PREVALENCE OF CARDIOVASCULAR RISK FACTORS AND TARGET ORGAN DAMAGE IN OUTPATIENT HYPERTENSIVE PATIENTS SEEN AT THE KENYATTA NATIONAL HOSPITAL

A dissertation submitted in part fulfilment of the requirements for the degree of Master of Medicine in Internal Medicine by:

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2003

DECLARATION

I certify that this dissertation is my own original work and has not been presented for a degree at any other university.

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DEDICATION

This research is dedicated to my loving mother, my wife and my children Umar, Khalid and Aminah.

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ABBREVIATIONS

BMI	- Body Mass Index
CVRF(s)	- Cardiovascular Risk factor(s)
CCF	- Congestive Cardiac Failure
CHD	- Coronary Heart Disease
DBP	- Diastolic Blood Pressure
ECG	- Electrocardiogram
ECG-LVH	- ECG diagnosis of Left Ventricular Hypertrophy
HDL-C	- High-density lipoprotein cholesterol
IGT	- Impaired Glucose Tolerance
JNC VI	- The sixth report of the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure
KNH	- Kenyatta National Hospital
LDL-C	- Low-density lipoprotein cholesterol
MOPC(s)	- Medical Outpatient Clinic (Clinics)
SBP	- Systolic Blood Pressure
TIA	- Transient Ischaemic Attack
TC	- Total Cholesterol
TOD	- Target Organ Damage
UKPDS	- United Kingdom Prospective Diabetes Study
USA	- United States of America
VLDL	- Very low-density lipoprotein
WHR	- Waist-Hip Ratio
WHO	- World Health Organization

ACKNOWLEDGEMENTS

My first acknowledgment is to The Almighty, The Most Knowledgeable without whom not only could I have not done this research, but would not have been able to pursue and accomplish this course.

Secondly there are very many people whose contribution to this study I gratefully acknowledge. Among whom I am especially grateful for the constant encouragement, guidance and assistance given to me by my supervisors – Prof E N Ogola and Dr E O Amayo – without whose contribution this work would not have been possible.

I am greatly indebted to, and wish to thank: Dr A Twahir and Dr M Twahir for their ever-willing support and encouragement; the entire staff of the Renal Unit, Kenyatta National Hospital (KNH) for their invaluable support; Prof E N Ogola and the Department of Internal Medicine, University of Nairobi, for use of the electrocardiogram machine and ophthalmoscope; the Department of Obstetrics & Gynaecology, University of Nairobi, for use of the weighing scale; the entire staff of the Renal Laboratory, Kenyatta National Hospital (KNH) for the fasting blood glucose and creatinine assays; Dr S B Sayed and the staff of Forest Medical Laboratories for the fasting lipid profile assays; Astra Zeneca, Dr S Farooqui and my family for their financial support; and all the patients and their relatives for accepting to be part of this study.

To my loving mother, my wife, my family and my friends I owe my undying gratitude for their unfailing moral, psychological and financial support.

ABSTRACT

BACKGROUND Hypertension is a well-established, common and powerful predisposing factor for the development of coronary heart disease, stroke, heart failure and renal failure. Furthermore hypertension seldom occurs in isolation, but tends to occur in association with other artherogenic risk factors that not only promote its occurrence but also greatly influence its impact on cardiovascular disease. Unfortunately there is a rapid development of the 'second wave epidemic' of cardiovascular disease that is now flowing through developing countries most of which are already in economic difficulties. Scanty data exists locally on the prevalence of cardiovascular risk factors and target organ damage amongst the hypertensive population.

OBJECTIVES The aim of the study was to determine the prevalence of CVRF; cigarette smoking, obesity, dyslipidaemia, diabetes mellitus, ECG-LVH, and TOD; clinical cardiac disease, cerebrovascular accident, nephropathy and hypertensive retinopathy in hypertensive patients seen in medical outpatient clinics at KNH.

METHODS A random sample of hypertensive patients seen at the MOPCs of KNH was selected and data obtained on age, sex, duration and treatment of hypertension, history of cigarette smoking, and family history of hypertension, diabetes and vascular disease in first-degree relatives. BMI, WHR and resting BP were recorded. Fundoscopy and a 12-lead Electrocardiogram were performed on the patients. A fasting venous blood sample was drawn to determine, fasting lipid profile (TC, HDL-C, LDL-C and triglycerides), FBG and serum creatinine. A spot specimen of urine was screened for proteinuria using a dipstick.

RESULTS 93 hypertensive patients (43 males and 50 females) were studied, with a mean age of 53.7 years [51.3 - 56.1,95% C.I] and a mean duration of hypertension of 8.6 years [6.7 -10.4, 95%C.I]. All patients were on antihypertensive medication with most (78.6%) using 2 or more drugs. Twenty-seven patients (29.3%) had history of cigarette smoking: 6.5% current smokers (all males) and 22.6% ex-smokers. Family history of hypertension was 43.0%, diabetes 20.4% and vascular disease in first-degree relatives 5.4%. The mean BMI was 27.5 kg/m^2 [26.6 – 28.5, 95% C.I], with 66 patients (71.0%) being either overweight or obese and 27 patients (29.0%) having central obesity. The mean SBP was 151 mmHg [147 – 155, 95% C.I], mean DBP was 95 mmHg [92 – 97, 95% C.I], with 20 patients (21.5%) having their BP controlled (<140 /<90mmHg). Dyslipidaemia was found in 65 patients (69.9%). The mean fasting blood glucose (FBG) was 5.9 mmol/L with 9 patients (9.7%) having diabetes. Of the 9 diabetic patients, 6 were newly diagnosed. ECG-LVH was observed in 30 patients (32.2%). Thirty patients (32.3%) had clinical cardiac disease with 18 (19.4%) having CCF and 14 (15.1%) having CHD (angina or previous MI). Eleven patients (11.8%) had cerebrovascular accident while 20 (21.5%) had nephropathy. The mean creatinine clearance was 86.1 ml/min with 39 (41.9%) having creatinine clearance of 60 – 89.9 ml/min. Four patients (4.4%) had proteinuria of $\geq$ 30 mg/dl. Hypertensive retinopathy was detected in 60 patients (64.5%). Nearly all patients (96.8%) had at least one other CVRF and 76.3% had at least one target organ damage.

CONCLUSIONS There is a high prevalence of vascular risk factors and target organ damage, frequently multiple, in patients with hypertension seen at KNH.

1 LITERATURE REVIEW

1.1. INTRODUCTION

The positive relationship between hypertension and cardiovascular risk has long been recognised. In the Framingham Heart Study, artherosclerotic sequelae imposed by hypertension occurs at a 2-fold to 3-fold increased rate compared with normotensive persons of the same age [1].

Blood pressure appears to be critical to the artherosclerotic process as it seldom occurs in low-pressure segments of the circulation, such as the pulmonary arteries or veins, unless disease induces a raised blood pressure in these segments of the circulation. Also, animal experiments have shown that lipid-induced atherogenesis can be accelerated or retarded by manipulating the blood pressure [1]. Elevated blood pressure has been found to be related to the development of cardiovascular disease in a continuous, graded fashion, with no indication of a critical value. The risk of cardiovascular sequelae increases with each increment in blood pressure, even within the high-normal range. However, the risk of development of all clinical manifestations of coronary disease has been shown to be related to the severity of antecedent hypertension in the Framingham Study [2] and elsewhere.

The risk of cardiovascular disease in patients with hypertension is determined not only by the level of blood pressure, but also by the presence or absence of Target Organ Damage and other risk factors such as cigarette smoking, dyslipidaemia and diabetes mellitus.

Based on the assessment of Target Organ Damage (such as retinopathy, nephropathy, cerebrovascular accident and clinical cardiac disease), risk factors and the blood pressure, the patient's risk group can be determined [3] for the appropriate therapeutic decisions to be made and implemented. A similar approach of empiric classification and stratification of patients with hypertension into risk groups for therapeutic decisions has recently been recommended by The WHO Expert Committee on Hypertension Control [4].

Clustering of risk factors with hypertension was investigated in the Framingham Study, and hypertension was found to occur in isolation only ≈ 20% of the time. Clusters of two or three of these risk factors with hypertension were found to occur ≈ 50% of the time, a rate twice that expected by chance [5].

1.2 EPIDEMIOLOGY

Hypertension is a worldwide epidemic that can affect all ages but primarily affects adults and is also common to all human populations accounting for 6% of deaths in adults world wide [6]. In 1999 it was estimated that there were 3.45 billion adults (20 years and older) and on the basis of 20% prevalence, approximately 690 million adults had hypertension [7]. Hypertension is recognised worldwide as major risk factor of cardiovascular diseases, which accounted for 30% of the world's deaths (15 million people) in 1999 [7].

In a survey of the status of hypertension by members of the World Hypertension League, using a blood pressure cut off of 140/90mmHg, 14 countries reported a prevalence range of 11 - 43% with a median of 24% [8]. The prevalence of Hypertension in an urban and rural area in Tanzania was 30% in men and 28.6% in women in the urban area; and 32.2% in men and 31.5% in women in the rural area [9]. Various cross-sectional community based surveys done in Kenya showed a prevalence of 4.1% in rural Meru [10], 5.4% in rural and urban Nakuru [11] and 6.4% in rural and urban Kitui [12].

A study done at KNH on cardiovascular disease in elderly patients admitted in the medical wards showed a clinical evidence of cardiovascular disease in 39.5% of the patients evaluated [13]. In 1985, Lule et al [14] showed that most of the Kenyan hypertensives admitted in KNH had severe disease with the majority having established complications such as cardiac failure (33%), ECG-LVH (35%), eye changes (59%) and stroke (8%).

1.3 RISK FACTORS

1.3.1 OBESITY

Even though both obesity and hypertension independently increase cardiovascular risk, the relationship between hypertension and obesity is well documented and known. When compared to normal people, hypertensive patients have an increased prevalence of obesity [15]. In the Framingham study it was shown that the prevalence of hypertension in men and women as a function of age increases substantially with increases in relative

weight, so that the prevalence of hypertension is almost 50% in the most obese group [16]. In the same study (Framingham study), obesity or recent weight gain accounted for 70% of new onset hypertension.

Observations, made more than 50 years ago by Vague, that the cardiovascular and metabolic consequences of obesity were most marked in individuals with the abdominal or upper-body forms of obesity were confirmed in the mid–1980s by large-scale epidemiological studies from Scandinavia [17].

An increase in waist-to-hip ratio or waist circumference, surrogate markers for the upper-body fat pattern, is an independent risk factor for the development of high blood pressure and is independently associated with other cardiovascular risk factors [18]. It has further been shown that lifestyle modification, particularly weight loss, plays a central role in blood pressure lowering and cardiovascular risk reduction [19].

Increased body mass index (BMI) appears to be associated with endothelial dysfunction, which is a major factor in atheroma plaque formation and development of thrombosis [20]. In addition to the risk of hypertension, obesity further enhances total cardiovascular risk by increasing LDL-cholesterol levels, reducing HDL-cholesterol levels, diminishing glucose tolerance, and predisposing to the development of LVH (independent of systemic blood pressure) [21, 22]. A local study done at Kenyatta National Hospital in patients with mild to moderate hypertension reported the prevalence of obesity to be 28.3% [23].

1.3.2 ECG - LVH

Left ventricular hypertrophy refers to an increase in the left ventricular mass. This hypertrophy can be due to a response to chronic pressure overload caused by systemic hypertension among other factors.

Left ventricular hypertrophy, frequently found in hypertensive patients, is well established as an independent risk factor for cardiovascular morbidity and mortality from the early evidence of the Framingham heart study [24]. In that study a finding of ECG-LVH was a grave prognostic sign. All together 44% of cardiovascular deaths in this study (the Framingham heart study) were preceded by a definite or possible finding of LVH on ECG. From these studies a definite Electrocardiographic LVH was associated with an eight-fold increase in cardiovascular mortality and a six-fold increase in coronary mortality [24, 25]. A finding of Echo-LVH and/or ECG-LVH has further been shown in other studies to increase the incidence of coronary heart disease, stroke, heart failure and peripheral vascular disease [26, 27].

The mechanisms by which cardiac hypertrophy may promote cardiovascular morbidity and mortality are incompletely understood [28]. Left ventricular hypertrophy increases myocardial oxygen consumption while reducing coronary blood flow reserve. This supply – demand mismatch may predispose the patient to angina, arrhythmias, myocardial infarction and sudden death [28, 29]. Also the coronary blood flow may be impaired by artherosclerosis in persons with LVH, because factors associated with myocardial hypertrophy are artherogenic [30].

Though echocardiography is the procedure of choice for diagnosing LVH, the electrocardiogram (ECG) may be used when echocardiography is not available or too expensive [31].

The ECG is a useful but imperfect tool for detecting LVH. The utility of ECG relates to it being relatively inexpensive and widely available. The limitation of the ECG relates to its moderate sensitivity and specificity [32, 33].

The Electrocardiographic diagnosis of LVH is quite reliable when very prominent voltage is seen in conjunction with left atrial and ST-T abnormalities, leftward axis or widening of the QRS complex on the ECG [34, 35].

There are 30 or more indices of LVH by the ECG. The major criteria used are the Sokolow-Lyons Indices, the Romhilt-Estes point score system and the Cornell voltage criteria [36]. The sensitivity and specificity of these major criteria vary widely depending upon the populations studied, the "gold standard" employed and the severity of LVH. Overall, conservative estimates of the sensitivity of the various criteria for moderate to severe LVH is in the range of 30% to 60% with specificities in the range of 80% to 90% [36, 37].

The prevalence of ECG-LVH in studies done locally in KNH have been 34.5% [14], 31.7% [23], 27.5% [38] and 42.6% [39]. The studies done by Lule GN et al [14] and Yonga GO et al [23] used the Sokolow-Lyons criteria to assess ECG-LVH while Lore W et al [38] and Bukachi FO [39] used the Romhilt-Estes point score system to assess ECG-LVH.

1.3.3 DIABETES MELLITUS

It is well known that abnormalities of glucose, insulin, and lipoprotein metabolism are common in patients with hypertension. These metabolic abnormalities may play a part in both the pathogenesis and the complications of hypertension in many patients [40]. It is hypothesized that the metabolic abnormalities are linked to the hypertension by a pathophysiologic process that involves the sympathoadrenal system and exerts both pro-hypertensive and artherogenic effects. The higher plasma concentrations of glucose (impaired glucose tolerance) and insulin (hyperinsulinaemia) in patients with hypertension result from the resistance of peripheral tissue to the action of insulin to stimulate glucose uptake (insulin resistance), these being found in both obese and non-obese patients with hypertension [41].

The coexistence of diabetes mellitus and hypertension in the same patient is devastating to the cardiovascular system [42]. Unfortunately, many type 2 diabetics are hypertensive at the time of the diagnosis of diabetes, which suggests that there may be a common underlying mechanism for hypertension, obesity and insulin resistance. The association between hypertension and diabetes has also been reported locally in a study done by Vaghella VP (though the study looked at type 2 diabetic patients), in which 64.8% of the diabetic patients were also hypertensive [43].

The risk of stroke or any cardiovascular event is almost doubled when the hypertensive patient has diabetes [44]. Data from the Hypertension Detection and Follow-up Program showed that 5-year mortality rates were 1.5 to 1.8 times higher for hypertensive patients

with evidence of diabetes than for those without [45]. In the Hypertension Optimal Treatment (HOT) study hypertensive diabetic patients had a 2.5-fold increase in the rate of stroke compared with non-diabetic patients [46].

The UKPDS revealed that among patients with hypertension and type 2 diabetes, intensive lowering of blood pressure achieves clinically important reduction in the risks of deaths and complications related to diabetes [47]. A similar benefit was observed in the HOT study among hypertensive patients with diabetes, hence the importance of the management of hypertension in diabetics [46].

Not much local data is available on the prevalence of diabetes mellitus in hypertensive patients except for one study done by G.O. Yonga, et al in which they observed a prevalence of 15% [23].

