ESC
European Society
of Cardiology

May Measurement Month 2017: the results of blood pressure screening of 14 845 individuals in Kenya—Sub-Saharan Africa

Elijah N. Ogola[1]*, Felix Barasa[2], Anders L. Barasa[3], Bernard M. Gitura[4], Benson Njunguna[2], Thomas Beaney[5], Xin Xia[5], and Neil R. Poulter[5]

[1]*Department of Clinical Medicine and Therapeutics, University of Nairobi, Ngong Road, 00202 Nairobi, Kenya;*
[2]*Department of Medicine, Moi Teaching and Referral Hospital, Nandi Road, 30100, Eldoret, Kenya;*
[3]*Department of Medicine, Aga Khan University Nairobi, 808 Muthaiga Heights, 00100, Nairobi, Kenya;*
[4]*Department of Medicine, Cardiology Unit, Kenyatta National Teaching and Referral Hospital, Hospital Road, 00202, Nairobi, Kenya; and*
[5]*Imperial Clinical Trials Unit, Imperial College London, Stadium House, 68 Wood Lane, London W12 7RH, UK*

Elevated blood pressure (BP) is a growing burden worldwide leading to over 10 million deaths each year. Sub-Saharan Africa has the highest age-adjusted prevalence of hypertension. In Kenya, 24.5% of adults have elevated BP with lack of awareness being the main barrier to achieving satisfactory control rates. May Measurement Month (MMM17) is a global initiative aimed at raising awareness of high BP and to act as a temporary solution to the lack of screening programmes worldwide. An opportunistic cross-sectional survey of volunteers aged ≥18 years was carried out in May 2017. Screening was coordinated by the Kenya Cardiac Society in 17 sites across the country. Blood pressure measurements, the definition of hypertension and statistical analysis followed the standard MMM protocol. A total of 14 847 individuals were screened. After multiple imputation, 3647 (24.6%) had hypertension. Of individuals not receiving any antihypertensive medication, 2019 (15.3%) were hypertensive. Of individuals receiving antihypertensive medication, 740 (45.5%) had uncontrolled BP. Being diabetic and having a body mass index (BMI) ≥25 kg/m^2 were associated with higher BP. Lack of awareness and poor control in those identified is a major challenge in Kenya. The MMM project demonstrated that mass screening for elevated BP is feasible, even in settings with limited resources. The presence of hypertension in a quarter of Kenyan adults with poor awareness and control rates demonstrates the need for programmes to raise awareness in the community.

Introduction

Hypertension is the leading cause of global mortality accounting for 10.5 million deaths annually.[1] Africa has the highest age-adjusted prevalence which is increasing.[2-4] The prevalence of hypertension in Kenya is 24.5%.[5] Despite availability of antihypertensive therapy, control rates remain low, largely due to lack of awareness.[3,4] A recent meta-analysis of African studies showed awareness, treatment, and control rates of 27%, 18%, and 7%, respectively.[3] A Kenyan study showed 15.5% awareness rate, of whom 26.9% were on treatment and only 51.7% of these were controlled.[5] While reliable mortality statistics are unavailable, hypertension is the leading cause of myocardial infarctions, stroke, and heart failure in Africa.[6-8] Kenya joined the worldwide hypertension awareness campaign, May Measurement Month (MMM17), in an effort to raise national awareness about hypertension.[9] Here, we report our major findings.

*Corresponding author. Tel: +254 722737944, Fax: +254 20 3744956, Email: elijah.ogola@uonbi.ac.ke

Methods

Screening was coordinated by the Kenya Cardiac Society (KCS) on consenting adults in 17 sites in four regions of Kenya (Nairobi, Central, Coast, and Western) in May 2017. Sites were selected based on availability of volunteers (total $n = 120$). Local physicians trained the field staff using materials supplied by the International Society of Hypertension (ISH). Ethics approvals were obtained from the ethics committees of the Kenyatta National Hospital and Moi Teaching and Referral Hospital. Screening was conducted in health institutions, shopping malls, open markets, places of worship, and airports.

