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Original Article

Lipid levels of healthy adults in Jaffna district, Northern Province of Sri Lanka: An analysis of secondary data

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Abstract

Abnormal lipid profile is considered as an important contributor to cardiovascular diseases among South Asians. Sri Lanka is a multiethnic South Asian nation and differences in ethnicity may influence the pattern of lipid profile.

The aim of this paper is to analyse the lipid levels of healthy adults of a predominantly Sri Lankan Tamil population in the Northern Sri Lanka and compare it with the lipid levels of different ethnic groups reported in the literature.

It was a cross-sectional analysis of secondary data of 500 healthy adults who were the controls of a larger study on the lipid profile of diabetic and non-diabetic patients. Cut-off values for desirable lipid levels used in this study were determined according to national and international guidelines. Chi-squared test, independent t-test/ Mann–Whitney U-test and one-way analysis of variance were used to determine the statistical significance and a p-value <0.05 was considered significant.

The majority (61.4%) were women and the mean age was 54.8±12.6 years. Mean lipid levels were within normal range except HDL cholesterol (HDL-C) in women (46.6± ±10.6 mg/dL). Desirable lipid levels were observed in majority of the participants (58%-80%) except HDL-C among women (32%). Half of the study population had a desirable total cholesterol: HDL-C ratio (50.8%). Significant difference between men and women was observed for HDL-C (p<0.05). The HDL-C levels and total cholesterol: HDL-C ratio of Jaffna population were comparable to those of South Asian populations. Further studies are needed to determine the clinical implication of these observations.

Keywords: Lipid level, HDL cholesterol, Jaffna population, South Asians

Introduction

Cardiovascular diseases (CVD) are the most common non-communicable disease worldwide [1]. South Asians seem to be more prone to develop CVD than Caucasians or Chinese descendants [2, 3, 4, 5]. Dyslipidaemia is considered as one of the important contributors to the increased risk of CVD among South Asians [2, 6]. Lower high-density lipoprotein cholesterol (HDL-C) and elevated triglyceride (TG) levels were observed among South Asians [6, 7, 8]. A review on lipoprotein abnormalities in South Asians reported that the lipid profile of South Asians was characterized by low but more atherogenic low-density lipoprotein cholesterol (LDL-C), low and dysfunctional HDL-C, elevated TG, and high lipoprotein (a) [9].

Being a South Asian nation Sri Lanka may also have a similar abnormalities in lipid levels and risk of CVD. In Sri Lanka, ischemic heart disease has been the leading cause of death for more than a decade and is on the rise [10]. Like other South Asians, dyslipidaemia could have contributed to the increased risk of CVD in Sri Lankans too. However, studies that specifically

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examined the pattern of lipid profiles of Sri Lankans are limited. A few studies conducted in Sri Lanka reported the pattern of lipid levels: Sri Lanka Diabetes and Cardiovascular Study (SLDCS) conducted across the country except in Northern and Eastern provinces showed a high prevalence of dyslipidaemia (77.4%) among Sri Lankans and low HDL-C (49.6%) was the commonest type [11]; Tennakoon et al. compared the risk of CVD between Sri Lankans in Oslo and Sinhalese and Tamils in Kandy and the study concluded that Kandy Sinhalese and Tamils had greater risk of CVD mainly due to impaired lipid profile [12]; A study on the prevalence of metabolic syndrome conducted in Jaffna reported that almost 80% of the study population had low HDL-C and TG was elevated in one-fourth of the participants [13].

The present study was conducted in Jaffna district which is located in the Northern Province of Sri Lanka. Sri Lanka is a multiethnic country and the population in the Northern Province is predominantly Sri Lankan Tamils, one of the minor ethnic groups in Sri Lanka. As ethnicity and culture influence the pattern of lipid profile [14, 15], the lipid profile of Sri Lankan Tamils may differ from that of other ethnic groups in Sri Lanka. Further, the Northern Province was not included in the previous studies conducted in Sri Lanka due to the inaccessibility during the civil conflict. Analysing the lipid levels of healthy individuals will help to understand the trend of the lipid profile and the risk of CVD of a population. This paper analyses the lipid levels of the Jaffna population and compares findings of this study with those of the other studies conducted in South Asians and non-South Asian populations.

