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of Cardiology

May Measurement Month 2021: an analysis of blood pressure screening results from a suburban community in the Democratic Republic of the Congo

Nathan B. Buila[1], Tresor M. Tshiswaka[1], Yves N. Lubenga[1],
Fortunat K. Katamba[1], Pascal M. Bayauli[2], Georges N. Ngoyi[1],
Jean-Marc B. Bantu[3], Thomas Beaney[4,5], Gabriele Kerr[5,6], Neil R. Poulter[4],
and Jean-René M'Buyamba-Kabangu[1]*

[1]Department of Internal Medicine, Hypertension Unit/Cardiology, University of Kinshasa Hospital, Kinshasa,
The Democratic Republic of the Congo; [2]Department of Internal Medicine, Service of Endocrinology and Nuclear
Medicine, University of Kinshasa Hospital, Kinshasa, The Democratic Republic of the Congo; [3]Department of Cardiology,
Chirec Clinics, Brussels, Belgium; [4]Imperial Clinical Trials Unit, Imperial College London, Stadium House, 68 Wood Lane,
London W12 7RH, UK; [5]Department of Primary Care and Public Health, Imperial College London, St Dunstan's Road,
London W6 8RP, UK; and [6]Department of Cardiology, Amsterdam UMC location Vrije Universiteit Amsterdam,
De Boelenlaan 1117, Amsterdam, The Netherlands

KEYWORDS
Blood pressure screening;
Treatment and control;
DRC suburban setting

Hypertension remains the most powerful contributor to the global morbidity and mortality. May Measurement Month (MMM), a worldwide screening campaign initiated by the International Society of Hypertension (ISH), is organized annually to increase awareness of high blood pressure (BP). We screened 20 913 adult ($\geq$18 years) residents of suburb hamlets of Mbujimayi (mean age 35.1 $\pm$ 15.1 years; Black ethnicity: 98.8%; women: 29.6%; diabetes: 1.6%; alcohol drinkers: 16.8% and smokers: 6.7%, previous myocardial infarction: 1.4%; stroke: 0.8%; taking aspirin: 3.2%; taking statins: 1.9%). Three sitting BP readings were taken, and hypertension was defined as a systolic BP $\geq$ 140 mmHg or diastolic BP $\geq$ 90 mmHg or being on antihypertensive medication. Half of the participants had never had their BP checked, whilst 4.2% of respondents had participated in the MMM19 campaign. 0.9% and 1.7% reported COVID-19 vaccination and positive test, respectively. After multiple imputation of missing BP readings, 14.0% of respondents had hypertension of which 35.8% were aware, 28.0% were on antihypertensive medication and 14.1% had controlled BP. Of those on antihypertensive medication, 40.4% were on monotherapy, 37.2% adhered to taking their medication regularly, and 50.4% had controlled BP (<140/90 mmHg). In regression analyses adjusted for age, sex, and antihypertensive treatment, smoking was associated with lower systolic BP, having more years of education was associated with higher systolic and diastolic BP, and physical activity was associated with lower systolic and diastolic BP. This campaign contributes somewhat to reducing the 'black hole' on the prevalence of hypertension in DRC pending systematic countrywide BP screening.

*Corresponding author. Tel: +243999944232, Email: jerembu@yahoo.fr

Introduction

In the absence of methodologically representative nationwide prevalence statistics for hypertension in the Democratic Republic of the Congo (DRC), a few local studies indicate that a third of the adult population is hypertensive.[1-4] Worldwide, hypertension continues to be the most common associate of cardiometabolic endpoints.[5] This is the consequence of a deficient control of hypertension despite expert recommendations and effective treatment strategies that is in part because a large proportion of those with hypertension are unaware of their condition and therefore go untreated.[6] That is why the ISH initiated an annual global screening campaign, May Measurement Month (MMM), aimed at increasing this awareness. Embracing this vision through the Congolese Hypertension League (CoHL), the DRC has taken part in these campaigns carried out so far in urban areas of Kinshasa and Mbujimayi.[1,7] The present survey, conducted in 2021, is focused on a semi-urban environment; in the suburb of Mbujimayi, where 20 years ago, M'Buyamba-Kabangu *et al*.[8] reported a 22% death rate linked with stroke among hypertensive patients admitted to two urban hospitals.

Methods

MMM21 took place in the suburb's hamlets of Mbujimayi, the capital city of Kasai-Oriental, an east-central Province of DRC. Participants aged 18 years and above were screened in hospitals/clinics/pharmacies (3.0%), outdoor public areas (48.0%), indoor public areas (13.9%), workplaces (0.4%), and other locations (20.7%). Divided into six sites, each supervised by a medical doctor, 16 new CoHL members volunteered on top of the 16 previously involved in MMM19.[1] All volunteers were trained to be familiarized with the MMM campaign documents and tools. The campaign was fully funded by CoHL members.

