East African Medical Journal Vol. 91 No. 8 August 2014
PREVALENCE, TREATMENT AND CONTROL OF HYPERTENSION AMONG TYPE 2 DIABETIC PATIENTS AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA
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PREVALENCE, TREATMENT AND CONTROL OF HYPERTENSION AMONG TYPE 2 DIABETIC PATIENTS AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA

B. W. NDEGE, L. O. DIERO, M. O. G. OWITI, G. ANJICHI and A. M. SIIKA

ABSTRACT

***Objectives*: To describe the prevalence, treatment and control of hypertension among type 2 diabetic patients at Moi Teaching and Referral Hospital (MTRH) and to determine predictors of blood pressure (BP) control.**
***Design*: A cross-sectional study.**
***Setting*: Diabetic Outpatient Clinic at MTRH, Eldoret, Kenya**
***Subjects*: Type 2 diabetic patients**
***Interventions*: The study collected socio-demographic (age, gender, employment status, monthly income, education level, marital status, cigarette smoking and alcohol use), clinical (BP, weight, height and waist circumference) and laboratory (serum fasting lipids and creatinine, urine proteins) data from type 2 diabetic patients. Good BP control was defined as <130mmHg systolic and <80mmHg diastolic. Association between BP control and social demographic, clinical and laboratory variables of study subjects was determined using the chi-square, T-test, fisher's exact test and logistic regression.**
***Results*: We studied 218 type 2 diabetics: mean age 57±9 years; 122 (56%) were females. Average duration of diabetes was 11±7 years. Prevalence of hypertension was 185/218 (85%) out of who 40 (21%) had good BP control. Average duration of hypertension was 7±5 years. Of the 185 hypertensive diabetics: 92 (50%) had total cholesterol at goal; 102 (55%) had low density lipoproteins (LDL) at goal; 74 (40%) had triglycerides at goal; 65(35%) had high density lipoprotein (HDL) at goal and 85(45%) had Proteinuria. All hypertensive patients had >1 anti-hypertensive agent prescribed. Good BP control was associated with compliance to anti-hypertensives (OR= 0.342, 95% CI: 0.105-1.432) and having HDL at goal (OR = 0.247, 95% CI: 0.126-0.845). Poor BP control was associated with a higher number of prescribed anti-hypertensive agents (OR=1.377, 95% CI: 1.112- 2.302).**
***Conclusion*: Prevalence of hypertension among type 2 diabetic patients in MTRH is high and BP control is poor despite anti-hypertensive treatment. Significant predictors of BP control include compliance to anti-hypertensives and control of HDL.**

INTRODUCTION

Cardiovascular diseases (CVD) are the major cause of death in high income countries (HIC) and are rapidly becoming a leading cause of death in low income countries (LIC). Just like in the HIC, the major driving forces of CVD in LIC are hypertension and diabetes (1). Type 2 diabetes mellitus (DM), now a common disease in LIC, is associated with substantial morbidity and mortality. Most adverse outcomes in diabetes result from vascular complications both at a macro-vascular (coronary artery disease, cerebro-vascular disease or peripheral vascular disease) and micro-vascular (retinopathy, nephropathy or neuropathy) levels. Macro-vascular complications are more common; up to 80% of patients with type 2 diabetes will develop or die of macro-vascular disease (2).

The prevalence of hypertension in diabetic

patients is reported at between 20 and 79%. This prevalence is 1.5–3 times higher than that in age-matched non-diabetics (3).The development of hypertension in patients with diabetes worsens their already poor cardiovascular risk profile, resulting in marked increase in cardiovascular mortality and diabetes-related complications (2).

Appropriate BP control in patients with diabetes leads to a reduction in cardiovascular morbidity and mortality as well as diabetes-related complications (2, 4). Attaining BP control at <130/80 mm Hg provides substantial benefits in diabetic patients. It is thought that aggressive BP control might be the most important factor in preventing adverse outcomes in these patients. Despite effective anti-hypertensive therapies, achieving target BP control remains a challenge for diabetics, more so in resource limited settings (2). In community-based studies, only 28–36% of diabetic hypertensive patients have their BP controlled to <130/80 mmHg (5, 6).