1.3.4 DYSLIPIDAEMIA

As stated above apart from hypertension being associated with abnormalities of glucose and insulin metabolism, it is also associated with abnormalities of lipid metabolism. Patients with hypertension tend to have dyslipidaemia, with higher plasma triglyceride concentrations and lower concentrations of high-density lipoprotein (HDL) cholesterol than normotensive subjects [48]. It has also been shown that adolescents and adults with higher levels of blood pressure often have higher serum concentrations of total cholesterol, triglycerides, glucose, apolipoproteinB and lower HDL-cholesterol values.Data from the National Health and Nutrition Examination Survey II (NHANES II)

show that 40% of adults < 55 years of age with blood pressures >140/90 mmHg have serum cholesterol concentrations of > 6.20 mmol/L, a prevalence approximately double that found in normotensive age-matched control subjects [49].

In the Multiple Risk Factor Intervention Trial (MRFIT) study it was observed that coronary heart disease (CHD) risk increases progressively as systolic blood pressure, diastolic blood pressure, or total cholesterol (TC) levels increase [50]. Thus, a single TC measurement provides information that improves the accuracy of CHD risk assessments in both normotensive and hypertensive patients.

Given the protective value of serum HDL-cholesterol, it has been suggested that the serum total to HDL-cholesterol is of greater predictive value than the serum total or LDL-cholesterol. Data from the Lipid Research Clinics and the Framingham Heart Study suggest that the total to HDL-cholesterol ratio may have greater predictive value for CHD than serum total or LDL-cholesterol [51]. Of practical importance is that serum total and HDL-cholesterol can be measured in fasting or nonfasting individuals; there being only small clinically insignificant differences in these values when measured in the fasting or nonfasting state [52].

Under normal circumstances (when there is no oxidative stress), native LDL cycles in and out of the vessel wall. When there is oxidative stress (as in hypertension, diabetes, obesity, etc), the LDL particle undergoes modifications resulting in formation of a spectrum of oxidised lipoproteins, from minimally modified LDL to fully oxidised LDL. Elevated LDL cholesterol (particularly oxidised LDL) reduces endothelial production of nitric oxide and also increases its degradation. This further worsens the endothelial

dysfunction seen in hypertensive patients resulting in increase in the risk of development of cardiovascular disease. The resultant oxidised LDL increases production of oxygen radicals thus further worsening the endothelial dysfunction, which then progresses to artherosclerosis.

A clinical trial on newly diagnosed mild to moderate hypertensive patients done locally by G. O. Yonga et al found a prevalence of hypercholesterolaemia of 28.3% [23] while a study in Israel that looked at risk factor clustering in hypertensive patients observed that dyslipidaemia was the most common associated risk factor identified in 93% of coronary artery disease – positive and 77% of the coronary artery – negative hypertensive subjects. The most common dyslipidaemic abnormality was increased LDL-C (79.2% of the cohort), followed by hypertryglyceridaemia (31.7%) and low HDL-C (22.3%). The most common dyslipidaemic variant was isolated hypercholesterolaemia at 42% [53].

1.3.5 CIGARETTE SMOKING

Cigarette smoking is a major risk factor for coronary heart disease, and premature coronary heart disease is one of its most important medical consequences. The effect of cigarette smoking on the incidence of coronary disease in middle-aged people has been well described and it is known that it substantially increases the cardiovascular risk from hypertension [54].

Epidemiological studies have shown that smoking is a risk factor for progressive renal disease [55], thus further compounding the effect of hypertension on the kidney. Not surprisingly, the mechanism and risk factors relevant to artherosclerosis appear to be equally relevant to glomerulosclerosis and equally aggravated by cigarette smoking. Therefore elevated cholesterol, cigarette smoking, and hypertension act synergistically to accelerate renal failure [55]. It is also known that smoking acts both independently of and synergistically with the other CVRFs.

Approximately 20% of the 500,000 CHD deaths occurring each year in the U.S.A. are attributable to smoking. Large epidemiological studies in men and women have shown an increased risk of stroke among smokers compared to non-smokers, a dose-response relationship between smoking and stroke risk, and a decrease in stroke risk with smoking cessation [56]. A study done in England observed that, in hypertensives who were current smokers, the risk of stroke was increased 6 fold as compared to non-smokers without hypertension. There appeared to be a steady increase in risk of stroke according to the number of risk factors present, particularly in hypertensive subjects [57]. A local study reported the prevalence of smoking in our hypertensives to be 25.0% [23].

1.4 TARGET ORGAN DAMAGE (TOD)

The presence of TOD increases the risk of development of cardiovascular disease hence affecting risk stratification and management of the patient [3].

Target organ damage is defined in the JNC VI [3] as:

(a) Clinical cardiac disease: Angina / Prior myocardial infarction,

Prior coronary revascularization, Heart failure.

(b) Cerebro Vascular Accident: Stroke or Transient ischaemic attack.

(c) Nephropathy

(d) Retinopathy

(e) Peripheral arterial disease.

1.4.1 RETINOPATHY

Hypertensive retinopathy, due to arteriolar thickening, is one of the cardiovascular effects of long-standing hypertension. In 1939, Keith, Wagener and Barker [58] graded retinal changes of hypertension into four categories and since then, this classification (elaborated in appendix III) has been widely used in subsequent studies.

The ocular lesions of systemic hypertension convey important information about the duration and severity of the hypertensive state and the efficacy of treatment. Most of the time when there is hypertensive retinopathy similar arteriolar changes occur in other organs, potentially leading to distal ischaemia as the vascular lumen becomes narrowed [59]. *Therefore you will find that most patients with renal failure secondary to benign*

nephrosclerosis (target organ damage) will also have advanced retinal disease [59]. That is why in the JNC VI guidelines, the moment there is hypertensive retinopathy the risk stratification of the patient worsens and the recommended mode of management of the patient changes [3].

In a prospective study done among Kenyan Africans at the coast in 1963, Foster and JanMohamed [60] reported a 46.2% prevalence of hypertensive retinopathy. Lule GN et al in a retrospective study of 846 hypertensive Kenyans found retinopathy in 59.0% of the 305 patients in whom fundoscopy had been done [14]. Grade III and IV retinal changes were found in 30% of the cases. Awan AM et al, found hypertensive retinopathy in 75% of the 100 hypertensive Kenyans they studied [61], while Ngumuta AM observed a prevalence of hypertensive retinopathy of 72.9% [62]. The last two studies mentioned above employed retinal photography.

Retinal photography has the added advantage of revealing fine details, like early papilloedema or minor variation in vessel calibre found in advanced arteriosclerosis which may not be appreciated on routine fundoscopy, however well performed [63].

1.4.2 NEPHROPATHY

In 1836, Richard Bright first described the association of kidney disease (as evidenced by the presence of small kidneys and proteinuria) with hypertension (manifested by left ventricular hypertrophy and stroke) [64].

Nephrosclerosis is a renal parenchyma disease secondary to chronic small-vessel disease. It occurs in hypertensives and older patients. All will have some degree of renal insufficiency, usually a history of hypertension, <2g of proteinuria daily, and otherwise unremarkable urinalysis [65].

Hypertension is both a cause and a consequence of renal disease, and systemic hypertension is one of the most important risk factors for progressive loss of renal function. Although hypertension may initiate renal disease, the incidence of hypertensive nephropathy, defined as renal insufficiency in which hypertension is the only known etiologic factor, is difficult to quantify. Often, the coexistence of hypertension and chronic renal disease leads to a presumptive diagnosis of hypertensive nephropathy [55].

Several studies have examined "hypercreatinaemia", an intermediate stage between normal renal function and End Stage Renal Disease (ESRD), as an outcome. In the Hypertension Detection and Follow-up Program [66], the incidence of "clinically significant hypercreatinaemia" (defined as a creatinine $\geq$ 176μmol/l and at least 1.25 times the level at entry into the trial) during 5 years of follow-up was strongly related to DBP at baseline.

The risk of ESRD across a wide range of BP was determined in a prospective study of 332,544 men for the MRFIT. Of the ESRD cases, 49% occurred at a hypertension of stage I or higher [67]. The risk of ESRD associated with BP was strong, positive and statistically significant both overall and in subgroups defined by age and other baseline covariates.

Epidemiological and retrospective studies provide strong evidence that lowering blood

pressure slows the age-related loss of renal function. A retrospective study of patients coming with ESRD found that those patients whose diastolic blood pressures were greater than 90 mmHg, regardless of presence or absence of anti-hypertensive therapy, lost renal function at a faster rate than those whose diastolic pressures were less than 90 mmHg [66]. Similarly, retrospective analyses of data from both the Hypertension Detection and Follow-up Program Cooperative Group [67] and the MRFIT studies found accelerated loss of renal function in patients with persistent diastolic hypertension [67].

A six-year study [68] in South Africa reported hypertension as the cause of ESRD to be 20.9% in Blacks. Locally as in other tropical countries, there is an increase in the incidence of ESRD from hypertension and diabetes. The prevalence of chronic renal failure secondary to hypertension locally was reported to be 23.0% [69].

1.4.3 CEREBROVASCULAR ACCIDENT

Twenty percent of all cardiovascular disease deaths in the elderly in the United States are attributable to stroke [70]. Although cerebrovascular accident is the 3rd leading cause of death in the United States, stroke is 4 times more likely to produce disability than death and is the leading cause of neurological disability in the elderly [70].

In a prospective study done locally on patients presenting with stroke at the Kenyatta National Hospital, hypertension was associated with stroke in 30.6% of the patients [71]. The study also observed that most of the patients were in there 6th and 7th decades, 46% of the patients died and the remainder had residual neurological deficit.

However stroke is not limited to the elderly; nearly 20% occur in persons less than 60 years old. Among those less than 65 years old who are employed at the time of stroke, one third will never work again. To the functionally independent individual, stroke represents a condition that many consider worse than death itself [70].

Approximately 85% of strokes, in the west, are due to cerebral infarction with the remainder being due to haemorrhage. Hypertension is an important risk factor for transient ischaemic attack, cerebral infarction, and intracerebral haemorrhage [72]. Among stroke risk factors, hypertension is clearly pre-eminent and is of importance for all stroke types, infarction as well as haemorrhage.

The incidence of Artherothrombotic Brain Infarction (ABI), the most frequent subtype, is ≈ 3 times greater in persons with stage II or III hypertension (≥160 and ≥180 mmHg systolic, respectively) and 50% higher in stage I hypertension (140 to 159 mmHg) than those with high-normal blood pressure (BP) and normotensives [70].

Multiple clinical trials have shown that reduction of elevated blood pressure in hypertensives in middle and advanced age with systolic as well as diastolic hypertension incontrovertibly reduces stroke incidence. The results from 18 controlled trials show a reduction in relative risk of stroke of 25 – 47% among treated hypertensive patients. This reduction applies both to the elderly and to younger patients [73].

A 4-years retrospective study done in hypertensive patients seen at the KNH both as outpatients and in-patients between January 1977 to December 1980 by Lule GN et al [14], observed a stroke prevalence of 10.0%. Bahemuka [74] in 1985 and Kwasa [71] in 1987 found hypertension to be associated with stroke in 30 – 50% of the patients studied at Kenyatta National Hospital.

1.4.4 CLINICAL CARDIAC DISEASE

Patients with hypertension die prematurely, the most common cause of death being cardiovascular disease [75].

In its sixth report [3], the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure (JNC VI) defined clinical cardiac disease as:

- Angina/prior myocardial infarction,
- Prior coronary revascularization,
- Heart failure.

Cardiac compensation for the excessive workload imposed by increased systemic pressure is at first sustained by concentric left ventricular hypertrophy, characterized by an increase in wall thickness resulting in left ventricular dysfunction. Ultimately, the function of this chamber deteriorates, the cavity dilates, and the symptoms and signs of heart failure appear due to left ventricular systolic dysfunction.

Angina pectoris also may occur because of the combination of accelerated coronary arterial disease (secondary to artherosclerosis) and increased myocardial oxygen requirements as a consequence of the increased myocardial mass. Evidence of ischaemia or infarction may be observed late in the disease and most deaths due to hypertension result from myocardial infarction or congestive heart failure.

ECG evidence of left atrial enlargement is associated with left ventricular dysfunction and is highly concordant with an atrial diastolic gallop (S4) and echocardiographically demonstrable enlargement of the left atrium [76]. These signs reflect diastolic dysfunction much earlier than does ECG evidence of LVH. ECG also provides critical information related to myocardial ischaemia or infarction, arrhythmias and conduction defects [25, 38].

Lule GN et al reported the prevalence of cardiac failure in hypertensives to be 33% [14] in 1985. In 1999 Oyoo GO and Ogola EN in a hospital based descriptive study [77] reported among the causes of congestive heart failure in patients admitted in KNH, 17.6% was due to hypertensive heart disease.

Amoah et al in Accra, Ghana in a study that looked at the aetiology of heart failure observed that hypertension was the cause of heart failure in 21.3% of the cases studied [78].

2 JUSTIFICATION OF THE STUDY

Hypertension and its long-term complications including cardiovascular problems are major and growing health problems locally, these being important causes of morbidity and mortality at the KNH. Notwithstanding this, hypertension is associated with co-morbid cardiovascular risk factors that necessitate comprehensive management of the patient.

There is little data locally on the prevalence of cardiovascular risk factors and target organ damage in hypertensive patients. Some data is available from within the African continent with most data emanating from the developed world; the latter data might not directly reflect on our situation due to major socio-cultural, economic and environmental differences.

This study therefore sought to determine the prevalence of certain known risk factors known to be of major importance in the genesis and progression of cardiovascular disease and target organ damage in patients with hypertension.

The data generated from this study will assist in:

(a) Assessing the burden of established major cardiovascular risk factors and target organ damage in our hypertensives.

(b) Planning and conducting further detailed studies on cardiovascular morbidity in this population.

(c) Planning strategies for comprehensive cardiovascular disease management

3 OBJECTIVES

3.1 BROAD OBJECTIVES

To determine the point prevalence of established cardiovascular risk factors and target organ damage in hypertensive patients seen in the general medical outpatient clinics at the KNH.

3.2 SPECIFIC OBJECTIVES

A. To determine the prevalence of the following cardiovascular risk factors in hypertensive patients:
   Obesity, ECG-LVH, Diabetes Mellitus, Dyslipidaemia and Cigarette smoking.

B. To determine the prevalence of the following target organ damage in hypertensive patients:
   Hypertensive Retinopathy, Nephropathy, Cerebrovascular accident and Clinical cardiac disease.

C. To describe the clustering of the cardiovascular risk factors and target organ damage among hypertensive patients.

D. To describe the association between cardiovascular risk factors, clustering of cardiovascular risk factors and target organ damage mentioned above.

4 MATERIALS AND METHODS

4.1 STUDY DESIGN

This was a hospital based cross-sectional study from October 2002 to December 2002

4.1.1 STUDY AREA

General Medical Outpatient Clinics at KNH.

4.1.2 STUDY POPULATION

All patients with hypertension (see Definition of study variables on page 29) seen and followed up in the general medical outpatient clinics at the KNH who satisfied the study inclusion criteria.

4.1.3 SAMPLING TECHNIQUE

All the files of patients who satisfied the study inclusion criteria on a particular clinic day were assigned a number. Then seven files of patients (as this was a suitable number after considering the sample size and study duration expected) were randomly selected, after which the patients were approached and those willing to participate in the study were recruited. Those who were recruited into the study were given a special appointment to be seen by the principal investigator. They were also advised to come fasting.

4.2 SAMPLE SIZE

The sample size for this study was estimated using the following sample size formula for a one-sample situation:

$$n = \frac{(Z_{1-\alpha/2})^2 \, P \, (1-P)}{d^2}$$

where,

n = minimum sample size

Z = 1.96 at 95 % confidence interval

P = estimated prevalence from other studies

d = margin of precision error

The prevalences and the minimum sample sizes for each of the risk factors and target organ damage determined in this study is indicated in the table 1 below (see page 26), having been established from previous studies and the highest number at 10% margin of precision error was selected.

Thus the minimum sample size necessary was 93 patients.

