

## Lipid Levels in Sri Lankan Adults: An Analysis from Sri Lanka Diabetes and Cardiovascular Study

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### Abstract

**Introduction:** Cardiovascular disease (CVD) remains the leading cause of death in Sri Lanka. Dyslipidaemia is a major risk factor for development of CVD. Distribution of lipid parameters in Sri Lankans from Sri Lanka Diabetes and Cardiovascular Study (SLDCS) 2005-06 are reported.

**Methods:** SLDCS was a cross sectional study where a nationally representative sample of 5000 adults was recruited by a multi-stage random cluster sampling. Data were collected using interviews, physical examination and 12-hour fasting blood samples. Total cholesterol (TC), high density lipoprotein cholesterol (HDL) and triglyceride levels were measured. Low density lipoprotein cholesterol (LDL) was calculated using the Friedewald formula and directly measured when TG was more than 400 mg/dL. Non-HDL-cholesterol (NHDLC) and TC/HDL ratio were calculated.

**Results:** Total of 4486 participated (response rate 89.7%) in the study; women 60.5%; mean age 46 years. Among them 35 people who were already on treatment were excluded. Mean (SD) TC, HDL, LDL, TG and NHDLC levels were 206.7 mg/dL (43.5), 46.8 mg/dL (10.6), 135.5 mg/dL (37.6), 121.7 mg/dL (66.8), 159.9 mg/dL(41.6) and 4.6 (1.1) respectively. People with high TC, LDL, NHDLC and low HDL were 20.1%, 23.4%, 21.5% and 53.9% respectively and all abnormalities were commoner in females.

**Conclusion:** Dyslipidaemia which is a major cardiovascular risk factor is common among Sri Lankan adults. It is significantly associated with increasing age, gender, physical activity level, BMI and diabetes.

**Keywords:** Dyslipidaemia, Cardiovascular risk, LDL cholesterol, Non-HDL cholesterol, Sri Lanka

### INTRODUCTION

Dyslipidaemia is a major modifiable risk factor for atherosclerotic cardiovascular disease. Patterns and prevalence of different type of dyslipidaemias show variations across ethnicities geographical regions and are influenced by genetic make-up, environmental factors and co-morbidities.[1] Prevalence, patterns and determinants of dyslipidaemia in Sri Lanka were recently reported from the findings of Sri Lanka Diabetes and Cardiovascular Study.[2] In this report we illustrate the percentage prevalence of dyslipidaemia

graded by severity according to NCEP/ATPIII guidelines and compare across age groups and sex.

### METHODS

SLDCS was a cross sectional study conducted by the Diabetes Research Unit of the Faculty of Medicine, University of Colombo and the Oxford Centre for Diabetes Endocrinology and Metabolism of the University of Oxford UK. Ethical approval was obtained from the Ethics Review Committee of the Faculty of medicine, University of Colombo. All participants provided informed written consent.

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Data collection was conducted between August 2005 and September 2006. Detailed methods have been previously published. [3].

This article is based on 4451 non-institutionalized participants aged  $\geq 18$  years, excluding 35 participants who were on lipid lowering medication. A multi-stage random cluster sampling technique was used to select a representative sample of 5000 non-institutionalized adults age at or above 18 years from seven provinces in Sri Lanka. Blood was collected after a 12-14 hour overnight fast. Serum was stored at  $-20^{\circ}\text{C}$ . TC, HDLC and TG were measured by enzymatic photometric methods using a Hitachi 704 chemical auto-analyser (Roche Diagnostics, Mannheim, Germany) in the Reproductive and Endocrinology Laboratory, Faculty of Medicine, University of Colombo, Sri Lanka. Low density lipoprotein cholesterol (LDLC) was calculated using the Friedewald formula except where TG was more than 400 mg/dL in which instance it was directly

measured. TC/HDL and non-HDLc were calculated. Lipid parameters interpreted using NCEP ATP III

All the statistical analyses were conducted with SPSS 16.0 statistical software package (SPSS, Inc., Chicago, IL, USA).

