LIPID DISORDERS IN HOSPITAL ATTENDANTS IN KUMASI, GHANA

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SUMMARY

Background: Lipid disorders are common worldwide and contribute to a significant proportion of the burden of atherosclerotic cardiovascular diseases.

Objectives: To determine the prevalence of lipid disorders among patients reporting at Komfo Anokye Teaching Hospital (KATH), Kumasi, Ghana.

Design: Cross-sectional study.

Setting: Directorate of Medicine and Polyclinic outpatient clinics of KATH.

Participants: A total of 424 patients, 20 years and over reporting for the first time to KATH were recruited. 77 had neither diabetes mellitus (DM) nor systemic hypertension (HPT) (controls), 94 had only DM, 109 had only HPT and 144 had both.

Methods: A questionnaire was administered after informed consent. Anthropometric measurements were then taken and blood investigations including total cholesterol (TC), high-density lipoprotein cholesterol (HDL) and triglycerides (TG) were done. Low-density lipoprotein cholesterol (LDL) was calculated using the Friedwald formula. The atherogenic index or ratio was the ratio of TC to HDL.

Results: The prevalence of lipid abnormalities was 60% for high TC, 32% for high TG, 17% for low HDL and 61% for high LDL. The mean (± standard deviation) TC was 5.33 (± 1.31) mmol/L, mean TG was1.52 (± 0.81) mmol/L, mean HDL was 1.65 (± 0.57) mmol/L and mean LDL was 3.42 (± 1.22) mmol/L. The mean atherogenic index was 3.40 and 9% of the participants had an atherogenic index more than or equal to 5.

Conclusion: The prevalence of lipid disorders was high in adult patients in Kumasi and there is the need to increase awareness, screening, detection, treatment and control of these disorders.

Key Words: Lipids, Lipid Disorders, Systemic Hypertension, Diabetes Mellitus.

INTRODUCTION

All over the world abnormalities of lipid metabolism are common. High serum cholesterol accounts for a third of all cardiovascular diseases (CVD) in the world and about 105 million people are estimated to have cholesterol levels that constitute a cardiovascular risk in the USA alone[1]. Since the Framingham study, which clearly showed lipid disorders as a major cardiovascular risk factor[2], the prevalence of abnormalities of lipids has shown a steady rise in all countries of the world over the years.[1] In the more developed countries however with lifestyle modifications and the introduction of lipid lowering drugs in the recent times, there has been a gradual but steady decline in the levels of serum cholesterol and this has resulted in the reduction of the incidence rate of acute coronary syndrome.[3-5]

Disorders of blood lipid levels promote atherosclerosis which is recognized as a major risk factor for CVD such as stroke, coronary artery disease and peripheral vascular disease.[1] These lipid abnormalities are more common in people with diabetes mellitus (DM) and systemic hypertension (HPT) and the process of atherosclerosis is more aggressive and rapid putting these individuals at a greater risk for CVD.[6] The three conditions, dyslipidaemia, DM and HPT tend to cluster in certain individuals, especially in obese subjects.[7] Several lipid studies have been carried out in different countries over the years. Dawber et al published one of the earliest from the Framingham Study, demonstrating clearly that in persons with elevated serum cholesterol there is an increased risk for atherosclerotic heart disease.[2] The serum lipid levels in healthy Nigerians was found to be generally lower than in Caucasians by Adedeji[8] and similar findings were obtained in early studies in Accra, Ghana.[9-16]

In Kumasi, Ghana two main lipid studies have been carried out. One was a hospital-based study at Komfo Anokye Teaching Hospital (KATH), Kumasi which was carried out in 1999-2000 and published in 2003. The second was a community based study undertaken in 2001-2002 in communities surrounding Kumasi.[17,18] The mean serum total cholesterol (TC) and the prevalence of hyperlipidaemia from these studies were remarkably different. Further it is over five years since these studies were undertaken and it is possible that the pattern of lipid disorders may have changed.

Further lipid studies, the authors believe will be of relevance to both the clinician in the hospital as well as the policy makers. Such studies will increase awareness and promote screening for lipid abnormalities in patients at the hospital and will also increase advocacy among policy makers for more facilities for prevention, early detection and treatment of lipid abnormalities. The authors therefore find it very important for further lipid studies to determine the prevalence of lipid disorders and determine the current levels of lipids in Kumasi. Our main objective for this study was to determine the prevalence of lipid disorders among patients reporting at KATH, Kumasi, Ghana.