Methods

This was a cross-sectional analysis of secondary data. We analysed the lipid levels of the control group (healthy adults) of a larger study on lipid profiles of diabetic and non-diabetic patients receiving treatment at Teaching Hospital, Jaffna using secondary data. In this study, healthy adults were the individuals who had no preexisting medical conditions and were not diagnosed with any medical condition during the screening for non-communicable diseases. Sample size of the groups were calculated with the power of 90% [16] using values of lipid levels of Sri Lankans reported by Katulanda et al [11] and recommended optimal lipid levels [17]. Lipid levels of healthy adults who underwent basic health screening for non-communicable diseases conducted in Jaffna district in 2021 and 2022 were obtained from the Regional Directorate of Health Services of Jaffna district. Information on age, gender, and total cholesterol (TC), LDL-C, TG and HDL-C levels were extracted from the database. Data were extracted consecutively until the required number of samples was reached. Ethical approval was obtained from the Ethics Review Committee of Teaching Hospital, Jaffna (Ref. No.: S02/08/2021) and administrative approvals were obtained from relevant authorities before commencing the data collection.

Estimation of lipid levels was carried out in two peripheral public hospitals in the Jaffna district using the same type of automated chemistry analyzer (Mindray BS-240). Enzymatic methods were used to determine TC and TG, HDL-C was estimated by direct method and LDL-C was estimated by calculation method.

Data analysis

Based on the national and international guidelines [17, 18, 19] desirable lipid levels were defined as follows; TC <200 mg/dL. LDL-C <130 mg/dL. TG <150 mg/dL. HDL-C (men) ≥40 mg/dL , HDL-C (women) ≥50 mg/dL, TC: HDL-C ratios (men) <4.5, TC: HDL-C ratios (women) <4.0

Data were entered in Microsoft Excel (version 16.0) and analysed. Descriptive statistics such as frequency, percentage, mean, and standard deviation (SD) were used to present the data. Interquartile method was used to identify the outliers. Lipid levels of men and women, different age groups and lipid levels with and without

outliers were compared. For the analysis, age was categorized as < 40 years, 40-59 years, and ≥60 years. Independent t-test/ Mann–Whitney U-test and one-way analysis of variance were used to compare the means of two groups and more than two groups respectively. Chi-square test was performed to compare proportions. A p-value less than 0.05 was considered statistically significant.

Results

Data from 500 healthy adults were analysed. The mean age of the study population was 54.8±12.6 years, ranging from 24 to 85 years. Fig. 1 shows the age distribution of the study population. Among the 500 participants, 193 (38.6%) were men and 307 (61.4%) were women. The Mean age of men was 57.6±12.8 years and that of women was 53.1±12.1 years. The number of participants in the age groups of <40 years, 40-59 years, and ≥60 years were 62 (men=17; women=45), 250 (men=81; women=169) and 188 (men=95; women=93) respectively.

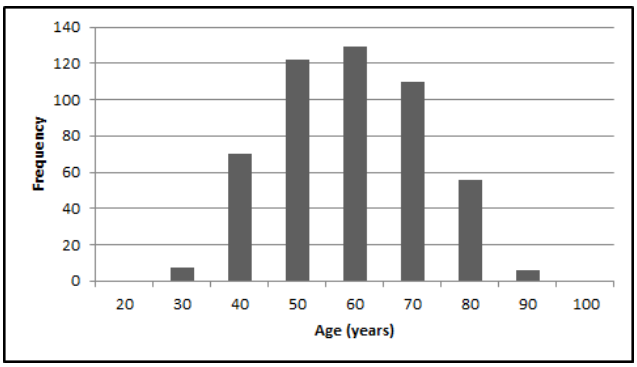

Fig. 1 Age distribution of the study population

Description of lipid levels

Distribution of lipid levels according to age groups and sex are shown in Table 1. All the mean lipid levels were within the normal range except HDL-C levels in women which were lower than the recommended value across all age groups. When comparing the mean lipid levels of men and women, a significant difference was observed for HDL-C (p=0.006). Differences in mean lipid levels among different age groups were not statistically significant.

The mean TC: HDL-C ratio of the total population, men and women were 4.4±1.5, 4.5±1.6 and 4.3±1.4 respectively. The difference in the mean TC: HDL-C ratio between men and women was not significant.

