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*Full Length Research paper*

# Serum total cholesterol in hypertensive Northern Nigerians

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**Hypertension is associated with several lipid abnormalities including elevated total cholesterol (TC) concentrations. The presence of dyslipidaemia increases risks of cardiovascular morbidity and mortality. There is paucity of data on the pattern of serum TC in hypertensive patients in northern Nigeria. The objective of the present study was therefore to evaluate serum total cholesterol in hypertensive patients and normotensive subjects in Zaria, Northern Nigeria. Serum concentrations of total cholesterol (TC) were measured in 100 hypertensive patients and fifty 50 normotensive. Body mass index (BMI) and blood pressure (BP) were also measured in both hypertensive patients and normotensive subjects. The data obtained were analysed using Microsoft Office Excel 2003. Two-tailed student's t- test for matched samples and Pearson's linear correlation analysis statistical methods were employed for the analyses. A p-value of equal to or less than 0.05 (p 0.05) was considered as statistically significant. The results of serum TC in hypertensive patients and normotensive subjects were 5.12 ± 0.12 and 4.50 ± 0.11 mmol/L, respectively ($p < 0.05$). Furthermore, there were positive and significant correlations between serum TC and BP in both hypertensive patients and normotensive subjects. Similarly, there were positive and significant correlations between serum TC and BMI in hypertensive patients and normotensive subjects. These findings demonstrate that serum TC levels increase as the BP and BMI rise in both hypertensive patients and normotensive subjects. Hypertensive patients demonstrate higher serum TC concentrations than their normotensive counterparts, suggesting a high risk of developing cardiovascular and cerebrovascular complications, such as coronary heart disease (CHD) and stroke among hypertensives. We recommend routine evaluation and proper management of serum TC in hypertensive patients.**

**Key words:** Hypertensive patients, serum total cholesterol, cardiovascular disease.

## INTRODUCTION

Hypertension (HTN) is defined as a sustained elevation of blood pressures. In current guidelines, it is defined as sustained blood pressure values of ≥ 140/90 mmHg (World Health Organization, 1999; World Health Organisation, 1978). It is the commonest of the cardio-vascular diseases (CVDs) and the leading cause of morbidity and mortality in the industrial world as well as becoming an increasing common disease in developing countries (World Health Organization, 1999). HTN is one of the ten leading reported causes of death and about 4% deaths were due to hypertensive complications (Directorate of General Health Services, 1998). The prevalence of HTN is higher among blacks than whites and it increases with advancing age in all groups (Pelkonen et al., 1977; Saha et al., 2006).

Serum lipids such as total cholesterol (TC), very low density lipoprotein cholesterol (VLDL-C), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and triglyceride (TG) assay form one of the special investigations in most chemical pathology laboratories worldwide. The importance of the assay is fast increasing in many developing countries, including Nigeria. Serum lipids assay has found useful application in the assessment of patients with cardiovascular diseases, alcoholics and subjects of high social status and

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**Table 1.** Blood pressure, body mass index and serum total cholesterol (Mean±SEM) in hypertensive patients and normotensive subjects.

| Subjects | n | SBP (mmHg) | DBP(mmHg) | BMI(kg/m$^2$) | TC(mmol/L) |
|---|---|---|---|---|---|
| Hypertensive patients | 100 | 147±4 | 97±1 | 27± 1 | 5.12±0.12 |
| Control subjects | 50 | 114±3 | 80±1 | 22 ±8 | 4.50±0.11 |
| p- value | | < 0.05 | < 0.05 | < 0.05 | < 0.05 |

**SEM,** standard error of the mean; **n,** sample size; **SBP**, systolic blood pressure; **DBP,** diastolic blood pressure; **BMI,** body mass index; **TC,** total cholesterol.

