



## Dyslipidemia in blood pressure control among adult hypertensive patients in Kiambu County Hospital Kenya

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### Abstract

**Introduction:** Hypertension is one of the most common non-communicable diseases with about 40% global prevalence in adults and 46% in Africa. Dyslipidemia, among other factors may lead to poor blood pressure control in hypertensive patients. Dyslipidemia occurs when someone has abnormal levels of lipids in their blood. However, the role of dyslipidemia in predicting hypertension has not received adequate attention.

**Objectives:** This study aims to determine the relationship between dyslipidemia and blood pressure control among hypertensive patients in Kiambu County Hospital Kenya.

**Methods:** This was a cross-sectional analytical study assessing independent association between blood pressure control and dyslipidemia in a cohort of 251 hypertensive patients in a hospital set up. Multiple logistic regression model was applied to determine factors associated with poor blood pressure control.

**Results:** In total, 251 hypertensive patients, mean age 55.7 years, females-majority (80.9%) were considered in the study. The mean systolic blood pressure was 145.1±22.4mmHg and 87.4±13.0mmHg for diastolic blood pressure. Blood pressure was poorly controlled in 56.6% of the patients. High LDL levels was diagnosed in 82.1% of the patients, 23.1% low HDL levels, 31.9% high triglycerides and 59.8% high total cholesterol levels. Patients with poorly controlled hypertension (68.7%) recorded significantly higher mean total cholesterol (221.4 mg/dl) compared to 193.4 mg/dl in the well-controlled group (mean 193.4 mg/dl),  $p<0.001$ , compared to 38.6% in those with desirable level of total cholesterol, ( $P<0.001$ ). Similarly, LDL were significantly higher in the poorly controlled group (mean 142.3 mg/dl) compared to the well-controlled group (mean 121.4 mg/dl),  $p=0.001$ . Triglycerides and HDL were not significantly associated to hypertension control ( $p>0.05$ ).

**Conclusion:** Dyslipidemia was recorded in 68% of adult hypertensive patients and was significantly associated with development of inadequate blood pressure control. Low density lipids (LDL) was significantly higher in the poorly controlled group where 68.7% of the patients with

high level of total cholesterol had poorly controlled blood pressure. Lifestyle modification, routine lipid profile testing among hypertensive patients, early treatment on high lipid level patients, change of lifestyle and use of statin were recommended for dyslipidemia treatment.

**Keyword:** Hypertension, cardiovascular, blood pressure, diastolic, systolic, non-communicable, disease

### Introduction

Globally, non-communicable diseases (NCD) are the leading cause of mortality and requires chronic care management [1]. Globally, cardiovascular diseases are recorded to be the greatest cause of mortality among the NCD at 30% [2]. Poor blood pressure control, tobacco use, unhealthy diet high in carbohydrates and low density lipoproteins (LDL), sedentary lifestyle and excessive use of alcohol are some of the risk factors that increase the risk of NCD. These factors normally lead to high blood pressure, obesity, raised cholesterol and elevated blood glucose [3].

Many people in the populations are not aware that they have hypertension or other NCDs and those who are aware have poorly controlled hypertension [4]. According to World Health Organization data (WHO 2014) hypertension deaths in Kenya reached 1,995 or 0.60% of total deaths. The age adjusted Death Rate is 12.49 per 100,000 of population and ranks Kenya number 120 in the world (WHO, 2014).

The role of dyslipidemia in predicting hypertension has not received much attention despite the increasing rate of non-communicable diseases. Dyslipidemia, among other factors has in several studies been shown to lead to poor blood pressure control. Early detection and management of dyslipidemia is key in optimizing blood pressure control and reducing the cardiovascular risk [5]. In resource limited settings, Kiambu included, uptake of routine lipid profiles among hypertensive patients remains low largely due to unavailability and prohibitive cost. Efforts have been made to avert this challenge by increasing patient's access to National Hospital Insurance Fund (NHIF) cover to cater for such costly tests.

