72.4)	24 (27.6)		
BMI** n (%)				
Underweight	2 (100)	0 (0)	4.470	0.215
Normal	23 (71.9)	9 (28.1)		
Overweight	31 (53.4)	27 (46.6)		
Obese	17 (65.4)	9 (34.6)		
Blood Pressure*** n (%)				
Normal	7 (31.8)	15 (68.2)	10.489	0.005*
Prehypertension	39 (67.2)	19 (32.8)		
Hypertension	27 (71.1)	11 (28.9)		
Medical History n (%)				
No	14 (30.4)	32 (69.6)	33.240	0.000*
Yes				
HPT only	38 (84.4)	7 (15.6)		
DM only	11 (68.8)	5 (31.3)		
HPT and DM	10 (90.9)	1 (9.1)		
Smoking History n (%)				
Smoker	7 (29.2)	17 (70.8)	13.653	0.000*
Non-smoker	66 (70.2)	28 (29.8)		

*Pearson Chi-square test; *p < 0.05 is significant*

BMI = body mass index; HPT = hypertension; DM = diabetes mellitus; **Based on the International Classification of adult underweight, overweight and obesity according to BMI (kg/m^2) by World Health Organization (WHO): underweight (<18.5); normal (18.5-24.9); overweight (25-29.9); obese (≥30).***Based on recommendations of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7): Normal (Systolic: <120 and Diastolic: < 80); Prehypertension (Systolic: 120-139 and/or Diastolic: 80-89); Hypertension (Systolic: ≥140and/or Diastolic: ≥ 90)

When comparing the median difference between the statins (Table VI), simvastatin showed significantly better effects on all studied lipid parameters. There are not many previous studies comparing lovastatin with other statins, locally and internationally. One study by Frohlich et al 20 years ago, compared the short-term efficacy and tolerability of lovastatin and simvastatin in the management of primary hypercholesterolaemia. In contrast to our study, the conclusion was that there were no significant differences between lovastatin and simvastatin in the treatment of moderate and severe primary hypercholesterolaemia (10). On the other hand, a more recent study by Schaefer et al. indirectly indicated that the same dose of simvastatin was more efficient in lowering LDL-C and non-HDL-C compared to lovastatin. This study was done by comparing the efficacy of atorvastatin with other statins (fluvastatin, pravastatin, lovastatin, and simvastatin) in the fasting and fed states. The efficacy of the same dose in the same patients of lovastatin and simvastatin were about 60%, and 85% of the efficacy of atorvastatin, respectively (2).

Most interestingly, significant improvement was observed in non-conventional lipid parameters (LDL:HDL-C ratio, non-HDL-C, TC:HDL-C ratio, apoA1, apoB, and apoB:apoA1 ratio), which are better predictors of cardiovascular risk. Both apoB and non-HDL-C have been shown to be valuable parameters in risk stratification compared to LDL-C (11). However, some evidence suggests apoB is a better marker than non-HDL-C since apoB represents the total number of circulating atherogenic particles whereas non-HDL-C

Table III. Laboratory parameters of study population (n = 118)

Parameter	First Appointment		Follow Up		Reference Range**	Z	*p* value
	Median (IQR)	Min-Max	Median (IQR)	Min-Max			
TC (mmol/L)	6.39(1.20)	4.43-12.10	4.37(1.72)	1.87-7.75	< 5.20	-9.239	0.000*
LDL (mmol/L)	3.53(0.78)	1.36-6.85	2.16(1.21)	0.62-4.73	< 2.60	-9.333	0.000*
HDL (mmol/L)	0.81(0.31)	0.40-1.73	0.75(0.42)	0.30-1.84	≥ 1.10	0.000	1.000
TG (mmol/L)	1.66(0.95)	0.57-8.66	1.28(1.21)	0.07-5.82	< 1.70	-5.849	0.000*
LDL:HDL	4.36(1.96)	1.35-9.88	2.84(1.34)	0.57-8.02	< 3.0	-8.917	0.000*
Non-HDL (mmol/L)	5.57(1.29)	3.66-11.54	3.51(1.71)	1.31-7.16	< 3.35	-9.329	0.000*
TC:HDL	7.88(3.03)	3.87-21.61	5.56(2.54)	2.32-15.03	< 4.0	-8.220	0.000*
ApoA1 (g/L)	1.37(0.47)	0.65-2.92	1.25(0.41)	0.72-2.99	Female: 1.04-1.63 Male: 1.09-1.72	-0.275	0.783
ApoB (g/L)	1.26(0.31)	0.59-2.41	0.86(0.36)	0.28-1.91	Female: 0.6 -1.17 Male: 0.66-1.33	-9.061	0.000*
ApoB:ApoA1 ratio	0.92(0.35)	0.38-2.10	0.69(0.24)	0.22-1.50	Female: < 0.7 Male: < 0.8	-9.098	0.000*