malnourished children and monitoring of patients with diabetes mellitus (Low et al., 1996; Ferreira et al., 1996; Poirier et al., 1996; Kramer-Guth et al., 1996; Ogunkeye and Ighogboja, 1992). It was reported that serum TC concentrations are elevated in hypertensive patients (Pelkonen et al., 1977; Osman et al., 1987). Many believe that sharper prediction of risk is provided by measurement of serum TC and HDL-C levels. It has also been documented that presence of hyperlipidaemia substantially worsens the prognosis in hypertensive patients (Harvey and Beevers, 1990). However, there is paucity of data on the pattern of serum TC in hypertensive pa-tients in Nigeria, most particularly in Zaria. Other reported studies were carried out elsewhere in the world, mostly in white population. The finding in blacks, Nigerian population may be different, as it has been well documented that serum lipids are under multi-factorial control where both genetic and environmental factors influence the levels of these parameters (Tejada and Strong, 1968; McGill, 1968).

In view of its clinical importance, there is the need to evaluate the levels of serum TC in hypertensive Nigerians. This could help in the management of hypertensive patients in Nigerian hospitals. The overall objective of the present study was therefore to evaluation serum total cholesterol in hypertensive and normotensive subjects in Zaria, Northern Nigeria.

## SUBJECTS AND METHODS

A total of one hundred (100) newly diagnosed hypertensive patients prior to the commencement of anti-hypertensive therapy were studied. These consisted of fifty (50) each of male and female patients. Fifty (50) apparently healthy (normotensive) subjects, who had normal levels of blood pressure, were recruited as controls. These consisted of twenty five (25) each of male and female subjects.

All the hypertensive patients were recruited from the out patients clinic of ABUTH, Zaria. At the clinic, arrangements were made with the physicians whereby consecutive patients who satisfied the study inclusion criteria were selected. These include patients who were hypertensive but were not diabetic. Informed consent for inclusion into the study was obtained from the patients. All patients who declined to give consent for inclusion were excluded from the study. The nature of the study was explained to the patients in the appropriate languages best understood by them. A full medical history was obtained from these patients. This was followed by measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), weight and height and then collection of blood specimens. The normotensive subjects were selected from the population of staff and students of ABUTH, Zaria. Measurements of SBP, DBP, weight and height as well as collection of blood specimens were also carried out on the normotensive subjects. Body mass indices (BMIs) were also determined in both hypertensive patients and normotensive subjects using the weight in kg divided by the square of the height in metres (Weight (kg)/Height (m) $^2$).

Blood specimens (about 5 ml each) were taken into plain tubes by venepuncture, using syringe and needle after sterilising the site with methylated spirit. The blood specimens were centrifuged and the sera were carefully drawn into sample bottles and then analysed immediately or stored frozen at -20°C until the time for analysis, in a situation whereby the analysis is not possible because of logistic problem. The samples were analysed for TC by enzymatic colourimetric method (Trinder, 1969) using reagent kits supplied by HUMAN, Gesel Für Biochemica Und Diagnostica mbH (Wiesbaden, Germany).

### Statistical analysis

The data obtained were analysed using Microsoft Office Excel 2003. The results of BP, BMI and serum TC obtained from hypertensive patients were compared with those of normotensive subjects using the two-tailed student's t- test for matched samples. Similarly, comparison of the BP, BMI and serum TC results between male and female hypertensive patients, as well as normotensive subjects were carried out using the two-tailed student's t-test for matched samples. Correlations between BP and serum TC as well as between BMI and serum TC in hypertensive patients and normotensive subjects were carried out using Pearson's linear correlation analysis. A p-value of equal to or less than 0.05 (p 0.05) was considered as statistically significant.

## RESULTS

A total of 150 subjects were recruited for this study. These consisted of 100 hypertensive patients (50 each of males and females) and 50 normotensive subjects (25 each of males and females). The mean age of the studied hypertensive patients was 49 (range 23-72) years, while that of the normotensive subjects was 26 (range 21-52) years.