Many studies worldwide have attempted to determine the predictors of poor BP control in different populations. The most frequently studied are the clinical and demographic characteristics of the patients and physician factors. Non-compliance to therapeutic plans is perhaps the most important factor responsible for poor BP control (7-10). Epidemiologic evaluation of the burden of the co-morbidity of diabetes and hypertension and the levels of control achieved is important to allow for rational planning and allocation of resources in any diabetes care programme. Reports on prevalence, treatment and control of hypertension and predictors of BP control exist elsewhere for both the general population and diabetic patients. This study set out to evaluate the prevalence, treatment and control of hypertension and to determine predictors of BP control in a diabetic population at Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya.

MATERIALS AND METHODS

Setting: This study was conducted at the Diabetic Outpatient Clinic in MTRH, Eldoret, Kenya. The study was approved by the Moi University School of Medicine/MTRH Institutional Research and Ethics Committee (IREC) and the MTRH director. Written informed consent was sought from all study participants.

Case definitions: For purposes of this study, type 2 diabetes mellitus was defined as: age at diabetes diagnosis >30 years and controlled on oral hypoglycemic agents and/or insulin and/or diet; or any diabetic patient regardless of age who was managed exclusively on oral hypoglycemic agents from the time of diagnosis.

Hypertension was defined as having a BP of >130mmHg systolic and/or >80mmHg diastolic; or previous recorded diagnosis of hypertension and/or on hypertension treatment. Patients on angiotensin converting enzyme inhibitors (ACE-I) and angiotensin receptor blockers (ARB) for renoprotection only (meaning they had no prior diagnosis/record of elevated BP) were excluded.

BP control was defined as a systolic BP <130mmHg and diastolic BP<80mHg as measured on the day of recruitment. If the systolic and diastolic BPs were in different categories, the higher reading was used to classify the patient.

Body Mass Index (BMI): BMI was calculated using the following formula; [Weight in kg] ÷ [height in meters] (2). Based on the WHO classification, a BMI of <18.5 kg/m^2 denotes underweight; 18.5 -24.9 kg/m^2 is normal; 25 -29.9kg/m^2 is overweight; 30-39.9 kg/m^2 is classified as obese and BMI ≥40 kg/m^2 is severe or morbid obesity.

Based on the American Diabetes Association (ADA) guidelines (16), the following cutoffs were used to define control of lipids; low density lipoproteins (LDL) < 2.6 mmol/L (100 mg/dL); Triglycerides (TG) < 1.7 mmol/L (150 mg/dL).Total Cholesterol (TC) <5.20 mmol/L. Patients with levels above these were classified as not at goal. High density lipoproteins (HDL) levels > 1.1 mmol/L (40 mg/dL) in men and >1.38 mmol/L (50 mg/dL) in women were defined as at goal and levels below these were classified as not at goal.

Subject recruitment: The diabetic outpatients clinic (DOPC) at MTRH runs once a week. Diabetic patients are also seen in the general medical outpatients clinic (MOPC) twice a week. In total, 90-120 diabetic patients are seen every week. On average, 40-60 patients are seen in DOPC and 20-30 diabetic patients are seen on each MOPC. Using this list of diabetic patients booked for DOPC and MOPC as the sample frame, systematic sampling was used to set representative samples.

Data collection and Study procedures: We included type 2 diabetic patients enrolled in the MTRH diabetic clinic. Patients on their first clinic visit and pregnant women were excluded. Participants had their social/demographic (age, gender, employment status, monthly income, education level, marital status, cigarette smoking and alcohol use) and clinical (targeted history and focused physical examination findings) data recorded. Self reported history on compliance to prescribed hypertensive medication was carefully taken using a questionnaire. Participants who reported missing any dose of prescribed anti-hypertensive medications in the previous one month were categorised as non-compliant.