Table 1: Lipid levels according to age groups and gender

Age group (years)	Total Cholesterol Mean ± SD mg/dl			LDL Cholesterol Mean ± SD mg/dl			Triglyceride Mean ± SD mg/dl			HDL Cholesterol Mean ± SD mg/dl		
	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
<40 (n=62)	196.6 ±26.1	175.3 ±27.2	181.1 ±28.5	125.4 ±26.2	110.8 ±24.0	114.8 ±25.5	113.6 ±43.2	105.8 ±52.2	108.0 ±50.0	48.5 ±10.1	43.4 ±6.9	44.8 ±8.2
40-59 (n=250)	188.8 ±38.1	192.4 ±42.9	191.2 ±41.4	121.1 ±33.9	122.1 ±38.5	121.8 ±37.1	135.3 ±79.0	119.3 ±52.0	124.4 ±62.5	40.7 ±12.5	46.4 ±10.4	44.6 ±11.4
≥60 (n=188)	180.4 ±43.9	196.8 ±44.3	189.0 ±44.8	111.6 ±39.9	123.1 ±41.3	117.0 ±41.0	117.4 ±57.5	125.7 ±57.7	122.0 ±57.7	45.3 ±11.7	48.5 ±12.0	47.0 ±12.0
Total (n=500)	185.4 ±40.6	191.2 ±42.0	189.0 ±41.5	116.8 ±36.8	120.8 ±37.9	119.2 ±37.5	124.6 ±67.0	119.3 ±54.2	121.3 ±59.5	43.7 ±12.2	46.6 ±10.6	45.5 ±11.4

SD, standard deviation; LDL, low-density lipoprotein; HDL, high-density lipoprotein

Outliers

Outliers are shown in Fig, 2. In TC, nine (1.8%) outliers were identified: eight of them were above the upper limit (>288.7 mg /dL) and one was below the lower limit (<84.5 mg/dL). There were six outliers (1.2%) in the LDL-C and all were above the upper limit (>210.5 mg/dL). Seventeen (3.4%) outliers were identified in TG which were above the upper limit (>243.4 mg/dL). The number of outliers in HDL-C was fifteen (3.0%) and all were above the upper limit (>73.2 mg/dL). Mean values of TC, LDL-C, TG, and HDL-C after removing the outliers were 187.2±38.2 mg/dL, 117.7±34.9.mg/dL, 114.3±44.9 mg/dL and 44.5±10.0 mg/dL respectively. There were no significant differences when comparing lipid levels with and without outliers.

