*Tanzania Journal of Health Research*
*Volume 16, Number 4, October 2014*
Doi: http://dx.doi.org/10.4314/thrb.v16i4.2

# Profile of plasma lipids and degree of derangements among the elderly of Morogoro region, Tanzania

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**Abstracts:** Changes in lifestyles and ageing have been associated with growing rates of modifiable cardiovascular risk factors (CRF). Dyslipidemia is one of the CRF associated with numbers of cardiovascular diseases. This descriptive cross-sectional study was conducted to determine the profile and degree of derangements of plasma lipids among 300 (176 females and 124 males) elderly individuals aged ≥60 years in Morogoro, Tanzania. The calorimetric enzymatic methods and the Friedewal's equation were used for determination of cholesterols and triglycerides (TG). Social and demographic characteristics were gathered by structured questionnaires. The logistic regression models were used to identify the determinants of abnormal serum lipids level. Mean Total Cholesterols (TC) and Low Density Lipoprotein Cholesterols (LDL-C) in females exceeded significantly that of males**.** Mean TC, LDL-C as well as TG (mg/dL) declined significantly with age while mean High Density Lipoprotein Cholesterols (HDL-C) also declined but only slightly. Elderly females were two times more likely to have elevated TC (OR=2.11; 95% CI: 1.04-4.28: P=0.05) and LDL-C (OR=2.15; 95% CI: 1.17-3.97: P=0.019) and three times to have lowered HDL-C (OR=3; 95% CI: 1.97-5.30: P<0.001) than males. Urban residents were about two times more likely to have elevated LDL-C (OR=1.84; 95% CI: 1.04-3.25: P=0.047) than their rural counterparts. Body Mass Index of ≥30 kg/m$^2$ was also associated with elevated LDL-C (OR=1.89; 95% CI: 1.05-3.42: P=0.045) and lowered HDL-C (OR=2.18; 95% CI: 1.3-3.65: P=0.004), respectively. The present study has established the profile and level of derangements of serum lipids among the elderly of Morogoro region in Tanzania. It appears that, female sex and BMI of ≥ 30kg/m$^2$ are significant factors for elevated TC, LDL-C and lowered HDL-C while urban life is a significant factor for elevated LDL-C.

**Keywords:** plasma lipids, dyslipidemia, cardiovascular diseases, elderly, lifestyle, Tanzania

## Introduction

Cholesterols and triglycerides are blood plasma components transported by lipoproteins (Birtchner & Ballantyne, 2004). Chylomicrons are lipoprotein for transporting dietary lipids from the intestines to other parts in the body. They consist of Triglycerides (TG), cholesterol esters, phospholipids and a protein formed in the enterocytes (Vaziri, 2006). Other lipoproteins are formed in the liver (Vaziri, 2006) and includes Very Low Density Lipoprotein (VLDL) which transports TG and Low-Density Lipoprotein Cholesterol (LDL-C) which transport cholesterols to the peripheral tissues and High-Density Lipoproteins (HDL-C) that carries cholesterol from the body's tissues to the liver for excretion or re-utilization(Birtcher & Ballantyne, 2004). Regulation of lipoprotein and cholesterols is critical for good health simply because cholesterol derangements can lead to a number of long standing health problems (Birtcher & Ballantyne, 2004; Reiner *et al.,* 2011). Generally, high cholesterol level of LDL and VLDL or a high level of TG increases the risk for atherosclerosis and thus the risk of heart attack and stroke (Birtcher & Ballantyne, 2004). On the other hand, high HDL level decreases the risk for atherosclerosis while the opposite is true for lowered level of HDL-C (Birtcher & Ballantyne, 2004; Reiner *et al*., 2011). The mechanism of atherosclerosis involves the interaction of

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Doi: http://dx.doi.org/10.4314/thrb.v16i4.2

LDL-C, the intima and sub-endothelia space of the blood vessels and is commonly associated with arterial hypertension in old age (Noll & Luscher, 1994).