We used an OMRON M3 digital device. Three BP readings were measured, 1 min apart, with the subject quietly seated, with the average of the last two readings recorded. Hypertension was defined as a systolic BP $\geq$140 mmHg or diastolic BP $\geq$90 mmHg or in those on antihypertensive treatment. Pulse rate, weight, and height were also measured. Participants with elevated BP received both oral and written information on appropriate lifestyle modification measures, and linked to relevant clinics for further care. Data was input directly into excel, the MMM app, or on hard copy with later transcription. All data were cleaned locally before being loaded onto the MMM central database for analysis.[9]

Results

The Kenyan sites screened 14847 subjects. The mean age was 38.9 (SD 13.9) years and 7969 (53.7%) were female. The majority ethnicity was black (99.4%). Four hundred and seven (2.1%) had diabetes, 106 (0.7%) had a history of myocardial infarction, and 75 (0.5%) had a history of stroke. Current smokers were 4.4% and 83.9% drank alcohol rarely or never. The mean BMI was 25.6 (SD 4.9) kg/m^2; 4.3% of women screened were pregnant.

After multiple imputation,[9] 3647 (24.6%) participants were hypertensive. Of these, 1628 were on antihypertensive treatment. Of the subjects on treatment with a mean blood pressure (BP) available, 740 of 1627 (45.5%) were uncontrolled. Of individuals not receiving any antihypertensive medication, 2019 (15.3%) were hypertensive.

After adjusting for age and sex, both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were higher in people on antihypertensive treatment. After adjusting for age, sex and antihypertensive treatment, diabetes, and alcohol intake were associated with increased SBP and DBP. However, history of stroke, myocardial infarction, and current smoking were not significantly associated with different levels of SBP or DBP. Measurement on the left arm was associated with lower SBP but not DBP. Pregnancy was associated with lower SBP and DBP (*Figure 1*). Compared with
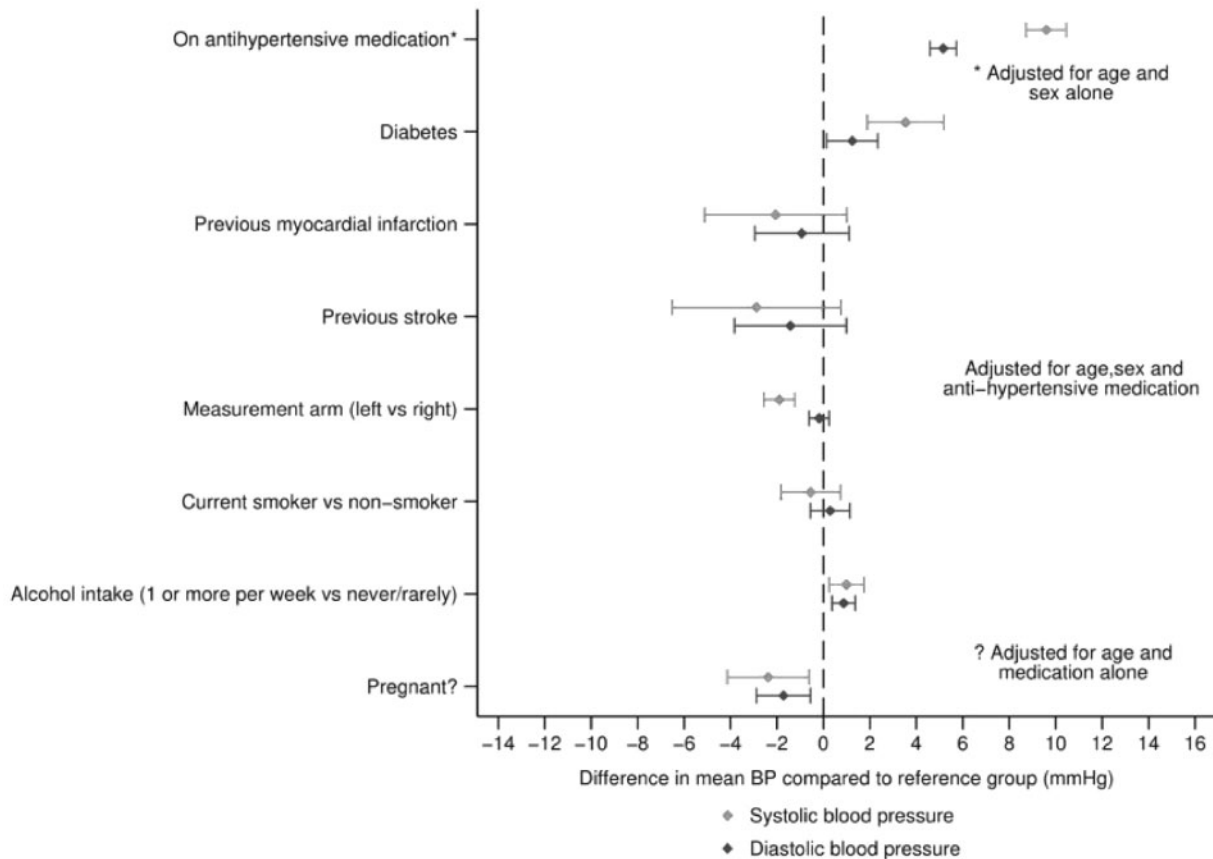