Table 1. Minimum sample size required for the study variables

STUDY VARIABLE	PREVALENCE (OTHER STUDIES)	ESTIMATED SAMPLE SIZE d = 0.10
OBESITY	28.3% [23]	78
ECG-LVH	31.7% [23]	83
DIABETES MELLITUS	15.0% [23]	* 77 (d = 0.08)
DYSLIPIDAEMIA	28.3% [23]	78
CIGARETTE SMOKING	25.0% [23]	72
RETINOPATHY	59% [14]	93
NEPHROPATHY	17.0% [69]	* 85 (d = 0.08)
CEREBROVASCULAR ACCIDENT	10.0% [14]	* 71 (d = 0.07)
CLINICAL CARDIAC DISEASE	33.0% [14]	85

4.3 PATIENT SELECTION

4.3.1 INCLUSION CRITERIA

1. Patients with hypertension, according to the study definition [3], attending the general medical outpatient clinics at the KNH. In this study, patients on anti-hypertensive treatment was the criteria used.
2. A duly signed written informed consent from the patient.

4.3.2 EXCLUSION CRITERIA

1. Patients with urinary tract infection (diagnosed on the basis of history, urine dipstick examination or urine culture) and acute or chronic febrile illness.
2. Pregnant women.
3. Unwillingness to enter into the study (this did not jeopardize patient management).

4 METHODS

ter ethical approval by the KNH Ethical and Research Committee, the study was mmenced. For each of the recruited patients the following was done after obtaining a itten consent (see Appendix V, page89 and Appendix VI, page90).

4.1 CLINICAL METHODS

A complete medical history was obtained and a physical examination was undertaken s per the proforma outlined in appendix I.

Standing height was measured once to the nearest 0.5cm, without shoes, the back square against the wall-tape, eyes looking straight ahead, with a set square resting on the scalp and against the wall [79].

Weight was measured once with a lever balance, to the nearest 100 grams, without shoes, in light garments [79].

Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared, and was categorized as per the WHO criteria [80].

Waist circumference in centimetres was taken as the narrowest circumference between the lowest rib and the top of the pelvis, measured in the horizontal plane at the end of a gentle expiration, with the subject standing [81, 82]. Hip circumference in centimetres was taken as the maximum circumference in the horizontal plane, measured over the

buttocks. Waist/hip circumference ratio (WHR) was calculated as the ratio of the former to the latter [82].

Blood pressure was measured as per the World Health Organization recommendation [83], with the patient in sitting position using the relevant cuff size and a mercury sphygmomanometer, after an initial rest period of 15 minutes.

The systolic blood pressure level was determined by the first perception of Korotkoff sound (phase 1). Diastolic pressure level was determined by the perception of disappearance of fifth Korotkoff sound (phase 5). Two measurements at five-minute intervals were taken and the average of these two readings was noted.

II) All patients' pupils were dilated with 1% tropicamide, a short-acting mydriatric. The principal investigator did the fundoscopy in the standard manner in a darkened room. The findings on examination of the retina were graded using Keith, Wagener and Barker staging of hypertensive retinopathy [58]. See appendix III.

III) All patients were subjected to a resting 12-lead electrocardiogram (ECG) using CARDIOFAX ECG 6353 (Tokyo, Japan), as per the standard ECG recording technique [84], at the Department of Cardiology, KNH.

4.4.2 LABORATORY METHODS

Blood

Following 10-12 hours of overnight fasting, 10ml of blood was withdrawn by venepuncture from each patient for the following investigations:

- Serum creatinine was performed at the Renal Laboratory, KNH, using the alkaline picrate reaction for creatinine assay, with the Random Access clinical chemistry analyser, RA 1000 (Technicon Instruments, USA)

- Fasting blood sugar was done at the Renal Laboratory, KNH, using the glucose oxidase colorimetric method on a RA 1000 analyser (Technicon Instruments, USA)

- Lipid profile assays were performed at the Forest Medical Centre Laboratory, using the HUMALYZER (Human GmbH, Germany)

Plasma cholesterol level was determined after enzymatic hydrolysis and oxidation using the enzymatic colorimetric test, "CHOD-PAP" [85].

HDL-cholesterol level was determined after separating chylomicrons, low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL) from serum by the addition of a precipitating agent (magnesium chloride and dextran sulphate). The HDL-cholesterol remains unaffected in the supernatant and was estimated by colorimetric method as for total cholesterol [85].

iglyceride was determined after enzymatic splitting with lipoprotein lipase using the zymatic colorimetric test, "GPO-PAP" [85].

DL-cholesterol level was calculated using the Friedewald-Fredrickson formula [86].

rine

0 ml mid-stream specimen of urine was collected in a sterile bottle and the following vestigations were performed:

- Urinalysis was done using the Multistix 10SG (Bayer) reagent strips, as per the standard procedures, at the Department of Microbiology, KNH [87].

4.5 DEFINITIONS OF STUDY VARIABLES

- Hypertension was defined as [3]:

  SBP ≥ 140 mmHg or DBP ≥ 90 mmHg or patient on antihypertensive treatment

- Cigarette smoking was classified [88] as:

  Current smokers: Have smoked ≥100 cigarettes in their lifetime and were still smoking or would have quit smoking within the preceding year.

  Former smokers: Have smoked ≥100 cigarettes in their lifetime but would have quit smoking more than one year earlier.

  Never to have smoked: Have smoked <100 cigarettes in their lifetime or who would have never smoked.

- Obesity using BMI (kg/m^2) was classified as [80]:

Normal	18.0 – 24.9
Overweight	25.0 – 29.9
Class1 Obesity	30.0 – 34.9
Class2 Obesity	35.0 – 39.9
Class3 Obesity	> 40.0

Central obesity was defined as: WHR ≥ 0.85 (in women), ≥ 0.95 (in men) [89].

- ECG-LVH was assessed using the Sokolow-Lyons criteria [32] because of it's simplicity and was defined as:

  $S_{V1} + R_{V5/6} \geq 35mV$ and / or R wave in aVL $\geq$ 11mm [90]

- Prior myocardial infarction was defined as [91]:

  Electrocardiographic pathological Q-waves that are deep (>1mm) and broad (>0.04seconds) in relevant leads (according to regions of infarct) with or without history of tightening chest pain radiating to the neck, left shoulder or left arm.

- Congestive heart failure was defined using the Framingham criteria as [92]:

  Current or past clinical symptoms (limitation of activity, fatigue, and dyspnoea or orthopnoea), signs (edema, elevated jugular venous pressure, rales, or S_3 gallop)

- Fasting Blood Sugar (FBS) was categorized as [93]:
  - FBS $\geq$ 7.0mmol/l to be Diabetes mellitus
  - FBS 6.1 – 6.9 mmol/L to be Impaired Glucose Tolerance (IGT)
  - FBS < 6.1 mmol/L to be Normal

- Dyslipidaemia was categorized as [94]:

Total cholesterol:	> 6.2mmol/L	(High)
	5.17 – 6.18mmol/L	(Borderline High)
	< 5.17mmol/L	(Desirable)

LDL – cholesterol:	≥ 4.91mmol/L	(Very High)
	4.13 – 4.88mmol/L	(High)
	3.34 – 4.11mmol/L	(Borderline High)
	2.58 – 3.33mmol/L	(Near Optimal)
	< 2.58mmol/L	(Optimal)
HDL – cholesterol:	< 1.03mmol/L	(Low)
	>1.55mmol/L	(High)
Triglyceride level:	≥ 2.26mmol/L	(High)
TC/HDL Ratio:	≥ 5.0	(Raised) [95]

- Nephropathy was defined as:

Clinical proteinuria (spot urine dipstick) ≥ 30mg/dl [96]

And/or

Creatinine clearance < 60 ml/min [96, 97]

Creatinine clearance was estimated using the Cockcroft-Gault equation [98] as shown:

[(140 – age) * weight (* 0.85 if female)]/ (72 * S_{Cr})

- Stroke was defined as: sudden onset of a persistent neurological deficit lasting more than 24 hours [99].

And

TIA was defined as: an episode of focal cerebral dysfunction of sudden onset lasting less than 24 hours [99].

6 DATA ANALYSIS

data from the study was entered into questionnaires and transferred to SPSS 10.0 tabase, and the data was analysed using SPSS 10.0 software. Continuous data were alysed into means and categorical data into percentages, with their corresponding 95% nfidence intervals. Comparisons of continuous data were made using the t test, and of tegorical data using the Chi-square test or Fisher's exact test. Correlations between ntinuous variables were tested using the Pearson correlation coefficient (see Objective page 20).

evalence rates of risk factors were calculated as percentages with 95% confidence ervals. Association of multiple (two or more) risk factor variables were determined, and rrelations between these variables were also identified as described above. Clustering o-occurrence) of risk factors was described as number of risk factors present.

tatistical significance was defined as a two-tailed p value of less than or equal to 0.05.

5 RESULTS

A total of 617 files of patients attending three general medical outpatient clinics of KNH were screened from 24th October 2002 to 11th December 2002 of which 216 met the study case definition. Of the 216 patients, 126 were randomly selected. Of the selected patients, 5 patients declined to participate in the study (were excluded) and 121 patients were interviewed (over 7 weeks), of which 21 did not return for appointment. We recruited 100 subjects of whom 7 had incomplete data (due to haemolysed blood samples) and were excluded from data analysis. Data for 93 patients was analysed.

5.1 BASELINE CHARACTERISTICS

There were 43 males and 50 females, giving a male to female ratio of 1:1.2. The mean age of the population studied was 53.7 years [95 percent confidence interval 51.3 to 56.1]. There was no gender difference in age of recruited patients: 54.7 [50.6 – 58.9] for males and 52.9 [50.1-55.8] for females, p=0.422. The patients' ages ranged from 23 years to 92 years, 55 patients (59.1%) being in the 41-60 years age group (Figure 1, page35).

Duration of hypertension ranged from 1 month to 38 years with a mean of 8.55 years [6.70 – 10.41, 95% C.I]. Most of the study patients (70%) had been diagnosed to have hypertension for a duration of 10 years or less (Figure 2, page35).

Nine patients (9.7%) were illiterate, 54 patients (58%) had attained up to the primary level of education, 24 patients (25.8%) secondary level of education and 6 patients (6.5%) tertiary level of education. Fifty-five patients (59.1%)had employment (self or otherwise) and 38 (40.9%) had no employment.

5.2 FAMILY HISTORY

Forty patients (43.0%) gave a family history of hypertension and 19 patients (20.4%) gave a family history of diabetes. A family history of heart attack, stroke or sudden death was obtained in 5 patients (5.4%).

5.3 BLOOD PRESSURE LEVELS

The mean SBP was 150.9 mm Hg [146.5 –155.3, 95% C.I] with a range of 98 to 205 mmHg. The mean DBP was 94.6 mm Hg [92.2 – 96.9, 95% C.I] with a range of 69 to 120 mmHg.

Twenty patients (21.5%) had their BP under control (SBP <140 & DBP <90 mmHg) [3] while 73 patients (78.5%) had their BP out of control (SBP ≥140 and/or DBP ≥90 mmHg). Figure 3 below, outlines the distribution of the BP ranges (according to JNC VI classification) observed in this study. Thirteen male patients (30.2%) compared to 7 female patients (14.0%) had their blood pressure under control [p=0.077]