### RESULTS

Study population included 4451 participants whose mean age was 46.1 ( $\pm 15.1$ ) years (men 46.3 ( $\pm 15.8$ ) and women 46.0 ( $\pm 14.6$ ),  $p = 0.55$ ). Majority (60.5%) were women. Most were from the rural sector (rural 78.0%, urban 17.6%, plantation 4.4%) paralleling the demographic distribution of the country. Women had significantly higher body mass index (men 21.1  $\text{kg}/\text{m}^2$  ( $\pm 3.7$ ) Vs women 22.2  $\text{kg}/\text{m}^2$  ( $\pm 4.5$ ),  $p < 0.001$ ) and lower waist circumference (men 78.1 ( $\pm 11.0$ ) Vs women 76.8 (12.2),  $p < 0.001$ ). Lipid parameters of participants are summarized in table 1.

**Table 1. Lipid levels of participants (N = 4451)**

	Men (N = 1758 [39.5%])			Women (N = 2693 [60.5%])			P	Total population		
	Mean	SD	Quartiles *	Mean	SD	Quartiles *		Mean	SD	Quartiles *
<b>TC</b>	202.1	42.9	172.0 – 228.0	209.7	43.7	180.0 – 235.0	< 0.001	204.0	43.2	177.0 – 232.0
<b>LDLC</b>	130.8	36.6	105.9 – 152.5	138.5	37.9	111.8 – 160.8	< 0.001	135.4	36.6	109.0 – 157.2
<b>TG</b>	132.4	73.7	84.0 – 161.0	114.4	60.8	75.0 – 138.0	< 0.001	121.7	66.8	78.0 – 146.0
<b>HDLC</b>	44.6	10.4	38.0 – 50.0	48.2	10.6	41.0 – 54.0	< 0.001	46.8	10.6	40.0 – 52.0
<b>NHDLc</b>	157.4	40.9	129.0 – 182.0	161.5	42.0	131.0 – 186.0	< 0.001	159.7	41.6	130.0 – 184.0
<b>TC:HDLC</b>	4.7	1.1	4.3 – 5.2	4.5	1.2	4.0 – 5.0	< 0.001	4.6	1.1	4.1 – 5.1

\* 25<sup>th</sup> and 75<sup>th</sup> quartiles

All values in mg/dL except TC/HDLC ratio

Among the participants, 125 (2.8%) had definite evidence of ischaemic heart disease. However their lipid levels were comparable to those without, except for having a higher triglyceride level (146.7 (88.5) Vs 120.4 (65.0) mg/dL). This is likely influenced by pharmacological and lifestyle interventions in those with ischaemic heart disease.

Only 35 participants were on treatment with statins (0.8%) and their mean TC, LDLc, HDLC, TG, NHDLc

levels were 202.2 ( $\pm 53.0$ ) mg/dL, 125.1 ( $\pm 47.1$ ) mg/dL, 45.8 ( $\pm 9.9$ ) mg/dL, 156.5 ( $\pm 71.4$ ) mg/dL and 156.4 ( $\pm 50.5$ ) mg/dL respectively. Only triglyceride level was significantly different from those who were not on statins. However interpretation of this finding is limited by very small number of participants who were on statin therapy.

Figure 1 shows the distribution of participants across different lipid levels. Twenty percent of the participants had high total cholesterol ( $> 240$  mg/dL) while 53.9% had low HDLC ( $< 40$  mg/dL in men,  $< 50$  mg/dL in women), 21.5% had high NHDLc ( $> 190$  mg/dL)

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and 23.4% had high LDLC (> 190 mg/dL). Furthermore, when defined according to National Cholesterol education Programme / Adult Treatment Panel III definition of dyslipidaemias, 76.9% of the study population had some form of dyslipidemia (data not shown).

Twelve percent of the participants had diabetes. Those with diabetes had significantly higher TC (217.6

(±44.8) Vs 205.3 (±43.2) mg/dL,  $p < 0.001$ ), TG (159.2 (±87.4) Vs 116.6 (±61.9) mg/dL,  $p < 0.001$ ), NHDLC (171.5 (±42.3) Vs 158.4 (±41.3) mg/dL,  $p < 0.001$ ) and LDLC (139.7 (±39.6) Vs 134.9 (±37.3) mg/dL,  $p = 0.006$ ) but HDLC (46.1 (±9.8) Vs 46.9 (±10.8) mg/dL,  $p = 0.103$ ) was not significantly different. Percentage prevalence of each lipid categories in association with diabetes, sector of living, sex and age are illustrated in figure 1.