MATERIALS AND METHODS

The study was a cross-sectional study conducted at KATH, a referral and tertiary teaching hospital with 1000 beds located in Kumasi, the second most populated city in Ghana. The study participants were recruited from the Polyclinic Directorate and the Directorate of Medicine from April 2008 to January 2009.The inclusion criteria were as follows: All new patients reporting at the outpatient clinic during the study period; patients who were 20 years and over; patients who consented to the study by completing the informed consent form and patients who were treated on outpatient basis.

The exclusion criteria were as follows: Patients who refused to consent; patients who were known or found to have liver cirrhosis during the interview and/or examination; patients who were unable to stand for their height and weight to be measured; and patients who were detained or admitted to the ward.

A questionnaire was administered and a physical examination carried out on each participant by one of the authors. Blood pressure (BP) and pulse rate were measured with an automatic BP machine (OMRON M7 sphygmomanometer; Omron Matsusaka Co. Ltd, Matsusaka City, Mie-Ken, Japan) using the appropriate size of cuff, after participants had been sitting undisturbed for at least five minutes. Three readings were taken one minute apart. The first reading was used to familiarize the patient to the procedure and was discarded and the mean of the last two readings was used in the data analysis. Height was measured to the nearest 0.5 cm and weight was measured to the nearest 0.1 kg after participants had removed their footwear using a standardized combined manual scale and stadiometer (Asimed MB 201T Plus from Aparatos Y Sistemas De Medida, S. A.).

Hip and waist circumferences were measured to the nearest 0.5 cm using a plastic tape measurement. The participants were then given the appropriate medical treatment and were requested to come back the following morning after an overnight fast for serum biochemical investigations which included fasting blood glucose (FBG), fasting lipid profile, liver function test, urea, creatinine and electrolytes as well as urine examination.

Ten ml of venous blood was drawn from the antecubital vein of each participant and this was separated into fluoride and EDTA tubes. The blood was allowed to stand for at least 30 minutes after which serum was separated by centrifugation at 3000 rpm for 10 minutes. The separated serum and the sample from the fluoride tubes were analysed using a BT3000 auto analyser, manufactured by Biotechnica Instruments S.p.A. Rome, Italy. Total cholesterol (TC), high density lipoprotein cholesterol (HDL), triglycerides (TG), urea, creatinine, albumin, total protein, bilirubin, aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP) and gamma-glutamyl transferase (GGT) were all determined by colorimetric methods. The level of low-density lipoprotein cholesterol (LDL) was calculated using the Friedwald formula.[19]

The following definitions were adopted for this study:

1. Systemic hypertension is systolic blood pressure (SBP) ≥ 140 and / or diastolic blood pressure (DBP) ≥ 90.[20]
2. Overall Obesity is Body Mass Index (BMI) ≥ 30 kg/m.[2,21]
3. Central Obesity or High Waist Hip Ratio (WHR) is WHR > 0.9 for males and > 0.8 for females.[22]
4. Diabetes mellitus.[22] Fasting venous blood glucose ≥ 6.1 mmol/L and or 2h post prandial capillary whole blood ≥ 11.1 mmol/L[7] or being on drug or diet therapy for DM.
5. Lipid disorders were defined as follows; high serum TC, TC >5.0mmol/l;high serum TG, TG >1.7mmol/l; high serum LDL was LDL >3.0mmol/l and low serum HDL,HDL <1.0mmol/l in males and HDL <1.2mmol/l in females.[7]
6. Atherogenic index was defined as the ratio of TC to HDL and high atherogenic index was defined as a ratio greater or equal to 5.[23]
7. Controls were participants who were not classified as having HPT or DM or both by the above definitions.

All participants gave formal consent by signing or thumb printing an informed consent form after the study has been thoroughly explained to them.

The study was approved by the Committee of Human Research, Publication and Ethics of KATH and School of Medical Sciences, Kwame Nkrumah University of Science and Technology.