The rate of release of free fatty acids (FFA) from adipose tissues into the circulation increases with age. In the circulation, increased levels of FFA lead to the increase in synthesis of bad cholesterol such as LDL-C hence increasing the risk for cardiovascular diseases (CVD) (Shanmugasundaram *et al.*, 2010). Body composition of fat and lean tissues changes with ages (Wilt, 1997). As age advances, a large proportion of lean tissues decreases due to impaired protein metabolism (Koopman & van Loon, 2009). Furthermore, it appears that the increase in body fat mass ratio with ageing, attains maximum in old age where it either remain steady or starts to decline (Kyle *et al*., 2001). Central accumulation of fat (visceral fat) with ageing is accompanied by degeneration of peripheral fat mass and is a characteristic feature of fat distribution in elderly (Kyle *et al*., 2001). It is also known that, increased risks for stroke, diabetes mellitus, hyperlipidaemia, heart disease and hypertension is associated with changes in pattern of fat distribution in old age (Kuczmarski, 1989).

There were previous perceptions that dyslipidemia is a non black African problem with suggestions that black people are genetically less prone to the condition. Also nutritional and other environmental and social activities made them less sedentary hence lowered incidences of dyslipidemia (Oguejiofor *et al*., 2012). Early reports suggested that blacks have lower prevalence of dyslipidemia possibly due to genetic, nutritional, and environmental factors (Kesteloot *et al*., 1989; Onyemelukwe *et al*., 1981). However, globalization has led to drastic changes in developing countries where the lifestyle has and is becoming more westernized with high urbanization, adoption of high caloric western diets and increased sedentary work. Recent studies have shown that CRFs and particularly dyslipidemia are no longer a rare problem in Africa (Oguejiofor *et al*., 2012). Tanzania is also affected by globalization and therefore it is not left out in the global trends taking place and more so in the urban settings (Maletnlema *et al*., 2002; Kuga *et al*., 2002)

Studies done in Tanzania revealed a prevailing burden of selected Modifiable CRF in middle aged and adult individuals and dyslipidemia was a burden (Njelekela *et al.*, 2001; Marina, 2009). However, considering the geographical, topographical, gender and age differences between individuals in Tanzania, data to explain the extent of CRF problem in the elderly (≥60 years) population are scanty. This study was carried out to determine the serum cholesterols levels among the elderly sampled in urban and rural areas of Morogoro in Tanzania.

## Materials and Methods

### *Study area*

A descriptive cross-sectional study was conducted in the urban and rural areas of Morogoro region in Tanzania from August, 2011 to May, 2012. The region lies between latitudes 5° 58' and 10° 0' South and longitudes 35° 25' and 35° 30' East. The good climatic condition of moderate temperature and enough rainfalls experienced in the region supports a variety of activities ranging from small to large scale crop and livestock farming, formal and informal employment works and small to large scale business activities (NBC, 2002).

### *Sample size and sampling*

The sample size in this study was determined during the assessment of the levels of cardiovascular risk factors (obesity, blood pressure, hyperglycaemia, dyslipidemia) and malnutrition among the elderly of Morogoro based on the assumptions that; prevalence of obesity in Tanzanian elderly is 22.8% (Njelekela *et al*., 2001). Significance level is 5% and maximum likely error of 5%. The calculated

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sample size was 270. However, 11% was added to take care of non respondents, hence the sample size for this study included 300 elderly participants. Recruitment of participants employed a combination of simple random and cluster sampling methods done in a lottery way. A total of 19 and 17 wards in Morogoro urban representing urban areas and Mvomero district representing rural areas, respectively were identified and to each were assigned unique numbers using special labels. A random selection of the wards was done. The same selection criteria was employed to obtain five representative villages or streets from each of the selected wards making a total of 50 study areas (streets or villages) from which six elderly participants were selected randomly. A sampling frame of elderly residence for streets or villages in each ward was obtained from the ward's offices. While any elderly of ≥60 years who willingly signed a consent form was eligible for the current study, terminally ill individuals were excluded.