*Wilcoxon Signed Rank Test; *p < 0.05 is significant*
y/o = years old; TC = total cholesterol; LDL = low density lipoprotein cholesterol; HDL = high density lipoprotein cholesterol; TG = triglyceride; ApoA1 = apolipoprotein A1; ApoB = apolipoprotein B
**Roche Diagnostic reference ranges for adults

Table IV. Laboratory parameters of study population on lovastatin (n =73)

Parameter	First Appointment		Follow Up		Reference Range**	Z	p value
	Median (IQR)	Min-Max	Median (IQR)	Min-Max			
TC (mmol/L)	6.20(1.00)	4.50-12.10	4.50(1.94)	1.87-7.75	< 5.20	-7.140	0.000*
LDL (mmol/L)	3.48(0.95)	1.85-5.06	2.26(1.29)	0.62-4.73	< 2.60	-7.317	0.000*
HDL (mmol/L)	0.82(0.36)	0.40-1.73	0.72(0.40)	0.30-1.84	≥ 1.10	-1.204	0.229
TG (mmol/L)	1.77(1.03)	0.57-8.66	1.25(1.28)	0.07-5.82	< 1.70	-4.727	0.000*
LDL:HDL	4.21(1.79)	1.35-9.88	2.91(1.60)	0.57-8.02	< 3.0	-6.726	0.000*
Non-HDL (mmol/L)	5.36(1.16)	3.93-11.54	3.62(1.80)	1.31-7.16	< 3.35	-7.237	0.000*
TC:HDL	7.75(3.10)	3.87-21.61	5.94(2.60)	2.75-15.03	< 4.0	-5.943	0.000*
ApoA1 (g/L)	1.37(0.41)	0.65-2.92	1.33(0.42)	0.72-2.99	Female: 1.04-1.63 Male: 1.09-1.72	-0.144	0.886
ApoB (g/L)	1.26(0.33)	0.59-2.02	0.86(0.43)	0.28-1.86	Female: 0.6 -1.17 Male: 0.66-1.33	-6.714	0.000*
ApoB:ApoA1 ratio	0.92(0.32)	0.38-1.57	0.69(0.28)	0.22-1.50	Female: < 0.7 Male: < 0.8	-6.785	0.000*

*Wilcoxon Signed Rank Test; *p < 0.05 is significant*
y/o = years old; TC = total cholesterol; LDL = low density lipoprotein cholesterol; HDL = high density lipoprotein cholesterol; TG = triglyceride; ApoA1 = apolipoprotein A1; ApoB = apolipoprotein B
**Roche Diagnostic reference ranges for adults

Table V. Laboratory parameters of study population on simvastatin (n =45)

Parameter	First Appointment		Follow Up		Reference Range**	Z	p value
	Median (IQR)	Min-Max	Median (IQR)	Min-Max			
TC (mmol/L)	6.70(0.90)	4.43-10.68	4.14(1.64)	2.16-7.32	< 5.20	-5.852	0.000*
LDL (mmol/L)	3.53(0.55)	1.36-6.85	2.15(0.85)	0.64-3.43	< 2.60	-5.846	0.000*
HDL (mmol/L)	0.81(0.19)	0.52-1.63	0.88(0.45)	0.39-1.50	≥ 1.10	-2.155	0.031*
TG (mmol/L)	1.66(0.86)	0.60-3.40	1.32(0.71)	0.18-4.29	< 1.70	-3.236	0.001*
LDL:HDL	4.49(1.18)	1.77-7.61	2.55(1.31)	0.73-7.59	< 3.0	-5.788	0.000*
Non-HDL (mmol/L)	5.89(1.09)	3.66-9.78	3.42(1.48)	1.42-6.19	< 3.35	-5.845	0.000*
TC:HDL	8.61(2.42)	4.09-12.44	4.79(2.37)	2.32-14.77	< 4.0	-5.548	0.000*
ApoA1 (g/L)	1.37(0.37)	0.67-2.17	1.25(0.39)	0.77-2.27	Female: 1.04-1.63 Male: 1.09-1.72	-0.124	0.901
ApoB (g/L)	1.26(0.18)	0.84-2.41	0.86(0.19)	0.39-1.91	Female: 0.6 -1.17 Male: 0.66-1.33	-6.055	0.000*
ApoB:ApoA1 ratio	1.02(0.31)	0.52-2.10	0.69(0.17)	0.28-1.34	Female: < 0.7 Male: < 0.8	-5.855	0.000*

*Wilcoxon Signed Rank Test; *p < 0.05 is significant*
y/o = years old; TC = total cholesterol; LDL = low density lipoprotein cholesterol; HDL = high density lipoprotein cholesterol; TG = triglyceride; ApoA1 = apolipoprotein A1; ApoB = apolipoprotein B
**Roche Diagnostic reference ranges for adults

Table VI. Comparison of median difference of lipid parameters (between first and follow up appointments) for statins (n = 118)