The formula from "A Practical Manual" was used to calculate the study population sample size.[24] With an estimated prevalence of lipid disorders of 50%, a confidence level of 95% and a margin of allowable error of 5% the estimated sample size was 384.

DATA ANALYSIS/CALCULATIONS

Information from all the subjects was recorded on a questionnaire and data entry form. These were subsequently entered on a computer using Epidata 3.1 software by double entry. The percentage or proportions were calculated for discrete variables while the mean with its standard deviation were computed for continuous variables. The Student t-test was used to compare continuous variables and the Pearson Chi-square test for discrete variables. The data was categorized into two main categories, a clinical group and an age group. The clinical group was made of controls, DM only, HPT only and both DM and HPT, while the age group was made up of <40, 40-<50, 50-<60 and ≥60 years. Where a continuous variable has been divided into levels one-way analysis of variance was used to compare the respective continuous variables. Also in these same situations a formal test for trend of increasing categorical variables was done using nptrend test from Stata. Univariate and multivariate regression analysis was also carried out with TC, TG, HDL and LDL as the independent outcome variables. The following variables, sex, age, height weight, BMI, SBP, DBP and FBG were used as the dependent variables. p-values of less than 0.05 were taken as statistically significant.

RESULTS

In all 424 subjects participated in this study, 163 (38%) males and 261 (62%) females giving a male:female ratio of 1:1.6. Majority of the participants were of the Ashanti ethnic group, 306 (72%), 20 (5%) were Fantis while the remaining 98 (23%) were made of other Ghanaian ethnic groups.

Eighty-six (20%) of participants never had formal education, 78 (18%) had completed primary school, 130 (31%) middle school, 61 (15%) secondary school, 47 (11%) technical training and 22 (5%) tertiary or university education. Sixty-six (16%) of the participants were government employees, 41 (10%) were non-government employees, 34(8%) were farmers, 141 (33%) were traders, 65 (16%) were retired, 17 (4%) were unemployed while the remaining 60 (14%) were made up of students, housewives and self-employed people. Most of the participants were married, 279 (66%), 55 (13%) were separated or divorced, 53 (13%) were widowed, 34 (8%) were single and 3 (less than 1%) were cohabiting.

The mean (standard deviation) age for the participants was 50 (14) years with no significant age difference between the males and females (Table 1). Weight was similar in the sexes but the men were taller so their BMI was significantly lower than the women. Both SBP and DBP were similar in men and women. The prevalence of high BMI (32% vrs 6%, p<0.001) and high WHR (88% vrs 50%, p<0.001) was higher in the women than the men. Seventy-seven (18%) of the participants had neither HPT nor DM (control group), 94 (22%) had only DM, 109 (26%) had only HPT and 144 (34%) had both DM and HPT.

Table 1 Characteristics of participants by sex

Variable	**Male**	**Female**	**Total**	**p-value**
N (%)	163 (38.4)	261 (61.6)	424	
Age (years) Mean (SD)	48.6 (14.3)	50.6 (13.2)	49.8 (13.7)	0.15
Age range (years)	21 - 88	20 - 83	20 - 88	
Weight(kg) Mean (SD)	68.9 (12.0)	68.3 (14.5)	68.5 (13.6)	0.65
Height (m) Mean (SD)	1.68 (0.06)	1.58 (0.06)	1.62 (0.07)	<0.0001
BMI (kg/m^2) Mean (SD)	24.3 (3.7)	27.3 (5.5)	26.1 (5.1)	<0.0001
SBP (mmHg) Mean (SD)	134 (22)	132 (22)	133 (22)	0.26
DBP (mmHg) Mean (SD)		84 (12)	84 (12)	0.95

There was no significant sex, weight and height difference between the four clinical groups. Mean BMI as well as percentage of high BMI (BMI ≥ 30) were also not different in the four clinical groups. However there were significant difference in age (p<0.0001), SBP (p<0.0001), DBP (p<0.0001) and prevalence of high WHR (p<0.001). These latter parameters increased as one moved from the control group through the DM only and HPT only groups to the DM - HPT group. There was also a statistically significant difference for increasing trend from the control group to the DM - HPT group (p <0.01) for these parameters.