Complications of dyslipidemia include retinopathy,

nephropathy, stroke, myocardial infarction in addition to hypertension[6]. The prevalence of essential hypertension among adults was estimated to be 40% in 2008 globally[1]. This was 29.1% among adults in USA between 2011-2014 and the estimated prevalence rate of poorly controlled blood pressure was 15.2 million cases (13.7%) among Americans[7]. Across World Health Organization (WHO) regions, the highest hypertension prevalence rate (46%) was recorded in Africa[8]. A study carried out in 2009, at Kenyatta National in Kenya, reported that only 26% of the population studied had their blood pressure well controlled[9].

Raised cholesterol is important in hypertension patients and influences the levels of dyslipidemia. According to WHO, the global prevalence of raised cholesterol was 39% and it was estimated that approximately 73.5 million adults (31.7%) in USA had high cholesterol levels. In another cross populations study among Africans, the prevalence of raised cholesterol was reported to be 25.5%. Lepira showed that 40% of a hypertensive cohort in Congo had dyslipidemia, with 23% of these having hypercholesterolemia and poor blood pressure control[11] (Lepira et al., 2005). Anecdotal data at Kiambu County hospital shows that approximately two thirds of the patients attending Medical Outpatient Clinic (MOPC) have hypertension and approximately one third of them have poorly controlled hypertension. Despite having many hypertensive patients with poorly controlled blood pressure, lipid profile tests are not routinely done at the hospital. Urbanization, aging and unhealthy lifestyles, non-compliance, high BMI and high waist-hip ratio (WHR) are also risk factors for uncontrolled blood pressure worldwide. These factors have been well studied and found to contribute to poor blood pressure control, although dyslipidemia has not received much attention, despite it being highly implicated in causing poor blood pressure.

Although several studies have indicated that dyslipidemia is associated with poor blood pressure control, lipid profiles remain relatively overlooked in the management of hypertension. In Kenya, a Human Resource Strategy study carried out by the ministry of health in 2014 ranked Kiambu as the second leading County in prevalence of NCDs. Majority of the population of Kiambu County are treated in Kiambu County Hospital hence providing a good population for our study. This study has the potential to identify the importance of monitoring and managing patient's lipid profile to enhance optimal blood pressure control and thus help reduce the cardiovascular risks and subsequent cardiovascular complications. The findings of the study will be useful in laying an emphasis on early diagnosis and treatment of dyslipidemia among the hypertensive patients. The study therefore aim to determine the relationship between dyslipidemia and blood pressure control, adjusting for socio-demographic and clinical characteristics among adult hypertensive

patients at Kiambu County Hospital in central Kenya.

## Materials and Methods

The study was cross-sectional analytical in design which investigates the relationship between dyslipidemia and blood pressure control among hypertensive patients in the outpatient clinic of Kambu County Hospital. Sub optimal blood pressure control was considered the dependent variable while lipid profile parameters, sex, age, income and level of education were the independent variables. Intervening variables include body mass index, waist hip ratio, non-adherence to treatment and lifestyle factors. The participants were adult patients who had a documented diagnosis with hypertension, on anti-hypertension treatment not on anti-lipid lowering drugs and on follow-up for more than 3 months. .

A semi-structured questionnaire was used to collect the data on physical examination, which included BP, height, weight, BMI, and blood sampling for fasting lipid profiles. Suboptimal blood pressure control was defined as 140/90mmHg blood pressure readings- and above while optimal control was readings below 140/90mmHg. Blood pressure measurements above 140/90 mmHg was considered the cut off point for poorly controlled blood pressure. The lipid profile of the hypertensive patients was categorized into undesirable and normal levels. Patient coding system was used to ensure confidentiality. Chi-square test was used to determine independent association between blood pressure control and socio-demographic characteristics and other risk factors that affected blood pressure and the lipid profile. Multiple logistic regression model was applied to determine independent factors associated with poor blood pressure control (P- value less or equal to 0.05). Signed consent to conduct the study was obtained from each participant and permission granted by the relevant authorities including the Kiambu County Hospital Management.