The results of BMI, SBP, DBP and serum TC in hypertensive patients and normotensive subjects are presented in Table 1. These results show that the levels of BMI, SBP, DBP and serum TC were significantly higher in hypertensive patients than in normotensive subjects (p < 0.001 for BMI and < 0.05 for SBP, DBP and serum TC). Tables 2 and 3 show the results of BMI, SBP, DBP and

**Table 2.** Blood pressure, body mass index and serum total cholesterol (Mean±SEM) in hypertensive patients according to gender.

| Gender | n | SBP (mmHg) | BP(mmHg) | BMI(kg/m$^2$) | TC (mmol/L) |
|---|---|---|---|---|---|
| Males | 50 | 143±4 | 98±1 | 27 ±6 | 4.99±0.14 |
| Females | 50 | 157±4 | 96±2 | 27 ±4 | 5.13±0.19 |
| p- value | | > 0.05 | > 0.05 | > 0.05 | > 0.05 |

**SEM,** standard error of the mean; **n,** sample size; **SBP,** systolic blood pressure; **DBP,** diastolic blood pressure; **BMI,** body mass index; **TC,** total cholesterol.

**Table 3.** Blood pressure, body mass index and serum total cholesterol (Mean±SEM) in normotensive subjects according to gender.

| Gender | n | SBP (mmHg) | DBP (mmHg) | BMI(kg/m$^2$) | TC (mmol/L) |
|---|---|---|---|---|---|
| Males | 25 | 117±2 | 85±2 | 21± 6 | 4.54±0.11 |
| Females | 25 | 111±2 | 75±2 | 23± 9 | 4.46±0.19 |
| p- value | | < 0.03 | < 0.001 | > 0.05 | > 0.05 |

**SEM,** standard error of the mean; **n,** sample size; **SBP;** systolic blood pressure; **DBP,** diastolic blood pressure; **BMI,** body mass index; **TC,** total cholesterol.

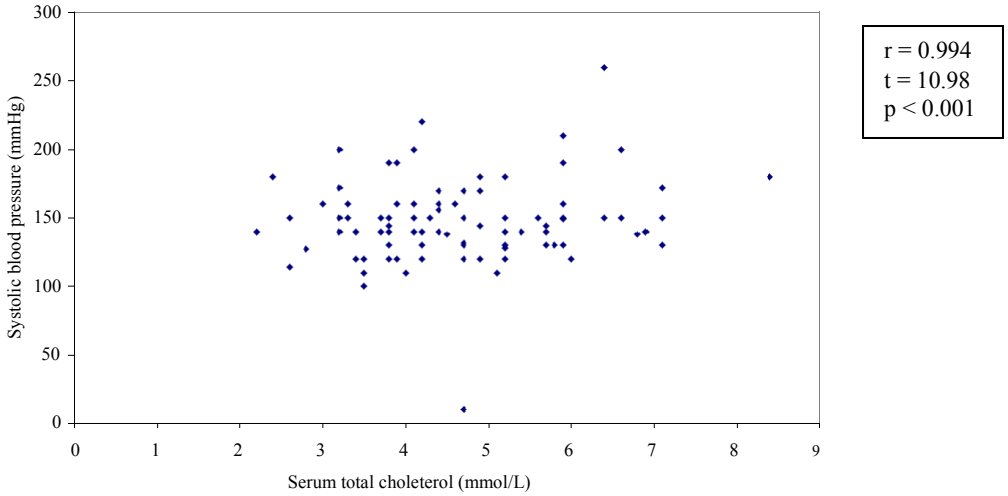


**Figure 1.** Relationship between systolic blood pressure and serum total cholesterol in hypertensive patients.

serum TC according to gender in hypertensive patients and normotensive subjects, respectively. The results in these tables indicate that there were no gender variation in BMI and serum TC in both hypertensive pa-tients and normotensive subjects (p>0.05). There were no statistically significant differences in the SBP and DBP values between male and female hypertensive patients (p>0.05), while these values were significantly higher ((p< 0.03 and p< 0.05 respectively) in female than in male normotensive subjects.