Figure 1 Associations of blood pressure in the screened population from linear regression models, adjusted for age, sex, and antihypertensive medication (except where annotated).

underweight, both overweight and obese subjects had higher SBP and DBP. Normal weight subjects had higher SBP but not DBP.

Discussion

We found 3647 (24.6%) of the screened population to be hypertensive, consistent with recent population surveys.[5,10] Almost half of these were on medication. However, only 45.5% of these were controlled, confirming poor control rates. These data show poor control rates in the presence of a high hypertension burden. The data on awareness is not specifically addressed here. However, the data suggest that for effective population control, interventions should be targeted at raising awareness, enabling linkage to the healthcare system to initiate treatment, and strengthening the healthcare system to ensure follow-up and control. The programme reached almost 15 000 people, most of whom were having a BP measurement for the first time. Local data shows that 66% of Kenyan adults have never had a BP measurement.[5] Beyond the individuals screened, these awareness activities are likely to have reached a wider audience. This was the first hypertension screening project with a national reach to have ever been conducted in Kenya. It supplements an ongoing programme, the Healthy Heart Africa programme in increasing hypertension awareness, with these important messages being reinforced by engaging in MMM18.

In conclusion, the MMM project demonstrates that population screening in the community for hypertension is a feasible exercise even in the setting of limited resources. The presence of hypertension in a quarter of Kenyan adults with poor awareness and control demonstrates the need for programmes to increase awareness which is the principal barrier to control.

Acknowledgements

References

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, Amann M, Anderson HR, Andrews KG, Aryee M, Atkinson C, Bacchus LJ, Bahalim AN, Balakrishnan K, Balmes J, Barker-Collo S, Baxter A, Bell ML, Blore JD, Blyth F, Bonner C, Borges G, Bourne R, Boussinesq M, Brauer M, Brooks P, Bruce NG, Brunekreef B, Bryan-Hancock C, Bucello C, Buchbinder R, Bull F, Burnett RT, Byers TE, Calabria B, Carapetis J, Carnahan E, Chafe Z, Charlson F, Chen H, Chen JS, Cheng AT, Child JC, Cohen A, Colson KE, Cowie BC, Darby S, Darling S, Davis A, Degenhardt L, Dentener F, Des Jarlais DC, Devries K, Dherani M, Ding EL, Dorsey ER, Driscoll T, Edmond K, Ali SE, Engell RE, Erwin PJ, Fahimi S, Falder G, Farzadfar F, Ferrari A, Finucane MM, Flaxman S, Fowkes FG, Freedman G, Freeman MK, Gakidou E, Ghosh S, Giovannucci E, Gmel G, Graham K, Grainger R, Grant B, Gunnell D, Gutierrez HR, Hall W, Hoek HW, Hogan A, Hosgood HD, Hoy D, Hu H, Hubbell BJ, Hutchings SJ, Ibeanusi SE, Jacklyn GL, Jasrasaria R, Jonas JB, Kan H, Kanis JA, Kassebaum N, Kawakami N, Khang YH, Khatibzadeh S, Khoo JP, Kok C, Laden F, Lalloo R, Lan Q, Lathlean T, Leasher JL, Leigh J, Li Y, Lin JK, Lipshultz SE, London S, Lozano R, Lu Y, Mak J, Malekzadeh R, Mallinger L, Marcenes W, March L, Marks R, Martin R, McGale P, McGrath J, Mehta S, Mensah GA, Merriman TR, Micha R, Michaud C, Mishra V, Mohd Hanafiah K, Mokdad AA, Morawska L, Mozaffarian D, Murphy T, Naghavi M, Neal B, Nelson PK, Nolla JM, Norman R, Olives C, Omer SB, Orchard J, Osborne R, Ostro B, Page A, Pandey KD, Parry CD, Passmore E, Patra J, Pearce N, Pelizzari PM, Petzold M, Phillips MR, Pope D, Pope CA, Powles J, Rao M, Razavi H, Rehfuess EA, Rehm JT, Ritz B, Rivara FP, Roberts T, Robinson C, Rodriguez-Portales JA, Romieu I, Room R, Rosenfeld LC, Roy A, Rushton L, Salomon JA, Sampson U, Sanchez-Riera L, Sanman E, Sapkota A, Seedat S, Shi P, Shield K, Shivakoti R, Singh GM, Sleet DA, Smith E, Smith KR, Stapelberg NJ, Steenland K, Stöckl H, Stovner LJ, Straif K, Straney L, Thurston GD, Tran JH, Van Dingenen R, van Donkelaar A, Veerman JL, Vijayakumar L, Weintraub R, Weissman MM, White RA, Whiteford H, Wiersma ST, Wilkinson JD, Williams HC, Williams W, Wilson N, Woolf AD, Yip P, Zielinski JM, Lopez AD, Murray CJ, Ezzati M. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012; **380**:2224–2260.