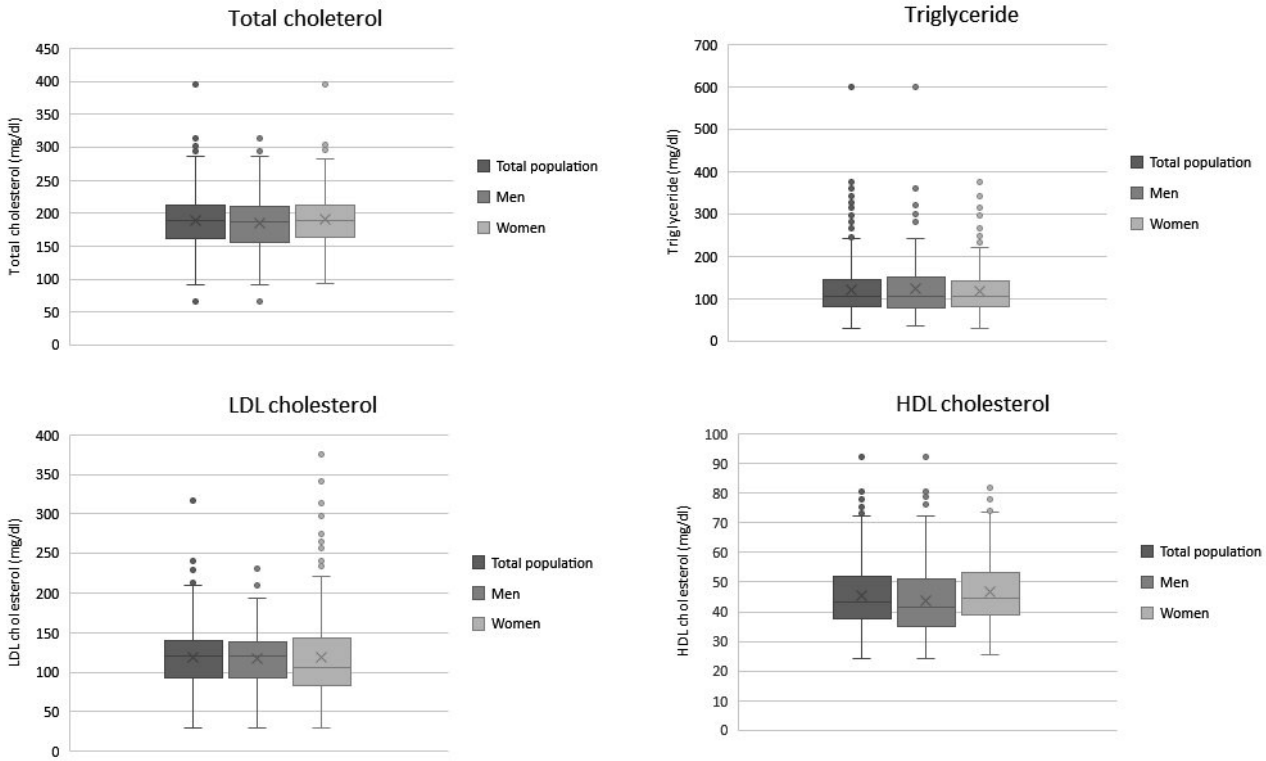

Fig. 2 Distribution of lipid levels among healthy adults

Pattern of lipid profile

Table 2 shows the proportion participants with desirable and undesirable lipid levels. Majority of the participants had desirable lipid levels except HDL-C in women. When comparing men and women, significant difference was observed for HDL-C ($p<0.001$). Proportion of participant with desirable and undesirable TC: HDL-C ratio was almost equal. Greater proportion of men had desirable TC: HDL-C ratio compared to women (Table 2). However, this difference was not significant.

Discussion

The present study found that the Jaffna population had a trend in HDL-C level similar to that of South Asian populations reported in literature. Table 3 compares lipid levels of different populations (values reported in mmol/L were converted to mg/dL).

We found that the mean HDL-C levels of the total population (45.5 mg/dL) and men (43.7 mg/dL) of our study were within an acceptable range. Although the mean HDL-C level of women (46.6 mg/dL) was higher than that of total population and men, it was below the acceptable value for women.

When compared to other studies conducted among Sri Lankans (Table 3), mean HDL-C of this study was comparable to the values reported in SLDCS study and Sri Lankans in Oslo and higher than the HDL-C levels of Sinhalese and Tamils in Kandy [11, 12]. A study conducted in three major cities in South Asia has reported low HDL-C levels (41.7 mg/dL to 46.2 mg/dL) in urban South Asians [24].

Table 2 : Proportion of participants with desirable and undesirable lipid levels

Description	Frequency (percentage)		
	Total population (N=500)	Men (N=193)	Women (N=307)
Total Cholesterol			
Desirable	306 (61.2%)	122 (63.2%)	184 (59.9%)
Undesirable	194 (38.8%)	71 (36.8%)	123 (40.1%)
LDL Cholesterol			
Desirable	321 (64.4%)	124 (64.3%)	213 (69.4%)
Undesirable	179 (35.8%)	69 (35.8%)	94 (30.6%)
Triglyceride			
Desirable	386 (77.2%)	142 (73.6%)	244 (79.5%)
Undesirable	114 (22.8%)	51 (26.4%)	63 (20.5%)
HDL Cholesterol			
Desirable	292 (58.4%)	111 (57.5%)	97 (31.6%)
Undesirable	208 (31.6%)	82 (42.5%)	210 (68.4%)
Total Cholesterol: HDL Cholesterol ratio			
Desirable	254 (50.8%)	107 (55.4%)	147 (47.9%)
Undesirable	246 (49.2%)	86 (44.6%)	160 (52.1%)

Other studies have also reported a lower HDL-C level among South Asians compared to non-South Asian populations [8, 25, 26]. The mean HDL-C level of the present study was similar to HDL-C levels of South Asian populations and lower than non-South populations [6, 11, 20-25].

