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May Measurement Month 2017: an analysis of blood pressure screening in Sudan—Northern Africa and Middle East

Ibtisam Ali^{1*}, Hind Behairy², Ashraf Abugroun³, Thomas Beaney⁴, Elsa Kobeissi⁴, Asma Abdalla⁵, Abdelrahim Mohamed², Naiema Wagialla⁶, Safa S. Medani⁷, Elamin M. Ismail¹, D.A. Hassan⁸, Fatima Altahir⁹, Mohamed Abdelrahim¹⁰, Awab Gdoor¹¹, Isra Mohamed¹², Sahar Elnour¹³, and Neil R. Poulter⁴

¹Department of Internal Medicine, Faculty of Medicine, Zamzam University College, Khartoum, Sudan;

²Department of Physiology, International University of Africa, Khartoum, Sudan;

³Department of Internal Medicine, Advocate Illinois Masonic Medical Center, Chicago, IL, USA;

⁴Imperial Clinical Trials Unit, Imperial College London, Stadium House, 68 Wood Lane, London W12 7RH, UK;

⁵Department of Community Medicine, Faculty of Medicine, University of Khartoum, Khartoum, Sudan;

⁶Department of Community Medicine, Faculty of Medicine, Almuttaribeen University, Khartoum, Sudan;

⁷Department of Pediatrics, Alneelain University, Khartoum, Sudan;

⁸Department of Biochemistry, Central Laboratory/Ministry of Higher Education, Khartoum, Sudan;

⁹Department of Medicine, Omdurman Islamic University, Khartoum, Sudan;

¹⁰Department of Emergency Medicine, Ibrahim Malik Hospital, Khartoum, Sudan;

¹¹Department of Internal Medicine, Palace Medical Clinic, Khartoum, Sudan;

¹²Department of Internal Medicine, Ibrahim Malik Hospital, Khartoum, Sudan; and

¹³Department of Family Medicine, UMST, Khartoum, Sudan

Elevated blood pressure (BP) is a growing burden worldwide, leading to over 10 million deaths each year. Sudan has the second highest prevalence of hypertension in North Africa. One in four people with a non-communicable disease has hypertension. May Measurement Month (MMM) is a global initiative, aimed at raising awareness of high BP to act as a temporary solution to the lack of screening programs worldwide. The MMM screening survey provided an opportunity to correlate between unique risk factors and BP levels among Sudanese population. Such an approach allows for directing efforts towards setting the appropriate preventive measures as opposed to disease treatment. An opportunistic cross-sectional survey of volunteers aged ≥ 18 was carried out in May 2017. Blood pressure measurement, the definition of hypertension and statistical analysis followed the standard MMM protocol. The study was conducted at 100 sites distributed in four states: Khartoum, Gezira, Blue Nile, and Kassala. Overall, a total of 44 413 participants were enrolled in the survey. After imputation, 7332 out of 44 118 participants with an available mean of the second and third readings had hypertension (16.6%). A total of 6956 (15.9%) participants were found to have hypertension of the 43 742 who were not receiving treatment. Among participants who were on treatment, 155 out of 374 (41.3%) had uncontrolled BP. After adjusting for age and sex, systolic and diastolic BP's were significantly higher in those receiving antihypertensive treatment, with a previous history of stroke and with elevated body mass index. Systolic BP was significantly higher in people with diabetes and with previous myocardial infarction. Smoking was associated with increased diastolic BP and decreased systolic BP. Alcohol intake as well as BP measurement on left vs. right arm had no association with BP reading. The MMM17 was the largest BP screening campaign ever held in the country. A considerable percentage of detected hypertensives were not on treatment with a significant proportion of uncontrolled hypertension among those on treatment. These results suggest that opportunistic screening can identify significant numbers with raised BP.