Figure 1. Age distribution of the hypertensive patients

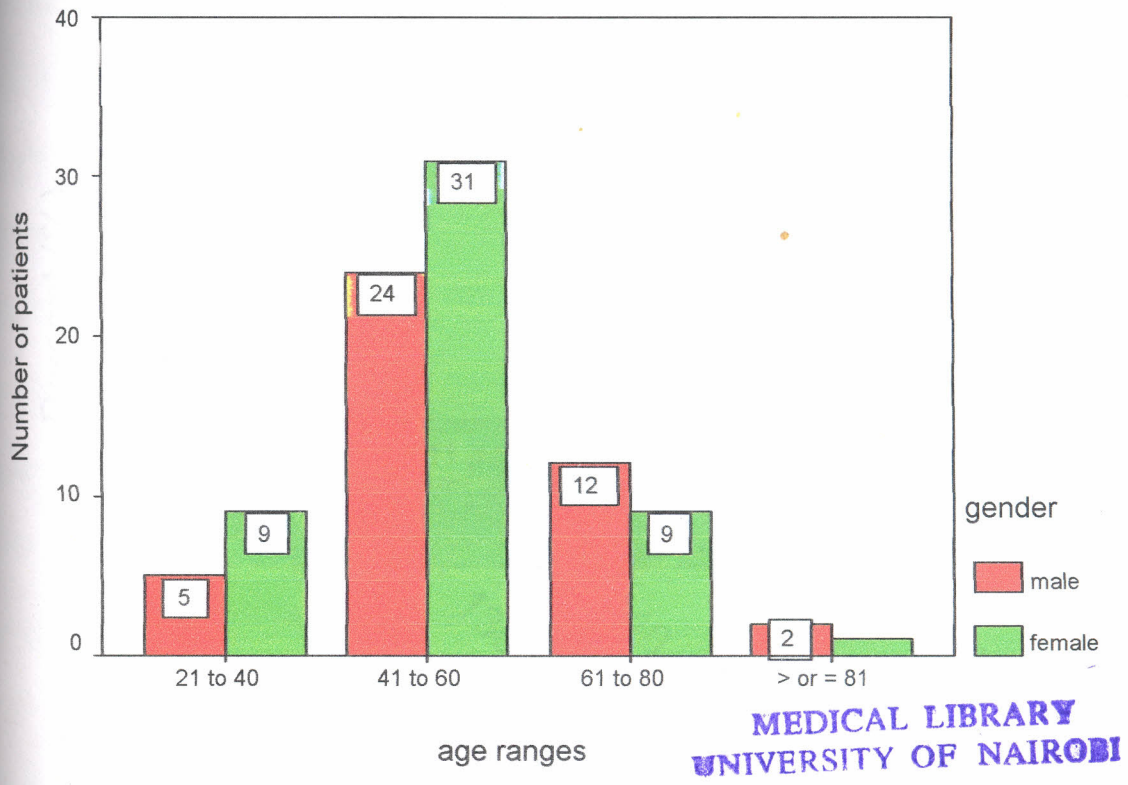


Figure2. Duration of hypertension in years of the hypertensive patients

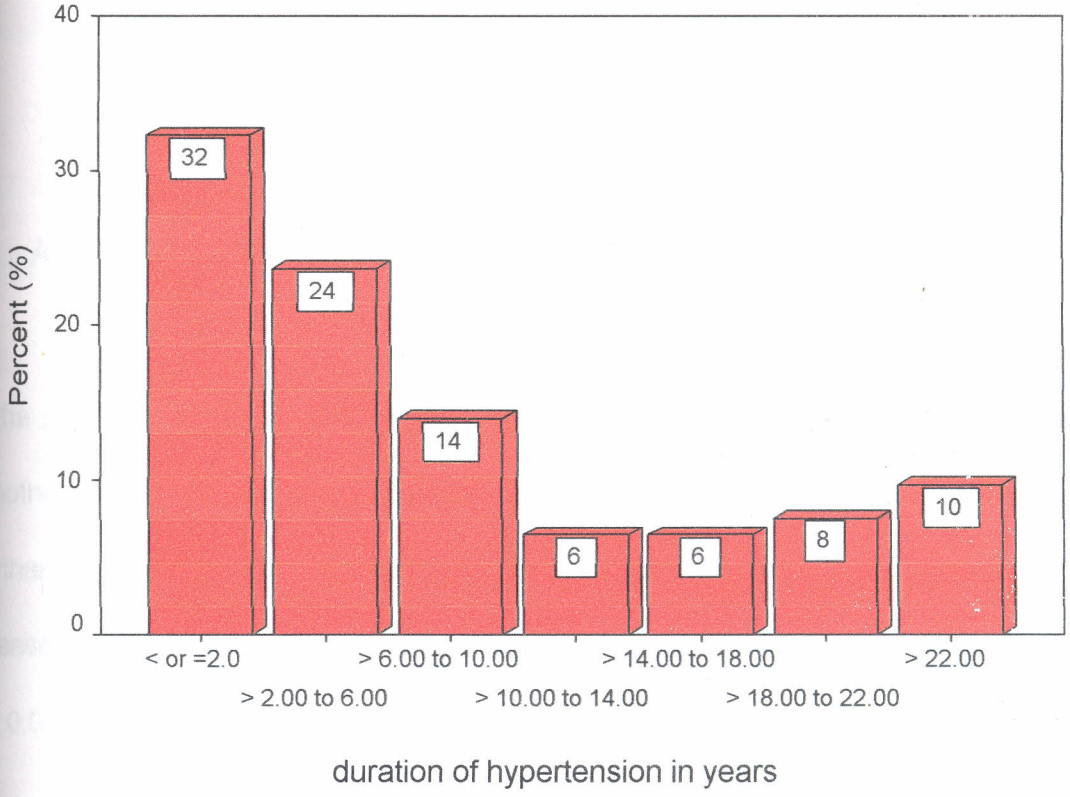
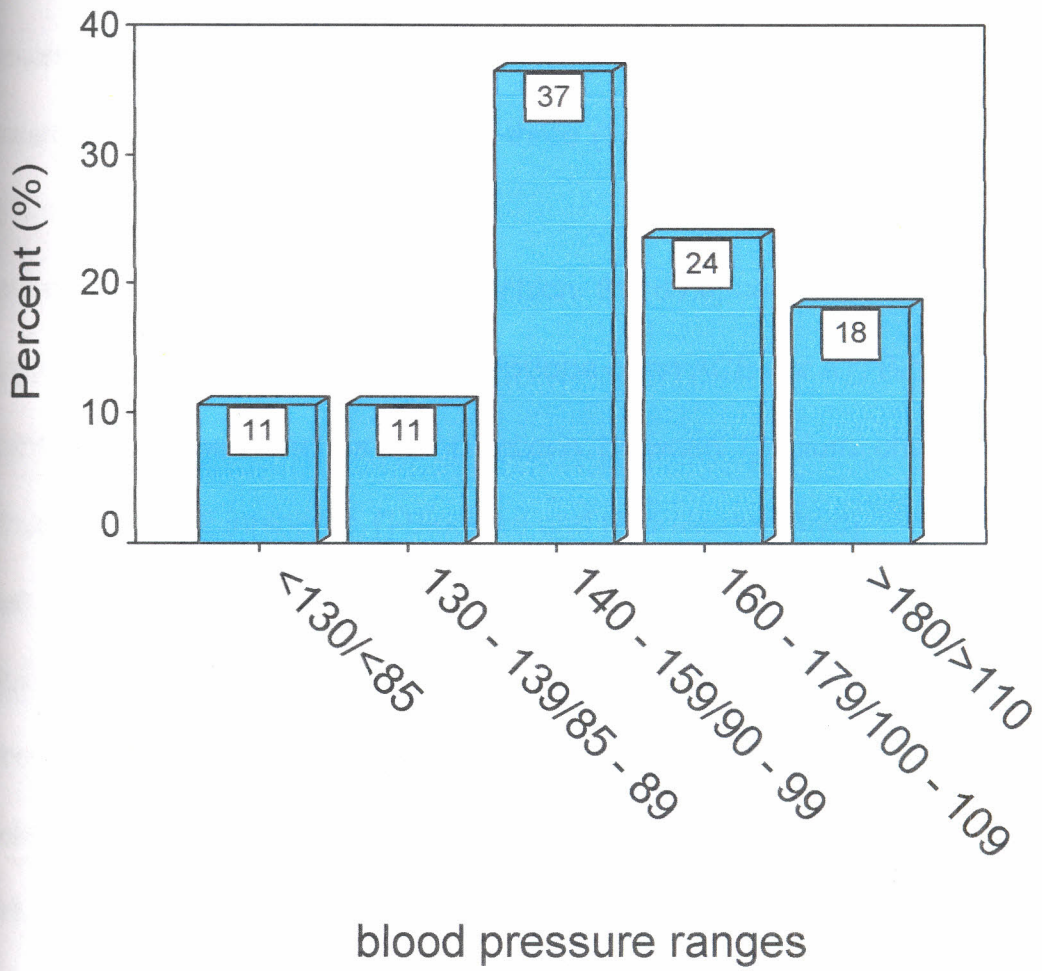


Figure 3. Blood pressure distribution according to the JNC VI classification of the hypertensive patients



5.4 ANTI-HYPERTENSIVE THERAPY

All the patients were on anti-hypertensive treatment. Twenty patients (21.5%) were on monotherapy for their blood pressure control while 73 patients (78.5%) were on polytherapy their blood pressure. As the number of drugs combined for BP control increased, the number of patients with good BP control increased (See figure 4 below) [p= 0.033].

ypertensive therapy was distributed as follows:

onotherapy – 20 patients (21.4%) of which; nine (45%) were on Calcium channel ockers (CCB), four (20%) were on □-Blockers (BB), three (15%) were on Angiotensin onverting Enzyme inhibitors (ACE-I), three (15%) were on α-methylpdopa (Aldomet) nd one (5%) on Diuretics (Diu).

Dual therapy – 48 patients (51.5%) of which; 31 (65%) combined a Diuretic with either a Calcium channel blocker or α-methylpdopa or an ACE-I or a □-Blocker. The other 17 patients (35%) used various combinations between Calcium channel blockers, α-methylpdopa, ACE inhibitors, □-Blockers and Hydrallazine (hyd).

Triple Therapy – 17 patients (18.3%) of which; 11 (65%) combined Diuretics and Calcium channel blockers with either ACE inhibitors, α-methylpdopa, or □-Blockers. Three patients combined ACE inhibitors and □-Blockers with either Calcium channel blockers or Diuretics and 2 patients combined α-methylpdopa and Diuretics with □-Blockers. Only 1 patient combined Carvedilol, a Diuretic and an Angiotensin receptor blocker.

Quadri-Therapy – 8 patients (8.6%) of which; 5 (62.5%) combined ACE inhibitors and Diuretics and Calcium channel blockers with either □-Blockers (4 cases) or α-methylpdopa (1 case). 2 patients combined Calcium channel blockers and Diuretics and □-Blockers with α-methylpdopa (1 case) or Hydrallazine (1 case). 1 patient combined Calcium channel blockers and diuretics and ACE inhibitors with Hydrallazine.

5.5 CARDIOVASCULAR RISK FACTORS RESULTS

5.5.1 OBESITY

The mean BMI was 27.54 kg/m^2 [26.60 – 28.49, 95% C.I] with a range of 19.00 – 39.70 kg/m^2 with statistically significant difference between the genders; 26.13 [24.97 – 27.29, 95% C.I] for males and 28.76 [27.37 – 30.16, 95% C.I] for females (p=0.012). The prevalence of obesity was 24.7% (23 patients) in the study population. There was statistically significant gender difference in the prevalence of obesity of recruited patients: 14% for males and 34% for females (p=0.022).

43 patients (46.2%) were overweight, 15 (16.1%) had class 1 obesity, and 8 (8.6%) had class 2 obesity (Figure 5 below). Therefore 66 patients (71.0%) were either overweight or obese.

Central obesity was measured using the waist/hip ratio (WHR). The prevalence of central obesity was 29.0% (27 patients). Of the male patients, 27.9% had central obesity compared with 30.0% of the female patients, a difference not statistically significant (p= 0.504).

5.5.2 ECG-LVH

Thirty patients (32.3%) had ECG-LVH. Of the male patients 18 (41.9%) had ECG-LVH compared to 12 (24.0%) of the female patients. This difference was statistically not significant (p = 0.078).

Figure 4. Distribution of BP Control by modes of anti-hypertensive therapy of the hypertensive patients

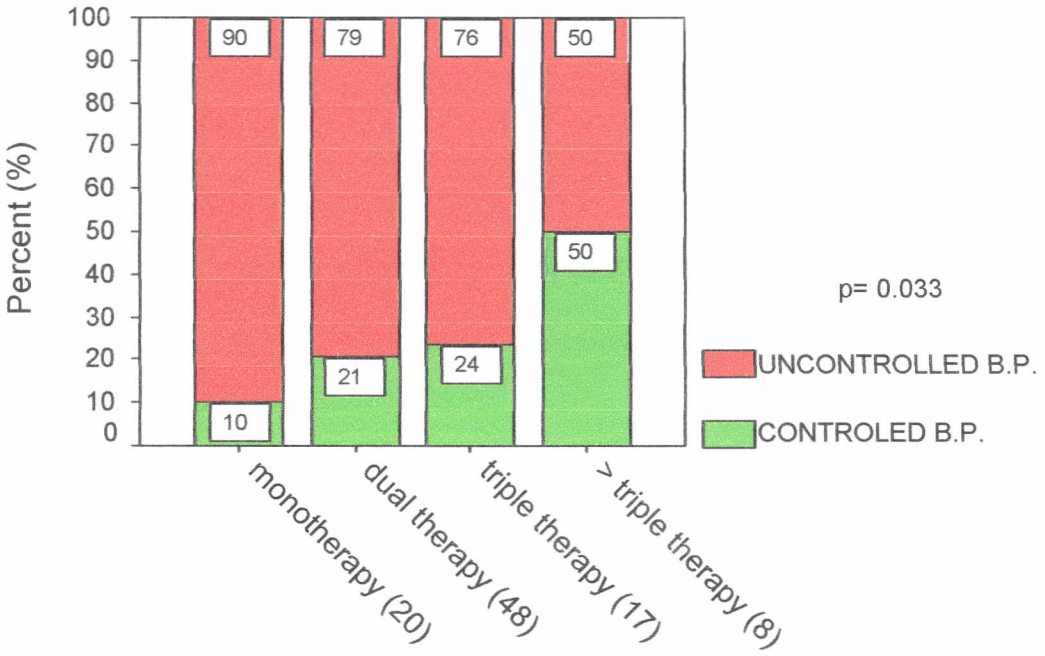
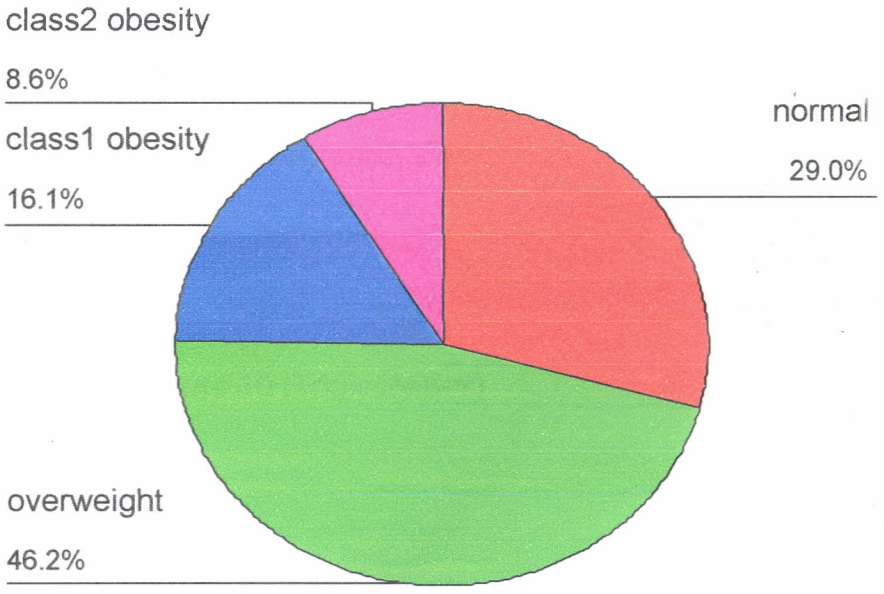


Figure 5. BMI Classification (WHO) of the hypertensive patients



5.3 DIABETES MELLITUS

e mean fasting blood glucose (FBG) was 5.9 mmol/l [5.3 – 6.6] with a range of 3.0 to .0 mmol/l. There was no significant difference in the mean FBG between the males and e females: 12.8 [4.4 – 21.2] for females and 14.1 [3.5 – 24.7] for males (p = 0.893). ne patients (9.7%) had FBG ≥7.0 mmol/l (diabetes mellitus), 11(11.8%) had FBG 6.2 – 9 mmol/l (Impaired Glucose Tolerance - IGT) [85] and 73(78.5%) had FBG less or equal 6.1mmol/l, as shown in Figure 6 below.

mong the patients with diabetes mellitus, 1 patient was on "GNLD" products, 1 was on n oral hypoglycaemic agent and another 1 was on an oral hypoglycaemic agent and sulin injections. The remaining 6(66.7%) were newly diagnosed in this study.

5.4 DYSLIPIDAEMIA

he mean values with 95% confidence intervals for the parameters of the fasting lipid rofile are shown in Table 2 below and the prevalence of dyslipidaemia based on the ational Cholesterol Education Program (NCEP III) criteria [86] is as shown in Table 3 elow. The categories and percentage distribution of the various individual lipid bnormalities are as shown below in figure 7 (Total Cholesterol), Figure 8 (LDL - C), igure 9 (HDL - C) and Figure 10 (Triglycerides)

Figure 6. Fasting blood glucose Classification of the hypertensive patients

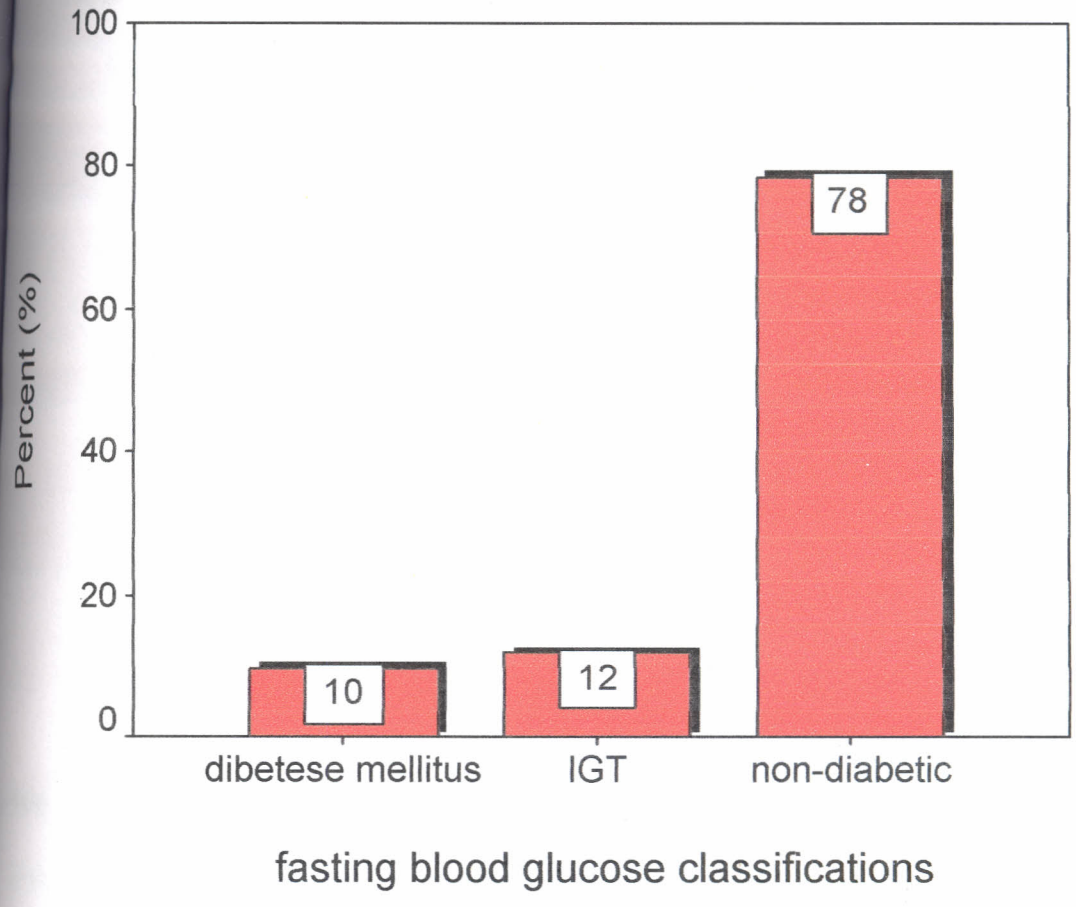


Table 2. Mean values [95% Confidence Interval] for lipid profile of the hypertensive patients

ipid variable	Total (n=93) [95% CI]	Males (n=43) [95% CI]	Females (n=50) [95% CI]	P value M/F
otal-cholesterol mmol/l)	4.93 [4.64 – 5.02]	4.76 [4.47 – 5.05]	4.89 [4.62 – 5.12]	0.532
HDL-cholesterol mmol/l)	1.14 [1.08 – 1.20]	1.13 [1.05 – 1.21]	1.15 [1.05 – 1.25]	0.725
LDL-cholesterol mmol/l)	2.86 [2.66 –3.06]	2.77 [2.47 – 3.07]	2.94 [2.67 – 3.21]	0.393
Triglycerides mmol/l)	1.83 [1.61 –2.04]	1.91 [1.50 – 2.32]	2.76 [1.55 – 1.96]	0.497

Table 3. Proportion of patients with dyslipidaemia based on the National Cholesterol Education Program (NCEP III) of the hypertensive patients

Lipid variable	NCEP III cut-off values	Number (%)
Total cholesterol (mmol/l)	$\geq$ 5.17	32 (34.4)
HDL-cholesterol (mmol/l)	< 1.03	36 (38.7)
LDL-cholesterol (mmol/l)	$\geq$ 3.34	28 (30.1)
Triglycerides (mmol/l)	$\geq$ 2.26	23 (24.7)

Sixty-five patients (69.9%) had some form of dyslipidaemia of whom 27 patients (29.0%) had only one lipid abnormality while 38 patients (40.9%) had at least two lipid abnormalities. Most of these patients had either elevated levels of total cholesterol or low levels of HDL-cholesterol (Table 3 above). Only one patient was on a lipid-lowering agent (statin).