In this study 253 (59.7%) were classified as having HPT from the definition of HPT adopted for the study. However, 198 participants were detected or known HPT patients while the remaining 55 were undetected, giving a detection rate (proportion of participants who knew they had the disease compared to the total number of participants who had the disease after the survey) of 78.3%. On the other hand 198 of the study participants who were known DM patients on diet or

some pharmacological treatment for DM and a further 40 were classified as DM giving a total of 238 (56.0%) and a detection rate of 83.2%. Only 16 (3.9%) of the participants were aware that they had dyslipidaemia or hyperlipidaemia. Of this number, 6 had only high TC, 8 had only high TG, 2 had only high LDL and 2 had both high LDL and high TG. None of the 16 had low HDL. In all 259 (61.1) participants had high LDL and 253 (59.7) had high TC. Though these figures cannot be compared directly with the 16 who knew they had lipid disorders it gives an idea of how low the detection rate for lipid disorders in this population of patients would be.

Table 2 Mean fasting blood glucose and serum lipids by sex

Variable	Male	Female	Total	p-value t-test
Number (%)	163 (38.4)	261 (61.6)	424	
FBG (mmol/L) Mean (SD)	7.86 (4.41)	8.22 (4.50)	8.08 (4.46)	0.42
TC (mmol/L) Mean (SD)	5.08 (1.40)	5.49 (1.23)	5.33 (1.31)	<0.01
TG (mmol/L) Mean (SD)	1.43 (0.77)	1.57 (0.83)	1.52 (0.81)	0.08
HDL (mmol/L) Mean (SD)	1.63 (0.59)	1.67 (0.56)	1.65 (0.57)	0.57
LDL (mmol/L) Mean (SD)	3.24 (1.32)	3.55 (1.12)	3.42 (1.22)	0.04

The mean FBG was 8.08 (± 4.46) mmol/L and there were no significant sex difference. The mean serum TC was 5.33 (± 1.31) mmol/L, mean TG was1.52 (± 0.81) mmol/L, mean HDL was 1.65 (± 0.57) mmol/L and mean LDL was 3.42 (± 1.22) mmol/L (Table 2) Mean TG and HDL were similar in males and females but both the mean TC and LDL were significantly higher in the females.

There was no significant difference in the mean FBG in the various age groups. Mean HDL was higher in the ≥60 age group than the other age groups (<40, 40-<50 and 50- <60 years) though this was not statistically significant. There were significant differences in the various age groups in mean TC ($p<0.001$), mean TG ($p<0.0001$) and mean LDL ($p<0.01$). Mean TC, TG and LDL increased from the younger age groups to the older groups and the statistical test for increasing trend was positive ($p<0.01$). The mean FBG was significantly higher in normotensive DM patients and DM- HPT patients than in the control and HPT groups ($p<0.0001$). There were significant clinical group differences for mean TC ($p<0.0001$), TG ($p<0.0001$) and LDL ($p=0.02$) but HDL was similar in the various clinical groups. There was a statistically significant test for increasing trend for mean TC, TG and LDL as one moved from the control group to the DM - HPT group ($p <0.01$).

When the participants were stratified by sex and clinical group there were significant sex difference in the control group in the mean TC ($p<0.05$), LDL ($p<0.05$) and HDL ($p<0.01$). There was no difference between the two sexes in the DM group. The mean LDL level was significantly raised in the females in the HPT ($p<0.01$) group while the females in the DM - HPT group had a significantly elevated mean TG compared to the males ($p<0.05$).

Table 3 Prevalence of lipid disorders by sex

Veriable	Male	Female	Total	p-value
	n (%)	n (%)	n (%)	χ^2 test
N (%)	163 (38.4)	261 (61.6)	424	
TC > 5.0 (mmol/L)	83 (50.9)	170 (65.1)	253 (59.7)	<0.01
TG > 1.7 (mmol/L)	43 (26.4)	93 (35.6)	136 (32.1)	0.05
HDL < 1.0 (M) HDL < 1.2 (F) (mmol/L)	15 (9.2)	55 (21.1)	70 (16.5)	<0.01
LDL > 3.0 (mmol/L)	89 (54.6)	170 (65.1)	259(61.1)	0.03

The mean atherogenic index was 3.40 (± 1.16). The males had an atherogenic index of 3.32 (± 1.14) and this was not significantly different from that of the females 3.46 (± 1.18) ($p=0.34$). The atherogenic index of the control group was 3.16 (± 1.34), the DM patients 3.31 (± 1.04), the HPT patients 3.32 (± 1.13) and the patients with both DM and HPT 3.61 (± 1.16). There were no significant differences between these atherogenic indices ($p=0.13$). There were no significant differences in the atherogenic indices of the various age groups ($p=0.11$).