The details regarding the questionnaire, blood pressure (BP) measurement technique, and monitoring machines used as well as data collection have been previously described.[9] Unlike previous MMM campaigns, information on new variables such as COVID-19 test or vaccination and use of Hormone replacement therapy or hormonal contraception was collected during the present campaign. Three sitting BP measurements were obtained by use of a validated electronic device (OMRON BP monitors) with an appropriately sized cuff secured at the upper arm. Hypertension was defined as a systolic BP $\geq$ 140 mmHg or diastolic BP $\geq$ 90 mmHg based on the mean of the second and third BP readings, or the taking of antihypertensive medication.

The MMM project team analysed DRC data centrally and performed multiple imputation to impute the mean of 2nd and 3rd readings where this was missing, based on global data.[9]

Linear regression analyses were conducted to investigate potential associations between each respondent characteristic and mean systolic or diastolic BP. Regression models were adjusted for participant age, sex, and use of antihypertensive treatment. Those included in each analysis were those with no missing data on age, sex, antihypertensive medication ($n = 1317$), as well as having complete data on the focal characteristic. Data collected on participants included a history of hypertension with treatment details, myocardial infarction, stroke, diabetes and smoking status, alcohol intake, education, physical activity according to WHO guidelines, positive COVID-19 test, and COVID-19 vaccination.

Results

The MMM21 DRC Campaign (*Table 1*) enrolled 20 913 participants (mean age 35.1 ± 15.1 years; 6181 women (29.6%); 20 654 Black ethnicity: (98.8%); mean weight 67.3 ± 8.5 kg). After multiple imputation, 2923 (14.0%) had hypertension, 338 (1.6%) were diabetic, whilst 291 (1.4%) and 171 (0.8%) had previous MI and stroke, respectively. Out of the female participants, 438 (7.1%) were currently pregnant, 291 (4.7%) had been hypertensive during a previous pregnancy and 209 (3.4%) were on hormonal contraception. Alcohol and current tobacco consumption were reported by 3520 (16.8%) and 1404 (6.7%) participants, respectively; 881 (4.2%) respondents had participated in the MMM19 campaign whilst 10 424 (49.8%) had never had their BP checked; 182 (0.9%) and 348 (1.7%) participants, respectively, reported COVID-19 vaccination and a previous positive test; 7502 (35.9%) met WHO physical activity guidelines. Over a half (59.8%) of participants reported having over an education responded to the question on education; 5084 (24.3%) had over 12 years, 5579 (26.7%) had 7–12 years, 1440 (6.9%) had 1–6 years, and 410 (2.0%) had no education.

Awareness, treatment, and control of hypertension are also summarized in *Table 1*. Of the 2923 (14.0%) participants with hypertension, 1046 (35.8%) were aware of their condition and 817 (28.0%) were recorded as being on treatment. Blood pressure control was observed in 412 individuals representing 50.4% of treated hypertensives and 14.1% of all participants with hypertension. Control rates were higher in females compared to males: 18.4% of females with hypertension and 11.7% of males with hypertension had controlled BP. The rate of adherence to antihypertensive medication use was 37.2%. For nearly one in five (18.8%) participants on antihypertensive medication, the medication being 'too expensive' was given as a reason for non-adherence. Antihypertensive medication use consisted of monotherapy in 330 subjects (40.4%), two drugs in 315 (38.6%), three drugs in 123 (15.1%), four drugs in in 32 (3.9%), and five drugs in 17

Table 1 Total participants and percentages with hypertension, awareness, on medication and with controlled blood pressure