The mean TC/HDL ratio was 4.6 [4.2 – 5.1, 95% CI], the mean for female patients being 4.8 [4.1 – 5.5, 95% CI] and that for the male patients being 4.4 [4.0 – 4.8, 95% CI], (p =0.310). Thirty-one patients (33.3%) had raised TC/HDL ratio, with 40.0% of the female patients having raised TC/HDL ratio compared to 25.6% of the male patients (p=0.187). The correlations between TC/HDL ratio and HDL , and TC/HDL ratio and TC are as shown infigures11and 12 below.

Figure 7. Total Cholesterol levels' distribution of the hypertensive patients

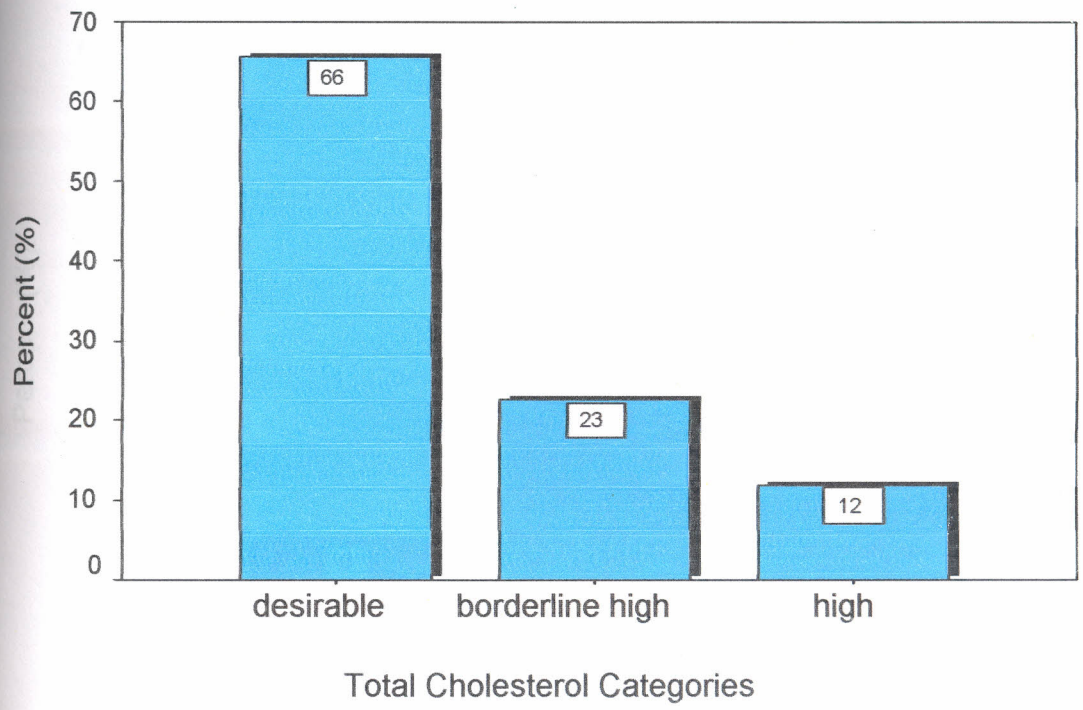


Figure 8. LDL Cholesterol levels' distribution of the hypertensive patients

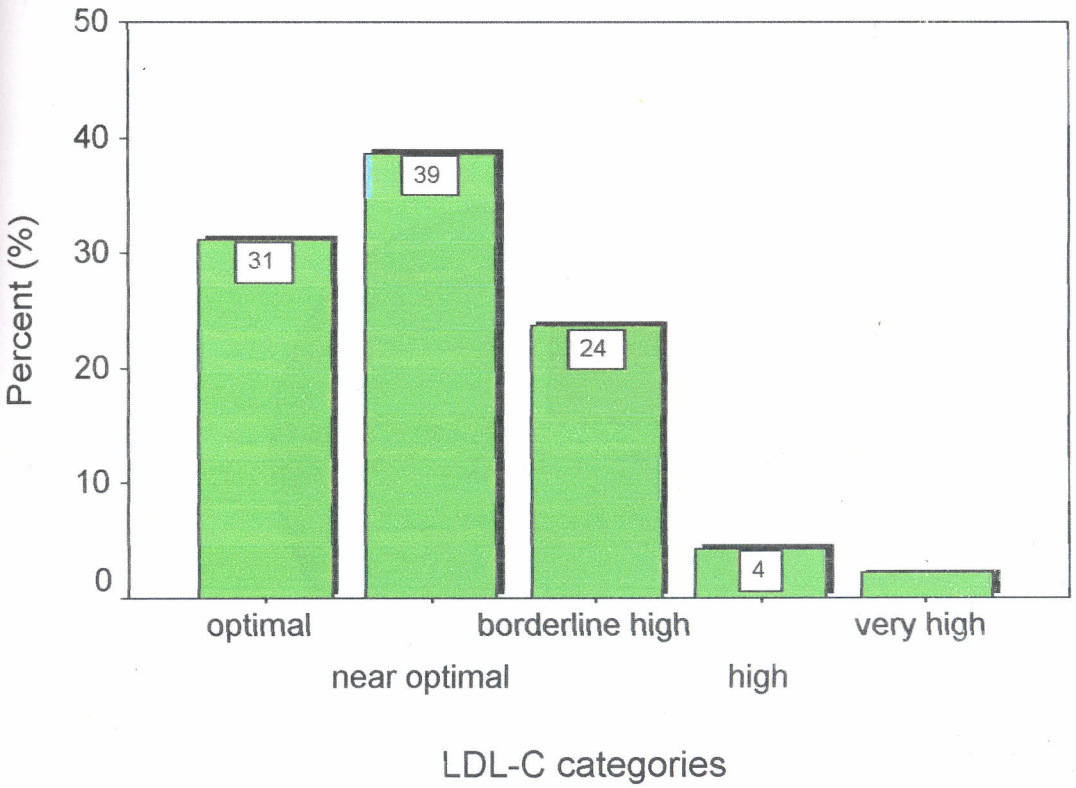


Figure 9. HDL Cholesterol levels' distribution of the hypertensive patients

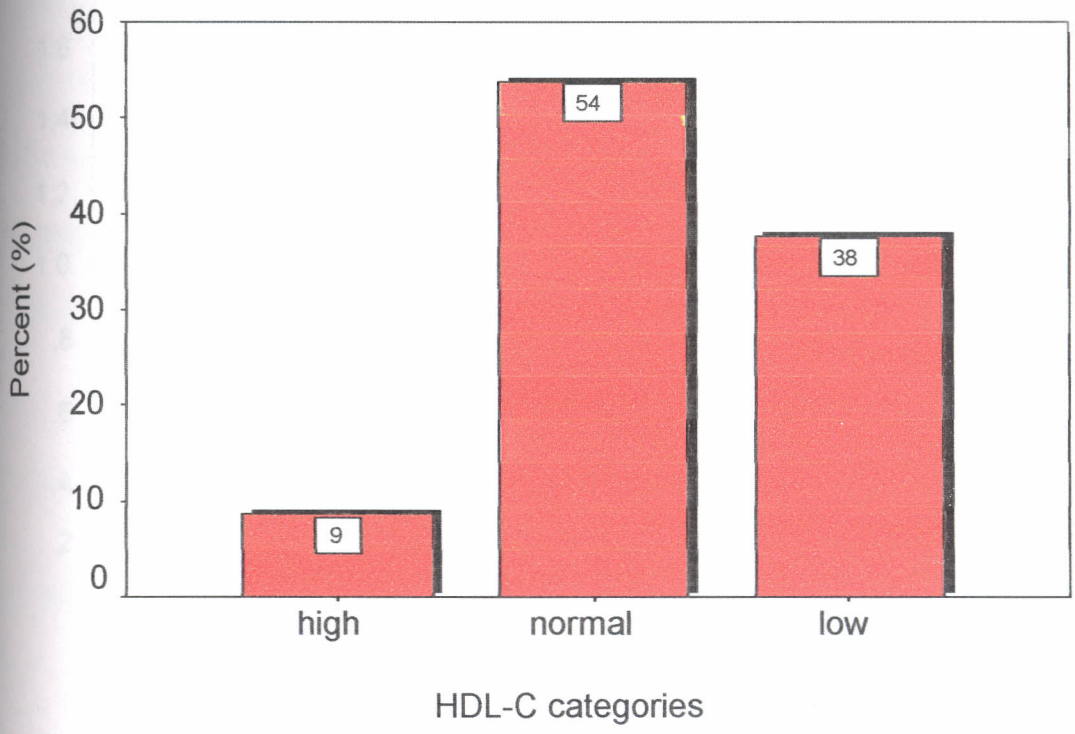


Figure 10. Triglycerides levels' distribution of the hypertensive patients

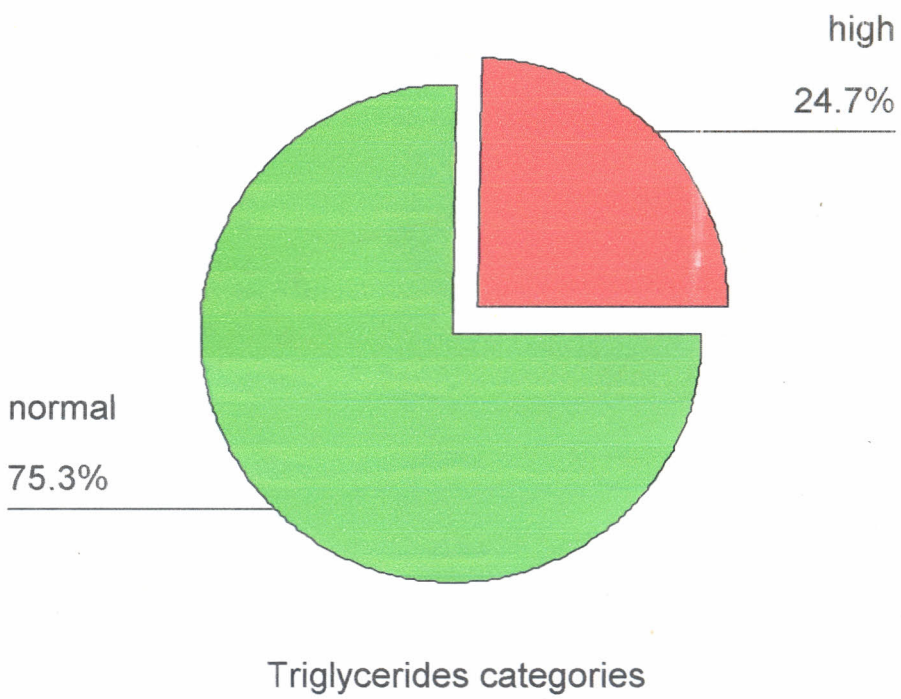


Figure 11. Correlation between TC/HDL ratio and HDL-C of the hypertensive patients (r = - 0.761, p < 0.001)

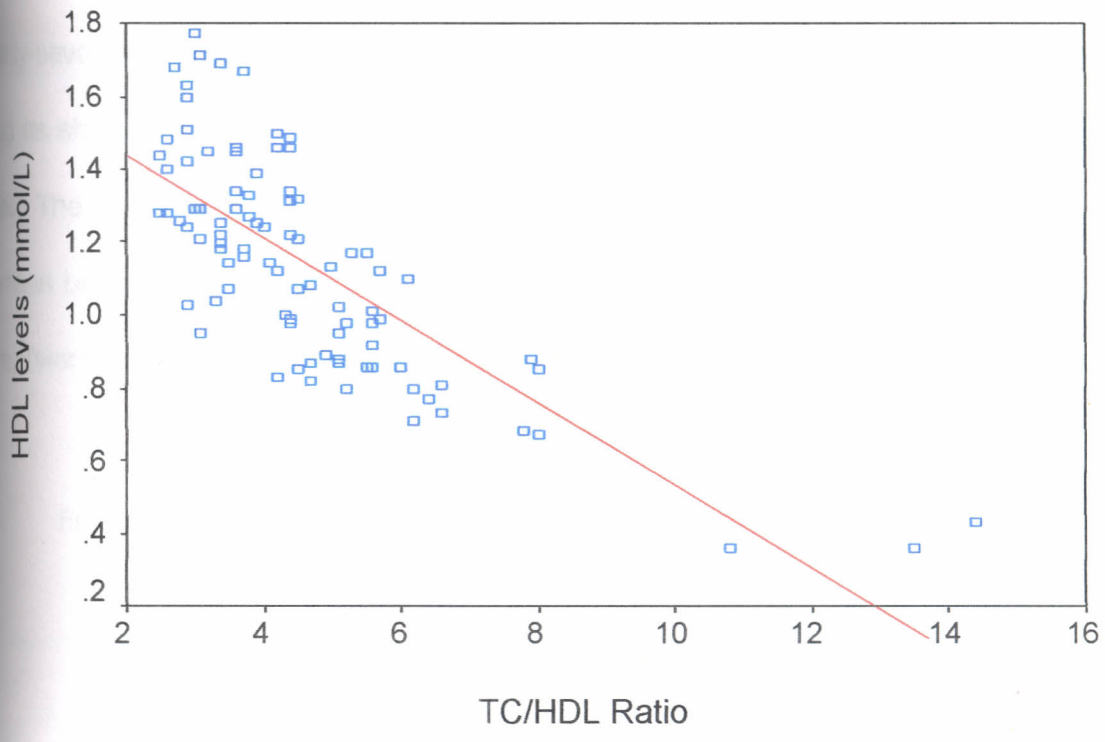
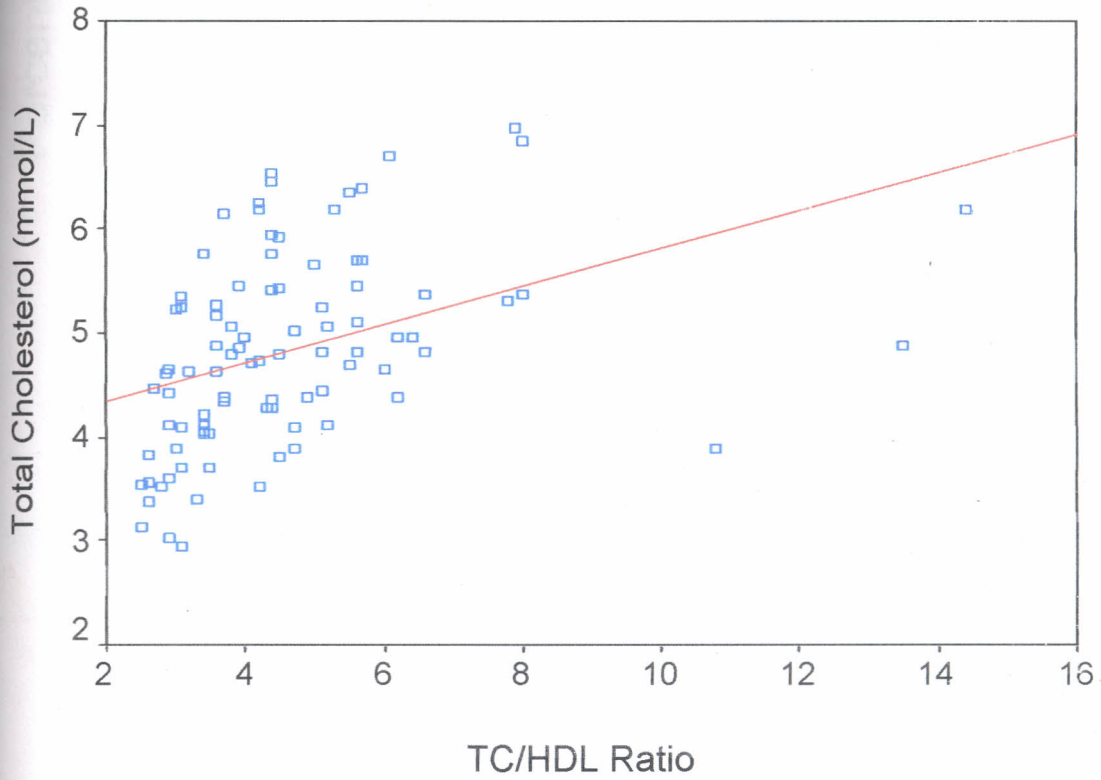