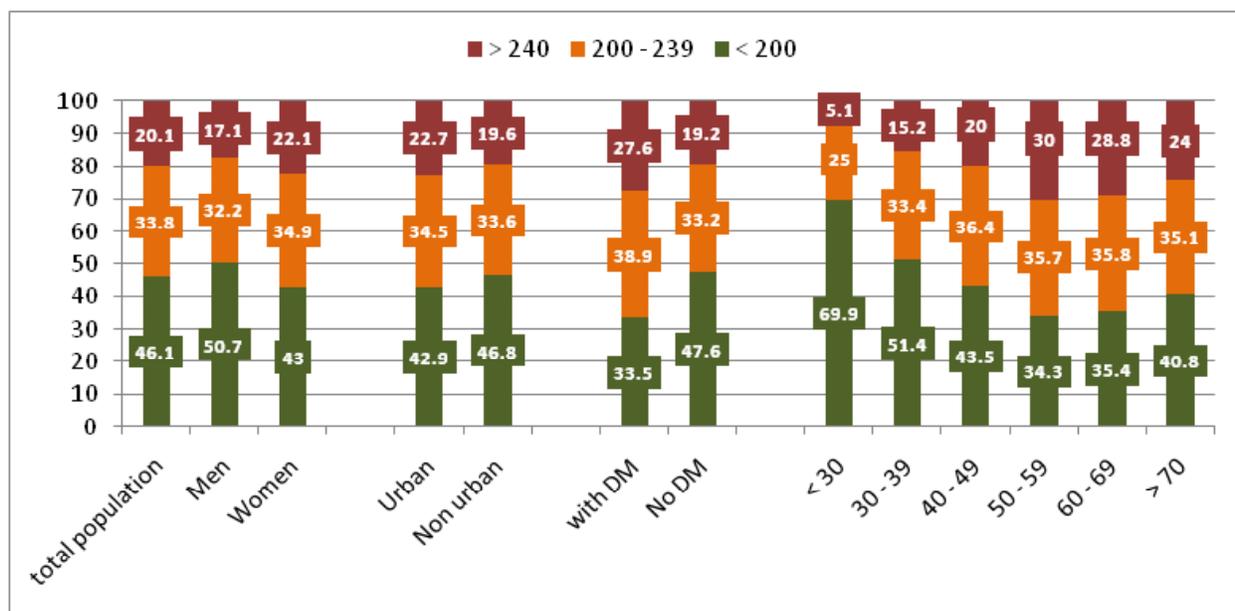


Figure (a). Total cholesterol. 1: desirable (< 200 mg/dL), 3: Borderline high (200 – 239 mg/dL), 5: High (>240 mg/dL)