Participants considered to have lipid derangements had any of the following: TC: ≥ 240mg/dL (≥6.20mmol/L), LDL-C: ≥160mg/dL (≥4.13mmol/L), TG: ≥200mg/dL (≥5.18mmol/L) and HDL-C: <40 mg/dL (<1.03mmol/L) in males and<50mg/dL (< 1.04mmol/L) in females (Birtcher & Ballantyne, 2004) or was under cholesterol lowering drugs. Classification of individual cholesterols and TG was done as follows; desirable TC: < 200 mg/dL, borderline high TC: 200-239 mg/dL, high TC: ≥240mg/dl. Optimal LDL cholesterol: <100 mg/dL, near optimal LDL cholesterol: 100-129 mg/dL, border line high LDL cholesterol: 130-159 mg/dL, high LDL cholesterol: 160-189 mg/dL and very high LDL cholesterol: ≥190 mg/dL. Normal TG: <150mg/dL: borderline high TG: 150-199 mg/dL, high TG: 200-499 mg/dL and very high TG: 500 mg/dL. High HDL-C: 60+ mg/dL, normal HDL-C >40 mg/dL in men and >50 mg/dL in women, low HDL-C< 40 mg/dL in men and<50 mg/dL in women (Birtcher & Ballantyne, 2004).The blood samples were collected by a qualified nurse.

***Data collection***

Body weights were taken using a calibrated clinical scale with 150kg capacity and an accuracy of 0.1kg (Detecto-medic, Detecto scale inc, Brooklyn. N.Y., USA). Heights of the participants were also measured using a calibrated stadiometer at 0.1 cm accuracy. BMI was determined by dividing weight in kilograms by height in square meters. Social and demographic data were collected by a simple structured questionnaire during an interview. The data for each participant included name, age, sex, education profile, histories of smoking habit and usage of anti-cholesterols.

Blood samples for analysis of cholesterols and TG was collected from 06:00 to 08:00 hours in the morning following about 12 hours of fasting. Participants were informed in advance to suspend their morning meal prior to the study. Plain vacutainer tubes and five cubic centimetre syringes were used for blood collection. The coagulated blood samples were centrifuged in macro centrifuge (Sigma Labozentrigugen 202 MC, 3600 rpm, German) to obtain sera which were transferred into Eppendorf storage tubes and stored in a freezer at -40 $^{o}$C to the end of the analysis.

The calorimetric enzymatic methods by the ARCHITECH c8000 Clinical Chemistry Analyzer (Abbot Laboratories, USA) at Muhimbili National Hospital diagnostic laboratory was used for analysis of fasting TC, TG and HDL-C with the Friedewald equation [LDL cholesterol] = [TC] - [HDL-C] - ([TG]/5) being applied for determination of LDL-C. Conversions of measurements in Mmol/L to mg/dL were done by standard procedures (David *et al*., 2005) and values in mg/dl of TC, LDL-C, TG, HDL-C serum levels were used for data analysis.

***Data analysis***

Data analysis was performed using Epi-Info version 6 and Excel 2007 software packages. Descriptive statistics consisting of means, standard deviation and frequencies described the general characteristics of participants. Unpaired t-test was used for comparison of means between

 Doi: http://dx.doi.org/10.4314/thrb.v16i4.2

quantitative variables. Fisher exact, Chi-squared ($X^2$) and the logistic regression models were used to identify the differences attributable to social and demographic factors of the abnormal serum lipids level.

### *Ethical considerations*

An ethical clearance was granted by the Muhimbili University of Health and Allied Sciences Senate for Research and Publication Committee. Ethical issue were closely observed during the whole period of the study. An informed written consent was obtained from each study subject.

## Results

A total of 300 individuals (females=176; males= 124) were involved in the study. The mean ages of participants were 67 ± 7.22 for females and 69 ± 7.99 for males. Mean values of TC, LDL-C, TG and HDL-C varied between males and females (Table 1). Mean TC and LDL-C serum levels were significantly higher in elderly female than males.