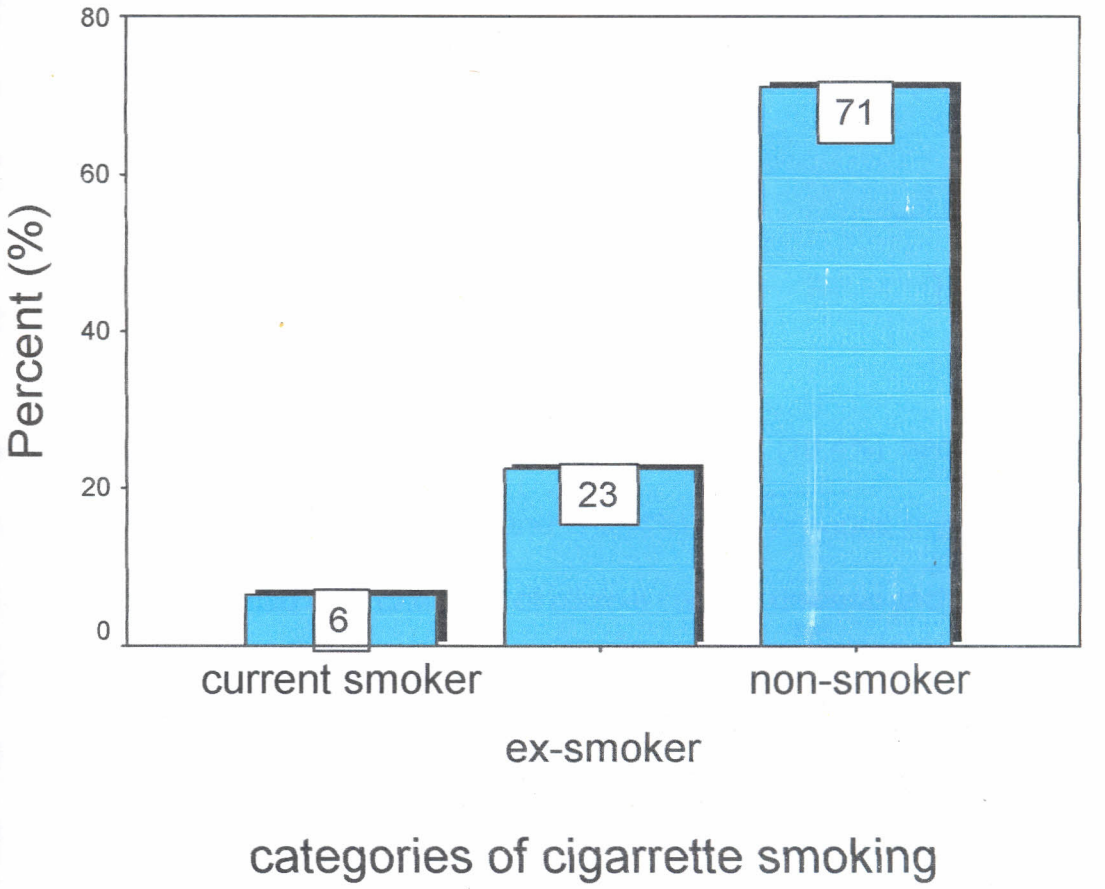
Figure 12. Correlation between TC/HDL ratio and TC of the hypertensive patients (r = 0.400, p < 0.001)



5.5.5 CIGARETTE SMOKING

Twenty-seven patients (29.1%) had a history of cigarette smoking with the classification being as shown in figure 13 below. Six patients (6.5%) were current smokers (all were males). The range of smoking in pack years in the current smokers was 0.40 to 32.00 with the mean being 13.88 [1.34 – 26.41] with 4 patients having smoked for 2 or more pack years. Twenty-one patients (22.6%) were ex-smokers of whom only one was a female.

Figure 13. Cigarette Smoking Distribution of the hypertensive patients



6 TARGET ORGAN DAMAGE RESULTS

6.1 HYPERTENSIVE RETINOPATHY

otal of 60 patients (64.5%) had hypertensive retinopathy, with 46 patients (49.5%) ving grade I retinopathy, 13 (14.0%) grade II retinopathy, 1 (1.1%) grade III retinopathy d none with grade IV retinopathy.

6.2 STROKE / T.I.A

e prevalence of stroke or transient ischaemic attacks was 11 (11.8%). Six patients were ale (14.0% of all male patients) while 5 patients were female (10.0% of all female tients), p = 0.556.

6.3 CLINICAL CARDIAC DISEASE

hirty patients (32.3%) had clinical cardiac disease. 18 (19.4%) had congestive heart ailure, 9 (9.7%) had history of angina and 5 (5.4%) had previous myocardial infarction. wenty-eight patients had only one form of clinical cardiac disease and 2 patients had two orms of clinical cardiac disease (congestive heart failure and previous myocardial nfarction). Fifteen of the male patients (34.9%) had clinical cardiac disease and 15 fifteen f the female patients (30.0%) had the same [p=0.615]. There was no statistical gender ifference in the individual cardiac diseases.

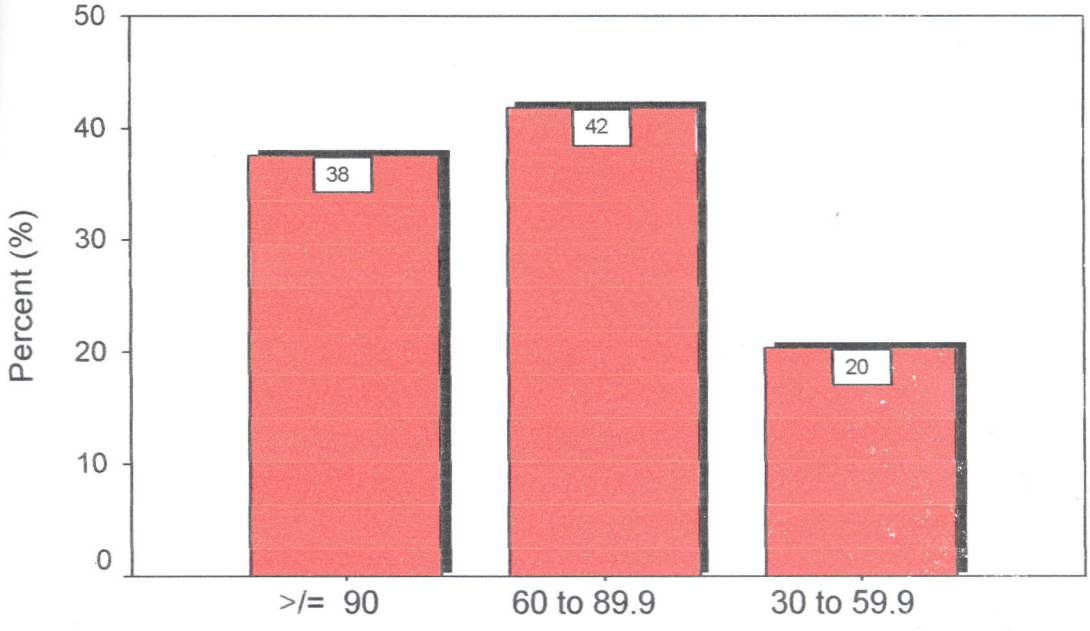
6.4 NEPHROPATHY

enty patients (21.5%) had nephropathy. Nine patients (20.9%) were male and 10 0%) were female (p = 0.912).

e mean creatinine clearance was 86.1 ml/min with the mean for males being 88.2 min and that of females being 84.3 ml/min (p = 0.557). The distribution of the various eatinine clearance ranges is as shown in figure 14 below.

ur patients (4.4%) had proteinuria ≥ 30 mg/dl, 27 patients (29.0%) had trace proteinuria d 62 patients (66.7%) had no proteinuria. Of those patients who had trace proteinuria, (38.0%) were female and 8 (18.6%) were male. This difference was not statistically nificant (p = 0.075).

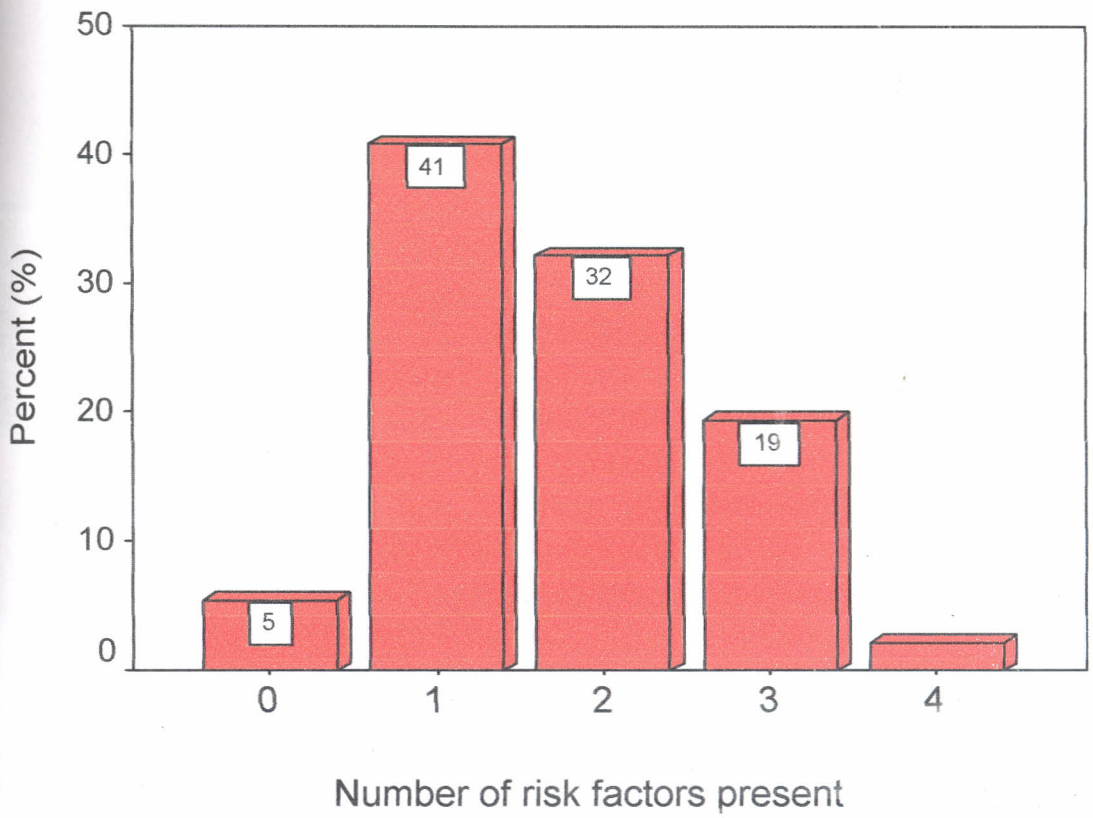
Figure 14. Creatinine clearance distribution ranges of the hypertensive patients



CARDIOVASCULAR RISK FACTOR CLUSTERING

stering of cardiovascular risk factors present in individuals in the study population was lysed (Figure 15 below). These were age (age >60yrs), family history of diovascular disease in first-degree relatives, smoking, diabetes, obesity, dyslipidaemia d ECG-LVH. Nearly all patients (94.6%) had at least one CVD risk factor present, luding their hypertensive state, with the majority (53.8%) having two or more risk tors. As shown in figure 16 below, as the number of risk factors increased in a patient, e percentage of presence of target organ damage increased though this was not tistically significant (p=0.052)

Figure 15. CVRF Clustering of the hypertensive patients



CLUSTERING OF TARGET ORGAN DAMAGE

Most of the patients (76.3%) had at least one target organ damage, with only 23.7% having no target organ damage (see figure 17 below). Thirty-four patients (36.6%) had only one target organ damaged, 26 patients (28.0%) had two target organs damaged and 11 patients (11.8%) had three target organs damaged.