Figures 1 and 2 illustrate the relationship between SBP and serum TC and between DBP and serum TC, respectively. These indicate that there were positive and significant correlations between SBP and serum TC (r = 0.994, p < 0.001) and DBP and serum TC (r = 0.633, p < 0.001) in hypertensive patients. Similarly, there were positive and significant correlations between SBP and serum TC (r = 0.781, p < 0.001) and DBP and serum TC (r = 0.993, p < 0.001) in normotensive subjects as illustrated in Figures 3 and 4 respectively. Figures 5 and 6 illustrate the relationship between BMI and serum TC in hypertensive patients and normotensive subjects, respectively. These Figures demonstrate that there were positive and significant correlations between BMI and serum TC in both hypertensive patients (r = 0.434, p < 0.001) and normotensive subjects (r = 0.509, p < 0.001).

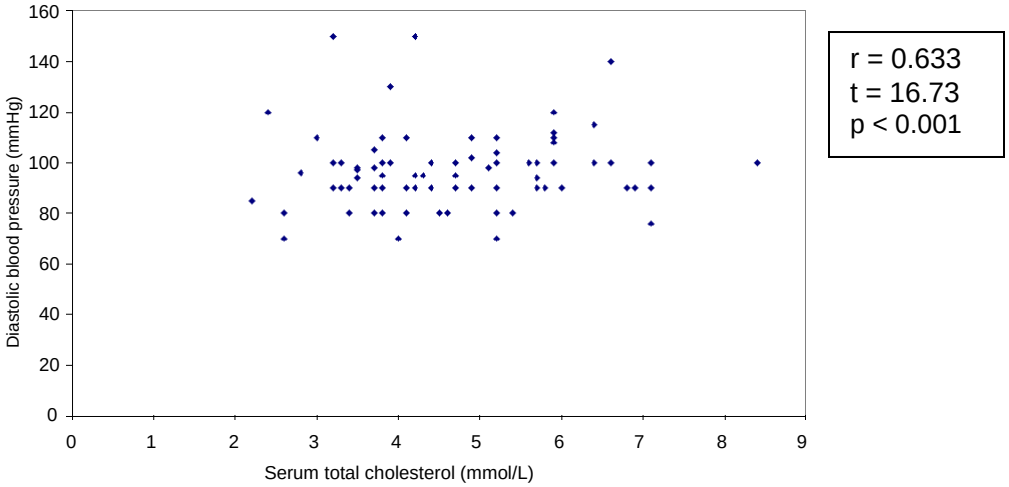


**Figure 2.** Relationship between diastolic blood pressure and serum total cholesterol in hypertensive patients.

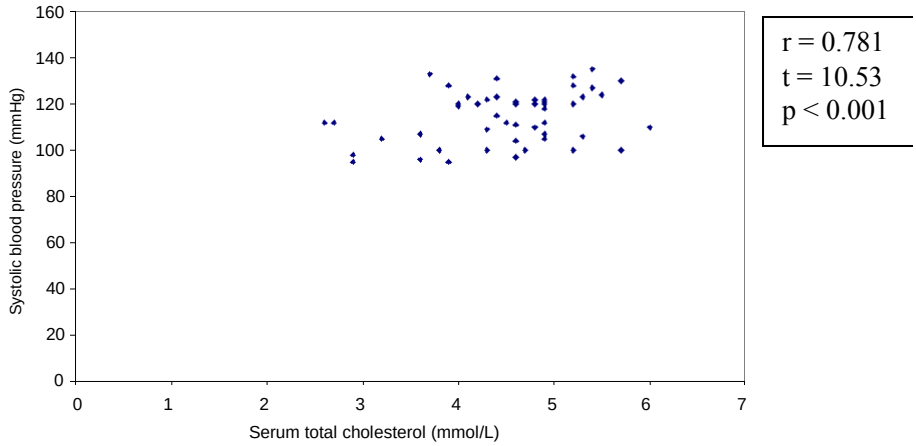


**Figure 3.** Relationship between systolic blood pressure and serum total cholesterol in normotensive subjects.

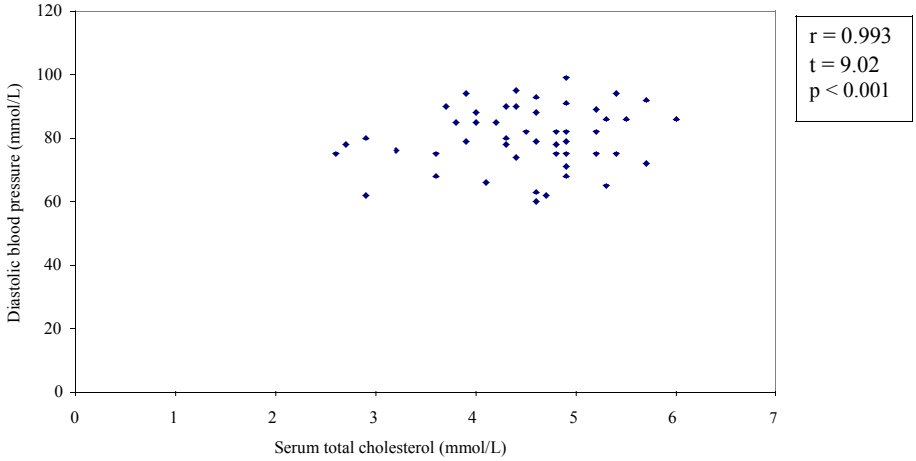


**Figure 4.** Relationship between diastolic blood pressure and serum total cholesterol in normotensive subjects.

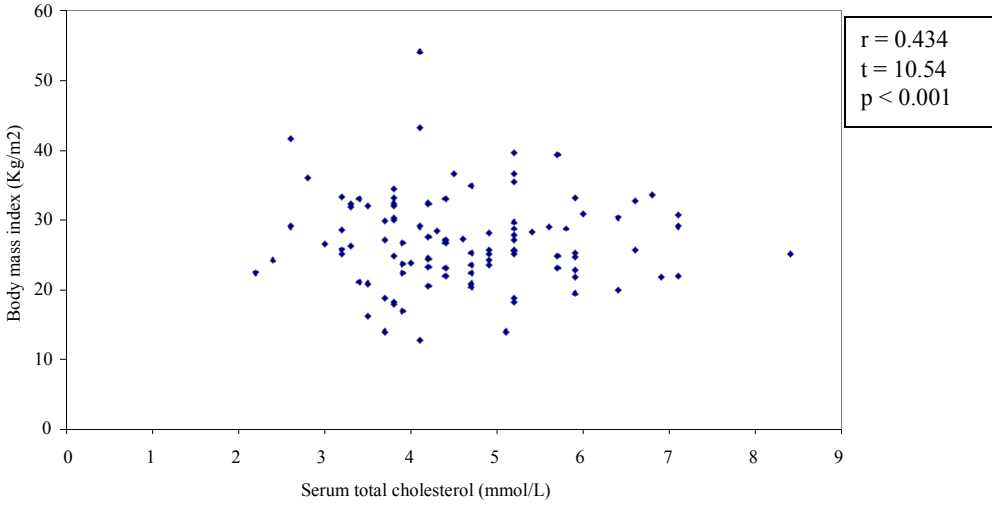


**Figure 5.** Relationship between body mass index and serum total cholesterol in hypertensive subjects.

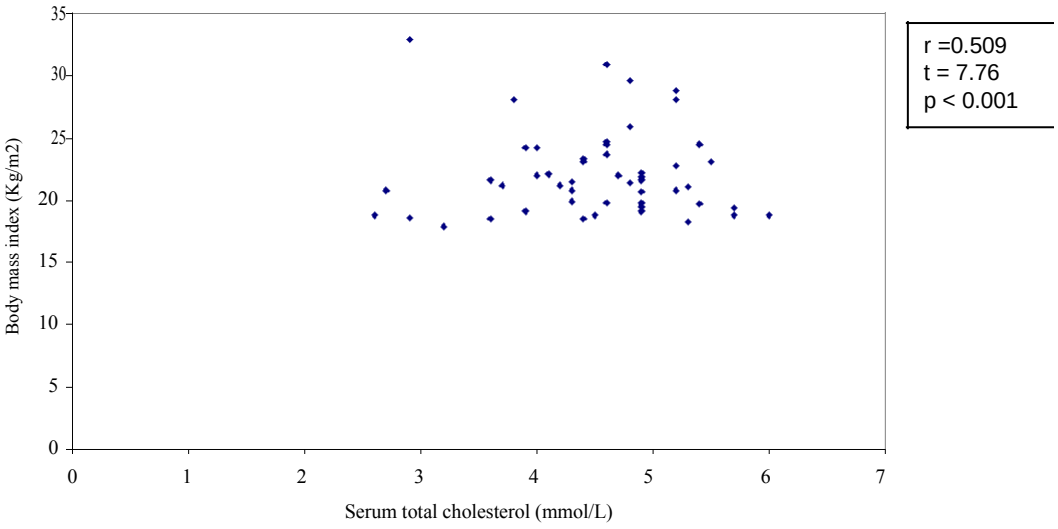