2. Ataklte F, Erqou S, Kaptoge S, Taye B, Echouffo-Tcheugui JB, Kengne AP. Burden of undiagnosed hypertension in Sub-Saharan Africa: a systematic review and meta-analysis. *Hypertension* 2015; **65**:291–298.

3. Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, Bahonar A, Chifamba J, Dagenais G, Diaz R, Kazmi K, Lanas F, Wei L, Lopez-Jaramillo P, Fanghong L, Ismail NH, Puoane T, Rosengren A, Szuba A, Temizhan A, Wielgosz A, Yusuf R, Yusufali A, McKee M, Liu L, Mony P, Yusuf S; PURE (Prospective Urban Rural Epidemiology) Study investigators. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. *JAMA* 2013;**310**:959-968.

4. Mills KT, Bundy JD, Kelly TN, Reed JE, Kearney PM, Reynolds K, Chen J, He J. Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation* 2016;**134**:441–450.

5. Mohamed SF, Mutua MK, Wamai R, Wekesah F, Haregu T, Juma P, Nyanjau L, Kyobutungi C, Ogola E. Prevalence, awareness, treatment and control of hypertension and their determinants: results from a national survey in Kenya. *BMC Public Health* 2018;**18**(suppl 3):1219.

6. Damasceno A, Mayosi BM, Sani M, Ogah OS, Mondo C, Ojji D, Dzudie A, Kouam CK, Suliman A, Schrueder N, Yonga G, Ba SA, Maru F, Alemayehu B, Edwards C, Davison BA, Cotter G, Sliwa K. The causes, treatment, and outcomes of acute heart failure in 1006 Africans from 9 countries. *Arch Intern Med* 2012;**172**:1386-94.

7. Kaduka L, Korir A, Oduor CO, Kwasa J, Mbui J, Wabwire S, Gakunga R, Okerosi N, Opanga Y, Kisiang'ani I, Chepkurui MR, Muniu E, Remick SC. Stroke distribution patterns and characteristics in Kenya's leading public health tertiary institutions: Kenyatta National Hospital and Moi Teaching and Referral Hospital. *Cardiovascular Journal of Africa* 2018;**29**:68-72.

8. Steyn K, Sliwa K, Hawken S, Commerford P, Onen C, Damasceno A, Ounpuu S, Yusuf S; INTERHEART Investigators in Africa. Risk factors associated with myocardial infarction in Africa: the INTERHEART Africa study. *Circulation* 2005;**112**:3554-61.

9. Beaney T, Schutte AE, Tomaszewaki M, Ariti C, Burrell LM, Castillo RR, Charchar FJ, Damasceno A, Kruger R, Lackland DT, Nilsson PM, Prabhakaran D, Ramirez AJ, Schlaich MP, Wang J, Weber MA, Poulter NR; MMM Investigators. May measurement month 2017: an analysis of blood pressure screenings worldwide. *Lancet Glob Health* 2018; **6**(7):e736-e743.

10. Joshi MD, Ayah R, Njau EK, Wanjiru R, Kayima JK, Njeru EK, Mutai KK. Prevalence of hypertension and associated cardiovascular risk factors in an urban slum in Nairobi, Kenya: a population-based survey. *BMC Public Health* 2014;**14**:1177.