Figure 16. Prevalence of TOD according to number of risk factors present of the hypertensive patients

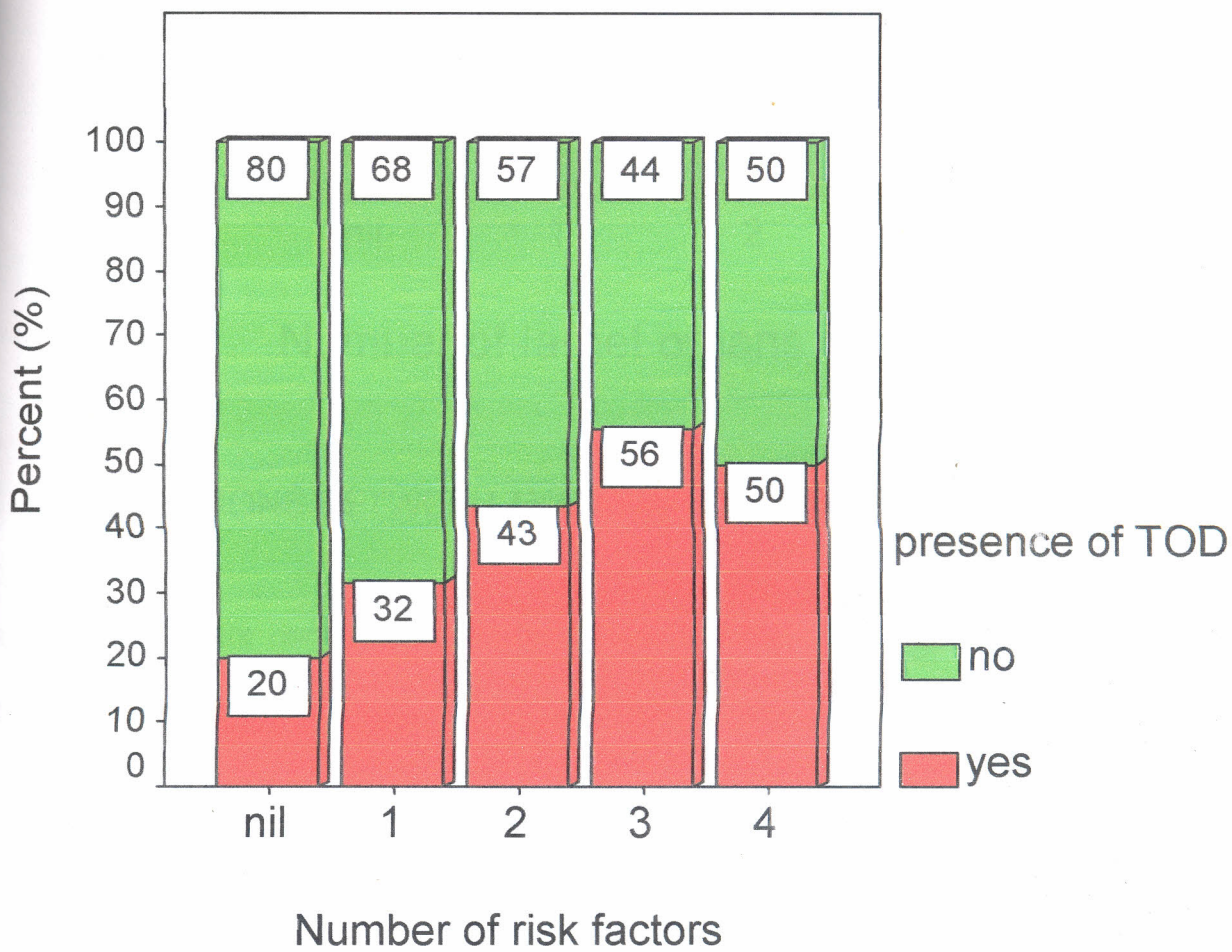
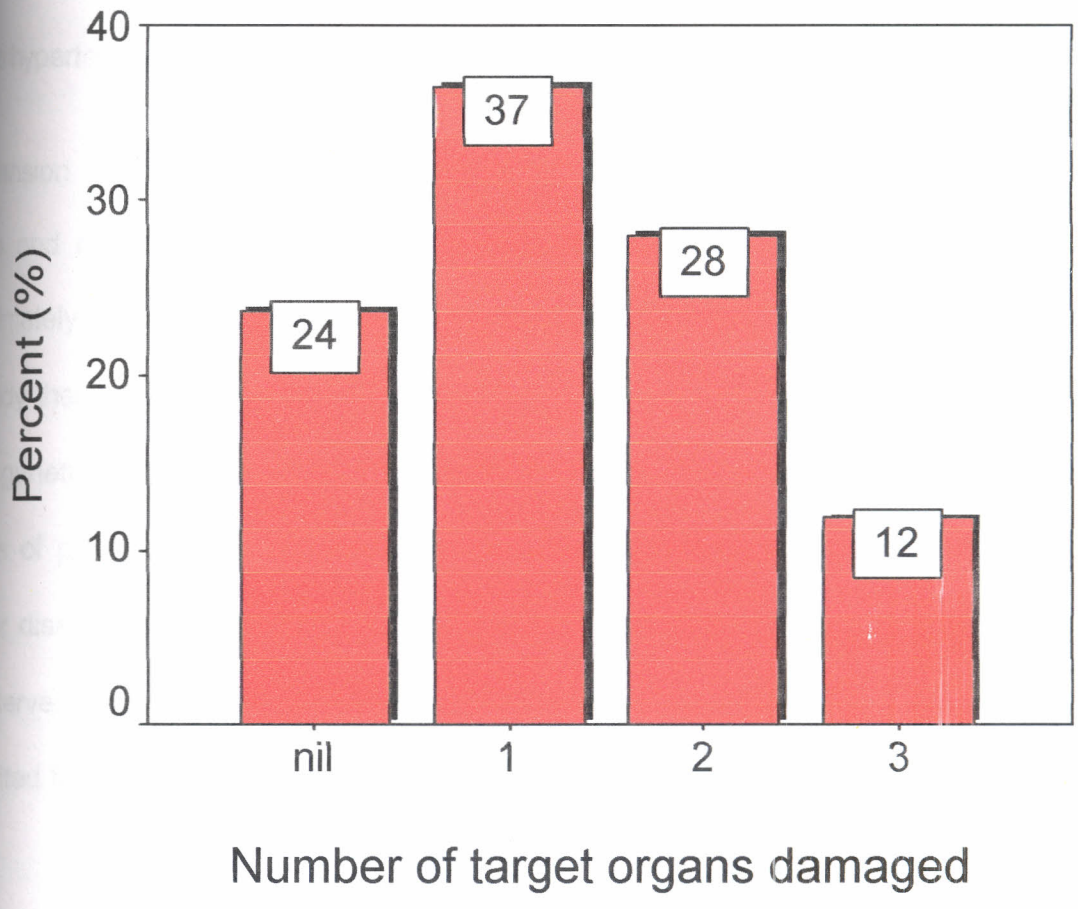


Figure 17. Clustering of number of target organ damaged

of the hypertensive patients



9 CORRELATIONS BETWEEN THE STUDY VARIABLES

here were significant correlations between TC/HDL ratio and HDL ($r = -0.761$, $p < 001$), TC/HDL ratio and TC ($r = 0.400$, $p < 0.001$), and between BMI and creatinine earance ($r = 0.480$, $p < 0.001$). No other significant correlations were observed etween the study variables.

DISCUSSION

Most of the patients in this study were of middle age, with the male to female ratio being almost equal. The mean duration of hypertension of eight and a half years observed in this study might be an underestimate considering that most of the patients are diagnosed to have hypertension incidentally when they go to a medical centre for other illnesses.

Hypertension is about twice as common in subjects who have one or two hypertensive parents and multiple epidemiological studies suggest that genetic factors account for approximately 30 percent of the variation in blood pressure in various populations [100]. In this study there was a high prevalence of family history of hypertension, which could be due to genetic factors, environmental factors or both. It is therefore advisable to screen relatives of patients with hypertension (as a specific target group) for risk factors for vascular disease (especially hypertension) and appropriate measures be taken towards early intervention, which would be more cost-effective in a resource-poor country like ours with limited facilities available for definitive management of vascular events.

The prevalence of family history of vascular diseases or sudden death among first-degree relatives was very low (5.4%) compared to that observed in a previous local study (26.7%) by Yonga et al [23]. The population of the study done by Yonga et al was different in that they were younger and newly diagnosed hypertensives, though these differences cannot explain the difference in the prevalences of family history of cardiovascular diseases or sudden death among first-degree relatives between the two studies.

ost of the patients (78.5%) used more than one drug for their blood pressure control. is conforms to general practise, as most of the times to adequately control blood essure one needs to use more than one anti-hypertensive drug. Another reason for the eed to use more than one anti-hypertensive drug to adequately control BP could be that e study population was a select group of patients considering that KNH is a tertiary ferral hospital and patients who were difficult to control their BP been referred to KNH. espite such a comment, it is important to note that KNH also doubles as a primary ealth care provider and most of the patients being followed-up in the general medical utpatient clinics are being followed up in KNH for this reason and not due to referral. In is study it was observed that the more the number of drugs used, the higher the ercentage of patients with good BP control ($p = 0.033$).

e combination of a calcium channel blocker and a diuretic with or without another drug s the most commonly used combination in the polytherapy group. Of importance to te also, is that the most common drug used in the monotherapy group was a calcium annel blocker (Nifedipine-R) and diuretics (Furosemide) were the least used. The fact at a calcium channel blocker is used more frequently than a diuretic is very interesting, nsidering that diuretics are the recommended initial drugs for uncomplicated pertension in the JNC VI [3] and have been shown in the recent Anti-hypertension and id-Lowering treatment to prevent Heart Attack Trial (ALLHAT) and the Second stralian National Blood Pressure Study (ANBP2) to be as effective as CCBs and ACE- Also diuretics are generally cheaper compared to other anti-hypertensive drugs.

hereas most studies used Thiazide diuretics and few (if any) used Furosemide, we still eem to be using a lot of Furosemide instead of Thiazide diuretics. The rational of this ractice is questionable but it could be based on the availability of drugs in KNH, the nviction of the medical practitioners on the superior efficacy of these drug combinations both. We also observed that most of our patients (78.5%) had a poor BP control that uld possibly have contributed to the high prevalence of target organ damage.

hough the prevalence of obesity (24.7%) in hypertensive patients seems to have ecreased over the last 10 years since the study done by Yonga et al (28.3%)[23], nearly alf of the total studied patients were overweight. It is well known that being overweight ffects blood pressure control and it has been shown that in overweight patients with ypertension, weight reduction enhances the blood pressure lowering-effect of oncurrent antihypertensive agents and can significantly reduce concomitant ardiovascular risk factors such as diabetes and dyslipidaemia [101]. The observation at more female patients were obese than male patients (p=0.022) is not unexpected as all ages after puberty, women are more obese than men [102]. The prevalence of ntral obesity (29%) observed in this study is comparable to those seen in the west 0.2% – 27.1%) [102] perhaps reflecting the westernisation of our lifestyle.

he prevalence of ECG-LVH in our study (32.3%) fell within the range of prevalences of 7.5% to 42.6% observed in previous local studies. All the local studies, including ours ther used the Sokolow-Lyons criteria (due to it's simplicity) or the Romhilt-Estes point core system (thought to be the most sensitive criteria) to assess ECG-LVH. As discussed arlier, the sensitivity and specificity of these criteria vary widely depending upon the opulations studied, the "gold standard" employed (Echocardiographic left ventricular

ass versus necropsy measurements), and the severity of LVH [36, 37]. Never the less, though it is relatively insensitive compared to Echocardiography [39], the ECG does ave prognostic significance. Hypertensive patients with echocardiographically proven VH who also meet ECG criteria have a greater left ventricular mass than those without e expected ECG changes [104].

Only nine patients (9.7%) had diabetes mellitus. This figure is far less than that observed by Yonga GO et al (15%) [23]. This large difference could be due to two reasons: first; most of the diabetic patients in KNH are being followed in the special diabetic clinic and second; the cut-off value used for diabetes mellitus in the previous study was a fasting blood sugar of greater than 6.0 mmol/L while we used a higher cut-off value of a value FBG greater or equal to 7.0 mmol/L [85]. It is also important to note that we observed that a significant percentage of the patients had IGT, there being no significant difference between the males and the females (in diabetes mellitus and IGT) despite the female patients having more obesity than the males. It is known that the risk of developing IGT or type 2 diabetes is not only dependent on obesity but is also dependent on genetic factors, sedentary lifestyle and weight gain after the age 18yrs for females and 20 years for males among other factors [105]. These factors were not assessed in our study but could explain the absence of gender difference in our diabetics despite more female patients being obese.

It was interestingly observed that two-thirds of the diabetic patients were newly diagnosed in this study and managed accordingly. Also all the patients with impaired glucose

rance were not aware of their condition. This re-emphasizes the need for us to screen hypertensive patients for other co-morbid conditions.

e of the findings in this study is the very high prevalence of dyslipidaemia (69.9%), it ng the most prevalent risk factor. This could possibly be explained by the fact that 0% of the patients were either *overweight or obese*. As we know obesity is associated h a number of deleterious changes in lipid metabolism resulting in dyslipidaemia [106]. has also been shown in NHANES III that the prevalence of high blood cholesterol and ean levels of cholesterols were higher at BMI levels of over 25.0 rather than below 25.0 t did not increase consistently with increasing BMI above 25.0 [107].

study done locally observed a dyslipidaemia of 28.3% in hypertensive patients [23], ile a study in a provincial teaching hospital done in Barcelona that looked at the evalence of lipid disorders in hypertensive patients observed the prevalence of slipidaemia to be 47% [108]. These studies were done ten years ago, while a study ne three years ago in Israel which looked at risk factor clustering in hypertensive atients observed the prevalence of dyslipidaemia to be 77% in the coronary artery sease-negative hypertensive subjects and 93% in the coronary artery disease-positive ypertensive subjects [53]. As there is an international trend of increase in the prevalence f overweight and obesity [109], and the association between increased BMI and yslipidaemia [107], the prevalence of dyslipidaemia can be expected to have increased. his could also contribute to the great difference observed between the prevalence of yslipidaemia in our study and studies done 10 years ago.

ost of the patient had more than one lipid abnormality, with the most prevalent type of slipidaemia being low HDL-C. The presence of Metabolic Syndrome in the studied pulation is suggested considering that all the study patients were hypertensive, a high evalence (71%) of patients who were either overweight or obese and a 38.7% evalence of low HDL-C. Of interest is the significant correlations observed between C/HDL ratio and HDL-C and TC. Although one might explain these correlations by the vious constituent reason of the TC/HDL ratio, it should be noted that the two nstituents (TC and HDL-C) vary and manifest differently and independently in slipidaemic conditions.

n a study done in Stanford University School of Medicine, USA [110] that had set to fine the pathophysiologic characteristics of patients at high risk for coronary heart sease due to an increased TC/HDL ratio also observed significant ($p < 0.001$) rrelations between the TC/HDL ratio and HDL-C ($r = -0.73$). They also observed that atients with a high TC/HDL ratio were also significantly more insulin resistant, glucose tolerant with a greater plasma insulin response to oral glucose, and ypertriglyceridaemic ($p < 0.05 – 0.001$). Considering that TC/HDL ratio is not affected by sting levels, the cost of doing the full lipid profile and the suggestion that it may have reater predictive value for CHD than serum total or LDL-cholesterol [51]; It is therefore uite in order for one to suggest the use of TC/HDL ratio rather than the full lipid profile in ur set-up.

t was also observed that only 1 patient was on a lipid-lowering agent (Statin) and that nly 5 patients had had lipid profile assays in their follow-up at KNH; perhaps reflecting

e lack of comprehensive management of the hypertensive patients, lack of reliable cilities or poor socio-economic status of the patients. This problem needs to be looked o as the majority of the hypertensive patients studied have dyslipidaemia, therefore ey need to be screened for the same and managed accordingly.

ough the prevalence of current cigarette smoking observed in this study (6.5%) is uch smaller than that of a study [23] done locally (25.0%), twenty-one patients (22.6%) ere classified as ex-smokers. Also the afore-mentioned local study [23] considered moking to be significant when the habit of smoking had been consistently a daily routine r many years. Such a definition, if used in our study, would easily have included all the x-smokers in the "significant smokers" group resulting in a prevalence of about 29%. Not ithstanding the above comment, our prevalence of current smokers is low and most of e patients who had a history of cigarette smoking had quit smoking more than one year go, a habit that should be encouraged more as it has been shown that cardiac risks ssociated with cigarette smoking diminish relatively soon after smoking cessation and ontinue to fall with increasing length of time since quitting [111]. In fact in one study of 64 post-infarction patients the risk of recurrent infarction fell by 50 percent within one year f smoking cessation and normalized to that of nonsmokers within two years [112].

was also observed that all the current smokers and ex-smokers were males except for 1 x-smoker was a female ($p<0.001$). This observation is similar to that seen in previous ocal studies [23] but different from the western population in which prevalences of urrent smokers have been reported to be 23.6% in males and 20% in females [113]. nterestingly in the above-mentioned study [113], whereas the percentage of male current

nokers had decreased compared to previous studies, the percentage of female current nokers had increased. Locally, studies in hypertensives have not shown an increase in e percentage of female current smokers, possibly due to the different socio-cultural ehaviours of the two regions.

he prevalence of hypertensive retinopathy was very high (64.5%), it being the most revalent target organ damage. Previous local studies had observed prevalences of 9.0%[14], 72.9% [61] and 75% [62]. The studies done by Awan AM et al [61] and gumuta AM [62], used retinal photography while the retrospective study done by Lule N et al [14], used routine fundoscopy. As stated in the literature review (above) retinal hotography is superior in detecting minor changes of hypertensive retinopathy, hence ore sensitive, than routine fundoscopy [63].