The majority of the participants (91%) had an atherogenic index below 5 with only 9% having a high atherogenic index. There were no significant sex difference in the prevalence of high atherogenic index ($p=0.56$), no significant clinical group difference ($p=0.90$) and neither age group difference ($p=0.98$).

The prevalence of lipid disorders was 60% for high TC, 32% for high TG, 17% for low HDL and 61% for high LDL (Table 3).

The prevalence was significantly higher in the females for high TC, high TG and low HDL but the prevalence of high LDL was not statistically significant.

In Table 4 the prevalence of high TC, high TG and high LDL increased from the less than 40 age group to the ≥60 age group. The prevalence of low HDL showed no particular pattern and the differences were not significant.

Table 4 Prevalence of lipid disorders by age

Age range	**<40** N (%)	**40-<50** N (%)	**50-<60** N (%)	**≥60** N (%)	**p-value** χ^2 test
N (%)	104 (24.5)	111 (26.2)	107 (25.2)	102 (24.1)	
TC > 5.0 (mmol/L)	42 (40.4)	61 (55.0)	80 (74.8)	70 (68.6)	<0.0001
TG > 1.7 (mmol/L)	18 (17.3)	35 (31.5)	41 (38.3)	42 (41.2)	<0.01
HDL < 1.0 (M) HDL < 1.2 (F) (mmol/L)	22 (21.2)	18 (16.2)	19 (17.8)	11 (10.8)	0.24
LDL > 3.0 (mmol/L)	48 (46.2)	66 (59.5)	75 (70.1)	70 (68.6)	<0.01

Table 5 shows the prevalence of lipid disorders by the different clinical groups. There were no significant differences in the clinical group prevalence of low HDL. However the prevalence of high TC, high TG and high LDL increased from the control group to the DM - HPT group. There was a statistically significant test for increasing trend for high TC, high TG and high LDL as one moved from the control group to the DM - HPT group (p <0.01).

Table 5 Prevalence of lipid disorders by clinical group

Variable	**Control n (%)**	**DM n(%)**	**HPT n(%)**	**DM-HPT n (%)**	**p-value χ^2 test**
N (%)	77 (18.2)	94 (22.2)	109 (25.7)	144 (34.0)	
TC > 5.0 (mmol/L)	28 (36.4)	48 (51.1)	77 (70.6)	100 (69.4)	<0.00001
TG > 1.7 (mmol/L)	10 (13.0)	32 (34.0)	40 (36.7)	54 (37.5)	<0.01
HDL < 1.0 (M) HDL < 1.2 (F) (mmol/L)	16 (20.8)	12 (12.7)	19 (17.4)	23 (16.0)	0.56
LDL > 3.0 (mmol/L)	33 (42.9)	56 (59.6)	69 (63.3)	101 (70.1)	<0.01

In multivariate regression analysis TC remained associated with SBP (r=0.01, p<0.01) but not DBP and FBG after controlling for sex, age and weight. TG was still associated with FBG (r=0.02, p<0.01) and SBP (r=0.01, p<0.01) but not DBP upon controlling for sex, age and weight. Also HDL was still associated with FBG (r=-0.01, p=0.05) but not with SBP and DBP after controlling for age and sex. There was no association between SBP, DBP, FBG and LDL after adjusting for various variables.

Table 6 shows the results of the univariate regression analysis. TC was associated with the following; sex, age, weight, height, BMI, SBP and DBP. There was no association with FBG. age, height, BMI, FBG, SBP and DBP were associated with TG. LDL was associated in univariate analysis with sex, age, weight, height, and BMI. There were no association between LDL and SBP, DBP and FBG. HDL was associated with FBG but not with SBP and DBP.