## Results

A total of 251 hypertensive patients, mean age 55.7± 13.4 years; (Females 80.9% males 19.1% ) of varying social demographic characteristics were recruited for this study (Table.1). The level of education among the patients was low or no formal education at all (34.2%). For the behavioral and clinical characteristics of the participants, most were of poor social- economic background where more than half (57.8%) earned less than Shillings 5000.0 per month.

**Table 1:** Socio demographic characteristics of the patients (N=251)

Variable	Patients (%)
Mean age in years	55.7
<b>Gender, (%)</b>	
Male	48
Female	20
<b>Marital status (%)</b>	
Single	21
Married	15
Divorced/Separated	21
Widowed	56
<b>Education level (%)</b>	
No formal education	86
Primary	90
Secondary	61
Tertiary	14
<b>Monthly income (KSh.)</b>	
<5000	14
5000-9999	33
10000-19999	37
20000-49999	31
50000-99999	5

Table.2 is the assessment of the risk factors associated with dyslipidemia where the mean BMI was 28.7 kg/m<sup>2</sup> (5.8) with a high proportion (38.6%) of patients being overweight and obese (35.9%). About half of the patients (58.6%) were on two (2) anti-hypertensive drugs and the duration of treatment was 1 to 5 years among 49.8% of the patients, Three-quarters (74.9%) of the patients had high level of adherence to treatment.

**Table.2:** Behavioral and clinical characteristics of the patients.

Variable	Patients (%)
<b>Number of drugs, (%)</b>	
1	15.5
2	58.6
3	23.9
4	2.0
<b>Treatment duration in years (%)</b>	
<1	21.5
1-5	49.8
5-10	22.7
> 10	6.0
<b>Contraceptive use, (%)</b>	
Yes	12.4
No	87.6
<b>Smoking, (%)</b>	
Yes	0.4
No	99.6
<b>Alcohol use (%)</b>	
Yes	6.8
No	93.2
<b>Level of activities (%)</b>	
Sedentary	98.0
Moderately active	1.2
Vigorously	0.8
<b>BMI, mean kg/m<sup>2</sup></b>	28.7
<b>Body weight categories,</b>	
Underweight	1.6
Normal	23.9
Overweight	38.6
Obese	35.9

Table 3 is the relationship of blood pressure levels and lipid profile of hypertensive patients in which the mean systolic blood pressure was 145.1 mmHg and diastolic blood pressure was 87.4 mmHg. Blood pressure was well-controlled in 43.4% of the patients and poorly controlled in 56.6% (95% CI 50.6-62.9%). High LDL level was diagnosed in 82.1% of the patients, low HDL 23.1%,31.9% high triglycerides and 59.8% high total cholesterol

**Table 3:** Blood pressure levels and lipid profile in the hypertensive patients

Variable	N=251	95% CI
<b>Mean Blood pressure, (sd)</b>	145.1(22.4)	142.4-147.9
Systolic	87.4 (13.0)	85.8-88.9
Diastolic		
<b>BP control, n(%)</b>		
Well	109(43.4)	37.1-49.4
Poor	142 (56.6)	50.6-62.9
<b>LDL, n(%)</b>		
Optimal	45 (17.9)	13.5-22.7
High	206 (82.1)	77.3-86.5
<b>HDL, n(%)</b>		
Low	58 (23.1)	17.5-27.9
Normal	163(64.9)	59.4-70.5
High	30(12.0)	8.4-15.9
<b>Triglycerides n(%)</b>		
Normal	171 (68.1)	62.9-73.7
High	80(31.9)	26.3-37.1
<b>Total cholesterol, n (%)</b>		
Desirable	150 (59.8)	53.8-65.7
High		
<b>Blood pressure levels (%)</b>		
Well Controlled	43.4%	
Poorly controlled	56.6%	50.6-62.9

Table 4 compares the social demographic and other characteristics in patients with well controlled blood pressure and the poorly controlled blood pressure ones. The mean age for patients with poorly controlled hypertension was 55.7 years and 55.8 years for the well-controlled group (p=0.970). A significantly higher proportion of males were in the poorly-controlled group (79.2%) compared to females (51.2%), OR 3.6 (95% CI 1.7-7.7), p<0.001. The duration of treatment and the pill burden was not significantly associated hypertension control. However, patients with non-optimal level of adherence to treatment were more likely to have poorly-controlled hypertension (69.8%) than those with high level of adherence (52.1%), OR 2.1 (95% CI 1.2-3.9), p=0.014.