he fact that we still observe a high prevalence of hypertensive retinopathy after studies one 15 to 20 years ago had observed similar high prevalences is very saddening. This ould be a reflection of the poor BP control in our patients or due to late diagnosis of ypertension or referral of our patients. We also observed that nearly all the patients tudied had milder grades of hypertensive retinopathy (grade I and II), with the majority aving grade I hypertensive retinopathy. This implies that we still have a chance to revent further progression of hypertensive retinopathy in hypertensives if we take ppropriate measures and manage the patients in totality. Previous local studies [61, 62] ad observed a higher prevalence of the higher grades of hypertensive retinopathy as heir study populations had more severe blood pressures due to the criteria for *ypertension used in the studies (160 – 170/100 mmHg).*

e prevalence of nephropathy observed (21.5%) was higher than that of 15% observed patients with essential hypertension in a study done in the United Kingdom [114]. ssible explanations could be that the United Kingdom (UK) study was done 10 years o and the prevalence in the UK might now be higher due to the increase of obesity bally resulting in poorer BP control. Also genetic and environmental factors may have ntributed to this difference. A local prevalence in the audit report done by Kayima JK 9] when he looked at the scope of renal disease in the Renal Clinic at KNH was 17%. data is available locally or in Africa that looked at the prevalence of nephropathy in pertensive patients.

t withstanding the above observation, we observed that most of the patients (41.9%) d a creatinine clearance of 60 – 89.9 ml/min. Though this range of creatinine clearance y be normal for certain age groups (those above 60 years old), it was observed that ee-quarter of the patients with a creatinine clearance of 60 – 89.9 ml/min were of the e 60 years or below (p=0.023) inferring that for the majority of these patients this was abnormal creatinine level. These observations suggest that a large number of our pertensive patients, though may not have chronic renal failure, do have chronic kidney ease (CKD) stage II according to the K/DOQI staging and guidelines [115].

the (four) patients with proteinuria ≥ 30mg/dl had abnormal creatinine clearance ues. The very low prevalence of patients with proteinuria ≥ 30mg/dl is in keeping with hropathies associated with hypertensive nephrosclerosis suggesting that the hropathy observed in our study was likely secondary to hypertension.

e significant correlation in which the higher the BMI the better the creatinine clearance served was an expected finding, as increased renal blood flow and glomerular filtration e has been associated with obesity [116]. It is also known that using actual body ight in the Cockcroft - Gault equation overestimates the creatinine clearance of obese tients [117].

e prevalence of Cerebrovascular Accidents in this study is 11.8%. A 4-years trospective study done in hypertensive patients who had attended KNH both as tpatients and in-patients between January 1977 and December 1980 by Lule GN et al 4], reported a stroke prevalence of 10.0%. Though there is a very small difference in the evalence of CVA between our study and that done by Lule GN et al, it should be noted at we observed patients who were attending as *outpatients* in the general MOPCs only. so most of our stroke patients maybe are being followed up in the special Neurology inic in KNH. By virtue of the above scenario it is but only logical to argue that the evalence of this target organ damage in reality can only be higher and not lower than 1.8%.

ore W et al [71] and Bahemuka M [74] found hypertension to account for 30 – 50% of trokes at Kenyatta National Hospital. All these studies involved *in-patients*, their ypertension definition was; at least 2 BP readings of 165/95 or higher and most mportant of all, they looked at patients with stroke whereas we looked at patients with ypertension.

he study by Lule GN et al [14] mentioned above, they reported the prevalence of diac disease to be 33.0% of whom all had congestive cardiac failure (CCF). A similar valence of clinical cardiac disease (32.3%) was observed in our study. Just over a half he clinical cardiac diseases comprised of congestive cardiac failure with the rest ing had a history of angina or previous myocardial infarction. Nearly all the patients only one clinical cardiac disease, with only 2 patients having two clinical cardiac eases (congestive cardiac failure and previous myocardial infarction). Ogola EN and oo GO [77] observed that among the patients admitted with CCF in KNH, 17.6% of m were due to hypertensive heart disease. A study done in Ghana that evaluated the iology of heart failure in 572 consecutive patients with heart failure referred to the ional Cardiothoracic Centre, Accra, over a 4-year period observed that hypertension s the cause of heart failure in 21.3% of the patients [78].

spite our prevalence of clinical cardiac disease being similar to that observed by Lule et al [14], the fact that most of the patients in KNH are followed up in the special rdiology Clinic, the real prevalence of clinical cardiac disease in our hypertensive tients may be more than 32.3%. The fact that the previous study [14] did not find any ses of coronary heart disease (CHD) could partly be explained by: the lack of ndardization of the clinical assessment of CHD due the study design employed etrospective), and the low prevalence of obesity as compared to that observed in our udy (see above).

he Framingham study [5] and a local study [23], it was observed that clusters of two or e of these risk factors with hypertension were found to occur ≈ 50% of the time milar to our finding of 53.8%). The distribution of risk groups observed in our study nts a gloomy picture of our hypertensive patients considering only 10 years ago Yonga et al [23] had reported a much better picture than this. The local study [23] observed t 45.0% of the patients had no other risk factor; 6.7% had hypertension with one other k factor and 48.3% had hypertension with 2 or more other risk factors. This difference y be due to the high prevalence of dyslipidaemia observed in our study. According to e JNC VI risk stratification, JNC VI group risk A patients (no risk factors) comprise a very nall minority in this study (5.4%). A similar observation, group risk A patients < 5%, was ported in a study done in Israel [53] that looked at risk factor clustering in hypertensive atients.

he prevalence of target organ damage observed of 76.3% is very high and could be flective of the quality of control of blood pressure in our patients and the deficiency of e total management of the patient due to whatever factors (another study could be ndertaken to look into these factors). In spite of such a comment, we need also to realise at KNH is not only a primary health care provider but also doubles as a tertiary referral entre. Therefore some of the patients seen could already have had target organ damage ior to being referred to KNH. A study done in Burkina-Faso that examined the clinical atures of renal disease in patients admitted in the Ouagadougou hospital for high blood essure to determine the risk factors in the black population, also observed the effect of pertension on at least one target organ damage in 73.2% of the patients and on at least ree target organs in 38.2% [95].

s shown in figure14 above, there seems to be a pattern suggesting that the more the mber of risk factors the hypertensive patients had, the higher the chance of having rget organ damage. This is logical and can be expected considering the additive and ultiplicative effects of the risk factors one on another in the development of a rdiovascular event. Not withstanding this observation, a more powered study is needed assess this correlation.

LIMITATIONS

An under estimation of prevalence of target organ damages in this population is possible since the study was limited to medical out-patient clinics, while some patients with target organ damage were possibly being followed up in the respective special clinics.

An underestimation of prevalence of cardiovascular disease in this population is possible since no effort was made towards screening for or definitive diagnosis of CHD (no exercise stress test or angiographic studies were done).

Cockcroft – Gault equation was used to calculate creatinine clearance, which is known to overestimate creatinine clearance in the obese patients.

CONCLUSIONS

1. There was a high prevalence of cardiovascular risk factors in our hypertensives with nearly all patients having a cardiovascular risk factor, with at least two risk factors (excluding hypertension) being found in most study patients. The most prevalent risk factor was dyslipidaemia and the least prevalent risk factor being cigarette smoking.

2. There was a high prevalence of overweight patients, chronic kidney disease, ECG-LVH, clinical cardiac disease, impaired glucose tolerance and ex-smokers.

3. Nearly all patients had at least one target organ damage, with the most prevalent organ damage being hypertensive retinopathy and the least prevalent being cerebrovascular accidents.

4. There was a trend suggesting that the more cardiovascular risk factors a patient had, the higher the chance of developing target organ damage.

RECOMMENDATIONS

1. A comprehensive protocol (taking into consideration co-morbid conditions and target organ damage) be designed which will be used for total management of hypertensive patients and sensitisation of health workers in Kenyatta National Hospital.

2. A study be done in KNH to look at the determinants for the low percentage of patients with controlled blood pressures.

3. More prospective studies are needed to identify the specific vascular risk factors, and their associated relative risks of developing target organ damage, in patients with hypertension in the general population, using larger samples with case-control or cohort designs, more active diagnosis of vascular disease, involving accurate screening and diagnostic techniques, and comparison of urban and rural populations.

REFERENCES

William BK, Peter WFW. Cardiovascular risk factors and hypertension. In: Joseph L Izzo and Henry R Black, *et al.* Hypertension Primer: The essentials of high blood pressure, 2nd edition, Maryland: Lippincot Williams and Wilkins, 1999;199.

Kannel WB, Gordon T, Schwartz MJ. Systolic versus diastolic blood pressure and risk of coronary heart disease: the Framingham study. Am. J Cardiol.1971;27: 335 – 46.

The sixth report of the joint national committee (JNC VI) on prevention, detection, evaluation, and treatment of high blood pressure. Arch Intern Med. 1997;157: 2413 – 45.

Hypertension Control: Report of a WHO Expert Committee. WHO Technical Report Series no. 862. Geneva, 1996.

William BK, Peter WFW. Cardiovascular risk factors and hypertension. In: Joseph L Izzo and Henry R Black, et al. Hypertension Primer: The essentials of high blood pressure, 2nd edition, Maryland: Lippincot Williams and Wilkins, 1999;200.

Richard SC. Geographic patterns of hypertension: a global perspective In: Joseph L Izzo and Henry R Black, *et al.* Hypertension Primer: The essentials of high blood pressure, 2nd edition, Maryland: Lippincot Williams and Wilkins, 1999;224.

Patrick JM. Hypertension a worldwide epidemic. In: Joseph L Izzo and Henry R Black, *et al.* Hypertension Primer: The essentials of high blood pressure, 2nd edition, Maryland: Lippincot Williams and Wilkins, 1999;271.

Mulrow PJ, Pötzsch J, Sleight P, eds. WHL – *Yearbook* 1997. Toledo, Ohio: World Hypertension League; 1997.

Edwards R, Unwin N, Kissima J, *et al.* Hypertension prevalence and care in an urban and rural area of Tanzania. J. Hypertension. 2000;8: 145 – 52.

Adoi JP, Maritin ST. Hypertension prevalence survey in North Imenti Division, Meru District, Kenya. WHO senior level course in Epidemiology and Disease control, Oct 1984,Nairobi.

Koinange RB, Worede MA. Cross-sectional study of hypertension comparing urban workers in Nakuru district, Kenya. WHO senior level course in Epidemiology and Disease control, Oct 1985, Nairobi.

Katsivo MN, Apeagyie F. Hypertension in Kitui district, Kenya. A comparative study between urban and rural populations. E Afr. Med. J. 1991;68: 531 – 38.

Lodenyo HA, McLigeyo SO, Ogola EN. Cardiovascular disease in the elderly in-patients at the KNH, Nairobi, Kenya. E Afr. Med J 1997;74: 647 – 51.

Lule GN, Otieno LS, Kinuthia D. Hypertension over a 4 – year period at KNH (1977 – 1980). E Afr Med. J. 1985;62: 6 – 13.

Thompson D, Edelsberg J, Colditz GA, *et al.* Lifetime health and economic consequences of obesity. Arch Intern Med. 1999;159: 2177 – 83.

Kannel WB, Brand N, Skinner JJ Jr, *et al.* The relation of adiposity to blood pressure and development of hypertension. The Framingham study. Ann Intern. Med. 1967;67: 48 – 59.

Lewis L. Obesity In: Joseph L Izzo and Henry R Black, *et al.* Hypertension Primer: The essentials of high blood pressure, 2nd edition, Maryland: Lippincot Williams and Wilkins, 1999; 118.

APPENDICES

.1 APPENDIX I STUDY PROFORMA

ame _____ Study No _____

ate _____ OP No _____

OB (month, year) _____ Age (years) _____

ate of diagnosis of hypertension (month, year) _____ /_____

uration of hypertension (months, year) _____ /_____

EMOGRAPHICS

Gender 1= Male 2=Female ☐

Marital Status

1=Single 2=Married 3=Divorced 4=Widowed 5=Separated ☐

Usual residence _____

Usual occupation _____

Current formal employment status

1=Employed 2=Unemployed 3=Never had formal employment ☐

4=Retired

Level of formal education

1=None 2=Primary school 3=Secondary school 4=Tertiary level ☐

5=Other (specify) _____

ST MEDICAL HISTORY

Have you ever had any of the following? (Tick response/s)

☐ 1 = Been told by a doctor that you have coronary heart disease?

☐ 2 = Heart attack

☐ 3 = Angina pectoris (chest pain due to insufficient blood flow the heart).

☐ 4 = Coronary bypass surgery

☐ 5 = Coronary angioplasty (coronary "balloon" procedure)

☐ 6 = Abdominal aortic aneurysm

☐ 7 = Blockage of arteries to the limbs

☐ 8 = Transient Ischaemic Attacks (transitory strokes)

☐ 9 = Blockage of carotid artery

☐ 10 = Stroke

FAMILY HISTORY

'. Did or do any of your relatives suffer from diabetes?

1=Yes 2=No ☐

☐ *Father* ☐ *Mother* ☐ *Brother/Sister* ☐ *Children* ☐ *Other (specify)*

Did or do any of your relatives suffer from hypertension?

1=Yes 2=No ☐

☐ Father ☐ Mother ☐ Brother/Sister ☐ Children ☐ Other (specify)

Did any of your first-degree relatives (father, mother, brothers, sisters or children) suffer from heart attack, stroke or sudden death?, if a male relative before 55years / female relative before 65 years.

1=Yes 2=No ☐

MOKING HABITS

Are you currently smoking cigarettes?

1=Yes 2=No ☐

a) If "yes" how many cigarettes do you usually smoke per day? _____

Cigarettes /day

b) How many cigarettes did you smoke per day a year ago? _____

Cigarettes /day

c) How old were you when you began to smoke cigarettes? _____ years

11. Have you ever smoked cigarettes?

1=Yes 2=No ☐

a) If "yes" what is the maximum number of cigarettes you ever smoked per day for as long as a year?

Do you drink alcohol?

1=Yes 2=No ☐

Quantify _____ units/day

URRENT MEDICATIONS

Are you currently on any of the following medications?

1=Yes 2=No 3=Don't know ☐

OHA (drug, dose & duration) ☐

Insulin treatment (formulation, dose & duration) ☐

Blood pressure lowering drugs (drug, dose & duration) ☐

Blood lipid-lowering drugs (drug, dose & duration) ☐

Any other drug taken regularly, at least once a day (drug, dose & duration)) ☐

PHYSICAL EXAMINATION

14 Height (cm) _____

15. Weight (kg) _____

16. BMI (kg/m^2) _____

17. Waist circumference (cm) _____

18. Hip circumference (cm) _____

19. WHR _____

20. 1st BP Reading _____mmHg 2nd BP Reading _____mmHg

Average of 2 BP Readings: _____mmHg

EYES

Keith Wagener grading 1 ☐ 2 ☐ 3 ☐ 4 ☐

NECK

Raised jugular venous pressure

Yes=1 No=2 ☐

HEART

Apex beat _____

Thrills: Yes =1 No=2 Specify _____ ☐

Herat rate _____ /min, Rhythm:

Regular=1 Irregular=2 Gallop=3 Other=4 Specify _____ ☐

Heart sounds

Normal Yes=1 No=2 ☐

Specify _____

Significant murmurs

Systolic Yes= 1 No= 2 ☐

Specify _____

Diastolic Yes=1 No=2 ☐

Specify _____

NEUROLOGICAL EXAMINATION (Tick finding/s)

Stroke Yes=1 No=2 ☐

LAB RESULTS

Fasting blood sugar _____ mmol/L

Creatinine _____ μmol/L

Creatinine Clearance _____ mL/min

Serum Lipid profile

Total cholesterol _____ mmol/L

HDL-cholesterol _____ mmol/L

LDL-cholesterol _____ mmol/L

Triglycerides _____ mmol/L

Urinalysis

Specific gravity _____ Nitrites _____

pH _____ Leucocytes _____

Glucose _____ Blood _____

Protein _____ Bilirubin _____

Ketones _____ Urobilinogen _____