In the present study mean LDL-C levels in both men and women across all age groups were within the desirable range whereas the SLDCS study (Table 3) reported a borderline high LDL-C among Sri Lankans [11]. A relatively lower LDL-C levels (102.2 mg/dL to 113.3 mg/dL) were reported in urban South Asians [24]. Several other studies also reported a slightly lower LDL-C level in South Asians than many other ethnic groups [7, 8, 25, 26]. Like most of the South Asians, our study population also had a relatively lower LDL-C level (119.2 mg/dL).

The mean TG level of the present study was within the normal range. The SLDCS study also reported a similar finding whereas Sri Lankans in Oslo and Kandy (Table 3) had a higher TG levels [11, 12]. In our study, women had a lower TG level than men which was observed in the SLDCS study as well [11]. It is interesting to note that the TG level of Jaffna population (121.3 mg/dL) was lower than the TG levels (128.4 mg/dL to 161.4 mg/dL) of most of the South Asians [6, 12, 21, 23, 24]. Triglyceride levels (<100 mg/dL to 145.3 mg/dL) among non-South Asian populations varied widely [6, 7, 25, 27].

In the present study both men and women had a desirable mean TC levels whereas SLDCS study (Table 3) reported a borderline high TC level [11]. Among South Asian, TC levels varied from 162.0 mg/dL to 224.3 mg/dL and a comparable variation in TC levels (138.8 mg/dL to 224.3 mg/dL) was observed among non-South Asian populations as well [6, 7, 11, 12, 20-27].

Total cholesterol: HDL-C ratio is considered as a useful predictor of risk of CVD [19, 28-30]. In our study, both men (4.4) and women (4.3) had a suboptimal mean TC: HDL-C ratio. Similar findings were reported by SLDCS study (men=4.5; women=4.4) and a study conducted in India (men=4.5; women=4.2) [11, 31]. Manchester study showed an undesirable TC: HDL-C ratio in South Asian women (4.7) and both men (4.7) and women (4.1) among non-South Asians [6]. A study compared Caucasians and Indo-Asians in United Kingdom reported undesirable TC: HDL-C ratio in Indo-Asian women (4.5) and both Caucasians (4.6) and Indo-Asian (4.9) men [22]. The UK-Biobank study reported a higher TC: HDL-C ratio among South Asians (4.3) compared to White Europeans (4.0) and Black Africans or Caribbean (3.7) [25]. Like other South Asians, Jaffna population also tend to have an undesirable TC: HDL-C ratio. Most of the findings, including the present study are suggestive of a female preponderance for undesirable TC: HDL-C ratio in South Asians [6, 11, 22, 25, 31]. Although we use the same target lipid levels across all ethnic groups, the prediction of risk of CVD based on lipid levels may not be the same for all ethnic groups.

Table 4 Lipid levels of different populations

Study, year	Country	Population (n)	Lipid level (mg/dL)			
			Total Cholesterol	LDL Cholesterol	Triglyceride	HDL Cholesterol
Present study, 2023	Sri Lanka	Healthy adults in Jaffna (500)	189.0±41.5	119.2±37.5	121.3±59.5	45.5±11.4
		Men (193)	185.4±40.6	116.8±36.8	124.6±67.0	43.7±12.2
		Women (307)	191.2±42.0	120.8±37.9	119.3±54.2	46.6±10.6
de Groot et al., 2019 [20]	Netherlands	Dutch blood donors (2547)	195.3±37.9	111.8 ±32.5	114.3 *	57.6±15.5
Katulanda et al., 2018 [11]	Sri Lanka	Adults (4451)	206.7±43.5	135.5±37.6	121.7±66.8	46.8±10.6
		Men (1758)	202.1±42.9	130.7±42.9	132.8 ±73.7	44.6 ±10
		Women (2693)	209.7±29.1	138.5±36.6	114.4±60.8	48.2±10.6
Telles et al., 2018 [21]	India	Healthy obese adults (1140)	176.7±35.6	-	148.8±80.6	44.5±11.2
Tennakoon et ai., [12]	Sri Lanka Norway	Sri Lankans in Oslo[1] (1145)				
		Men (685)	208.8	-	230.3	41.4
		Women (460)	193.4	-	159.4	46.8
		Kandy Sinhalese (445)				
		Men (143)	212.7	-	221.4	37.1
		Women (302)	212.7	-	168.3	41.0
		Kandy Tamils (233)				
		Men (103)	201.1	-	221.4	35.2
		Women (130)	208.8	-	194.86	37.51
France et al., 2003 [6]	UK	Adults ≥30 years				
		South Asians (348)				
		Men (179)	199.9 ±3.9	-	140.0 ǂ	41.4 ±1.2
		Women (169)	212.7 ±3.5	-	143.5 ǂ	46.4±1.2
		Non-South Asian (3225)				
		Men (1633)	207.7 ±1.2	-	145.3 ǂ	47.6±0.0
		Women (1592)	219.6 ±1.2	-	128.4ǂ	56.5 ±0.8
Gama et al., 2002 [22]	UK	Caucasians (787)	224.3*	-	-	54.1*
		Men (421)	220.4*	-	-	46.4*
		Women (366)	224.3*	-	-	54.1*
		Indo-Asians (223)	220.4*	-	-	50.3*
		Men (129)	220.4*	-	-	46.4*
		Women (94)	208.8*	-	-	46.4*
Hoogeveen et al., 2001 [23]	USA India	Adults				
		Control[2] (46)	162.0±25.6	84.2±25.4	139.9±65.5	47.4±12.9
		CHD[3] (46)	193.6±47.3	110.7±40.1	186.0±101.3	42.3±8.8
		USA Asian Indians (206)	191.2±35.3	117.8±32.2	151.3±102.6	43.4±11.8