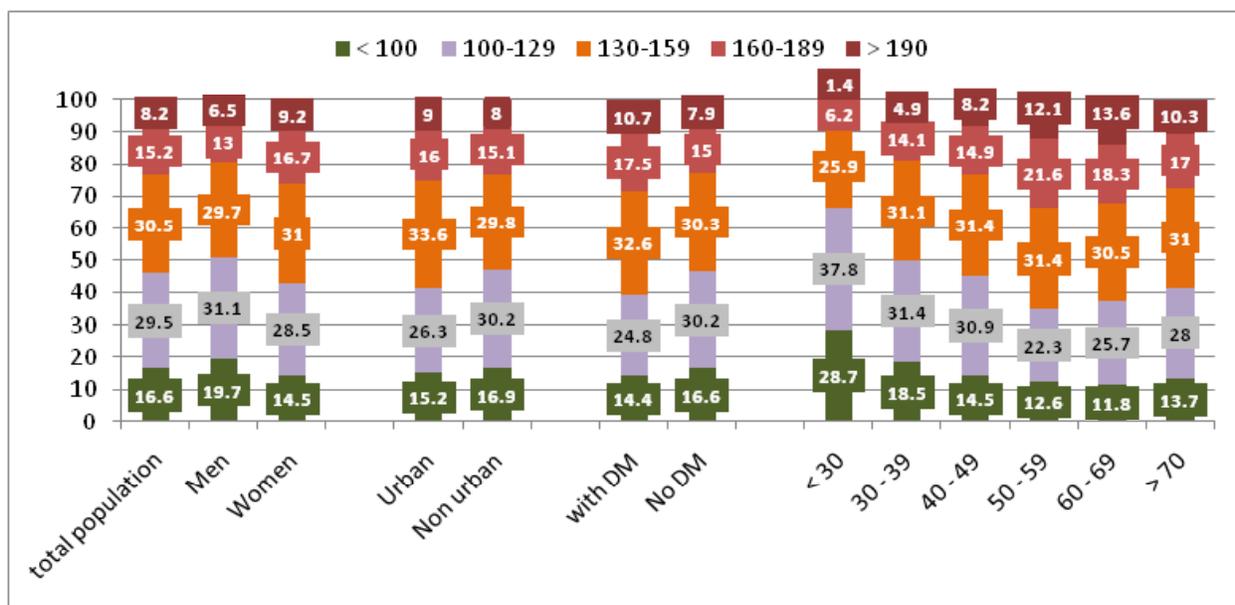


Figure (b). LDL cholesterol. 1: optimal (< 100 mg/dL), 2: above optimal (100-129 mg/dL), 3: Borderline high (130-159 mg/dL), 4: high (160-189 mg/dL), 5: very high (> 190 mg/dL)

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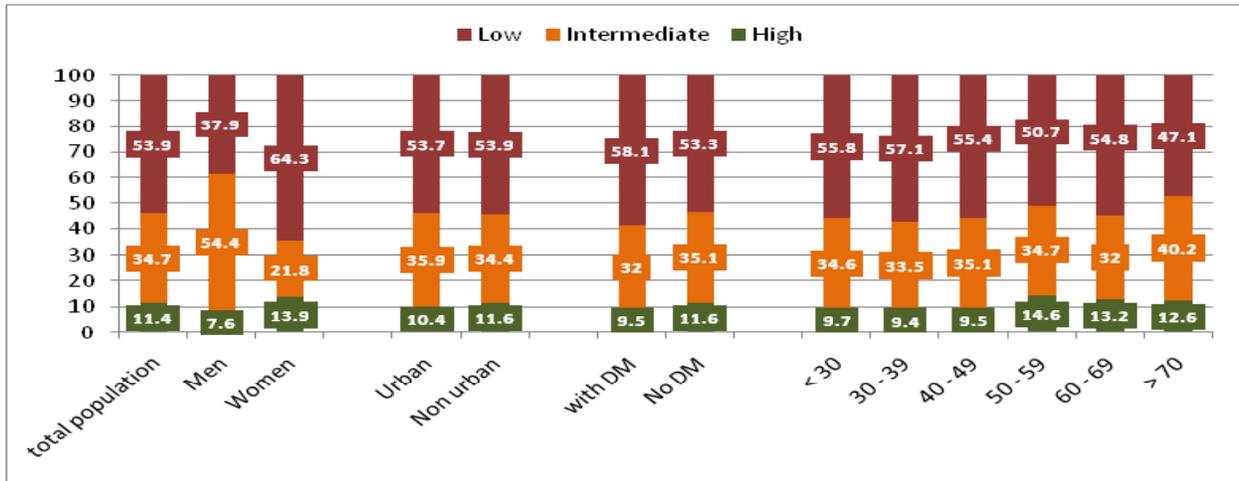


Figure (c). HDL cholesterol. 1: high (> 60 mg/dL in women, > 50 mg/dL in men), 3: intermediate (50-60 mg/dL in women, 40-50 mg/dL in men), 5. Low (< 50 mg/dL in women, < 40 mg/dL in men)