Table 6 Correlation (r) of various variables with TC, TG, HDL and LDL as the outcome variable (p=p-value)

	TC		**TG**		**HDL**		**LDL**	
	r	**p**	**r**	**p**	**r**	**p**	**r**	**p**
Sex (years)	0.41	<0.01	0.14	0.08	0.04	0.57	0.31	0.04
Age (years)	0.02	<0.001	0.01	<0.001	0.003	0.30	0.02	<0.01
Weight (kg)	0.02	<0.001	0.004	0.13	0.001	0.79	0.02	<0.01
Height (m)	-2.80	<0.01	-1.39	<0.01	-0.20	0.67	-2.50	0.01
BMI (kg/m^2)	0.07	<0.001	0.02	<0.01	0.004	0.59	0.07	<0.001
SBP (mmHg)	0.01	<0.001	0.01	<0.001	0.001	0.48	0.01	0.07
DBP (mmHg)	0.02	<0.001	0.01	<0.01	0.004	0.22	0.01	0.10
FBG (mmol/L)	0.01	0.58	0.02	0.01	-0.01	0.05	0.004	0.80

DISCUSSION

This study has indeed shown that lipid disorders are common in Kumasi, Ghana. These patients had high levels of all the serum lipids and the prevalence of high TC and LDL was particularly high. Generally these disorders were identified in all the different groupings of patients but they were more common in women, in older patients and in patients with both DM and HPT. The mean atherogenic index and the prevalence of high atherogenic index were both low. The prevalence of lipid disorders was 60% for high TC, 32% for high TG, 17% for low HDL and 61% for high LDL.

These prevalence rates were very high by all standards especially for high LDL and high TC. Similar results have been obtained in the previous study at KATH with high TC of 45%, high TG of 26%, low HDL of 31% and high LDL was also 72%[17]. Such high prevalence of these lipid disorders definitely increases the risk of these patients for atherosclerotic CVD such as stroke, coronary artery disease and peripheral vascular disease especially in the group with DM, HPT and DM - HPT. The prevalence was particularly high in women, in older age groups and in the DM - HPT groups. The lowest values of prevalence were recorded in all the instances in the control group indicating the increased burden of risk in participants with DM and HPT. The good news was that low HDL prevalence was low, 17% in this study and about half compared to 31% reported in the previous study (Pearson Chi-square test $p<0.0001$).[17] This low prevalence was in both females and males as well as in all the clinical groupings that were analysed. This implies that most of the participants have levels of HDL which confers some protection against CVDs.

The community study from Kumasi had reported 8.7% of participants as having TC above 5.20 mmol/L and 8.2% with serum TG greater than 1.70 mmol/L.[18] These results were remarkably low compared to the findings in our study. This is not surprising since this was not a hospital-based study. Idogun et al reported a prevalence of lipid abnormalities of between 25-69% among DM patients with and without complications from Benin, Nigeria[25]. Akpa et al found a prevalence of high TC of 31.52% in a community survey in Port Harcourt, Nigeria[26]. This prevalence was also low, as one would expect from a community-based study. Among 141 healthy male blood donors at Korle-Bu Teaching Hospital, Asibey-Berko and Avorkliyah found 18% of this study population had a TC above 5.2 mmol/L.[12] This prevalence was much lower than our findings but then the Accra participants were healthy blood donors who were likely to be much younger and healthier than the participants in our study. In the Women's Health Study of Accra, it was shown that 25% of women in Accra had an elevated TC.[15,16]

The mean TC, mean TG, mean HDL and mean LDL were 5.33 (± 1.31) mmol/L, 1.52 (± 0.81) mmol/L, 1.65 (± 0.57) mmol/L and 3.42 (± 1.22) mmol/L respectively. Mean HDL was not significantly different in men and women and there were not significant clinical group difference. However upon stratification by sex and clinical group the females in the control group had significantly higher HDL levels compared to the males in the control group. Mean LDL and TC were significantly elevated in the women and they also increased as you moved from the control group to the DM - HPT group. Mean TG showed a similar trend for the clinical groups but there were no sex differences.