**Figure 6.** Relationship between body mass index and serum total cholesterol in normotensive subjects.

## DISCUSSION

In this study, serum TC concentrations are significantly higher in hypertensive patients than in normotensive subjects. This is consistent with earlier observations elsewhere and in other parts of Nigeria (Pelkonen et al., 1977; Harvey and Beevers, 1990; Oghagbon and Okesina, 2006; Ukoh and Oforofuo, 2007; Akpa et al., 2006). High levels of serum cholesterol are known to increase the risk of developing macrovascular complications such as coronary heart disease (CHD) and stroke. Many epidemiological studies indicate a progressive increase in CHD risk as the serum TC exceeds 5.0 mmol/L (McGill, 1968). It was therefore suggested by Lewis (Lewis, 1986) that levels of serum TC in the range 5.0 - 6.5 mmol/L be considered undesirable.

Also noteworthy is the positive and significant correlation between serum TC and both systolic and diastolic BP in both hypertensive patients and normotensive controls; suggesting that as blood pressure increases so also does TC. Similarly, there were statistically significant correlations between serum TC and BMI among both hypertensive and normotensive groups. This observation is expected, and may be due to common risk factors for hypertension, obesity and dyslipidaemia.

Obesity is known to play a central role in the causation and sustenance of insulin resistance (Pelkonen et al., 1977; Modan, 1985) . Insulin resistance is considered the underlying factor in the pathogenesis of hypertension, dyslipidaemia and the metabolic syndrome in some popu-

lations (Modan, 1985). In African patients however, there are doubts as to the role of insulin resistance in the aetiology and sustenance of hypertension (Saad et al., 1991; Bakari, 2004) suggesting that other mechanisms or chance may be responsible for the observed relationship between these variables.