BP measurements were taken in accordance with

the American Heart Association (AHA) Guidelines (17). Five milliliters of blood was collected aseptically from the ante-cubital fossa for measurement of fasting lipids (TC, TGs, HDL and indirect LDL using the Cobas Integra 400 plus and Humastar 180 machines) and for creatinine measurements. Before analysis, all the assays were calibrated according to the manufacturers' specifications. The recommended procedures for specimen collection, preparation and storage were followed to minimise pre-analytical sources of errors. A urine sample was taken for estimation of proteinuria using the Clinistrip-10 parameter urinalysis strips.

Statistical analysis: The prevalence of hypertension in type 2 diabetic patients was calculated. Participants were divided into two groups: good BP control (systolic BP <130mmHg and diastolic BP <80mmHg); and poor BP control (systolic BP >130mmHg or diastolic BP >80mHg). The chi- square test and the Fisher's exact test were used to check for association between categorical demographic and clinical variables and BP control. The independent sample t-test was used to determine differences of means for continuous variables between the two groups (BP control). Multiple binary logistic regression was used to identify variables with significant association with BP control, adjusting for confounders. A p-value <0.05 was considered significant for all analyses.

RESULTS

A total of 248 diabetic patients were screened between January and June 2011. We excluded 30 patients: 22 did not meet the definition of type 2 diabetes; three were pregnant and five patients declined to consent. Of the 218 patients successfully enrolled into the study, were female majority, middle aged and married. Only a few had formal employment. Details of the participants' social and demographic characteristics are shown in Table 1.

Table 1
Socio-economic and demographic characteristics of 218 type 2 diabetic at MTRH

Characteristic	Overall value	Blood pressure control n = 185		P-value
	n = 218	Good n = 40	Poor n = 145	
Age (yrs) Mean (sd)	56.6± 9.3	50.3±8.0	58.9±8.6	<0.001
Gender				
Male	96 (44)	21(53)	65(45)	0.38
Female	122 (56)	19 (47)	80 (55)	
Marital status; n (%)				
Married	194 (89)	33 (83)	130 (89)	0.21
Single	24 (11)	7 (17)	15 (11)	
Employment; n (%)				
Employed	38 (17)	19 (48)	15 (10)	<0.001
Unemployed	180 (83)	21 (52)	130 (90)	
Education; n (%)				
Non-formal	45 (21)	5 (12)	35 (24)	0.021
Primary	107 (49)	10 (26)	77 (53)	
Secondary	34 (15)	11 (27)	19 (13)	
College and above	32 (14)	14 (36)	14 (10)	
Monthly income (KSHs)	4000	6000	4000	0.041
Median(IQR)	(1000, 6000)	(2000, 7000)	(1000, 5000)	
Alcohol use	8 (4.1)			
Cigarette Smoking	5 (2.2)			

Prevalence of hypertension and BP control: A total of 185/218 (85%) study participants had hypertension. As shown in table 1, 145/185 (79%) hypertensive diabetic patients had poor BP control while 40/185 (21%) had good BP control.

Clinical characteristics of type 2 diabetic patients at MTRH: The clinical characteristics of the patients enrolled in the study are shown in Table 2. Components of the lipid profile were classified as either at goal or not at goal. Of the 218 patients, 132 (60%) had LDL at

goal, 124 (57%) had total cholesterol at goal and 102 (47%) had HDL at goal. Triglycerides was the most poorly controlled component of the lipid profile with 126 (58%) of the patients not at goal. Amongst the hypertensive patients; 92 (50%) had total cholesterol at goal; 102 (55%) had low density lipoproteins (LDL) at goal; 74 (40%) had triglycerides at goal; 65 (35%) had high density lipoprotein (HDL) at goal; and 85 (45%) had Proteinuria.