CHD, coronary heart disease; LDL, low-density lipoprotein; HDL, high-density lipoprotein; MS, metabolic syndrome; UK, United Kingdom; USA, United States of America

** Median, ǂ Geometric mean, [1] 99% were ethic Tamils*

[2] Healthy individuals living in northern India , [3] Individuals with documented CHD living in northern India

The REGARDS study concluded that low HDL-C levels were associated with an increased risk of coronary heart disease in Whites but not in Blacks [32]. The Northern Manhattan Study reported that low HDL-C and high TG/ HDL-C ratios were not associated with the risk of myocardial infarction in Hispanics, but were predictive in non-Hispanic Blacks and Whites [33]. The INTERHEART study reported that changes in ApoA1 levels were better determinants of risk of acute myocardial infarction than changes in HDL-C levels [34]. The above findings indicate the need for ethnic and region-specific consideration in determining the risk of CAD. Despite the extensive works on ethnic differences in the pattern of lipid profiles over the past decades, clinical significance of these differences is yet to be established. Therefore, further extensive in-depth studies are needed to determine the role of ethnic variations in lipid profile and characteristics and their association with CAD. We may need to redefine the optimal lipid levels based on the ethnicity and region in future.

There are limitations in our study that need to be acknowledged. Firstly, the data were extracted from the data source of a screening programme, therefore, the study population may not be a representative sample of the local population. However, as healthy adults were identified using well-defined criteria, this study would give an insight to the pattern of the lipid profile of the local population. Secondly, the data we analysed was from Sri Lankan Tamils, therefore cannot be generalised to all Sri Lankans. Thirdly, since we used the data from a data source that was not designed for this study, we were not able to examine the likely contributors for suboptimal lipid levels and outliers. Nevertheless, the finding of this study would give an idea about the pattern of lipid abnormalities of the local population and help to plan future studies to investigate the link between the lipid levels and the risk for CVD.

Conclusion

Findings of our study support the claim that South Asians tend to have low HDL-C. Similar to other South Asians, Jaffna population also had a relatively low LDL-C levels than non-South Asians. However, TC and TG levels were not consistent with those of South Asians and Sri Lankans reported in the literature. Since the pattern lipid profile is influenced by ethnicity and culture, differences ethnicity and culture could have contributed to these differences. These findings indicate the complex nature of prediction of the link between lipid abnormalities and cardiovascular risk. Further studies that investigate the association between the lipid levels and the cardiovascular risk in the local population are needed to understand the implications of these observations. Since previous studies have shown that not only the quantity but also the quality particularly of LDL-C and HDL-C contribute to the risk of cardiovascular disease, the characteristics of lipids and their association with cardiovascular disease in the local population also need to be examined.

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Declarations

Competing Interest: None of the authors have any competing interest.

Ethical approval: Ethical approval was obtained from the Ethics Review Committee of Teaching Hospital, Jaffna (Ref. No.: S02/08/2021). Approval from the Regional Directorate of Health Services-Jaffna was obtained to extract information from the database.

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