**Table 1: Social-demographic characteristics study participants (n=300)**

| Variable | Response | All participants | Males | Females | P- value |
|---|---|---|---|---|---|
| | | Mean±SD n(%) | Mean±SD n(%) | Mean±SD n(%) | |
| **Age (years)** | | 68.4±7.6 | 69 ± 7.99 | 67 ± 7.22 | 0.0041* |
| **Education** | None | 121(40.3) | 90(51.1) | 31(25) | <0.001* |
| | Primary | 160(53.3) | 83(41.2) | 77(62) | 0.01* |
| | Secondary | 11(3.7) | 2(1.1) | 9(7.3) | 0.0067* |
| | Post-Secondary | 8(2.7) | 1(0.6) | 7(5.6) | 0.012* |
| **Age category** | 60-69 | 172(57.3) | 61(49.2) | 111(63.1) | 0.023 |
| | 70-79 | 96(32) | 48(38.7) | 48(27.2) | 0.07 |
| | 80-89 | 26(8.7) | 11(8.9) | 15(8.5) | 0.91 |
| | ≥90 | 6(2) | 4(3.2) | 2(1.2) | 0.2 |
| **Residency** | Urban | 150(50) | 51(41.1) | 99(56.3) | 0.013* |
| | Rural | 150(50) | 73(58.9) | 77(43.8) | |
| **Smoking habit** | | 113(37.7) | 72(58.1) | 41(23.3) | <0.001 |
| **BMI(kg/m²)** | | 26.3±6.4 | 23.97±4.7 | 28.0±6.8 | 0.001* |
| **Lipid profile** | TC (mg/dL) | 194.5±47.4 | 182.25±44.90 | 202.4±49.6 | P<0.001 |
| | LDL_C(mg/dL) | 133.5±39 | 123.37±35.26 | 140.19±41.14 | P<0.001 |
| | TG (mg/dL) | 128.7±70.3 | 126.23±77.59 | 130.23±65.49 | P=0.68 |
| | HDL-C(mg/dL) | 49.8±15.3 | 47.86±15.40 | 50.94±15.53 | P=0.129 |
| **Abnormal level** | TC:≥ 240mg/dL | 45(15.1) | 12(9) | 33(19) | 0.041* |
| | LDL:≥160mg/dL | 63(21) | 17(13.7) | 46(26.1) | 0.014* |
| | TG:≥200mg/dL | 35(11.7) | 12(9.7) | 23(13.1) | 0.47 |
| | HDL-C(<40mg/dL M,<50 mg/dL F) | 130(43.3%) | 33(26.6) | 97(55.1) | <0.001* |

*There is a significant difference between groups (P≤0.05). values obtained by Chi-squared ($\chi^2$) and T-test . <40mg/dL M,<50 mg/dL F : HDL-C level Less than 40 mg/dL in males and less than 50 mg/dL in females

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The pattern of mean TC, LDL-C as well as TG (mg/dL) declined significantly with increased ages, HDL-C level also declined but only slightly. Similarly, cases with the abnormally high levels of TC and LDL-C were significantly more among the females than males (Figure 1).