Table 2
Clinical characteristics of 218 type 2 diabetic patients at MTRH

Characteristic	All n = 218	Blood pressure control n=185		P-value
		Good n = 40	Poor n = 145	
Diabetes duration (yrs); mean (sd)	10.7± 6.6.	6.8± 6.5	12.6 ± 6.1	<0.001
Hypertension duration (yrs); mean (sd)	6.8 (5.6.)	3.3±1.9	9.1±5.2	<0.001
Waist circumference (cm); mean(sd)	98.3 ±6.2	91.6 ±8.4	106.6±9.5	<0.001
# hypertensive agents; mean (sd)	2.3±1.1	1.4±0.5	2.9 ±0.7	<0.001
BMI class; n (%)				
normal	46 (21)	13 (33)	17 (12)	
overweight	133 (61)	25 (65)	91 (64)	0.001
obese	39 (18)	2 (2)	37 (24)	
Anti-diabetic agent; n (%)				
insulin	31 (14)	10 (25)	17 (12)	
oral hypoglycemic	101 (57)	14 (35)	67 (46)	0.095
both	86 (29)	16 (40)	61 (42)	
Compliance n (%)	n=185			
compliant;	111 (60)	39 (98)	72 (50)	<0.001
non-compliant	74 (40)	1 (2)	73 (50)	
eGFR (mls/min); n (%)				
<60	14 (6)	5 (13)	6 (4)	0.343
=/>60	204 (94)	35 (87)	139 (96)	
Proteinuria; n (%)				
detected	122 (56)	14 (35)	71 (49)	0.071
not detected	96 (44)	26 (65)	74 (51)	
Total cholesterol; n (%)				
at goal	124 (57)	25 (63)	67 (46)	0.031
not at goal	94 (43)	15 (37)	78 (54)	
TG; n (%)				
at goal	92 (42)	26 (65)	48 (33)	0.028
not at goal	126 (58)	14 (35)	97 (67)	
LDL; n (%)				
at goal	132 (61)	21 (53)	81 (60)	0.386
not at goal	86 (39)	19 (47)	64 (44)	
HDL; n (%)				
at goal	102 (47)	28 (70)	37 (26)	<0.001
not at goal	116 (53)	12 (30)	108 (74)	

Compliance to anti- hypertensives among type 2 diabetic hypertensive patients at MTRH: Of the 185 patients with hypertension, 74 (40.5%) were noncompliant to the prescribed hypertensive medication (Table 2). The most common reasons given for noncompliance were that patients run out of money to buy medication (43/74; 58%) and that patients run out of medication before their scheduled clinic visit (27/74; 37%). Other reasons given were that patients forgot to take their medication while others stopped taking medication because they felt better or cured. All patients reported they were aware that the prescribed hypertensive medication was to be used indefinitely.

Treatment of hypertension: All the hypertensive patients had at least one anti-hypertensive prescribed. The mean total number of prescribed anti-hypertensives was 2.3±1.1 (Table 2); 30 (16.2%) were on mono-therapy, the rest were on >1 anti-hypertensive agent. No patient was on any fixed dose combination. The most commonly prescribed class of anti-hypertensive was angiotensin converting enzyme inhibitors (ACE-I) (>80%), as mono-therapy or in combination. Angiotensin receptor blockers (ARB) were prescribed as mono-therapy in the rest (20%). No other anti-hypertensives had been prescribed as mono-therapy. Among those on combination therapy, the most frequently prescribed combination was ACE-I+ thiazide diuretic + calcium channel blocker (CCB) at 47% (Table 3).

Table 3

Anti-hypertensive drug prescriptions among type 2 diabetic hypertensive patients in MTRH

Regimen	Value n (%)
	n=185
Monotherapy	30 (16)
Combination therapy	155 (84)
Drug given as Monotherapy	n = 30
ACE-I	24 (80)
ARB	6 (20)
Combination therapy	n = 155
2 drug combinations	41 (26)
ACE-I +Thiazide	24 (15)
ACE-I+ CCB	11 (8)
ACE-I+BB	4 (3)
Others	
3 drug combinations	109 (70)
ACE-I +Thiazide + CCB	74 (48)
ACE-I + Thiazide-blocker(BB)	11 (7)
Others	24 (15)
>3 drug combinations	5 (3)

Association between social/demographic characteristics and BP control: There was a significant relationship between BP control and age, employment status, education level and average monthly income ($p<0.05$; t/chi square tests).The mean age was higher among poorly controlled patients compared to those with good BP control. Majority of patients with poor BP control were unemployed, reported lower incomes and had a lower level of education (Table 1).