*Corresponding author. Tel: +249914747396, Fax: +249183499743, Email: ammowdody@hotmail.com

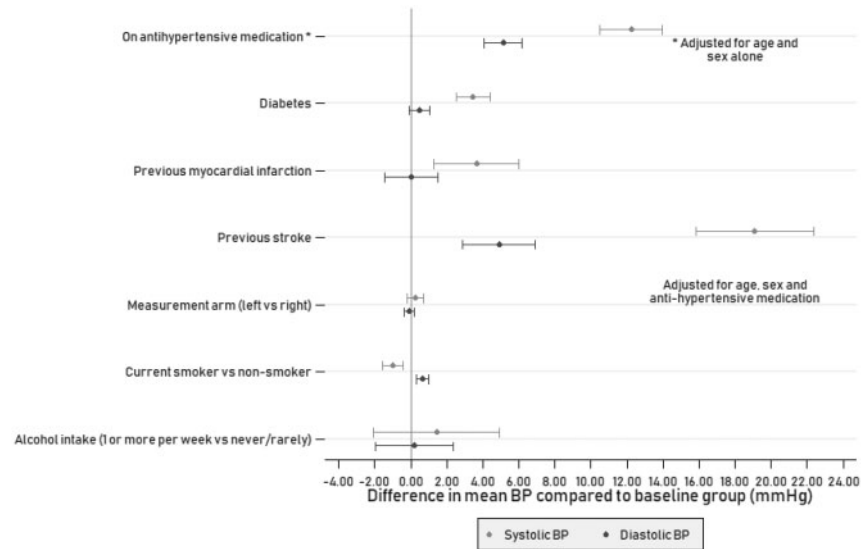


Figure 1 Difference in mean blood pressure according to individual characteristics from linear regression models adjusted for age, sex and, antihypertensive medication (except where annotated).

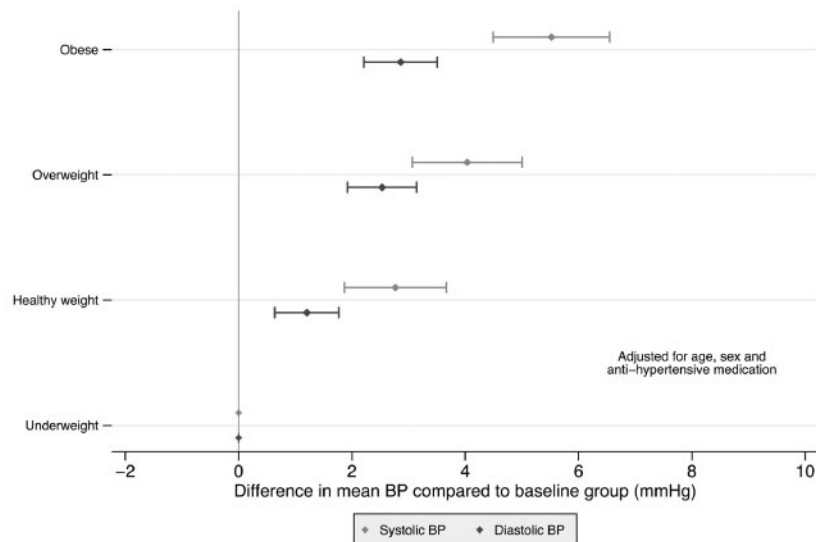


Figure 2 Difference in mean blood pressure according to body mass index from linear regression models, adjusted for age, sex, and antihypertensive medication, with underweight as the reference category.

Background

Hypertension is among the leading contributors to death and disability from cardiovascular diseases. Sudan has witnessed a large-scale urbanization which correlated with a significant variation in socioeconomic status and limited accessibility to effective primary health preventive programs by a large proportion of the population.¹ Such changes resulted in a sharp rise in non-communicable diseases (NCD), particularly of hypertension.² Sudan has the second highest prevalence of hypertension in North Africa. One in four people with NCD has hypertension. In previous studies, the prevalence of hypertension in Khartoum state the capital of Sudan was estimated at 23.6% of the total population.^{2,3} According to

the latest WHO data published in 2017, hypertension deaths in Sudan reached 2990 or 1.12% of total deaths. The age adjusted death rate is 16.12 per 100 000 of population ranks Sudan #69 in the world.^{4,5} Despite the high burden of hypertension in the Sudanese population, there is a paucity of literature on the prevalence and risk factors for hypertension in Sudan. The efforts of promoting awareness of hypertension, early detection, and proper management, a nationwide screening survey ‘May Month Measurement’ (MMM), introduced by the International Society of Hypertension (ISH) was conducted in May 2017 in Sudan. The key to success and wide participation in the survey was the collaborative effort of a wide range of young and senior investigators and prior planning prior to the MMM event month.