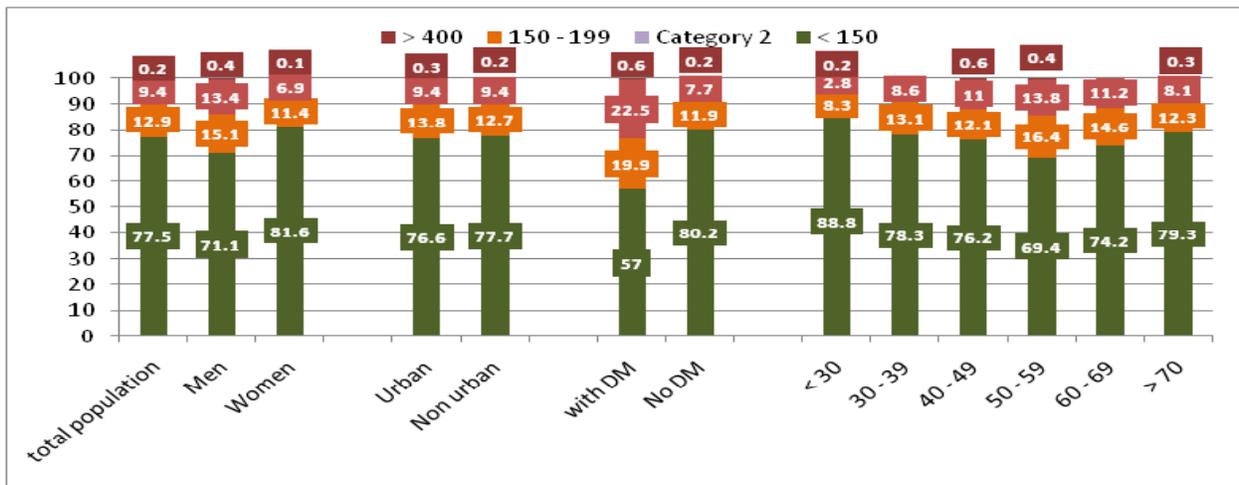


Figure (d). Triglycerides. 1: Normal (< 150 mg/dL), 3: Borderline high (150-199 mg/dL), 4: High (199-400 mg/dL), 5: very high (> 400 mg/dL)

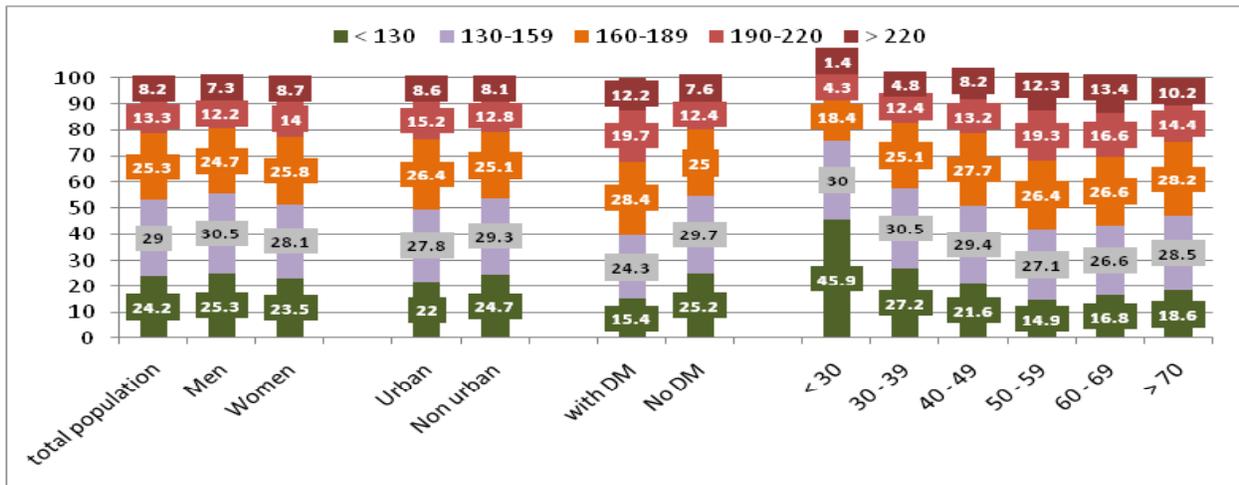


Figure (e). Non HDL cholesterol. 1: optimal (< 130 mg/dL), 2: above optimal (130-159 mg/dL), 3: Borderline high (160-189 mg/dL), 4: high (190-219 mg/dL), 5: very high (> 220 mg/dL)