Association between clinical characteristics of the patients and BP control: The estimated duration of diabetes since diagnosis, estimated duration of hypertension, BMI, compliance and waist circumference were significantly associated with BP control ($p<0.001$). The mean duration of diabetes and the mean duration of hypertension were significantly longer in patients with poor BP control compared to patients with good BP control. The mean total number of prescribed hypertensive agents was significantly higher among patients with poor BP control compared to patients with good BP control. A similar trend was noted with waist circumference. Patients with poor BP control tended to have higher BMI compared to those with good BP control. Majority of the patients with good BP control were compliant to their hypertensive medication. BP control was significantly associated with control of total cholesterol, TGs and HDL. Hypertensive patients with good BP control tended to have Total cholesterol, TGs and HDL at goal. This association was not observed with LDL (Table 2).

Association between patient characteristics and BP control; Logistic regression: Variables found to have significant association with BP control on chi- square and t- test were included in a logistic regression model (Table 4). The odds of having poorly controlled BP was increased in patients on a higher number of anti-hypertensive agents (OR=1.377, 95% CI, 1.112- 2.302). Compliance to prescribed anti-hypertensives (OR= 0.342, 95% CI, 0.105-1.432) and having HDL at goal (OR = 0.247, 95% CI, 0.126-0.845) reduced the risk of being poorly controlled. Age, estimated monthly income, BMI, waist circumference, estimated duration of hypertension, total cholesterol levels and TG levels were not found to have significant association with BP control.

Table 4
Association between BP control and patients clinical/ social/demographic characteristics on logistic regression

Variable	Adjusted OR	95% CI	P-value
Age	0.948	0.189-3.059	0.345
Income	0.806	0.102-6.353	0.838
Level of education			
<Secondary	1.015	0.341-3.237	0.242
Secondary	0.908	0.552-5.358	0.281
BMI	1.081	0.607-1.222	0.082
Waist circumference	1.110	0.999-1.232	0.073
Estimated duration of hypertension	1.027	0.861-4.595	0.113
# hypertensive medications	1.377	1.112-2.302	0.003[1]
Compliance	0.342	0.105-1.432	0.047[1]
Total cholesterol at goal	0.565	0.0211-3.651	0.116
HDL at goal	0.247	0.126-0.845	0.032[1]
TG at goal	0.496	0.0110-2.651	0.079

Key1- significant association

DISCUSSION

The prevalence of hypertension in type 2 diabetic patients at MTRH was high (85%). Though high, the prevalence of hypertension observed in our study is consistent with findings in other studies in Sub Saharan Africa. Choukem *et al* in Cameroon reported a prevalence of 67% in a diabetic population. The lower prevalence in their study, compared to our study, could be explained by the higher diastolic BP cut-off of >85 mmHg used in their study and the inclusion of both type 1 and type 2 diabetic patients (11). Klisiewicz A.M in South Africa reported a prevalence of hypertension in type 2 diabetic patients of 85% using BP cut offs similar to our study (12). Otieno C.F *et al* reported a much lower prevalence (50%) of hypertension in type 2 diabetics at Kenyatta National Hospital (KNH) in Nairobi, Kenya, using BP cut offs similar to our study (13). Transition from agrarian life to the wage-earning economy of towns and cities might be responsible for the high prevalence of hypertension in these countries. Also, urbanisation, aging, societal changes, physical inactivity and changes in food consumption may contribute to this finding (20).