Methods

The study was coordinated by the Sudanese Society of Hypertension (SSH) in collaboration with the International University of Africa and other Sudanese universities, together with executive members of the young investigator committee and volunteers from the community. The ethical clearance for the study was obtained from the ethical committee at the International University of Africa. An opportunistic cross-sectional survey of volunteers aged ≥ 18 was carried out in May 2017. Blood pressure (BP) measurement, the definition of hypertension and statistical analysis followed the standard MMM protocol. The study was conducted at 100 sites distributed in four states: Khartoum, Gezira, Blue Nile, and Kassala. The sites included were either local universities, prayer houses, recreational places, e.g. gardens, sports sites, boarding houses for military personnel, airports, and some households. A total of 500 volunteers participated in the study. Prior to the survey, workshops were carried out in the Capital Khartoum for the training of trainers and the experience was conveyed to the other three states Gezira, Blue Nile, and Kassala. Funding was provided by the ISH different Universities, pharmaceutical companies, societies including the SSH. A wide campaign for screening the population of the targeted states was launched, and the screening process continued for a total of 30 days. A wide range of BP measuring devices was used, mostly were electronic of the Omron type and some other brands. Blood pressure was measured three times while patients were sitting with back supported with 3-5 min' gap between readings. Both weight and height were estimated. Data were collected using a hard copy and subsequent data entry into an excel sheet was performed by volunteers. The data were then cleaned locally by a designated statistician. Finally, all data were analysed centrally by the MMM project team.

Results

Overall, a total of 44 413 participants were enrolled in the survey. The majority were males (62.3%) and of mixed race (85.8%) followed by black race (13.7%). The mean age was 37.6 ± 15.2 and the mean body mass index (BMI) was 25.05 ± 5.5 . A total of 376 participants (0.8%) were on anti-hypertensive medication at the time of the survey. Of 44 413 screenees, 1242 (2.8%) participants reported having type 2 diabetes, 206 (0.5%) reported a history of myocardial infarction, and 99 (0.2%) reported a history of stroke. A total of 3559 (8.0%) respondents reported smoking, 86 (0.2%) reported alcohol consumption once or more per week. The mean systolic BP was 120.2 mmHg, and the mean diastolic BP was 75.7 mmHg.

Of 38 839 respondents with three BP readings, systolic and diastolic BP decreased on average by 6.1 and 2.5 mmHg, respectively, between the first and third readings. After imputation, participants who were diagnosed with hypertension were 7332 of 44 118 (16.6%). Among the 43 742 participants who were not receiving antihypertensive medication, 6956 had hypertension (15.9%). Among

participants who were on treatment, 155 of 374 (41.3%) had uncontrolled BP.

After adjusting for age and sex, systolic and diastolic BP's were significantly higher in those receiving antihypertensive treatment, with a previous history of stroke (*Figure 1*) and with elevated BMI (*Figure 2*). Systolic BP was significantly higher in people with diabetes and with previous myocardial infarction. Smoking was associated with increased diastolic BP and decreased systolic BP. Alcohol intake as well as BP measurement on left vs. right arm, had no association with BP readings (*Figure 1*).

Discussion

Hypertension is among the leading contributors to heart disease and stroke among the Sudanese population.⁶ Our study revealed high rates (41.3%) of uncontrolled BP among participants who were on treatment.

Compared to international MMM figures, the screening survey from Sudan showed higher proportions of male participants (62.3% vs. 45.0%) and were relatively at younger age (37.6 vs. 44.9). In MMM, after adjusting for age and sex, Sudanese participants with history of stroke, elevated BMI diabetes, or history of previous myocardial infarction had findings consistent with previous epidemiological studies. Interestingly, smoking was associated with elevated diastolic BP and reduced systolic BP. Whereas different epidemiological studies have showed equivocal findings on the association between smoking and BP.⁷ A more reliable assessment of the impact of smoking on BP readings among participants may require ambulatory BP monitoring. Although previous studies showed that chronic alcohol consumption correlates with higher BP in a linear fashion,⁸ such a relationship was not observed in the Sudan survey results. Thus discrepancy might be related to lower prevalence of alcohol use in the country and possible under reporting of the true prevalence of alcohol use.

Overall, MMM17 was the largest BP screening campaign ever undertaken in Sudan. Unfortunately, a considerable percentage (95%) of detected hypertensives were not on treatment with a significant proportion of uncontrolled hypertension among those on treatment. These results suggest that opportunistic screening can identify significant numbers with raised BP. The MMM screening survey results provided an opportunity to correlate between unique risk factors and BP levels among the Sudanese population. Such an approach allows for directing the efforts towards setting the appropriate preventive measures as opposed to disease treatment.

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