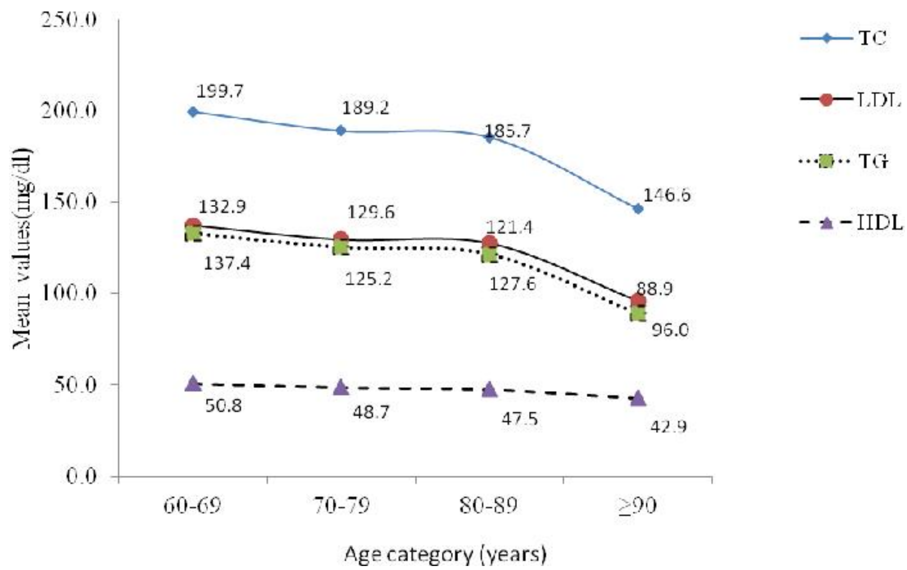


**Figure 1: The mean TC, LDL-C cholesterol, TG and HDL-C at increased ages of the elderly participants (n= 300) s**

**Table 2: Multivariate logistic regression models for determinants of elevated total cholesterol and LDL-C serum levels (n=300)**

| | | High TC≥240 (mg/dl) | | | High LDL-C≥160(mg/dl) | | |
|---|---|---|---|---|---|---|---|
| **Factors** | **Value** | **OR** | **95%CI** | **P value** | **OR** | **95%CI** | **P value** |
| Age (years) | 60-69 (n=172) | 1.41 | 0.73-2.73 | P= 0.38 | 1.65 | 0.92-2.95 | P=0.123 |
| | 70-79 (n=96) | 0.66 | 0.32-1.37 | P=0.34 | 0.61 | 0.32-1.16 | P=0.18 |
| | ≥80 (n=32) | 1.02 | 0.34-3.13 | P=0.80 | 0.88 | 0.32-2.45 | P=0.98 |
| Sex | Male (n=124) | 0.47 | 0.23-0.95 | P=0.05 | 0.46 | 0.25-0.85 | P=0.02 |
| | Female (n=176) | 2.11 | 1.04-4.28 | P=0.05 | 2.15 | 1.17-3.97 | P=0.019 |
| BMI ($kg/m^2$) | ≥30 (obese) | 0.95 | 0.46-1.94 | P=0.96 | 1.89 | 1.05-3.42 | P=0.045 |
| | 25-29 (over weight) | 1.8 | 0.95-3.47 | P=0.1 | 1.2 | 0.69-2.20 | P=0.57 |
| | 18.5-24.5 (Normal wt) | 0.8 | 0.4-1.6 | P=0.65 | 0.6 | 0.33-1.18 | P=0.2 |
| Residence | urban (n=150) | 0.96 | 0.51-0.81 | P=0.96 | 1.84 | 1.04-3.25 | P=0.047 |
| | Rural (n=150) | 1.03 | 0.55-1.96 | P=0.10 | 0.54 | 0.30-0.96 | P=0.05 |
| Education | None | 0.61 | 0.31-1.21 | P=0.21 | 0.67 | 0.38-1.22 | P=0.25 |
| | Primary | 1.4 | 0.7-2.7 | P=0.39 | 1.21 | 0.69-2.1 | P=0.58 |
| | ≥Secondary | 1.5 | 4.5-4.9 | P=0.67 | 1.8 | 0.66-4.98 | P=0.38 |
| Smoking | | 0.79 | 0.40-1.54 | P=0.60 | 0.6 | 0.33-1.10 | 0.041 |

Wt: weight, Sec- Secondary school.