The occurrence of high serum TC levels in hypertensive patients, as found in the present study may be due to variety of causes such as genetic factors, increased consumption of dietary animal fats, lack of physical exercise, stress. Advancing age is known to be associated with increase in cholesterol levels, since the control subjects were younger than the hypertensive patients in this study, this could partly explain the differences observed between hypertensive and the normotensive population. However given the trend of TC and blood pressure even among the normotensive controls, provides strong arguments to suggest increasing risk of dyslipidaemia in hypertension.

Other possible reason for the high serum TC found in hypertensive patients are effects of the drugs used in the treatment of HTN, as both beta blockers and thiazide diuretics may adversely affect serum lipid profiles (Grimm et al., 1981; Day et al., 1982). However, calcium channel blockers and angiotensin converting enzyme inhibitors have no deleterious effects on plasma lipids, and the newer alpha receptor blockers, terazocin and doxazocin may even modestly reduce lipid levels (Deger 1986). The cholesterol levels in the hypertensive patients in this study were taken prior to anti-hypertensive therapy and hence the observed difference between hypertensive and the normotensive groups cannot be attributed to the effects of therapy.

## Conclusion

It is concluded from the findings of the present study that hypertensive patients have higher serum TC concentrations than their normotensive counterparts, suggesting a higher risk of developing cardiovascular and cerebrovascular complications among hypertensives. Routine evaluation of serum TC in hypertensive patients in this environment is recommended.

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