Parameter	Statin				Z	*p* value
	Lovastatin (n=73)		Simvastatin (n=45)			
	Median Difference[a]	IQR	Median Difference[b]	IQR		
TC (mmol/L)	-1.63	1.11	-2.89	1.43	-3.814	0.000*
LDL-C (mmol/L)	-1.14	0.66	-1.51	0.96	-2.993	0.003*
HDL-C (mmol/L)	+0.03	0.37	+0.03	0.49	-2.212	0.027*
TG (mmol/L)	-0.59	0.63	-0.34	0.58	-1.960	0.050*
LDL:HDL Ratio	-1.30	1.26	-1.65	1.72	-2.541	0.011*
Non-HDL-C (mmol/L)	-1.74	1.14	-2.97	1.75	-4.343	0.000*
TC:HDL-C Ratio	-1.72	2.06	-2.98	2.47	-3.646	0.000*
ApoB (g/L)	-0.31	0.18	-0.50	0.10	-5.362	0.000*
ApoA1 (g/L)	+0.07	0.22	+0.10	0.22	-2.720	0.007*
ApoB:ApoA1 Ratio	-0.23	0.20	-0.37	0.31	-4.542	0.000*

*Mann-Whitney Test; *p < 0.05 is significant*
[a]*Median difference in lipid parameters between first appointment and follow up for lovastatin*
[b]*Median difference in lipid parameters between first appointment and follow up for simvastatin*
TC = total cholesterol; LDL-C = low density lipoprotein; HDL-C = high density lipoprotein; TG = triglyceride; ApoB = apolipoprotein B; ApoA1 = apolipoprotein A1; IQR = interquartile range.

Table VII. Risk of CAD in terms of increased apoB:apoA1 ratios (13)

	Low risk	Moderate Risk	High Risk
Men	0.40 – 0.69	0.70 – 0.89	0.90 – 1.10
Women	0.30 – 0.59	0.60 – 0.79	0.80 – 1.00

Adapted from AMORIS and INTERHEART studies.

measures the cholesterol content of all atherogenic lipoproteins (LDL-C, IDL-C and VLDL-C) (12). Based on the results of the AMORIS and INTERHEART studies that further established apoB:apoA1 ratio risk ranges for CAD as in Table VII (13), though we did not stratify according to gender, our results showed that the study population was at high risk prior to treatment (median = 0.92) but reduced to moderate risk (median = 0.69) at follow up (Table III), a measure not revealed by conventional lipid profile.

However, the widespread use and application of apolipoproteins has been hampered by arbitrary treatment cut-offs, technical issues of laboratory testing, standardisation and the cost factor (12). Although the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) has achieved a consensus on a practical standardisation procedure, this will take time to incorporate these markers into national and international guidelines and to be implemented worldwide (14).

In the interim, as shown in this study, non-HDL-C also decreased on follow-up. Its initial median value in the study population was raised at 5.57 mmol/L, suggesting an increased risk of developing CVD (15). However, on follow-up post statin, it was of decreasing trend though not to the recommended value of < 3.35 mmol/L (15, 16). As such, considering that it is not only a predictive marker of CAD but also an established secondary target for therapy in patients where the TG > 2.3 mmol/L (16, 17), we propose that it should be included in all formal reports of lipid profile. The other benefits for its official implementation in standard reporting are i) being a calculated value, there is no added cost; ii) it can be measured in non-fasting sample and iii) increased non-HDL-C with normal LDL-C may potentially detect subjects with raised apo B, LDL-C particle number and small dense LDL (17). Furthermore, with the increasing prevalence of metabolic syndrome, non-HDL is a more accurate risk predictor for CVD compared to when LDL-C is used alone in this subset of patients (18).

Although this study had its strengths being a prospective study as it was able to establish a temporal relationship between the exposure and outcome of interests, its main limitation includes the lack of assessment of different types of statins as only two types of statins were prescribed. Furthermore, therapeutic lifestyle changes (diet and exercise) were not taken into account and may have confounded the results. Although the change in lipid parameters were significant post-statin treatment, some values were not within the target values. This could be due to the fact that a one month reassessment time frame may not truly reflect the final steady state lipid status of the subject.

CONCLUSIONS

In summary, this study shows that statins have varying biochemical effects on lipid parameters, with simvastatin showing significantly better effects than lovastatin. However, future studies should look at a longer follow-up period that may reflect the steady state lipid status of patients on statins. Non-HDL value should be included in the standard lipid profile report given its ease of use and implementation as it's both a marker of coronary artery disease (CAD) risk stratification as well as an established determinant of goal attainment during therapy.

ACKNOWLEDGEMENTS

The authors would like to thank the Director-General of Health Malaysia for approving publication of this paper. A special appreciation to the Director of Selangor State Health Department (JKNS) for permitting this study. The authors would like to extend their gratitude to the clinicians of the government health clinics (Kajang, Bandar Baru Bangi and Dengkil) and staff of Chemical Pathology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia for their contribution in this study. This study was funded by the Universiti Putra Malaysia Research University Grant Scheme (RUGS Project No: 9338400). There is no conflict of interest with respect to this article.

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