While all of the hypertensive patients in this study were on pharmacologic treatment, optimal BP control of <130 / 80 mmHg was achieved in only a minority of the diabetic hypertensives (21%). Rates of BP control in diabetics in sub-Saharan Africa range between 11 and 35% (11-13). Despite effective anti-hypertensive therapies and availability of clear guidelines and evidence demonstrating that lowering BP reduces cardiovascular and renal complications, BP control among diabetic patients remains a challenge. It has been demonstrated in clinical trials (18) that hypertension may be intrinsically more difficult to control in the diabetic population; diabetics require up to 50% more anti-hypertensive medication to control BP compared with non diabetics (18). However, in research settings, control levels of above 60% have been reported suggesting that additional factors (other than presence of diabetes) must contribute to inadequate BP control (19). Various factors have been hypothesised to have influence on BP control including patient, physician and ecological / social cultural factors. Patient factors contribute to poor BP control through non adherence to therapeutic plans, more commonly due to unaffordable health care costs. This is especially so in low income countries (LIC). Non-compliance among our patients was high (40.5%) and the major reasons for poor compliance given relate to barriers in accessing medical care. Given the relationship between inadequate management of hypertension and cardiovascular complications in diabetes, efforts to achieve optimal BP control cannot be over-emphasised. It would be worthwhile for health policy makers to look into ways of making anti-hypertensives affordable and accessible in this population.

Patients with poor BP control in our study were receiving a higher number of anti-hypertensive medications than those with good control. An established requirement for more anti-hypertensives has been reported in several studies as a predictor of poor BP control (7, 9). However, this association is not

necessarily a causal effect; having a higher number of hypertensive agents prescribed could lead to poor BP control due to a high pill burden and increased cost of medication, hence poor compliance. Alternatively, it could be as a result of difficult to control BP.

The association between BP control and components of the metabolic syndrome has been evaluated previously (15). In our study having HDL at goal was associated with good BP control. Results of our study were consistent with findings in a follow up analysis of the GOOD study (Global Cardio-metabolic Risk Profile in Patients with Hypertension Disease), that concluded that visceral obesity and dyslipidemia (hypertriglyceridemia and low HDL cholesterol levels), rather than impaired glucose tolerance, are associated with resistance to anti-hypertensive treatment (15). Though the mechanism by which these components of the metabolic syndrome result in hypertensive medication resistance are unclear, these findings suggest that comprehensive management of diabetic patients aiming at controlling all the components of the metabolic syndrome may have a role in improving BP control.

One limitation of our study was that one clinic visit BP measurement was used to determine control. Benjamin *et al* and Gillian *et al* compared the various methods of assessing BP control that have been used in research settings (21, 22). These studies concluded that there was a tendency to underestimate BP control when one clinic visit BP was used to assess control. In their analysis, home BP monitoring using ambulatory BP monitors gave a more accurate assessment of BP control compared to either one clinic visit BPs or an average of BPs taken over a period of time. However, ambulatory monitors are expensive and not routinely used for monitoring BPs, especially in resource limited settings. As such, our study reflects what is observed in clinical practice and is therefore an appropriate tool for health policy making.

CONCLUSIONS AND RECOMMENDATIONS

In type 2 diabetic patients in MTRH, prevalence of hypertension is high. BP control in these patients was poor despite anti-hypertensive treatment. There is therefore an urgent need to formulate strategies to improve BP control in this population. Contributors to good BP control in this study were compliance to anti-hypertensives and control of HDL. We recommend that clinicians managing these patients optimise control of the dyslipidemias, especially HDL. The most common reason given for missed doses of anti-hypertensives was financial constraints. It is worthwhile for policy makers to look into ways of making anti-hypertensives affordable and accessible to these patients.

ACKNOWLEDGEMENTS

To the biostatisticians, MTRH records staff, laboratory personnel, diabetic clinic nurses and the diabetic patients who participated in this study.