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Increased elder's ages from 60 years was not associated with abnormal serum levels of cholesterols and TG. Elderly females were two times more likely to have elevated level of TC (OR=2.11; 95% CI: 1.04-4.28: P=0.05) and LDL-C (OR=2.15; 95% CI: 1.17-3.97: P=0.019) and three times to have lowered levels of serum HDL-C (OR=3; 95% CI: 1.97-5.30: P<0.001) as compared to elderly males. Moreover urban residents were about twice more likely to have elevated levels of LDL-C (OR=1.84; 95% CI: 1.04-3.25: P=0.047) as compared to rural ones. Furthermore, BMI of ≥30 kg/m$^2$ was a significant factor for the elevated level of LDL-C (OR=1.89; 95% CI: 1.05-3.42: P=0.045) and lowered levels of HDL-C (OR=2.18; 95% CI: 1.3-3.65: P=0.004) respectively. The study also revealed a weak association of smoking habit with lowered serum levels of HDL-C (OR=0.59; 95% CI: 0.37-0.96: P=0.041) (Table 2).

Pearson correlation coefficient between the patterns of lipids profiles versus ages were as follows: TC (r = -0.904, P= 0.02): strong negative correlation, LDL cholesterol (r=-0.902, *P*=0.024): strong negative correlation, TG (r = -0.9, *P*=0.042): strong negative correlation, and HDL (r =-0.706, P = 0.405): weak negative correlation (Table 3).

**Table 3: Multivariate logistic regression models for determinants of elevated triglycerides and lowered HDL-C serum levels**

| Factor | Value | High TG ≥200(mg/dl) | | | Low HDL-C (< 40 mg/dl: M, <50 mg/dl: F) | | |
|---|---|---|---|---|---|---|---|
| | | OR | 95%CI | P value | OR | 95%CI | P value |
| Age (years) | 60-69(n=172) | 1.49 | 0.71-3.12 | P=0.37 | 0.65 | 0.41-1.04 | P=0.09 |
| | 70-79(n=96) | 0.85 | 0.39-1.84 | P=0.82 | 1.2 | 0.77-2.07 | P=0.40 |
| | ≥80(n=32) | 0.6 | 0.14-2.69 | P=0.73 | 1.59 | 0.71-3.59 | P=0.35 |
| Sex | Male(n=124) | 0.73 | 0.35-1.54 | P=0.52 | 0.3 | 0.19-0.50 | P<0.001 |
| | Female(n=176) | 1.36 | 0.64-2.80 | P=0.53 | 3 | 1.97-5.30 | P<0.001 |
| BMI (kg/m$^2$) | ≥30(obese) | 1.45 | 0.69-3.07 | P=0.44 | 2.18 | 1.30-3.65 | P=0.004 |
| | 25-29(over weight) | 1.13 | 0.54-2.4 | P=0.89 | 0.8 | 0.50-1.30 | P=0.49 |
| | 18.5-24.5 (normal) | 0.67 | 0.30-1.50 | P=0.43 | 0.57 | 0.35-0.94 | P=0.037 |
| Residence | urban(n=150) | 1.2 | 0.60-2.46 | P=0.71 | 1.18 | 0.75-1.86 | P=0.56 |
| | Rural (n=150) | 0.82 | 0.40-1.67 | P=0.72 | 0.84 | 0.53-1.34 | P=0.6 |
| Education | None | 0.85 | 0.41-1.8 | P=0.82 | 1.5 | 0.96-2.44 | P=0.09 |
| | Primary | 0.9 | 0.45-1.86 | P=0.95 | 0.67 | 0.42-1.06 | P=0.11 |
| | ≥Secondary | 2.2 | 0.7-6.9 | P=0.34 | 0.95 | 0.37-2.42 | P=0.9 |
| Smoking | | 0.54 | 0.24-1.19 | P=0.17 | 0.59 | 0.37-0.96 | P=0.041 |

<40mg/dL M,<50 mg/dL F : HDL-C level less than 40 mg/dL in males and less than 50 mg/dL in females