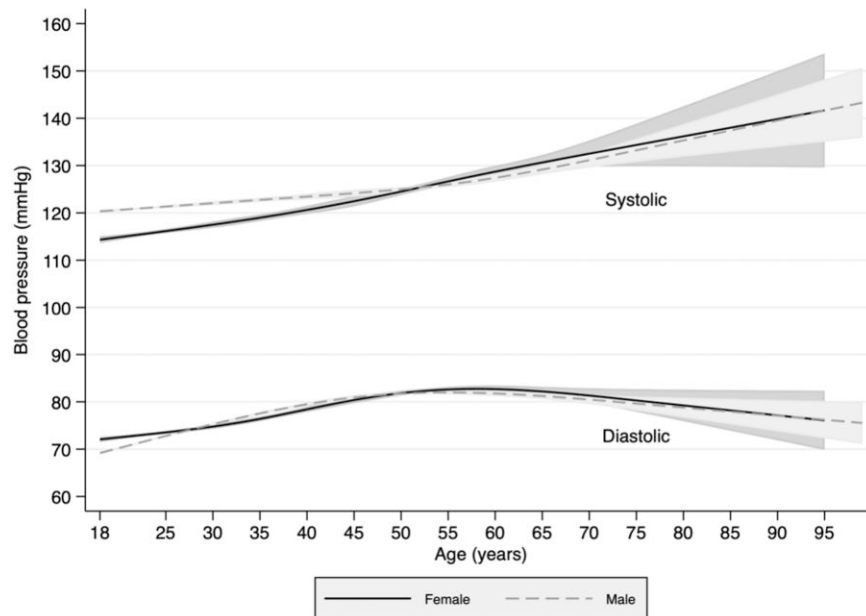| Total participants	Number (%) with hypertension	Number (%) of hypertensives aware	Number (%) of hypertensives on medication	Number (%) of those on medication with controlled BP	Number (%) of all hypertensives with controlled BP
20 913	2923 (14.0)	1046 (35.8)	817 (28.0)	412 (50.4)	412 (14.1)

Figure 1 Average blood pressure by age in untreated female and male participants.

(2.1%). 662 (3.2%) and 3,97 (1.9%) participants reported use of aspirin and statins, respectively.

The relationship between BP and age and gender in untreated individuals shows a linear increase in systolic and a U-shaped relationship with diastolic BP for both males and females (*Figure 1*).

Regression analyses adjusted for age, sex, and antihypertensive medication use were conducted. Relative to participants who were not current smokers, being a current smoker was associated with lower average systolic BP (−4.3 mmHg [95% CI −7.8 to −0.9, $P = 0.012$]). Meeting WHO physical activity guidelines was associated with lower average systolic (−6.1 mmHg [95% CI −8.4 to −3.8, $P < 0.001$]) and diastolic (−3.6 mmHg [95% CI −5.2 to −2.0, $P < 0.001$]) BP relative to those who exercised less. Relative to participants with no education, the systolic BP of participants with 7-12 years of education was 6.1 mmHg (95% CI 1.6 to 10.5, $P = 0.007$) higher. Similarly, participants with 1-6, 7-12, and over 12 years of education had higher average diastolic BP (5.5 mmHg [95% CI 2.1 to 8.9, $P = 0.002$]; 8.0 mmHg [95% CI 4.8 to 11.2, $P < 0.001$]; 5.5 mmHg [95% CI 2.3 to 8.6, $P < 0.001$], respectively) relative to participants with no education. Associations between other participant characteristics investigated and average systolic or diastolic BP were not statistically significant.

Discussion

The DRC MMM21 data indicated that 14.0% of participants had hypertension with 35.8% aware of their condition and 28% being on treatment. Half of those on treatment had controlled BP. Nearly 1 in 5 individuals on antihypertensive medication found antihypertensive medication too expensive to adhere to the treatment. The major difference regarding the DRC MMM21 hypertension prevalence (14.0%)

and the rates reported in previous local campaigns such as the VITARAA Study (30.8%) and DRC-MMM-18 (33.5%) in Kinshasa,[3,6] the DRC-MMM-19 (25.5%) in Kinshasa and Mbuji-Mayi[7] and the study by Musung *et al.*[4] (33.6%) in Lubumbashi largely lies on the fact that the present campaign was carried out totally in a semi-rural setting. Indeed, most studies carried out in DRC and elsewhere showed lower BP levels among rural inhabitants than city dwellers who are exposed to different diets and various stressors.[2] In contrast to the recommendation that about 70% of hypertensive patients require combined therapy,[10] monotherapy was still prescribed to 40.4% of our treated hypertensive subjects and, together with unaffordability of drugs, could well explain the lower BP control rate.[11]

There are some limitations and strengths to the MMM21 campaign in DRC. We used three BP measurements on a single occasion rather than the gold-standard ambulatory or home BP measurement as suggested by current guidelines to diagnose hypertension. The sample was not randomly selected and hence the current results cannot necessarily be extrapolated to the entire rural population of the country. Nevertheless, this campaign contributes to reduce the 'DRC hypertension prevalence black hole', and to highlight the need for training of professional care providers to comply with suitable guidelines. Our results from this suburban setting reflect those from urban cities, with low proportions of people aware of their condition, treated and controlled. Additional MMM campaigns are needed in other DRC provinces to raised awareness and strengthen estimates of hypertension prevalence nationwide.

Acknowledgements

Funding

Data availability

Data underling this article will be shared on reasonable request to the corresponding author.

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