**Table 4:** Socio-demographic and other risk factors associated with hypertension control

Variable	Hypertension control		P value
	Poor (n=142)	Well (n=109)	
Age in years, mean (sd)*	55.7 (13.1)	55.8 (13.8)	0.970
<b>Sex</b>			
Male	38 (79.2)	10 (20.8)	<0.001
Female	104 (51.2)	99 (48.8)	

Educational Level, n (%)			0.243
None	46 (54.8)	38 (45.2)	0.297
Primary	51 (56.7)	39 (43.3)	0.282
Secondary	34 (55.7)	27 (44.3)	
Tertiary	10 (71.4)	4 (28.6)	
Monthly Income- KSh, n (%)			1.000
Less than 5000	75 (55.1)	61 (44.9)	1.000
5000-9999	20 (60.6)	13 (39.4)	0.637
10000-19999	26 (70.3)	11 (29.7)	1.000
20000-49999	16 (51.6)	15 (48.4)	
50000-99999	3 (60.0)	2 (40.0)	
Treatment duration in years, n(%)			
< 1	35 (64.8)	19 (35.2)	0.083
1-5	72 (58.1)	52 (41.9)	0.183
5-10	28 (49.1)	29 (50.9)	0.574
>10	6 (40.0)	9 (60.0)	
Number of anti-HTN drugs, n (%)			
1	24 (61.5)	15 (38.5)	1.000
2	81 (55.1)	66 (44.9)	1.000
3	34 (56.7)	26 (43.3)	1.000
4	3 (60.0)	2 (40.0)	
Contraceptive Use, n (%)			
Yes	16 (51.6)	15 (48.4)	0.537
No	123 (57.5)	91 (42.5)	
Alcohol, n (%)			
Yes	12 (70.6)	5 (29.4)	0.227
No	130 (55.6)	104 (44.4)	
Level of Activity, n (%)			
Sedentary	141 (57.3)	105 (42.7)	0.170
Moderately/ vigorously active	1 (20.0)	4 (80.0)	
Morisky Adherence Scale, n (%)			
Low/Medium	44 (69.8)	19 (30.2)	0.014
High	98 (52.1)	90 (47.9)	
Body Mass index, n (%)			
Underweight	2 (50.0)	2 (50.0)	0.846
Normal	33 (55.0)	27 (45.0)	
Over weight	58 (59.8)	39 (40.2)	0.554
Obese	49 (54.4)	41 (45.6)	0.947

NB; The p value for mean age, waist and hip circumference was calculated using *t*-test

Education level, income level, contraceptive use, alcohol consumption, level of activity, BMI, weight circumference, hip circumference and waist-hip ratio were not significantly different between the poorly controlled and the well-controlled patients ( $p > 0.05$ ).

In blood pressure control association with lipid profile, the mean total cholesterol was 221.4 mg/dl in patients with poorly controlled blood pressure and 193.4 mg/dl in the well-controlled group (Table 5). The mean LDL was also higher in poorly controlled group (142.3 mg/dl) compared to Patients with high LDL levels were more likely to have poorly controlled hypertension (59.7%) compared to those with optimal levels (42.2%), OR 2.0 (95% CI 1.1-3.9),  $p = 0.032$ . HDL and triglycerides were not significantly associated to hypertension control ( $p > 0.05$ ) (Table 5).