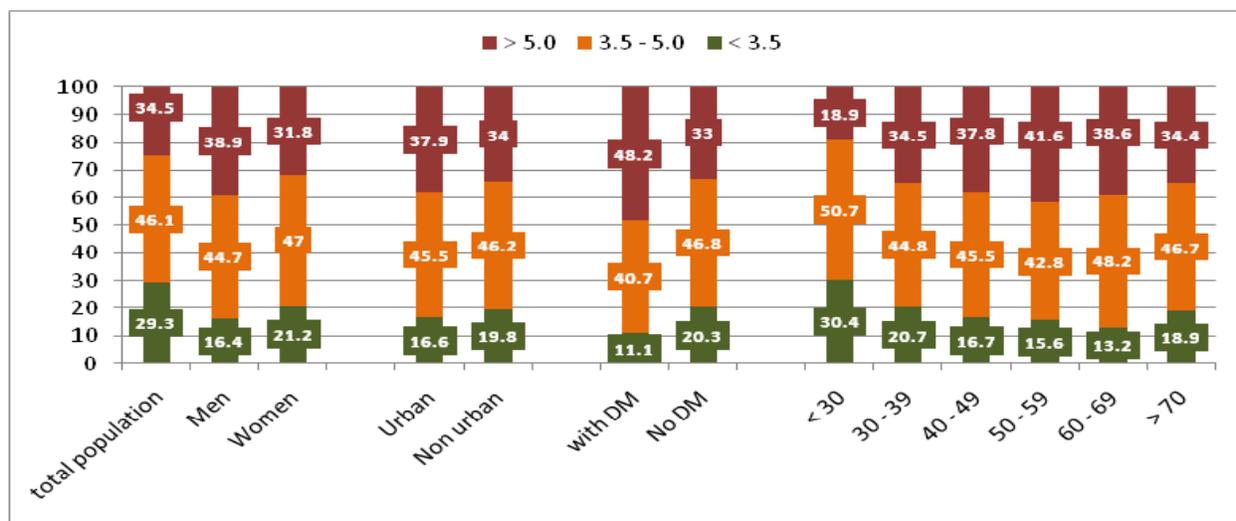


Figure (f). Total cholesterol : HDL cholesterol ratio. 1: optimal (< 3.5), 2: above optimal (3.5-5.0), 5: high (>5.0)

Figure 1. Percentage of participants in different lipid categories

## DISCUSSION AND CONCLUSIONS

Cardiovascular disease is a leading cause for morbidity and mortality. Recent data from WHO estimated that cardiovascular diseases account for 40% of deaths in Sri Lanka.[4] It is estimated that 25.4% of Sri Lankan adults are at high risk for cardiovascular disease. [5] Dyslipidemia is a key modifiable risk factor for cardiovascular disease and data on its prevalence in the country and region were scarce.

This is the largest group of previously unscreened Sri Lankan population studied for lipid disorders and has revealed several key aspects of lipid disorders among our adult population. Dyslipidaemia is highly prevalent among Sri Lankans. Commonest type is low HDL cholesterol affecting 53.9% of Sri Lankan adults while 8.2% had LDLC over 190 mg/dL and 20.1% had total cholesterol over 240 mg/dL. It is noteworthy that when accounted for other cardiovascular risk factors, 46% of Sri Lankan adults had LDL cholesterol above the desirable target.[2] Unique high prevalence of low HDL cholesterol is likely to be contributed at least partly by genetic characteristics which remain elusive. Furthermore, even among Sri Lankan people with diabetes on statin therapy, low HDL cholesterol remains the least corrected dyslipidaemia.[6]

Results analyzed here indicate that presence of diabetes is associated with high rates of dyslipidemia. Interestingly sector of living had minimal influence on the lipid categories. Although high TC and high

TC:HDLC was more prevalent in urban communities difference was not significant. These similarities may be a result of genetic factors common to South Asians, irrespective of the sector of living.

When compared to data from other countries and regions, these values are alarming. NHANES III data indicate that prevalence of high total cholesterol (> 240 mg/dL) and low HDL cholesterol (according to same sex specific cut offs) in adult US population were 12.1% and 18.5% in 2011-14 study.[7] In fact US have observed a reduction in the prevalence of low HDL cholesterol from 30% (NHANES II) in 2003-06. [8] However, in 2008, Chandalia et al reported the prevalence of low HDLC in Asian Indians to be 42 – 72% being higher among females and those in rural sector.[9] Higher prevalence of low HDLC among Asian Indians was also observed in a study in California, USA that compared lipid profiles among minor ethnic groups. This study also showed higher prevalence of high TC and high TG in Asian Indians residing in their state.[10]

It is important to determine whether this high prevalence of dyslipidaemias among Sri Lankans confer similar cardiovascular risk as observed in western communities and this would require long term prospective studies. This will be useful in setting treatment goals for optimization of cardiovascular risk management in our populations.

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### Abbreviations

BMI	Body mass index
CVD	cardiovascular disease
HDLC	High Density Lipoprotein cholesterol
LDLC	Low Density Lipoprotein cholesterol
NCEP/ATPIII	National Cholesterol Education Programme / Adult Treatment Panel III
NHANES	National Health and Nutrition Examination Survey
NHDL	Non HDL cholesterol
SLDCS	Sri Lanka Diabetes and Cardiovascular Study
TC	total cholesterol
TG	triglycerides

*Sri Lanka Diabetes, Cardiovascular Study (SLDCS). Diabet Med, 2008. 25(9): p. 1062-9.*

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