Mean TC, TG and LDL increased with increasing age groups and demonstrating a clear trend. Mean HDL was similar in the various age groups and was rather high in the ≥60 age group though this was not statistically significant. Oyelolola et al reported similar findings to this study.[27] They found HPT and DM HPT subjects to have higher mean TC, LDL and TG than controls. However mean HDL was significantly lower in the normotensive subjects with DM. Nyarko et al in an earlier study in 1997 found the levels of cholesterol to be similar in subjects with DM, HPT and age-matched healthy controls.[11] In a latter study in 2003 however TC and LDL levels were similar to the earlier study but the levels in apparently healthy controls were much lower than previously[28]. Hence there was statistically significantly elevation of the TC and LDL in the persons with DM and HPT compared to the healthy control group.[28]

The results of Eghan and Acheampong are similar to the findings of this study.[17] They reported mean TC, mean TG, mean HDL and mean LDL of 5.13 (±1.39) mmol/L, 1.48 (±0.81) mmol/L, 1.30 (±0.63) mmol/L and 3.29 (±1.22) mmol/L respectively.[17] The mean TC, TG and LDL were not significantly different from the results of this study (t-test $p>0.05$) but the mean HDL 1.30 (±0.63) mmol/L was significantly lower than the reported mean of 1.65 (± 0.57) in this study (t-test $p<0.0001$). Therefore over this period of about 9 to 10 years since the other study was conducted the serum lipid levels of patients have not worsened and but rather the antiatherogenic HDL portion has significantly increased. This observed increase in HDL while the TC and the other components remained stable may be due to increase in physical activity as a result of health education. In the US over a 10-year period of recent measurements in the Framingham Study, there was a decrease in dyslipidaemia with a decrease in TG levels and an increase in the levels of HDL and this was in spite of an overall increase in BMI.[5]

Atherogenic index is the ratio of TC to HDL and is used as a predictor of atherosclerosis and cardiovascular risk with a higher ratio indicating an increased risk and vice-versa.[23,29-32] In this study the mean atherogenic index was 3.40 and there were no significant sex, age or clinical group differences. The goal is to keep the atherogenic index below 5 and the optimum ratio is 3.5. The mean ratio of 3.32 for males and 3.46 for females was therefore in the optimum range. Further only 9% of participants had an index higher than five, which was very good considering the

fact that 60% of these same participants had levels of TC which were high. Oyelola et al reported a TC/HDL ratio of 4.97 (± 1.44) for persons with DM, 5.38(±3.25) for HPT, 5.86(±1.95) for DM - HPT and 3.15 (±1.01) for a control group.[27] These results were much higher compared to the results of this study.

Using simple linear and multiple regression analysis this study also explored whether any relationship existed between serum lipids, FBG, SBP and DBP in this patient population. After controlling for various confounding variables in multivariate analysis, TC was associated with SBP, TG was associated was associated with SBP and FBG and HDL was associated with FBG. LDL was not associated with any of the variables. These results do not show a definite pattern but at least it shows that SBP is an important determinant of TC and TG while FBG explained most of the effect of TG and HDL. Akuyam et al reported a positive and significant association between TC and BP in both normotensives and subjects with HPT[33]. Nyarko et al found no association between lipid levels and both FBG levels and BP in Accra.[11]

One important issue that came out strongly in this study was the sheer magnitude of ignorance of lipid abnormalities among the patients studied. Firstly there were no clear or popular terminology in the local vernacular for lipid disorders compared to DM and HPT. Secondly there is very little public health education on lipid disorders especially on radio and television programmes. As a result most of the participants have never heard of the condition and were not aware that it was a disease state that is treatable. Only 16 participants had been told that they had a form of lipid abnormality and out of this number 6 of them were on treatment with statins. Considering the fact that this study classified 61% and 60% of participants as having high LDL and high TC respectively, this paints a picture of a very low rate of detection, treatment and control of lipid disorders among this patient population. Especially taking into account that the detection rate of HPT was 78% and DM had a detection rate of 83% among the same group of participants. These latter rates were high by most standards and commendable.

CONCLUSION

The prevalence of lipid disorders among adult patients in Kumasi was high. The mean serum lipids were also high but the detection rate of lipid disorders was low. In view of these findings there is the urgent need to increase awareness, screening, detection, treatment and control of these lipid disorders in patients in Kumasi.

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