**Table 5:** Association between blood pressure control and lipid profile

Variable	Hypertension control		OR (95% CI)	P value
	Poor (n=142)	Well (n=109)		
Total cholesterol				
Mean (SD)	221.4 (41.5)	193.4 (38.1)	-	
Categories, n (%)				
<200 Desirable	39 (38.6)	62 (61.4)	1.0	<0.001
≥200 Hnmigh	103 (68.7)	47 (31.3)	3.5 (2.1-5.9)	
<b>Triglycerides</b>				
Mean (SD)	149.3 (81.7)	136.6 (77.9)	-	0.213
Categories, n (%)				
<150 Normal	95 (55.6)	76 (44.4)	1.0	
≥100 High	47 (58.8)	33 (41.3)	1.1 (0.7-2.0)	0.683
<b>HDL</b>				
Mean (SD)	57.2 (74.2)	47.0 (9.8)	=	9.155
Categories, n (%)				
<40 Low	34 (58.6)	24 (41.4)	1.2 (0.6-2.2)	0.597
40-59 Normal	89 (54.6)	74 (45.4)	1.0	0.376
≥60 High	19 (63.3)	11 (36.7)	1.4 (0.6-3.2)	0.213
				0.683
<b>LDL</b>				
Mean (SD)	142.3 (37.4)	121.4 (32.5)	1.0	<0.001
Categories, n (%)				
<100 Optimal	19 (42.2)	83 (40.3)	2.0 (1.1-3.9)	0.032
≥100 High	123 (59.7)	26 (57.8)		
				0.683
Mean (SD)	149.3 (81.7)	136.6 (77.9)		
Categories, n (%)				
<100 Optimal	95 (55.6)	76 (44.4)	1.0	
≥100 High	47 (58.8)	33 (41.3)	1.1 (0.7-2.0)	

Table 6: are factors independently associated with blood pressure control. These are the findings of the multiple logistic regression model for factors significantly associated with blood pressure control at bivariate analysis. Gender of the patients, and total cholesterol levels were independently associated with blood pressure control. LDL was not an independent factor associated with blood pressure control

**Table 6:** Factors independently associated with blood pressure control

Variable	Adjusted OR (95% CI)	P value
<b>Gender</b>		
Male	3.3 (1.5-7.2)	0.003
Female	1.0	
<b>Total cholesterol</b>		
<200 Desirable	3.4 (1.8-6.3)	<0.001
≥200 High	1.0	
<b>LDL</b>		
<100 Optimal	1.1 (0.5-2.5)	0.805
≥100 High	1.0	

## DISCUSSION

The mean blood pressure of the patients that were studied was 145.1 mmHg systolic and diastolic BP of 87.4 mmHg. Blood pressure was well-controlled (<140/90) in 43.4% of the patients and poorly controlled (>140/90) in 56.6% (95% CI 50.6-62.9%), which indicated, that despite being on treatment and follow up, more than a half of the hypertensive patients still had poor blood pressure control. The Joint National Committee (JNC 8) recommends good blood pressure control so as to reduce the cardiovascular risks. The findings agree with the report of the Kenya National Health and Nutrition Examination Survey 2003–2004 report. In which two out of three patients with hypertension had poorly controlled BP[12] and in another study in Nyeri Provincial General Hospital (Kenya) in which only 33.4% of the patients studied demonstrated well controlled blood pressure[13].

Male gender was independently associated with poor blood pressure, which indicated that being male was a risk factor for having poor blood pressure. This finding is against a background of knowledge that gender doesn't affect blood pressure control. This different outcome may have been due to the fact that more of the males studied had been on treatment for only one year, took alcohol and had a higher waist hip ratio as compared to the females.

Obesity and smoking were not associated with poor blood pressure. Several studies and literature have repeatedly reported that these factors contribute to development of hypertension and poor blood pressure control. In Africa, these factors were found to highly contribute to uncontrolled blood pressure[14]. However, in this study, the above factors were not associated with poor blood pressure control. This different outcome could be genetic related or due to the fact that most of the study population were females who were not smokers.