## Discussion

Our study revealed a significant decline in levels of TC, LDL-C cholesterol, TG and a gradual decrease in HDL-C with increasing ages from 60 to 90 years old. It has been shown in other studies that serum levels of cholesterols and TG increases relatively sharply from childhood up to puberty and then steadily within the 60s, followed by a slight decline or plateau afterwards (Schaefer *et al.*, 1994). In other studies involving elderly people, results related to our study showed that, only TC, LDL-C and TG decreased with ages from 65 years in both males and females while HDL-C either remained stable or increased steadily with ages in males (Ferrara *et al.*, 1997). This decrease of lipids level observed in our study is probably due to the decline in the BMI. It has also been reported that with ageing ≥ 60

Doi: http://dx.doi.org/10.4314/thrb.v16i4.2

years, the body weight decreases and hence being probably associated with the lowered levels of TC, LDL-C and improved levels of HDL-C (Ferrare *et al.,* 1997).

In this study, cases of elevated level of LDL-C and lowered level of HDL-C were significantly associated with BMI of ≥30kg/m$^2$. Wing *et al*. (1992) revealed not only the association but also the fact that, levels of cholesterols and other CRF can be reversed to agreeable level by changing the BMI. Findings of our current study showed that cigarette smoking has a weak association with lowered HDL-C levels contrary to reports by Davis *et al*. (1996) who revealed that apart from the correlation between BMI ≥ 30kg/m$^2$ on lowered HDL-C and elevated LDL-C levels, other social behaviours such as cigarette smoking and alcoholism are associated with derangements of serum lipids level. It is therefore advised in this study to uphold the practice of health lifestyle in the elder's age in order to maintain their serum cholesterol at levels considered healthy for that particular age.

We have also shown that females were highly associated with elevated levels of TC, LDL-C and lowered levels of HDL-C probably due to their lifestyles and hormonal effects. Already lifestyle and hormonal levels have been described to have influences not only on the serum levels of cholesterols but also on the varying degree of derangements between female and male elderly individuals (Davis *et al*., 1996; Schaefer *et al*., 1994; Jacques, 2001; Atiku & Yusuf, 2011). The present study observed that there were pathological elevated LDL-C and lowered HDL-C levels in elderly people and this impose high risk to heart diseases including atherosclerosis, coronary heart disease and heart attack if left uncorrected (Birtcher & Ballantyne, 2004).

The findings of this study indicate that urban life was associated with elevated levels of serum LDL-C. This is in consistence with studies reported by Pongchaiyakul *et al*., (2006) and Gupta *et al*., (1997). The activities practiced in urban settings are more of sedentary type compared to those of rural life which are more of agrarian type. Adoption of sedentary lifestyle plus westernized diet which is being practiced at an increasingly rate in urban areas of Tanzania (Maletnlema *et al*., 2002; Kuga *et al*., 2002), may have a significant effect on the lipid profiles.

The limitations in our study included the lack of assessment of the dietary history and consumption of alcohol which have influences on serum lipids levels (Ruixing *et al.*, 2008). In addition, the study did not assess the levels of awareness and knowledge of the elderly people on CRF and healthy lifestyles which may have indirect effects on lipids profile and other CRF.

The present study has established the profile and level of derangements of serum lipids among the elderly people of Morogoro region in Tanzania. Moreover, our study showed elderly females to be more affected by the elevated levels of TC, LDL-C and lowered HDL-C as compared to their male counterparts. Furthermore, urban life has shown to be more associated with the abnormally high level of LDL-C as compared to rural life. It has also been shown that, BMI of ≥ 30kg/m$^2$ is a significant predictor for elevated LDL-C and lowered HDL-C serum levels respectively and therefore it is advised to uphold the practice of health lifestyle in the elder's age in order to maintain their healthy bodyweight and serum lipids level. Further studies should be done to explore more factors which are likely to be linked with the pathological serum levels of cholesterols in the elderly people and establish means for the control measures.

**Acknowledgements**

The authors are grateful to the technical staff of the Muhimbili National Hospital Laboratory (CPL) for their technical supports during the analysis of the samples. This study received financial assistance from Tanzania Commission for Science and Technology.

Doi: http://dx.doi.org/10.4314/thrb.v16i4.2

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