REFERENCES

1. H. King, R.E. Aubert and W.H. Herman. Global burden of diabetes, prevalence, numerical estimates, and projections1995–2025. *Diabetes Care*. 1998; **21**: 1414–1431.
2. United Kingdom Prospective Diabetes Study Group. Tight blood pressure control and risk of macro vascular and micro vascular complications in type 2 diabetes. (no authors listed) UKPDS 38. *BMJ*. 1998; **317**:703-713.
3. El-Atat F, McFarlane SI, Sowers JR. Diabetes, hypertension, and cardiovascular derangements: pathophysiology and management. *CurrHypertens Rep*. 2004; **6**:215-223.
4. Zanchetti A, Ruilope LM. Anti-hypertensive treatment in patients with type-2 diabetes mellitus: what guidance from recent controlled randomized trials? *J Hypertens* 2002; **20**: 2099-2110.
5. Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. *JAMA* 2004; **291**:335–342.
6. McFarlane SI, Castro J, Kaur J, *et al*. Control of blood pressure and other cardiovascular risk factors at different practice settings: outcomes of care provided to diabetic women compared to men. *J ClinHypertens* 2005; **7**: 73–80.
7. Sverre E. Kjeldsen , Kenneth A. *et al*. Predictors of blood pressure response to intensified and fixed combination treatment of hypertension: The ACCOMPLISH Study. *Blood pressure*. 2008; **17**: 7-17
8. Laura C. Plantinga, Edgar R. Miller, Lesley A. Stevens *et al*. Centers for Disease Control and Prevention Chronic Kidney Disease Surveillance Team; Blood pressure control among persons without and with chronic kidney disease: US trends and risk factors 1999-2006. *Hypertension*, 2009; **54**: 47-56.
9. Murali K. Duggirala, Robert M. Cuddihy, *et al*. Predictors of Blood Pressure Control in Patients With Diabetes and Hypertension Seen in Primary Care Clinics. *Am J Hypertens* 2005; **18**: 833–838.
10. Tamara Santiago, Craig A. Plauschinat, Feride Frech *et al*. Predictors of blood pressure control in primary care patients; *Am J Hypertens* 2005; **18**: 221A–221A.
11. S. Choukem, A. Kengne, Y. Dehayem, and N. Simo, *et al*. Hypertension in people with diabetes in sub-Saharan Africa: Revealing the hidden face of the iceberg. *Diabetes Research and Clinical Practice*, **77**: 293-299
12. Klisiewicz AM, Sub-Optimal Management of Type 2 Diabetes Mellitus– A Local Audit. Journal of Endocrinology, Metabolism and Diabetes of South Africa; *JEMDSA* 2009;**14**:13-16.
13. Otieno CF, VaghelaV, Mwendwa FW, *et al*. Cardiovascular risk factors in patients with type 2 diabetes mellitus in Kenya: levels of control attained at the outpatient diabetic clinic of Kenyatta National

Hospital, Nairobi. East African medical journal; Dec 2005; vol 8212(supplement); S184-184.
14. Walter Zidek, Lisa Naditch-Brûlé, Stefano Perlini *et al*. Blood pressure control and components of the metabolic syndrome: the GOOD survey: *Cardiovasc Diabetol.* 2009; **8**:51.
15. Chobanian AV, Bakris GL, Black HR, *et al* and the National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The JNC 7 Report. *JAMA* 2003; **289**: 2560-2571.
16. American Diabetes Association: Standards of medical care in diabetes (Position Statement). *Diabetes Care* 2005; **28** (Suppl. 1):S4 -S36.
17. Thomas G. Pickering, *et al*. Recommendations for Blood Pressure Measurement in Humans and Experimental Animals: Part 1: Blood Pressure Measurement in Humans. *Circulation* 2005; **111**: 697-716.
18. Brown MJ, Castaigne A, deLeeuw PW *et al*. Influence of diabetes and type of hypertension on response to anti-hypertensive treatment. *Hypertension* 2000; **35**:1038–1042.
19. Bakris GL, Fonseca V, Katholi RE, *et al*, for the GEMINI Investigators. Metabolic effects of carvedilol vs. metoprolol in patients with type 2 diabetes mellitus and hypertension: a randomized controlled trial. *JAMA* 2004; **292**:2227-2236.
20. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Science* 1998; **280**: 1371-1374.
21. Benjamin J. Powers, Maren K. Olsen, Valerie A. Smith, *et al.* Measuring Blood Pressure for Decision Making and Quality Reporting: Where and How Many Measures? *Ann of Intern Med:* 2011: **154**:781-788.
22. Gillian Manning, Andrew Brooks, Barbara Slinn, *et al.* Assessing blood pressure control in patients treated for hypertension: comparing different measurements and targets; *Brit. J. of General Practice*, 2006; **56**; 375-377.