High LDL levels were diagnosed in 82.1% of the patients in this study where, low HDL levels was recorded in 23.1% of the patients, 31.9% with high triglycerides while 59.8% recorded high total cholesterol. These levels were high in this study population, especially the LDL and the total cholesterol. In a study done in the rural hypertensive population in China from 2004 to 2006 involving 6,412 individuals (2805 men and 3607 women) all above 35 years of age, 51.3% had high total cholesterol, 8.8% had low HDL, 20.1% had high LDL and 35.7% had high triglycerides levels [15]. In Congo, a study done showed that the prevalence of dyslipidemia among the hypertensive patients was 40%. Those with elevated total cholesterol were 23%[11]. These findings [;] were almost similar in the three studies except the LDL which were highly raised in my study (82.1%) and the prevalence of low HDL was much higher in my group (23.1%) than in the Chinese population (8.8%). This outcome may have been due to the sedentary lifestyle in my study group and also difference in genetics.

Dyslipidemia can cause coronary heart disease and stroke among other complications. Patients with poorly controlled hypertension had a significantly higher mean total cholesterol (221.4 mg/dl) compared to the well-controlled group (mean 193.4 mg/dl),  $p < 0.001$  and similarly, The LDL levels were significantly higher in the poorly controlled group (mean 142.3 mg/dl) compared to that in the well-controlled group (mean 121.4 mg/dl),  $p = 0.001$ . This correlates with a study in the Republic of Macedonia where, among participants with uncontrolled BP, 67% of those with uncontrolled BP suffered from dyslipidemia. Dyslipidemia therefore has significant influence on the control of blood pressure.

The HDL and TG levels were within normal range in the current study unlike the findings among hypertensive patients with diabetes, high dyslipidemia, TG-38% and 59% for low HDL among patients with poor blood pressure control in semi urban South India region [16]. The normal levels of triglycerides and HDL according to this study may have been because the population studied did not have other comorbidities, for example diabetes, CKD and hypothyroidism among others. Diabetes, kidney disease, obesity, smoking cigarettes and taking alcohol have been shown to cause high triglycerides and low HDL levels. Similarly, the percentage of those consuming alcohol and those smoking cigarettes was low among these patients, which could also influence the HDL and triglyceride levels.

## Conclusion.

Dyslipidemia was present in 90.8% of the study population with an overall elevated cholesterol (59.8%) and LDL (82.1%) levels. Dyslipidemia was therefore important in the development of poor blood pressure control where males were more affected than female. Majority (56.6%) of the hypertensive patients on follow up had poor blood pressure control;  $> 140/90$  mmHg as compared to those who were well controlled, (43.4%). Routine lipid profile testing is therefore important on hypertensive patients, accompanied by early treatment on those with high levels in order to reduce the hazard of developing inadequate blood pressure control. Therefore, lifestyle modification, use of statin therapy or the combination are essential for the reduction of the hazard of dyslipidemia.

The setup of the study was in a region of one ethnic group with a specific lifestyle and behaviour. The role environment cannot be over emphasized in the development of hypertension in different communities. It would be of interest to conduct further studies in different regions in Kenya /with the question of hypertension and dyslipidemia in different communities, environment and lifestyle in order to address the extent of dyslipidemia in the country

Majority of the hypertensive patients on follow up had poor blood pressure control. For example BP.  $> 140/90$  mmHg was recorded in 56.6% of the patients compared to

43.4% of those who were well controlled. Dyslipidemia was present in 90.8% of the study population with total cholesterol and LDL significantly raised at 59.8% and 82.1% respectively. Dyslipidemia was associated with poor blood pressure control among hypertensive patients and the effects were significantly higher in the male gender than in females. It therefore shows that, early routine lipid profile testing and early starting of treatment on those with high levels of lipids lifestyle modification are necessary on the hypertensive patients in order to help in blood pressure control. Lifestyle modification, use of statin therapy or a combination of both is recommended for treatment of dyslipidemia. Further studies across Kiambu County and other counties are recommended for more correlation.

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### Conflict of interest

None of the authors expressed any potential conflict of interest in developing this manuscript.

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